

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

A SYSTEM OF MEAL PLANNING FOR SELF-IMPROVEMENT
OF THE DIET OF VILLAGERS IN NORTHEASTERN THAILAND

A Thesis presented in partial fulfilment
of the requirements for
the Degree of Doctor of Philosophy
in Food Technology
at Massey University

TIPVANNA NGARMSAK

February 1983

80101.60

ABSTRACT

A method for self-improvement of nutritional status was developed for the villagers in Northeastern Thailand using the raw materials already available in the villages with cowpeas as a protein supplement. A low cost and nutritionally balanced 7-Day menu was designed for a family unit; it was based on the foods and food dishes already eaten in the villages, the present eating pattern of the villagers and protein maximised dishes. It was designed and introduced using a three stage system - study of the present foods eaten, development of the cowpea dishes and the 7-Day menu and introduction of the 7-Day menu to the villages.

A survey of eating habits was conducted in ten villages in Khon Kaen Province, to find information on the types of food raw materials available in the villages, the types of foods and food dishes eaten throughout the year, the legumes and legume foods eaten in the villages. Twenty five cowpea recipes were developed from the traditional dishes and protein maximised using linear programming. They were highly acceptable to a taste panel of villagers. The protein content of 22 commonly eaten food dishes were also maximised using linear programming. These protein maximised dishes together with the other foods eaten by the villagers were used to develop a 7-Day menu in the traditional village meal pattern. A system was developed using mixed integer programming to select an acceptable daily menu pattern which could supply an adequate quantity of food for a family of 7 persons and meet their requirements for 26 essential nutrients. The 7-Day menu consisted of 6 daily menus of 29 foods and food dishes including 11 cowpea dishes and steamed glutinous rice. The 7-Day menu was found highly acceptable by the villagers.

Three Introduction Models fitting with the village life style were developed for introducing the 7-Day menu and the cowpeas to 6 villages in Khon Kaen Province. Each model was tested in two villages during a 21 week introduction period. The most successful introduction method was to firstly explain the whole menu to the village headman, and then

with his help organise a party for the villagers to introduce the menu and the cowpeas and to give nutritional information. Video demonstrations were used to teach the cooking methods for the various dishes and a cooking competition encouraged the villagers to cook the dishes and to follow the menu. This method of introduction created a large increase in the number of villagers using cowpeas.

ACKNOWLEDGEMENTS

The success of this project was due to the cooperation of the many villagers who took part in the food eating survey and in the introduction of the 7-Day menu to the six villages. Without their participation, there would have been no research study, and I shall always be grateful for their help.

This work would not have been possible without the support of the staff of Khon Kaen University, in particular Dean Kavi Chutikul of the Faculty of Agriculture.

The team in the KKU-IDRC Home Processed Legumes Project enthusiastically helped in the food eating surveys, development of the protein maximised recipes and in the introduction of the 7-Day menu to the six villages, their cheerful and willing help in the villages made it possible for such an extensive study to be undertaken.

This research would not have been accomplished without the thought and invaluable guidance of my supervisors.

I wish to express my deepest gratitude to my supervisors, Dr. Mary Earle and Dr. Allan Anderson for all the help, time and encouragement which they provided during the course of this work.

I wish to dedicate this research achievement to my Chief Supervisor, Dr. Mary Earle.

I should also like to thank the New Zealand Ministry of Foreign Affairs who provided a scholarship for this research study and the International Research Development Centre, Ottawa, Canada who provided funds for the village introduction.

I wish to express my appreciation to various people who assisted this research in many ways.

In particular, I would like to thank Sally Vogel, IDRC, Edmonton, Canada for supporting and encouraging this research study.

Prof. R.L. Earle and Prof. E.L. Richards of the Faculty of Food Science and Biotechnology, Massey University for providing facilities for the research and their encouragement.

The staff of the Food Technology Research Centre, Massey University for their continuing interest in the project and for the help in overcoming the problems that arose during the work at the university.

The staff of the Computer Research Centre, Massey University for their help in the computer work.

The staff of the Nutrition Research Centre, Mahidol University, Bangkok for their advice on nutritional aspect of the project.

Miss Vivienne Mair, my typist for her willingness always to spend time typing and correcting the final manuscript.

Finally, to my family and friends for their continual support, I shall be always be very grateful. I should like to thank my husband, Supachai Ngarmsak, for his understanding and encouragement and the final preparation of the thesis and my daughter, Manachaya (Jupjang) for her helpfulness in making it possible for me to have time to complete this research and my mother for her care and support.

CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	x
LIST OF FIGURES	xiii
LIST OF APPENDICES	xiv
INTRODUCTION	1
PART ONE: SURVEY OF FOOD EATING HABITS IN TEN VILLAGES IN KHON KAEN PROVINCE	8
1. The Food of Villagers in Northeastern Thailand	9
1.1 Food habits in Northeastern Thailand	9
1.2 Dietary surveys in Northeastern Thailand	11
1.2.1 Dietary intakes of infants and preschool children	11
1.2.2 Diet of pregnant women	11
1.2.3 Dietary survey in Nong Kohn village and an urban area in Ubol Province	12
1.2.4 Dietary survey of 42 families in seven villages in Khon Kaen Province	13
1.2.5 Dietary survey in Nakorn Rachasrima Province	15
1.3 The cause of nutritional problems in Northeastern Thailand	15
1.4 The need of a survey on the food eating habits	17
2. Survey Methods Used in Food Consumption Studies	18
2.1 Food consumption surveys	18
2.1.1 Food weightment method	19
2.1.2 Food composite analysis	19
2.1.3 Food recall	19
2.1.4 Inventory or log book method	20
2.1.5 Food list	20
2.1.6 Diet history	20
2.1.7 Food account	21
2.1.8 Calculation and interpretation of dietary intake	21
2.2 Choice of methods used in food consumption studies	22
2.3 Choice of method used in this survey	24
3. The Survey Method	26
3.1 The selection of the village and household samples	26
3.2 Method of information collection	31
3.3 The selection and training of the interviewer	31
3.4 General organisation of all surveys	32
3.5 The general survey on food eaten	34
3.6 The survey on legumes eaten, grown and stored	35
3.6.1 Types, frequency, and quantities of legumes	35
3.6.2 Sources of legumes eaten in villages	35
3.6.3 The storing of cowpea seeds	35
3.6.4 The methods of cooking and processing legumes	36
3.6.5 Types and quantities of legume food dishes	36
3.6.6 Consumption pattern of legumes and legume dishes	36

3.6.7	Liking of legumes and legume dishes	36
3.6.8	Attitude to cowpeas	36
4.	Food Eaten in Villages in Khon Kaen Province, Northeastern Thailand	37
4.1	Types and sources of food eaten	37
4.1.1	Meat, fish and poultry and other animals	40
4.1.2	Vegetables	40
4.1.3	Fruit	40
4.1.4	Insects and wild animals	41
4.1.5	Conclusions	41
4.2	The eating pattern throughout the year	42
4.2.1	Rice	42
4.2.2	The number of foods eaten	42
4.2.3	The number of households eating different food categories	44
4.3	The meal pattern	45
4.3.1	Foods eaten in main meals	45
4.3.2	Food eaten between meals	46
4.4	Types of food eaten	47
4.4.1	Animal, fish and insect foods	47
4.4.2	Vegetable foods and cereal foods	49
4.4.3	Fruits	50
4.5	Types of food eaten by 1-5 year old children	50
4.6	Types of northeastern cooking	52
4.7	Kinds of food dishes eaten	54
4.7.1	Dry main dishes	54
4.7.2	Liquid main dishes	56
4.7.3	Sauces	57
4.7.4	Vegetables	57
4.7.5	Desserts and snacks	59
4.7.6	Fruits	60
4.8	Home preservation of foods	61
4.9	Conclusion	62
5.	Legumes Eaten	63
5.1	Types, frequency and quantity of legumes eaten	63
5.2	Sources of legumes eaten in the villages	66
5.2.1	Growing of legumes	66
5.2.2	Buying and selling of legumes	67
5.3	Storing of cowpea seeds	67
5.4	Methods of cooking and processing legumes	68
5.5	Types and quantities of legume food dishes	69
5.6	Consumption pattern of legume and legume dishes	71
5.7	Eating of legumes throughout the year	73
5.8	Liking of legumes and legume dishes	74
5.9	The attitudes to cowpeas	76
5.10	Accuracy of survey	76
5.11	Conclusion	76
6.	The Food Eating Pattern in Northeastern Villages	78

PART TWO: DEVELOPMENT OF COWPEA DISHES AND 7-DAY MENU FOR VILLAGERS IN NORTHEASTERN THAILAND	81
7. Methods of Planning Diets	82
7.1 The developments in diet planning	82
7.2 Important factors in diet planning	83
7.2.1 The consumer	83
7.2.2 Nutritional requirements	84
7.2.3 Acceptability	86
7.2.4 Palatability	86
7.2.5 Food attributes	87
7.2.6 Monotony and food preference	88
7.2.7 Food compatability	89
7.2.8 Meal patterns	89
7.3 Quantitative techniques used in diet planning	91
7.3.1 Linear programming in raw material selection	91
7.3.2 Menu planning by linear programming	92
7.3.3 Menu planning by integer programming	94
7.4 Choice of diet planning method for Northeastern Thailand	95
8. Development of Cowpea Dishes	97
8.1 Choice of cowpea variety used in the development of cowpea dishes	97
8.2 The selection and screening of cowpea dishes	100
8.3 The selected cowpea dishes	101
8.4 The formulation of cowpea dishes by linear programming	106
8.4.1 Organisation of data for the formulation	106
8.4.2 TEMPO input data preparation	108
8.4.3 The problem solution	109
8.5 The evaluation of the computerised recipes	110
9. Menu Planning by Linear Programming	118
9.1 Factors for consideration	118
9.1.1 The consumer	118
9.1.2 The meal pattern	120
9.1.3 The nutrient requirements	121
9.1.4 Acceptability of the menu	124
9.1.5 Food input for linear programming	125
9.1.6 Consumption quantity	126
9.2 Data collection	127
9.2.1 Nutrient composition	127
9.2.2 Cost	128
9.2.3 The consumption quantity	128
9.3 Linear programming model for menu planning for Northeastern Thailand	131
9.3.1 The initial model	131
9.3.2 The relaxed nutrient constraints model	132
9.4 Linear programming input	132
9.5 Linear programming output	133
9.5.1 The solution of relaxed nutrient constraint Model - Menu 1	133
9.5.2 The solution of relaxed nutrient constraint with limit on liquid main dishes model - menu 2	136
9.6 Conclusion	137

10. Planning 7-Day Menu by Mixed Integer Programming	139
10.1 TEMPO mixed integer algorithmic procedure	139
10.2 Scheme for selection of specific number of dishes for the menu planning by mixed integer programming	141
10.3 The meal pattern	144
10.4 The revised data for input menu planning by mixed integer programming	145
10.4.1 Food selection	145
10.4.2 The nutrient composition	146
10.4.3 The nutrient constraints	147
10.4.4 The limit quantity on food intake	149
10.5 Planning a weekly menu	150
10.6 Trial running of mixed integer programming for menu planning	150
10.7 Selection of 7-Day menu by mixed integer programming	153
10.8 Menus for 7 days	154
10.9 Conclusion	162
11. The 7-Day Menu for the Introduction	163
PART THREE:	
INTRODUCTION OF COWPEAS IN A NUTRITIONALLY BALANCED MENU TO SIX VILLAGES IN KHON KAEN PROVINCE	166
12. Methods of Introducing New Foods	167
12.1 The adoption of innovations	167
12.2 Adoption in rural society	171
12.3 Introduction of new foods	173
12.3.1 Commercial methods of introducing new nutritional food products	174
12.3.2 The delivery system of food aid for supplementary feeding programmes	177
12.4 Nutritional education	179
12.4.1 Nutritional education programmes	179
12.4.2 Places and people used in nutrition education	180
12.4.3 Methods used in nutrition education	182
12.4.4 Effectiveness of nutrition education programmes	183
12.5 Communication methods	185
12.5.1 Types of mass communication	186
12.5.2 The organisation of the communication programme	187
12.6 Evaluation of nutrition programmes	189
12.6.1 Evaluation indicators	190
12.6.2 Evaluation methods	192
12.7 Conclusion	194
13. The Methods Used in Introducing 7-Day Menu and Cowpeas to Six Villages	196
13.1 Workplan	196
13.2 The development of the Introduction models	197
13.3 Designing the procedure for conducting the Introduction	204
13.3.1 Group discussion	204
13.3.2 Person contact	206
13.3.3 Food party	206
13.3.4 Cooking demonstration	207
13.3.5 Video cooking demonstration	209
13.3.6 Competition for best dish	210

13.3.7	Competition for best cook	211
13.3.8	Cooking at home	211
13.4	Village selection and method involved in personnel recruitment	212
13.4.1	The village selection	212
13.4.2	The group discussion leader selection	212
13.4.3	The "contact" person selection	212
13.4.4	Contacting the selected person	213
13.4.5	The sub-group discussion selection	212
13.5	The development of the evaluation method	213
13.5.1	Introduction	213
13.5.2	The collecting of data	214
13.5.3	The costing	217
13.6	Conducting introduction and evaluation in villages	217
14.	The Response of Villagers to the 7-Day Menu and the Cowpeas	219
14.1	Awareness and Interest Stages	219
14.1.1	People aware and their initial interest	219
14.1.2	The diffusion rate of information	221
14.1.3	Knowledge at the food party	223
14.1.4	Comparison of knowledge of "sub group" and "food party group"	224
14.1.5	Conclusion for the Awareness and the Interest stage	228
14.2	Evaluation and Trial stage	230
14.2.1	The 7-Day menu, the acceptability and choice of dishes	230
14.2.2	The acceptability of the cowpea dishes	235
14.2.3	Cooking of the 7-Day menu	236
14.2.4	Cooking of cowpea dishes	238
14.2.5	Number attending cooking demonstration and taking part in the competition	238
14.2.6	Conclusion from the evaluation and trial stage	239
15.	The Effect of the Total Introduction	241
15.1	The number of villagers who cooked the cowpea dishes	241
15.1.1	The total number	241
15.1.2	The rate of increase of the numbers of households who cooked the cowpea dishes	243
15.2	The cowpea dishes cooked by the villagers	245
15.3	Amount of cowpeas eaten before and after introduction	245
15.4	Knowledge and attitude to cowpeas at the beginning of the Introduction and at the end of the introduction	252
15.4.1	Knowledge of cowpeas	
15.4.2	Growing of cowpeas	255
15.4.3	Eating of cowpeas	257
15.4.4	Opinions of cowpeas	259
15.5	The Costing of the Three Introduction Models	261
15.6	Conclusion	262
16.	The Final Analysis of the Introduction of the 7-Day Menu and the Cowpeas	263
	CONCLUSION	267
	BIBILOGRAPHY	274

LIST OF TABLES

Table 1:	Range and Mean Daily Consumption of Food Per Person in Seven Villages in Khon Kaen Province	13
Table 2:	Average Nutrient Intake from the Survey of 42 Families in Khon Kaen Province	14
Table 3:	Village Information	28
Table 4:	Average Consumption of Household (from 100 Households in 10 Villages)	29
Table 5:	Income of the Households	29
Table 6:	Total Income of Households in Villages	31
Table 7:	Meat, Fish and Poultry Normally Eaten in the Households	37
Table 8:	Vegetables Normally Eaten in the Households	38
Table 9:	Fruit Normally Eaten in the Households	39
Table 10:	Insects and Wild Animals Normally Eaten in the Household	39
Table 11:	Foods Eaten in Different Food Categories in the three Seasons	42
Table 12:	Foods Eaten at Different Meals in the three Seasons	43
Table 13:	Households Eating Different Foods in the three Seasons	44
Table 14:	Frequency of Different Categories of Food Eaten by a Household in One Day	45
Table 15:	Households Eating Food Between Meals	46
Table 16:	Foods Eaten Between Meals	46
Table 17:	Animal, Fish and Insect Food Dishes Eaten in the three seasons	48
Table 18:	Vegetable Food Dishes Eaten in the three seasons	49
Table 19:	Fruits Eaten in the three seasons	50
Table 20:	Types of Food Eaten 1-5 Year Old Children	51
Table 21:	Types of Northeastern Cooking in the three seasons	53
Table 22:	Dry Main Dishes Eaten in the three seasons	55
Table 23:	Liquid Main Dishes Eaten in the three seasons	56
Table 24:	Sauces Eaten in the three Seasons	57
Table 25:	Vegetable Eaten with Sauces Eaten in the three seasons	58
Table 26:	Desserts and Snacks Eaten in the three seasons	59
Table 27:	Fruits Eaten in thr three Seasons.	60
Table 28:	Preservation of Food at Home	61
Table 29:	Households Eating the Different Legumes	64
Table 30:	Quantities of Legumes Eaten	65
Table 31:	Growing of Legumes	66
Table 32:	Methods of Cooking Legumes	66
Table 33:	Types of Legume Food Dishes	69
Table 34:	Quantities of Legume Dishes Eaten	70
Table 35:	Types of Meals Using Legumes	71
Table 36:	Time of Day When Legumes Eaten	72
Table 37:	Legumes Eaten in the three Season	73
Table 38:	Degree of Liking of Legumes	74
Table 39:	Ranking of Liking of Food Legume Dishes and Products	75
Table 40:	Cowpea Main Dishes - Protein Content, Protein Contribution from Cowpeas, Serving Quantity and Frequency of Serving	102
Table 41:	Cowpea Snacks and Desserts - Protein Content, Protein Contribution from Cowpeas, Serving Quantity and Frequency of Serving	103

Table 42: Selected Cowpea Main Dishes - Their Protein Content, Protein Contribution from Cowpeas and Preference Ranking	104
Table 43: Selected Cowpea Desserts and Snacks - Their Protein, Content, Protein Contribution from Cowpeas and Preference Ranking	105
Table 44: Cowpea Main Dishes - Protein Content Cost form and Quantity of Cowpeas Used in the Protein Maximised Recipes	110
Table 45: Cowpea Desserts and Snacks - Protein Content, Cost Form and Quantity of Cowpeas Used in the Protein Maximised Recipes	111
Table 46: The Acceptability of the Protein Maximised Cowpea Recipes	112
Table 47: An Average Household Composition of 10 Villages, Khon Kaen Province	119
Table 48: Composition f Family for Designing a Menu	119
Table 49: The Number of Times a Family Eats Categories of Food in Different Meals	120
Table 50: The Nutrients in Relationship with Other Nutrients and their Limitation Requirements	123
Table 51: Nutritional Constrants and Limitation of Requirements for a Family of Seven Persons for One Day	124
Table 52: Total Food Consumption per Day of Adult Man, Woman and Child	129
Table 53: Menu Selection by Linear Programming	134
Table 54: Daily Nutrients Provided in the Solution of Menu Planning by Linear Programming	135
Table 55: Nutrient Relationships in the Solution of Menu Planning by Linear Programming	135
Table 56: The Number of Times a Family Chosen to Eat Different Categories of Foods in Different Meals "A Preference Pattern"	144
Table 57: Loss of Vitamins and Amino Acid at VArrious Temperatures and Times of Cooking	146
Table 58: A New Revised Nutrient Cosntraint for Planning a Daily Menu for a Family of Seven Persons	145
Table 59: Trial Runs of Mixed Integer Programming for Day 1 Menu Planning on Preference Pattern	151
Table 59: Trial Runs of Mixed Integer Programming for Menu Planning of Survey Pattern	152
Table 61: Solution of Menu PLanning by Mixed Integer Programming The Menu and Cost	155
Table 62: Distribution in Cost and Quantity of Food in Different Categories in 7-Day Menus	158
Table 63: Percentage of Nutrient Requirement Cosntraints from the Solution of 7-Day Menu Planning by Mixed Integer Programming	160
Table 64: Quantity of Cowpea Seeds Used in the 7-Day Menus	164
Table 65: Channels of Reaching Consumer	186
Table 66: The Criteria for "Pass" and "Fail" Screening of Introduction Method Combinations	199
Table 67: The Criteria Scoring System	200
Table 68: Method Compatability	201
Table 69: Ranking of Introduction Models	202

Table 70: The Schedule of Introduction and Interviewing in the Six Villages	218
Table 71: The Number of People in the Villages Aware of the 7-Day Menu and the Cowpeas	220
Table 72: Magnitude of Interest at Beginning of Introduction	221
Table 73: Source of the Information	222
Table 74: Knowledge of the Menu	223
Table 75: The Amount of Information Transmitted to the Villagers in the "Sub Group" and the "Food Party Group"	225
Table 76: The Percentage of Villagers in the "Sub Group" and "Food Party Group" in Six Villages Able to Indicate the Food in Days 1-2	226
Table 77: Recognition of Pictures on Dietary Needs and Nutritional Deficiencies	227
Table 78: Preference Ranking of 7 Day Menu	230
Table 79: Preference of Dishes in Day 1-2 Menu	231
Table 80: Preference of Dishes in Menu	232
Table 81: Preference Time Eating of Dishes in the Menus	234
Table 82: Acceptability of 11 Cowpea Dishes	235
Table 83: Ease of Cooking of the 7-Day Menu	237
Table 84: The Average Percentage of Various Groups of Villagers Who Would Continue Cooking the 7 Day Menu	237
Table 85: Opinion About the Cooking of Cowpea Dishes	238
Table 86: Number of Villagers Attending Cooking Demonstration and Taking Part in Cooking Competition	239
Table 87: Number of Households Cooking Cowpea During the Different Period of Introduction	242
Table 88: Number of People Who Received Cowpea Seeds	243
Table 89: The Average Accumulated and the Average Rate of Increase in the Number of Households who had Cooked the Cowpea Dishes for the Six Villages	244
Table 90: Cowpea Dishes Cooked by Villagers During the Introduction and at the End of Introduction	246
Table 91: Frequencies of Cowpea Dishes Householders Cooking Cowpea Dishes From the Beginning of the Introduction to Two Months After the Introduction	247
Table 92: The Average Frequencies of Cowpea Dishes Cooked by a Household in Six Villages	248
Table 93: Quantity of Cowpea Seeds Given and Used for Cooking	250
Table 94: Knowledge on Method of Cooking Cowpea at the End of Introduction	254
Table 95: Growing of Cowpea Before and After the Introduction in the Six Villages	255
Table 96: Growing of Red Cowpea Before the Introduction and After the Introduction in the Six Villages and of the Local Cowpea in the Control Villages	256
Table 97: Frequency of Cooking Cowpea and Sprouting Cowpea by Villagers in the Six Villages and the Control Village	256
Table 98: Cowpea Dishes Indicated as Cooked More Often by a Group of Villagers After the Introduction	259
Table 99: Preference Ranking of 7 Kinds of Food by the Villagers Before and After the Introduction	260
Table 100: Comparison of the Cost of the Three Introduction Models at Different Stages of Introduction	261
Table 101: Cost of Different Introduction Methods per Householder	262

LIST OF FIGURES

Figure 1: The Selection of "The Other" Villages	26
Figure 2: Khon Kaen Province: The Ten Villages and Distances from Khon Kaen University	27
Figure 3: Organization Steps For All Surveys	32
Figure 4: A Plan for Conducting the Interviews	33
Figure 5: Northeastern Cooking Utencils	52
Figure 6: Photographd of the Two Varieties of Cowpea Seeds (<u>Vigna Unguiculata</u>)	99
Figure 7: Outline of Selection and Screening of Cowpea Dishes	100
Figure 8: Photographs of the 25 Cowpea Dishes	114
Figure 9: Photographs of the 7-Day Menu	156
Figure 10: Schematic Model of Consumer Behavior: Its Context and Determinants (Markin, 1969)	169
Figure 11: General Outline of Introduction of New Foods	173
Figure 12: A Simplified Communications System (Markin, 1969)	185
Figure 13: The Overall Work Plan fot the Introduction of Low Cost and Nutritional Balanced Menu to the Villagers	196
Figure 14: The Schematic Steps in the Development of the Introduction Models	198
Figure 15: Method Ideas Obtained From brainstorming	199
Figure 16: Grouping of Introduction Models	202
Figure 17: The Schemes for the Three Introduction Models	203
Figure 18: Diffusion of Information	221
Figure 19: Introduction of 7-Day Menu and Cowpeas in Villages	
Figure 20: Accumulated Number of Villager Who Cooked Cowpea Dishes	244
Figure 21: Accumulated Quantities of Cowpeas Used By Villagers in Six Villages	251
Figure 22: Basic Outline for Development of System for Self-Improvement of Nutrition Status in Cummunity	270

LIST OF APPENDICES

Appendix 1: Information on Villages	284
Appendix 2: The Description of Northeastern Cooking	285
Appendix 3: Minor Food Dishes Eaten by Households in Two Days in All Seasons	287
Appendix 4: Summary of Development Work in Diet Planning	292
Appendix 5: Information on Red Cowpea 6-1US	300
Appendix 6: Development of Cowpea Dishes	302
Appendix 7: Raw Materials Used in Linear Programming and Mixed Integer Programming	308
Appendix 8: The 26 Nutrient Content, Cost and Recipe of Cowpea Dishes and Commonly Eaten Dishes	312
Appendix 9: The Nutrient Requirements for Daily Menu	326
Appendix 10: Survey of Frequency of Eating Weekly Foods and "Preference" Meal Pattern for Menu Planning	335
Appendix 11: Computer Input and Solution	338
Appendix 12: Introduction Method Ideas from Brainstorming	351
Appendix 13: Evaluation of Introduction Method Ideas	356
Appendix 14: Description of Introduction Methods	362
Appendix 15: Procedure of Group Discussion and Programming	370
Appendix 16: Evaluation of the 7-Day Menu, the Cowpea Dishes and Cowpeas in Villages	374
Appendices 17-20	Fiche 1
Appendix 21	Fiche 2
Appendix 17: Recipes of 25 Cowpea Dishes for Home Used	
Appendix 18: Food Raw Material Composition Tables	
Appendix 19: Limit Quantity of Food Ingredients Used in Recipe Formulation to Maximise Protein Content by Linear Programming of Commonly Eaten Dishes	
Appendix 20: Solution of Post Optimum Analysis of Protein Maximisation by Linear Programming of Cowpea Dishes	
Appendix 21: Printout of Data Problem and Solution of Menu Planning by Mixed Integer Programming-Planning of Day 1 Menu on "Survey" Meal Pattern	

INTRODUCTION

The Northeast region is the largest region in Thailand in both area and population. It has an area of 17 million hectares, which is approximately one third of the country. There are 16 Provinces; Khon Kaen, where Khon Kaen University is situated, is the central Province.

Of the total Thai population, in 1981 estimated at 41.9 million, one third lives in the Northeast. About 85% of the Northeastern people live in villages and depend for their livelihood on agriculture. The annual income per household was estimated in 1975-76 as 7300 bahts, which was only half of the national average income (Ministry of Agriculture, 1978). The major part of this income is obtained from the production of rice, cassava, kenaf, corn and legumes. The low incomes are due primarily to poor agricultural production which is caused by unproductive soils and erratic rainfall (Cropping System Project, 1978). The majority of farmers still depend on rain-fed agriculture and a mono-cropping system. In only 6 months of the year, from mid-April to mid-October, there is more than 85% of the annual rainfall - in total 1255 mm (Shelton, 1976). Work is heavy during this period, the rainy season. There is little agricultural production during the 6 months of low rainfall, the dry season. This produces a peak of unemployment and no income earning.

The villagers have therefore little and sometimes no income and must grow or find most of their food. Most village households have an adequate supply of "bulk" food in the form of glutinous rice but they have a limited supply of the foods required for a nutritious balanced diet - meat, fruit and vegetables. There is scarcity of such food in the semi-arid areas and in the dry season in all areas. Only a few of the villagers have cash to buy food and they can usually buy only the basic, bulky foods. In many villages, there is no market place and not many foods are available in the village food stalls as there is low purchasing power and therefore a low demand for many varieties of food.

The diet of the Northeastern people is therefore mainly glutinous rice with small amounts of fish and fermented fish and green vegetables. This is generally an inadequate diet and results in a very high proportion of the population suffering from malnutrition. Several clinical, biochemical and food intake surveys have indicated the

inadequate dietary intake of the Northeastern population (Valyasevi, 1964, 1980; Valyasevi et al, 1967; Kumazawa et al, 1974; Taguchi et al, 1974; Division of Nutrition, 1975; Dhanamitta et al, 1981). Seven important nutritional deficiencies have been reported: protein-energy malnutrition, beri-beri, riboflavin deficiency, vitamin A deficiency, iron deficiency anemia, iodine deficiency, and urinary bladder stone disease. Protein energy malnutrition is the most widespread. This was shown by high mortality rates in children aged 0-4 years and in pregnant women, and by a high percentage of low birth weights between 2.5-2.6 kg (National Food and Nutrition Planning Board, 1977). Recently in Ban Nonghai, Ubol Province, 55% of preschool children had protein-energy malnutrition (Dhanamitta et al, 1981). In 1975, 16 cases of beri-beri were admitted to hospitals in Ubol Province. Most of these were infants whose mothers had a history of beri-beri (Dhanamitta et al, 1977). ICNND in 1962 identified riboflavin deficiency, vitamin A deficiency and iron deficiency anemia. In more recent years, a high prevalence of biochemical riboflavinosis in preschool children, high incidence of vitamin A deficiency in preschool and school children and widespread iron deficiency anemia among children and adults were found (Thumham et al, 1972; Dhanamitta and Valyasevi, 1977; Taguchi et al, 1974; Tanphaichitr and Sirivayd, 1977). Iodine-deficiency goitre was reported in 21% of the population in Ubol Province and 15% in Udon Province (Nondasuta, 1977). There was, in 1966, bladder stone hospitalisation in 15 Provinces in the Northeast (Halstead and Valyasevi, 1967). In a survey of this disease in 1970 among the 20 million population of the North and Northeast, 3.8% were found to have bladder stones (Valyasevi and Dhanamitta, 1977). Although most of the recent studies were conducted only in Ubol and Khon Kaen Provinces, it can be presumed that malnutrition is widespread throughout the Northeast.

Few attempts have been made to improve the nutritional status of the Northeastern population. A food supplement programme was carried out in some villages in Ubol Province and a school lunch programme in Khon Kaen Province (Valyasevi, 1980). In the early part of the Fourth National Food and Nutrition Plan (1977-1982), nutrition was not emphasised and it was left to the health sector. The nutrition programme was integrated into the existing health network carried out by the paramedical and auxiliary personnel at the village level. A pilot programme was conducted in villages in Ubol Province to find

suitable models for the implementation of the nutrition programme integrated into the existing health care network (Valyasevi, 1980).

Recently it has been recognised that there is a need for a wider approach towards improving the nutrition of the rural poor. The following elements need to be included and co-ordinated: food production and distribution, income generation, education, environmental hygiene, health and sanitation (FAO, 1977; Valyasevi, 1978). Obviously in a "low cash" village community, food production has to be increased and food storage methods improved, before better nutrition can be attained by the villagers. However, increased food production presents many problems - finding suitable crops, showing the villagers how to grow them and encouraging the villagers to eat them. Agricultural development, agricultural extension, development of foods and food dishes, home economics extension, need to be combined with nutritional studies for this type of nutritional improvement programme. There is no such programme in Northeast Thailand. Up to the present, there has been no government programme or research project introducing any nutritious foods which can be grown by the villagers and there is no satisfactory, recommended method of introducing new foods. A suitable method needs to be developed for introducing nutritious foods to areas of low nutritional status in Northeastern Thailand.

There have been various methods used in introducing new food products in other countries which might be used in Northeastern Thailand. New nutritious food products have been introduced in developing countries by commercial food companies and by agencies in food aid programmes (De Muelenaere, 1969; Orr, 1972, 1977; Cordaro and Gall, 1975; Forman and Hornstein, 1976; Ronchi and Lopex, 1976; Gongora and Shaw, 1977; Maxwell, 1978; Stevens, 1978). The commercial food companies have developed through the years, in the developed countries, a system of launching new products onto a market. This has been based mainly on consumer studies and on development of modern communication methods. The successfully marketed new food products have been carefully developed right from the initial stage of the product idea to the final stage of launching the product on the market. Each stage of development is systematically planned and evaluated in the system of product development. This system was used in the development of a number of protein rich foods, e.g. Incaparina in South America and ProNutro in South Africa. But although many highly nutritious food products have been developed, few were

successfully marketed so as to reach the people who need them. The real obstacle was the low purchasing power of the needy. This also caused the "trickle down" effect, the technique of transferring information through the social system often used by food companies for introducing new highly nutritious food to the needy, not to work. Promotion and advertising campaigns are directed to the middle and upper class income group. This is to create initial demand for the food products large enough for production and also to use the role played by the higher socio-economic groups in influencing the lower economic group to follow (Cordaro and Call, 1975).

Food agencies have been introducing new nutritious foods by distributing them through various government or international systems free of charge to the needy population. Often in the past, the existing food supplementary programmes were not successful in improving the nutritional standard of the community because they reached only a very small proportion of the priority target group because people have to travel far to the distribution centre, foods given often were mis-used, the programmes were cost ineffective, types of food available were limited, they were not suitable for nutrition education and creation of improved food habits because the foods were not locally available. Today, it has been suggested that it is better to use local food raw materials, and to use the village women themselves in the distribution of the food and the spread of nutrition education. More attention has to be given to reaching the family as a whole (Ronchi and Lopez, 1976; Gongora and Shaw, 1977; Maxwell, 1978; Stevens, 1978). Perhaps a combination of the method of introducing new food products by food commercial companies and the new suggestions of the food supplementary programmes could be used for introducing highly nutritious foods to the Northeastern villagers. But this needs to be carefully considered and planned as it has been stated that it is unreal and impractical to assume that methods used in the developed countries are appropriate and applicable in all situations. Success will not automatically follow from "plugging in" an innovation into a social system (Crooch and Chamala, 1981). "Trickle down" effects might not occur in the rural Thai social system as there was no difference in food consumption habits when socio-economic status was different (Kumazawa et al, 1974). It has now also been suggested that introducing new methods of growing new food crops to farmers by the "trickle-down" effect often used by agriculture extension, is not

successful in all communities and that this does not produce a general expansion of new crop growing in the community but only the rise of elitest farmers (McAllister, 1981; Roling et al, 1981). In the Thai peasant society, people are suspicious of ambitious persons. Thus in general farmers or housewives are hesitant to take the lead for fear of being disliked by others. It is therefore hard to find good leadership, for only those who think that the position will give them enough personal benefit to be worth the risk of being disliked would thrust themselves forward (Hein et al, 1980). This may have a vital effect on planning the introduction of new nutritious food products to the Northeastern villages. Therefore, there is a need to develop a method of introduction which will be acceptable to the village community, which is not foreign to their way of life and which they can really understand.

Because the villagers have several nutritional deficiencies, it is not sufficient to introduce just a single food, for example a protein food, but it is necessary to introduce a complete diet incorporating foods already grown or available with one or two supplementary foods so as to give a balanced food intake. Therefore there is a need first to identify the foods already available in the villages, then to find suitable supplementary foods and then to design a complete "menu".

As the most prevalent nutritional problem is protein-energy malnutrition, the supplementary foods needed most urgently are low cost and high quality protein foods. It is expensive and difficult to increase the production of meat and other pastoral products. There have been a number of research programmes on production of cattle, pigs and poultry but development has been slow. Agriculture research into increased production of legumes and vegetables has been encouraging and therefore it is more useful to consider these crops for increasing protein and energy intakes. Legumes in particular can be stored dry for long periods of time and would be suitable foods for the dry season when it is not possible to grow many vegetables and when malnutrition is most acute. In planning a reasonable protein and energy intake throughout the year, legumes could contribute significantly to the Northeastern diet as it consists mainly of steamed glutinous rice and a small amount of fish.

Although several legumes are grown, there is a reluctance on the part of the farmers to grow them until they are assured of their value either for home use or for a cash income. Soybeans cannot grow well in

Northeast soils because of poor nodulation and mungbeans have low production yields. There are indications that peanuts can be grown as a cash crop but already cowpeas and stringbeans are being grown in some places as green vegetables for household use and also cash crops. Therefore it appears that cowpeas would be the most suitable legume to grow for storage as a supplementary food in the dry season. There is only one problem - the villagers seldom eat cowpeas in the form of cowpea seed! The villagers would have to be taught to use cowpea seeds in their cooking before the farmers would want to grow cowpeas.

New food dishes incorporating cowpeas would have to be developed. Various kinds of cowpea dishes such as main meal dishes, desserts and snacks would have to be developed for the housewives to cook at home and for the food vendors to sell in the villages. These new foods would have to be based on the dishes and the methods of cooking already common in the villages and be acceptable to the villagers. Cowpea dishes and a menu developed to fit with the villagers' background would offer the best prospect of acceptance.

A weekly or monthly "menu" could be designed using the locally available food raw materials and the new cowpea dishes, but the most difficult part would be introduction of this balanced diet to the villagers. It is important that the villagers, especially the housewives, be told and encouraged to take the right quality and right quantity of food in the diet. But how can it be done?. People do not change their food unless they feel that they are going to benefit from the change. Food processing companies have already developed techniques to create awareness and to lead to the adoption of new food products and the nutrition education experts have developed effective nutrition education programmes. It was thought that these methods could be combined for the introduction of new foods to the Thai villages.

Therefore the aim of the present research was to design a nutritionally balanced diet based on the raw materials already available in the villages supplemented with cowpeas, the present eating patterns and the types of foods already eaten in the villages; and to introduce this diet to some typical villages in Khon Kaen Province using a combination of the new product introduction methods of commercial companies and the nutrition education programmes.

The research was designed in three parts as follows:

PART ONE: Survey of Eating Habits in Ten Villages in
Khon Kaen Province

This research was to find the basic dietary information on kinds and sources of food raw materials eaten, types and quantities of food legumes eaten and the eating pattern throughout the year of the Khon Kaen villagers.

It was necessary to document: the common food raw materials, the types of food dishes, desserts and snacks eaten, the dietary pattern of the villagers throughout the year, the types of legumes eaten, the percentage of farmers growing legumes, the percentage of villagers eating legumes and how the farmers store legumes.

PART TWO: Development of Cowpea Dishes and 7-Day Menu for
Villagers in Northeastern Thailand

This research was to design and develop firstly food dishes supplemented with cowpeas and secondly a nutritionally balanced menu which would be acceptable to the villagers.

PART THREE: Introduction of Cowpeas in a Nutritionally
Balanced Menu to Six Villages in Khon Kaen Province

The final part of the research was to find an appropriate method of introducing the cowpeas and the nutritionally balanced menu to villagers and to study the total impact of this system of growing a new food as a method for improving the diet.

The research was conducted in New Zealand and Thailand during the period 1978-1981. The survey was conducted in 10 villages in Khon Kaen Province. The formulation of the food dishes and the planning of the menu and the development of the introduction methods were carried out at Massey University, New Zealand. The acceptability of cowpea dishes was tested at Khon Kaen University, Thailand and the introduction of cowpea dishes and the 7-day menu was conducted in six villages in Khon Kaen Province.

PART ONE:

SURVEY OF EATING HABITS IN TEN VILLAGES
IN KHON KAEN PROVINCE

Foods eaten in each village in the Northeast may differ because of tradition and locality of the villages but certainly differ from season to season because of changes in the availability of food. In Khon Kaen Province, there are five villages to which the Khon Kaen University Cropping System Project have introduced legumes such as mungbeans, peanuts, and cowpeas to be used in intercropping. This introduced cropping pattern may influence the eating pattern of the villagers. Therefore in studying eating habits, it was important to survey different types of villages. The survey was conducted in the five Multiple Cropping and five Other Villages chosen from all non Multiple Cropping villages. A total of 100 households were used in the survey, 10 households from each village. Heads of households with different occupations were chosen. The householder was interviewed by a teacher in the village or the village headman.

There were two surveys:

1. The General Survey on the Food Eaten

The aims were to:

- (a) Determine the food raw materials available to the villagers and eaten by them.
- (b) Compare the foods eaten in the Multiple Cropping Villages and the Other Villages.
- (c) Obtain factual information on the kinds of foods and food dishes the villagers ate for each meal or between meals throughout the day in the three seasons - rainy, hot and cool.
- (d) Establish the pattern of eating throughout the year.

2. The Survey on Legumes Eaten, Grown and Stored

The aims were to obtain:

- (a) The type and quantity of legumes and legume dishes eaten in the different villages, the frequency of eating legumes,
- (b) Type of meal in which legumes were used,
- (c) Methods of cooking and processing legumes,
- (d) The villagers' attitude to legumes and legume dishes,
- (e) The growing, storing and the utilization of cowpea production,
- (f) The ways to encourage increased consumption of legume foods.

1. THE FOOD OF VILLAGERS IN NORTHEASTERN THAILAND

The food of villagers in Northeastern Thailand is mainly glutinous rice with vegetables and small quantities of fish, fermented fish, beef and chicken. Only five surveys of the food consumption have been done, and there have been to determine the nutritional level of the diet.

1.1 FOOD HABITS IN NORTHEASTERN THAILAND

Villagers normally eat their meals together as a whole family, at least two meals a day - breakfast and dinner. Foods are cooked and served for the whole family, no special foods are prepared for children, or pregnant and lactating women. School children usually come home for lunch, but the adults who work in the field usually take with them steamed glutinous rice and other food for lunch. During the rice harvesting season, the villagers sometimes stay in the field and eat whatever food they can find in that area or have brought with them. Generally the eating habits of the villagers are the same, but the kinds of food they count as exotic food or restricted food for the sick people, pregnant and lactating women may vary from place to place depending on the availability of food in the local area and their beliefs. Studies on the foods eaten in the villages have been done in Khon Kaen and Ubol Provinces.

Kumazawa et al, (1974) surveyed the eating habits of villagers in seven villages of Khon Kaen Province, in the cool season in 1972. Glutinous rice and vegetables were consumed daily with any other available food materials. Fish was eaten almost every day by many families but only in an extremely small quantity. Fruits were eaten only once or twice a week even though papaya, banana and watermelon were available. Frog, chicken, buffalo, duck, pork and beef were eaten only once a week or rarely eaten by some families. Only a few families had eaten duck eggs more frequently than once a week and some families had never eaten them at all. Vegetable oils and lard were available and were used in small quantities for frying, but were not often used, only once a week or a month. Sugar was a very precious food and most families seldom used it. Tea, milk and milk powder were rarely taken.

In three different seasons in Nong Kohn village in Ubol Province in 1963, the villagers generally ate meals which consisted of steamed glutinous rice, uncooked fermented fish (Pla-ra) mixed with hot peppers and condiments, various vegetables, and green leaves (Valyasevi et al, 1967). Fermented fish was usually eaten without cooking and was added to almost every dish. Leaf and plant parts obtained from the uncultivated, forested area were consumed nearly all year, either fresh, baked or boiled. Fresh water fish, snails, frogs and crabs were available in the latter half of the rainy season and the beginning of the cool season. Chicken and eggs, were not consumed except on special occasions. Meat was not eaten generally except when a water buffalo or cow died through accident or disease. Cattle placenta was consumed when available.

In 10 villages in Ubol Province during November 1961-February 1962 various categories of food was consumed in different seasons. Steamed glutinous rice was the main staple food. Fish was the main source of animal protein. Other animal protein foods were beef, frog, pork, chicken, shrimps and small crabs. Crickets, grasshoppers, insects and lizards were also eaten. Only 20% of the villagers ate eggs. Green vegetables, leaves from trees, water vegetables, legumes and fruits were the other foods. The number of villagers eating fish was higher in the rainy season than in the cool and hot seasons. Similarly, frogs and water vegetables were more commonly eaten in the rainy season. Insects and lizards were eaten in the hot season, vegetables mainly in the cool season (Valyasevi, 1964).

The basic diet in the villages is therefore glutinous rice and vegetables with fermented fish and fresh fish when available. Other foods are used when available. Little meat, oils, fats and eggs are eaten.

Foods with anti-nutritional factors are eaten. Leaves of native forest trees are commonly eaten and are reported to contain anti-thiamin factors (Valyasevi et al, 1967; Halstead et al, 1967; Vimoksanth et al, 1975). Vimoksanth et al, (1975) also reported that raw fermented fish, often eaten by the villagers, contained thiaminase which was destroyed by cooking. Betel nut chewing is still common among the adult villagers (Valyasevi et al, 1967) and also affects the thiamine intake. Valyasevi and Dhanamitta (1974) also found that the local vegetables and forest plants commonly consumed by villagers of all ages contain oxalic acid.

1.2 DIETARY SURVEYS IN NORTHEASTERN THAILAND

Five dietary surveys were conducted in three provinces in the Northeast (Ubol, Khon Kaen and Nakorn Rachasrima) from 1961 to 1978.

1.2.1 Dietary Intakes of Infants and Preschool Children

In a study in Nonghai village, Ubol Province in 1978, infants under 6 months of age were breastfed. The amount of breast milk secreted was about two thirds of the normal amount in most mothers. In addition to breast feeding, the village mothers usually gave substantial amounts of steamed glutinous rice as a supplementary food. Infants between 8 to 15 months of age, were still on breastfeeding and the amount consumed ranged from 400 to 700 ml per day. The supplementary feeding consisted mainly of rice. Additional foods were fish and fish products, meat, banana and vegetables. Carbohydrates, mainly from rice, constituted between 80 - 90% of the energy intake, protein 8 - 12% and fat 4 - 8%. Since rice is a bulky food and the fat intake was extremely low, the energy intake was inadequate. In reference to the protein intake, the inadequacy was not severe as compared with the energy intake (Valyasevi, 1980).

1.2.2 Diet of Pregnant Women

A dietary survey of 100 families in 10 villages in Ubol Province during November 1961-February 1962 found the average daily protein intake per capita of the pregnant and lactating women was 56 g or 1.73 g per kilogram of body weight and the average energy intake per capita was 2,093 kcal. The energy from protein were 10.6 % of the total energy. Animal protein constituted about 30 % of the total protein intake. The protein intake of pregnant and lactating women was about 75% and 50% respectively of the recommended allowance of the (US) National Research Council (Valyasevi, 1964). Dietary intake during pregnancy of the village women in Ubol Province, in 1978, was still deficient, energy and protein were about 70 - 80 percent of the FAO/WHO (1973) recommended intake; this was believed to be the reason for less secretion of breast milk. In addition multiple pregnancies, which were frequently observed in women from the rural area, further aggravated poor nutritional status (Valyasevi, 1980).

1.2.3 Dietary Survey in Nong Kohn Village and an Urban Area in Ubol Province

Three day dietary surveys were carried out in three different seasons - hot, rainy and cool, in Ubol Province in 1963. Sixteen families in Nong Kohn village, where bladder stone is endemic, and 15 families, Laos-Thai, living in an urban area were used in the survey.

In the village, there was an average daily per capita consumption of 400-500g rice 41-66g fish, 6-14g eggs and meat, 44-101g vegetables, 17-34g fruits. There were less vegetables in the hot season than in the rainy and cool seasons; more fruit and fish were eaten in the hot season than in the rainy and cool season.

The energy intake per capita per day were 1902, 1912, 1999 kcal for the hot, rainy and cool seasons respectively; the protein intake varied very little. Of the energy intake, approximately 83% was from carbohydrate, 4% from fat and 11% from protein. Approximately 70% of the protein consumed by the villagers was of vegetable origin and only 56% for the urban group. Calcium and phosphorus intakes were higher in the village than in the urban diets, because of the high amount of fermented fish in the village diet. Average vitamin A intake in village diets was approximately one third of that in urban diets, due to very low consumption of eggs and meats. During the rainy season when vegetables became more abundant in the village, the vitamin A intake increased. Riboflavin intake in village diets was approximately 75% that of urban families. This also reflected the low consumption of meat, egg and vegetables by the villagers. In the hot season, the vitamin C intake in the village was almost half that of the intake in the rainy and cool seasons. Thiamine and niacin intake did not differ in the two groups. In the village, the mean adult intakes of calcium and vitamin A, B1, B2 and C were lower than in the urban area. The mean adult intake in the village and in urban Ubol for total energy, total protein, iron and niacin were approximately as the recommended allowances (Valyasevi et al, 1967).

1.2.4 Dietary Survey of 42 Families in Seven Villages in Khon Kaen Province

A two day dietary intake of 42 families in seven villages in Khon Kaen Province in 1972 was reported by Kumazawa et al, (1974). The seven villages were: Ban Khota, Ban Nonghuaua, Ban Khoklalm, Ban Han, Ban Topradoo, Ban Huabeung and Ban Khoksoong. The survey was conducted during the cool season. The range and mean daily consumption of food per person found in their survey are shown in Table 1 and the average nutrient intakes are shown in Table 2.

Table 1: Range and Mean Daily Consumption of Food Per Person in Seven Villages in Khon Kaen Province (Kumazawa et al. 1974)

	RANGE (g)	MEAN (g)
Total Food	544.2 - 995.1	764.0
Rice	389.5 - 517.7	444.8
Fish and shellfish	20.0 - 35.5	26.5
Beef, pork, poultry and frog	4.7 - 39.2	15.5
High carotene vegetables	16.6 - 45.5	37.7
Other vegetables	61.3 - 184.9	121.5
Fruits	4.8 - 203.7	68.5
Fat and Oil	0 - 2.2	1.1

Table 2: Average Nutrient Intake of 42 Families
in Khon Kaen Province (Kumzazwa et al., 1974)

NUTRIENTS	MEAN INTAKE/PERSON /DAY \pm S.D		REFERENCE MAN INTAKE /DAY \pm S.D (3)	
Energy, kcal	1,832	\pm 332	2,295	\pm 404
Protein, total g	47.2	\pm 10.7	62.2	\pm 13.9
Animal, g	12.6	\pm 6.6	16.5	n.a.
Fat, g	11.5	\pm 5.8		
Carbohydrate, g	375.2	\pm 67.2		
Calcium, mg	351	\pm 165	335	\pm 144
Iron, total,mg	12.3	\pm 4.7	7.9	\pm 2.8
Animal, mg	2.8	\pm 3.3		
Vitamin A, activity IU	1,298	\pm 651	1,563	\pm 809
Thiamine, mg (1)	0.41	\pm 0.12	0.50	\pm 0.16
Riboflavin, mg	0.58	\pm 0.44	0.70	\pm 0.53
Niacin, mg	15.1	\pm 3.7	19.5	\pm 4.7
Vitamin C, mg (2)	58	\pm 9	60	\pm 36
Folate, free folate, μ g	156.3			
Total folate, μ g	252.1			

(1) The value was corrected by estimating that cooking loss of thiamine content in rice was 70%.

(2) The value was corrected by estimating that cooking loss of Vitamin C was 30%.

(3) Reference Man Intake = $\frac{\text{Daily Intake for a Person}}{\text{Reference Man Ratio}}$

Reference Man Ratio = $\frac{\text{Average Dietary Allowance for a Family}}{\text{Dietary Allowance for Reference Man}}$

Reference Man aged 20-29 years.

The consumption of rice was 58.2% of the total diet and contributed to the total diet energy 89%; protein, 65%; calcium, 20%; iron, 40%; thiamine, 73%; and riboflavin, 31%. When comparing the nutrient intake calculated in terms of the reference man to the Thai recommended allowances, they found that the energy intake for the seven villages was 90% of the Thai recommended allowance. The average total protein intake calculated in terms of the reference man was larger than the Thai recommendation but the intake of animal protein in all villages was low. The calcium intake for all villages was 80% of the

recommendation. The total iron intake of men was higher than the Thai recommendation but the iron intake of the adult women was considered insufficient. The intake of animal iron was considered to be at a low level. The intake of vitamin A in each village was not adequate in two villages the intakes were less than 50% of the recommendation. When the cooking loss of thiamine was taken into consideration, the average intake was less than 70% of the recommendation. The intake of riboflavin in each village was not adequate. The intakes ranged from 30 to 60% of the recommendation. The average intake of niacin and vitamin C for the seven villages were adequate. The folic intake per capita per day was 156 μg as free folic acid and this quantity was less than the FAO/WHO (1970) recommendation. Kumazawa et al, (1974) also found that the consumption of food was not always related to the economic status.

1.2.5 Dietary Survey in Nakorn Rachasrima Province

The survey was conducted in the urban and the rural area in Nakorn Rachasrima Province in 1975 (Division of Nutrition, 1975). The rural area had an adequate intake of energy, protein, iron, Vitamin A, thiamine, niacin, Vitamin C, but inadequate intake of calcium and riboflavin. It was found that the energy intake of the urban sample was not adequate - this was due to the low intake of carbohydrate. The calcium and riboflavin intakes of both urban and rural samples were very low and less than 50% of the requirement. Thiamine and Vitamin C intake of the urban sample was not adequate (Division of Nutrition, 1975).

1.3 THE CAUSE OF NUTRITIONAL PROBLEMS IN NORTHEASTERN THAILAND

The five dietary surveys in villages in Ubol, Khon Kaen and Nakorn Rachasrima Provinces reported nutritional deficiencies in the diet of these villagers. The most important nutrient deficiencies reported were protein, energy, calcium, iron, Vitamin A, thiamine and riboflavin. There were inadequate energy intakes in infants, preschool children, pregnant and lactating women but in some villages, the adult energy intake was adequate. Most of the energy intake is from glutinous rice and if sufficient can be eaten, then an adequate level of energy intake is achieved. Little oils and fats are consumed in the

diet so fat is unimportant as a source of energy. The protein was mostly from vegetable sources, there was only a small amount of animal protein, mainly in the form of fish, consumed. Low intake of animal foods may cause the inadequate intakes of riboflavin, calcium, iron, thiamine. Vitamin A inadequacy was due to low intakes of eggs, meat and high carotene vegetables.

The main cause of the nutritional problems in the Northeast is the consumption of an unbalanced diet. The diet is unbalanced because most of the energy is from glutinous rice, and the protein is from vegetables and rice. Consumption of high vitamins and mineral foods was below the requirements. Fat and oil consumption was very low. The unbalanced diet could be due to the unavailability of food in the villages and perhaps also due to seasonal effects. Fish and vegetables may not be available in the hot season. There is therefore a need for some supplementary foods in the diet and because of the difficulty in increasing meat, fish and eggs, it appears that legumes should be investigated as supplementary foods.

The consumption of an unbalanced diet may also be due to the food habits - the rarely eaten fatty foods and infrequent use of fat and oil in cooking, the common food dishes which consist of large quantities of green vegetables and leaves with small amounts of meat, the common practice of eating raw fermented fish, raw fish, and raw meat. There may be a need for education in cooking the available raw materials so as to give more nutritional meals and a more nutritional daily diet.

A balanced diet made up of self-supplied foods available in all seasons is therefore needed for these villages. This balanced diet must supply all of these important nutrients reported as inadequate as well as the other nutrients required. This means that various sources of nutritious foods are needed to make up the balanced diet to supply all the important nutrients for the daily requirements. Protein and perhaps energy can be supplemented with legumes such as cowpeas but other food raw materials available in the villages are also needed to make up the balanced diet for a daily supply of all the nutrients required. It is therefore important that a daily menu of common foods be designed for the villagers using village food raw materials and supplemented with legumes such as cowpeas.

1.4 THE NEED OF A SURVEY ON THE FOOD EATING HABITS

The surveys listed above were mainly to study the adequacy of the daily diet in terms of nutrient intake. Therefore the data available were mostly on kind of foods, e.g. cereals, meat, fish, vegetables and the quantity of each eaten by a family or a person per day. There was also available information on the frequency of different kinds of foods eaten in a week and a month and the consumption in different seasons of the year. But there were no data available on the types of foods and food dishes villagers commonly eat in different meals and in different seasons; the common methods of cooking and how the villagers obtained their food raw materials in different seasons. This information would be required to establish the pattern of food supply and the eating pattern throughout the year. Information on the types of legumes and legume foods eaten in the villages, source of legumes obtained in the villages, and how much legumes has been eaten in the villages is needed to determine the possibility of using legumes as supplementary foods.

In designing and developing a daily menu of nutritious and acceptable food dishes, there was specific information needed e.g. for whom and for how many people should the menu be planned? Should the menu be planned for a separate meal or for a whole day? How many dishes should be in the menu, and what types of dishes? Therefore more information was required on the eating pattern of the villagers, the common food eating habits amongst different villages, the common pattern of meals and dishes at a specific time of a day, the methods of cooking these commonly eaten dishes, the raw materials and the sources where the villagers obtained the raw materials found in the common dishes.

2. SURVEY METHODS USED IN FOOD CONSUMPTION STUDIES

Generally there are three types of nutrition surveys: firstly "food consumption" surveys which provide data on food and nutrient intakes, secondly, "nutritional status" surveys which provide both food consumption data and anthropometric, clinical or biochemical data; and thirdly "physical status" surveys which provide only anthropometric, clinical or biochemical data (Schofield, 1979).

There are many reviews and recommendations on the methods used in nutritional surveys, e.g. the methods used in all surveys were reviewed by Pike and Brown (1975), Schofield (1979); methodology for large scale surveys of household and individual diets by Burk and Pao (1976); the recommendations on medical assessment of nutritional status by WHO (1963); the recommendations on assessment of protein nutritional status by FAO (1970); the assessment of the nutritional status of the community by Jelliffe (1966). Perhaps the most useful summary of the information needed for assessment of nutritional status is by WHO (1963).

This chapter discusses only the methods used in the food consumption surveys, and the factors needed to be considered to prove validity of the information collected, in particular at the village level.

2.1 FOOD CONSUMPTION SURVEYS

Food consumption surveys provide information about predominant dietary patterns, specific foods consumed, the amounts of foods consumed and estimated nutrient intakes for the entire population, family groups or individuals within the family. There are several methods used in food consumption surveys: Food Weightment Method; Food Composite Analysis; Food Recall; Inventory or Log Book Methods; Food Lists, Diet Histories and Food Accounts (Pike and Brown 1975; Burk and Pao, 1976; Schofield, 1979).

2.1.1 Food Weightment Method

Food Weightment Method involves measuring the amounts of food (both raw and cooked) consumed at each meal, taking into account food wasted in preparation and left-overs. Individual portions can be painstakingly measured or total family intake is weighed and individual intake calculated from consumption coefficients (Schofield, 1979). This method usually requires that an investigator be present in the home at the time that foods are prepared. The method has the advantage of providing precise information. It is perhaps the best approach to use in rural or small village situations where much food is obtained from home gardens or local barter and where retail measures or weights are uncertain. However, the method requires a greater investment in time and personnel than other techniques and is seldom used unless it is certain that data of comparable validity cannot be obtained by other means (Pike and Brown, 1975).

2.1.2 Food Composite Analysis

Food Composite Analysis is more precise than the Food Weightment Method. Aliquot portions of all meals consumed are obtained and their nutrient content chemically determined (Schofield, 1979).

2.1.3 Food Recall

This method relies on the housewife remembering the amounts of food consumed by the family over a specified time period. The housewife may be required to use standardized measuring units to indicate the size of the raw and cooked ingredients consumed, or the investigator may permit her to indicate these by using household utensils whose capacity must be determined (Schofield, 1979).

The 24 hour recall is a useful method to measure individual food consumption. The subject is asked to recall all food consumed during the previous day. Information obtained by this method obviously is not necessarily representative of the usual intake of an individual. The method, therefore, is more useful when relatively large numbers of subjects are involved and provides a qualitative rather than a quantitative description of group dietary patterns. When large numbers of subjects are involved, the method is considered to be indicative of

the dietary pattern characteristic of the group. Because of ease of obtaining data, the 24 hour recall has become more widely used (Pike and Brown, 1975).

2.1.4 Inventory or Log Book Method

The field worker weighs the amount of food available in the household at the beginning of the survey and leaves the scales with the housewife who records the weights of all foods brought into the household during the survey period. Food left in the household at the end of the survey is weighed by the investigator and the family food consumption over the survey period can be approximated (Schofield, 1979).

2.1.5 Food List

The Food List is essentially a recall method. The housewife is asked to estimate the quantity of food consumed by the entire household during the previous week by weight, retail unit, or household measure. The method requires a well trained interviewer who can help the housewife recall by daily menu or purchases all food consumed by the household. The food list is advantageous in that only one visit to the household is necessary. Because it requires little time and effort on the part of the homemaker, co-operation usually is good (Pike and Brown, 1975). Food lists are used to determine the type and frequency of food consumption (Schofield, 1979).

2.1.6 Diet History

The Diet History is designed to discover the usual food intake pattern over a relatively long period of time and is most often obtained by interview. A series of food records kept at intervals over a period of months or years yields data comparable to the diet history but obviously is a more expensive procedure both in terms of time and personnel. The diet history is often used for studies of food habits or in clinics or hospital dietetics. The method also measures frequency of intake of a large number of foods or groups of foods and thus smooths out seasonal variations in food intake.

This technique is useful in epidemiological studies, in which interest is directed toward the usual food pattern over a period of several years (Pike and Brown, 1975).

2.1.7 Food Account

The Food Account is commonly used in the survey of household food consumption. The Food Account is a record of all food purchased or produced for family consumption over a period of several weeks. The length of time depends on the complexity of the diet and the amount of food stored. When the diet is relatively monotonous or few foods are routinely stored in the home, a period of two weeks is often satisfactory since under these conditions food purchases tend to represent food consumed. The method has been used chiefly in areas where the diet is less complex (Pike and Brown, 1975).

2.1.8 Calculation and Interpretation of Dietary Intake

Various methods used for calculation of dietary intake from food surveys have been reviewed by Pike and Brown (1975). There are limitations in using tables of food composition in evaluating dietary intakes. In addition to the wide variation in nutrient content of foods in the raw state due to differences in cultivation, harvesting, and storage, there is a paucity of data on commercially prepared and processed foods and on nutrient losses during preparation and cooking. Tremendous variation exists in methods of food preparation in the home, and this is particularly true in the case of mixed dishes. For these reasons, differences between calculated values and values obtained by laboratory analyses of meals and individual mixed dishes may be considerable and this confirms the suspicion that calculated values may not represent the actual nutrient value of food consumed. In the review by Burk and Pao (1976), it appeared that close approximations of actual diet content were found between calculation and analysis for potassium, sodium, calcium and nitrogen but not for phosphorous and magnesium. Wide variations occurring between different preparations of the same meal was due to variation in raw materials and cooking methods. The dietary intakes calculated from food composition tables most likely approximate the general diet as well as the chemical analysis method because of the difficulty in sampling the widely varied

raw materials. It is preferable, whenever possible, that food composition data are not considered as exact single data but as a range of reported values.

For the interpretation of dietary intake, Pike and Brown (1975) said that proper interpretation of dietary data requires a sound knowledge of dietary requirements and an appreciation of the errors inherent in the methods for collecting and analyzing the data. One cannot depreciate the value of survey data as an indication of nutritional status, but there is little virtue in assigning to such data an accuracy that cannot possibly pertain. The human being is a highly variable creature, and the human living in an uncontrolled community setting is even more variable. There are many pitfalls in the study of population groups, and they should be recognized.

2.2 CHOICE OF METHODS USED IN FOOD CONSUMPTION STUDIES

According to Schofield (1979), ideally the choice of method used in the food consumption studies should be determined by the survey aims. Two types of aims are identified: the primary objective which specifies the main area of data collection and the secondary aim which specifies the intended use of the data after collection. But survey resources are not always unlimited and therefore choice of method will be restricted by available funds. It is important to weigh costs against reliability, asking how accurate results need to be, and what it will cost to increase accuracy in alternative ways: excessive costs incurred by large samples would often be better spent on field checks, supervision and re-interviewing. It is important to select methods within the budget from the start; ad hoc adaptation of methods because of an unforeseen shortage of money will give less reliable results, than a well planned survey held throughout within the budget. Thus the aims and data requirements of the survey will be constrained by both the practical costs of the survey and by the desired level of scientific accuracy.

According to Burk and Pao (1976), the evaluation of alternative methods of collecting data in nationwide surveys must take into account the reliability and the validity of the measurements of food consumption obtained, the burden on respondents, costs of field work and of data processing, as well as the usefulness of the data.

Comparison of methods employed in food consumption surveys have been made by various workers as indicated by Schofield (1979) and also reviewed by Burk and Pao (1976). These comparisons have provided some useful guidelines as to choice of method as described by Schofield (1979). In general, the food list method is cheap and quick but the inventory/log book method provides more data and demands less of the field worker as the housewife weighs and records the food purchases. However, the housewife must be literate and the data obtained are still not as accurate as data obtained by Food Weighment. Since Food Composite Analysis is expensive and time consuming, the real choice of method for obtaining quantitative data is between Recall and Food Weighment. The former is quicker because the amounts of foods consumed in the previous 24 hours can easily be recorded at one interview whereas the Weighment Method involves weighing all meals and returning the following day to assess the amount of in and between meal eating. Both methods require trained investigators and extensive time for data calculation but unless food wastage, snacks between meals, seasonal intakes, physiological requirements and other factors are taken into account, then the degree of reliability obtained by more expensive and time consuming methods may not justify the extra cost.

Food consumption surveys should be flexible; if intensive pilot surveys indicate that protein calorie malnutrition is the main and most widespread deficiency problem and that certain foods are the main protein and calorie sources, future surveys could concentrate on measuring the consumption of these foods instead of the entire diet.

In the studies of methods of data collection for the measurement of village nutritional status, Schofield (1979) concluded that the most frequently used method in the food consumption surveys was Food Weighment which is more costly than all other food consumption survey methods except Food Composite Analysis. Diet histories are next in popularity, especially in Asia, but these only provide qualitative information on food practices, taboos, etc.

2.3 CHOICE OF METHOD USED IN THIS SURVEY

The aim of the present survey was to obtain factual information on the availability of food raw materials in the villages, type of foods and food dishes eaten, methods of cooking and preservation, food eating pattern and particularly information on legumes eaten. Extensive information concerning the type, the source, the frequency and the quantity of legumes and legume dishes eaten was required as the basis for the development of cowpea supplemented foods and of a nutritionally balanced diet. There was no requirement for quantitative information on the daily food consumption, only the quantities of legumes and legume based foods eaten were required. A simple method for obtaining factual information was required. The Food Weightment and Food Composite Analysis were too expensive and such detailed quantitative data was not necessary. The recording methods such as the Inventory/Log Book Method, Diet History and Food Account Method were not suitable because many of the village women are illiterate and it was too expensive to have trained staff recording the data for them. Therefore the only methods that could be used were Food Recall and Food List. Information on the eating pattern, on type of foods and food dishes eaten in different meals of a day were needed and this could be obtained by recall interviewing.

As information needed to be collected on many topics, the villagers had to be interviewed. Self-administered questionnaires could not be used because a large proportion of the villagers cannot read or write; and if they do, they are not used to completing complex questionnaires. The information could be gathered more easily and quickly by interviewing.

It was decided to use someone from the village as the interviewer. Most of the villagers, including the housewives, usually work in the fields some distance away from the village. The times when all members of the family are together is usually during breakfast and the evening meal. The only suitable time to interview is when all the members of the family are present and when they are relaxing; this time is between the evening meal and bed time. It is not appropriate for an outside person to visit them at this time at night. The interviewer has to be a person who is living in the village and whose visit is welcomed by the villagers. Also it is the nature of the Northeastern villagers that they are usually shy and do not readily talk to

strangers. They may also not be willing to explain or answer any questions on the real situation to strangers. The interviewer who belongs to the village would be more suitable than the outside interviewer. Factual information could be easily passed to the person who is familiar to the villagers and in whom they have confidence. High co-operation could be expected and this would result in a high percentage of answers. By using the village interviewers, the surveys in different villages could be conducted at the same time without using large numbers of field staff. School teachers or the village head men were appropriate persons to use as interviewers in the village. The school teachers were preferred as the interviewers and therefore the questionnaires would be lengthy. Therefore the Food Recall Method, using the school teachers as interviewers, was chosen for the survey. A two day recall of the foods eaten was chosen because this would give a wider range of the foods eaten than one day recall, but the villagers most likely could not recall what they had eaten three days previously.

3. THE SURVEY METHOD

The two surveys were conducted in the same households ten villages scattered throughout Khon Kaen Province. They were "recall" surveys; the interviews being conducted by the villages' school teachers. The general survey on the foods eaten was conducted at three times in the year, the rainy, cool and hot seasons, August/September 1978, January 1979 and May 1979 respectively. The survey on legumes eaten, grown and stored was conducted in the rainy season in August/September 1978.

3.1 THE SELECTION OF THE VILLAGE AND HOUSEHOLD SAMPLES

Five villages were purposely selected from the Multiple Cropping Villages which were under the KKU-Cropping System Project. The Multiple Cropping Villages had been encouraged to grow cowpeas and other legumes. and it was thought that it would be valuable to compare their use of legumes with the use in other villages. It was necessary also to obtain information on the food eaten throughout the Province so the other five villages were chosen randomly from five amphors (amphors is a district - a sub province). The criteria used in choosing the five amphors were: scattered throughout Khon Kaen Province, geographically different because this may influence the food consumption pattern and accessibility. After the five amphors were selected, one tumbol (sub district) was randomly chosen from each amphor and one village was again randomly chosen from the random tumbol (see Figure 1).

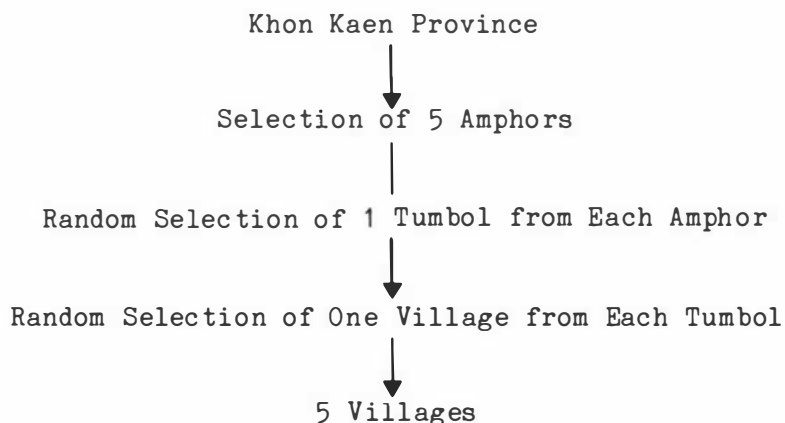


Figure 1: The Selection of "The Other" Villages

The randomly chosen villages were then visited. It was found that one village in Amphor Phol had difficult access, so another village was then chosen.

The Multiple Cropping Villages were: Ban Jode, Ban Koksri, Ban Maung, Ban Had and Ban Pasan. The Other Villages were: Ban Wang Yawl, Ban Huey Sai, Ban Na Dee, Ban Nong Pai and Ban Huey Tuey. Their location in Khon Kaen Province and distances from Khon Kaen University are shown in Figure 2.

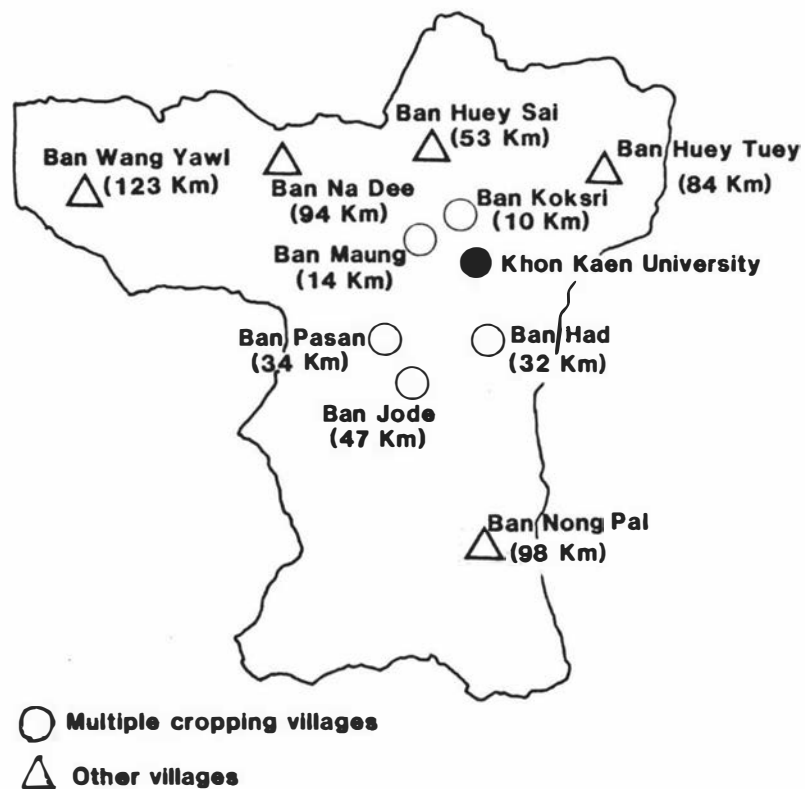


Figure 2: Khon Kaen Province: The Ten Villages and Distances from Khon Kaen University

The number of households and the villagers main careers are shown in Table 3. The information on village facilities, the nearer market places and approximate distance from villages, and the road condition to villages are shown in Appendix 1.

Table 3: Village Information

Name of Village	Amphor	Number of Households	Main Occupation of Villagers
<u>Multiple Cropping Villages</u>			
Ban Jode	Phra Yune	74	Rice and cassava grower, cattle raising
Ban Koksri	Muang	168	Rice, kenaf and cassava grower, cattle raising
Ban Maung	Muang	480	Rice, cassava, kenaf and ground nut grower, cattle and swine raising.
Ban Had	Muang	222	Rice and water melon grower.
Ban Pasan	Phra Yune	140	Rice, cassava and ground nut grower, cattle raising.
<u>The Other Villages</u>			
Ban Wang Yawl	Chumpae	174	Rice and field crops growing and bamboo shoot picking.
Ban Huey Sai	Nam Pong	134	Fishing and rice grower.
Ban Na Dee	Phu Vieng	300	Rice, kenaf and cassava growing and bamboo shoot picking.
Ban Nong Pai	Phol	83	Rice grower
Ban Huey Tuey	Kranuan	117	Rice, cassava and sugar cane growing.

Ten households were chosen from each village, this made up 100 households in the sample. The ten households were purposely chosen to represent a cross-population sample. They were:

- One household - village headman
- One household - assistant village headman
- Two households - farmers
- Two households - government officers
- Two households - labourers
- Two households - food shops or food vendors.

The total number of villagers in the 100 households were 663 persons or on average 6.63 persons per household. More than fifty percent were adults, aged over fifteen years. The average composition of a household is shown in Table 4.

Table 4: Average Composition of Household (from 100 households in 10 villages)

	Number per Household + S.D	% Composition
All ages population	6.63 + .75	100
Male over 15 years	1.85 + .38	27.9
Female over 15 years	1.94 + .37	29.3
Male 5-15 years	1.02 + .37	15.4
Female 5-15 years	.97 + .34	14.6
Male 1-5 years	.35 + .17	5.3
Female 1-5 years	.36 + .20	5.4
Male less than 1 year	.09 + .13	1.4
Female less than 1 year	.05 + .12	0.8

The main occupations of the villagers in the households were: rice growing, 69% (which was significantly higher than the other occupations), government service, 12%, field crop grower, 8%; and rice and field crop grower, 7%. The field crop growers were mostly in the Multiple Cropping Villages. The minor occupations of the 100 households were field crop grower (45%), labourer (22%), horticultural grower (18%), merchant (17%) and cattle raising (16%).

Incomes earned by the households were within the range from 3000 to 90,000 bahts (NZ\$ 150-4500) per annum. The largest percentage of income earners was in the lower range of 3000-8999 bahts. As shown in Table 5, a higher percentage of the households in the Multiple Cropping Villages than in the Other Villages had an income less than 9,000 bahts.

Table 5: Incomes of the Households

Annual Income (Bahts)	Multiple Cropping (%)	Other Villages (%)	Total Households (%)
<3,000	8	8	8
3,000- 8,999	44	28	36
9,000-14,999	28	26	27
15,000-20,999	8	8	8
21,000-26,999	2	10	6
27,000-29,999	0	4	2
30,000-59,999	8	16	12
60,000-90,000	2	-	1

However, the total annual income of the households in the Multiple Cropping Villages was slightly higher than that in the Other Villages as shown in Table 6. This was likely caused by the households having an income above 60,000 bahts.

Table 6: Total Income of Households in Villages

	Total Annual Income (Baht) of 10 Households	Mean Annual Income (Baht) per Household
<u>Multiple Cropping Villages</u>		
Ban Jode	70,485	7,049
Ban Koksri	154,280	15,428
Ban Maung	159,180	15,918
Ban Had	224,205	22,421
Ban Pasan	65,760	6,576
TOTAL	673,910	13,478
<u>Other Villages</u>		
Ban Wang Yawl	16,770	1,677
Ban Huey Sai	252,053	25,205
Ban Na Dee	174,410	17,441
Ban Nong Pai	93,440	9,344
Ban Huey Tuey	76,360	7,636
TOTAL	613,033	12,261
Total All Villages	1,286,943	12,869

Seventy three percent of the heads of households had only primary school education. Three percent could not read and write, 2% could only read, 6% finished secondary school, 8% finished high school, 2% finished pre-university school and 5% finished college. In 45% of the households, one of the household members had higher education than the head of the household. The distribution of the level of the highest education of the household members were primary school, 18%; secondary school, 29%; high school, 24%; pre-university school, 13%, and college 16%.

3.2 METHOD OF INFORMATION COLLECTION

Information required for the surveys was collected by interviewing the households, by an interviewer who belonged to the village. One interviewer was used for each village. The interviewer visited the households in the evening when all members of the household were present and interviewed the particular person in the household as instructed. The questions for the interview were provided in the questionnaire form and the interviewer recorded the answer on the same form. The questions were kept short and simple. Checklist answers were also provided. A recall interview was used to obtain information for the survey on eating pattern throughout the year. The cook or housewife was asked what she had cooked for the family or she had eaten during the past two days by starting to recall from the evening meal of the day interviewed and recalling backwards the prior meals to one after another until completing the sequence.

3.3 THE SELECTION AND TRAINING OF THE INTERVIEWER

The school teachers who lived in the villages were identified and approached. In two villages, there was no school teacher living in the village, so the school teachers who taught in the village school and lived nearby were used.

The school teachers were asked to come to Khon Kaen University for one day of training on 13 August 1978. The aim was to explain the objective of the surveys, the meaning of each question in the questionnaire and how to conduct the survey. Special training emphasised how to record the quantity of legumes eaten in which the same unit of the local standard dessert cup was recommended. In the training, the interviewers practised how to ask the questions and how to write the answers.

3.4 GENERAL ORGANISATION OF ALL SURVEYS

There were 5 steps used in organising the two surveys and the collection of the household information as shown in Figure 3.

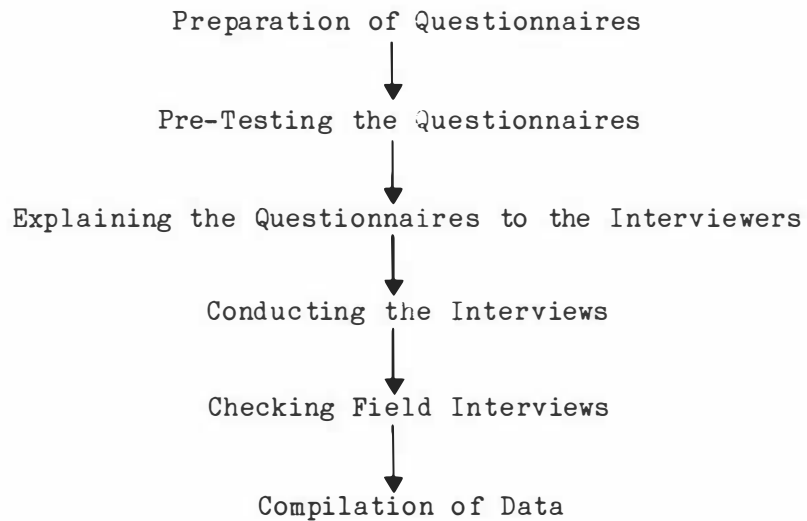
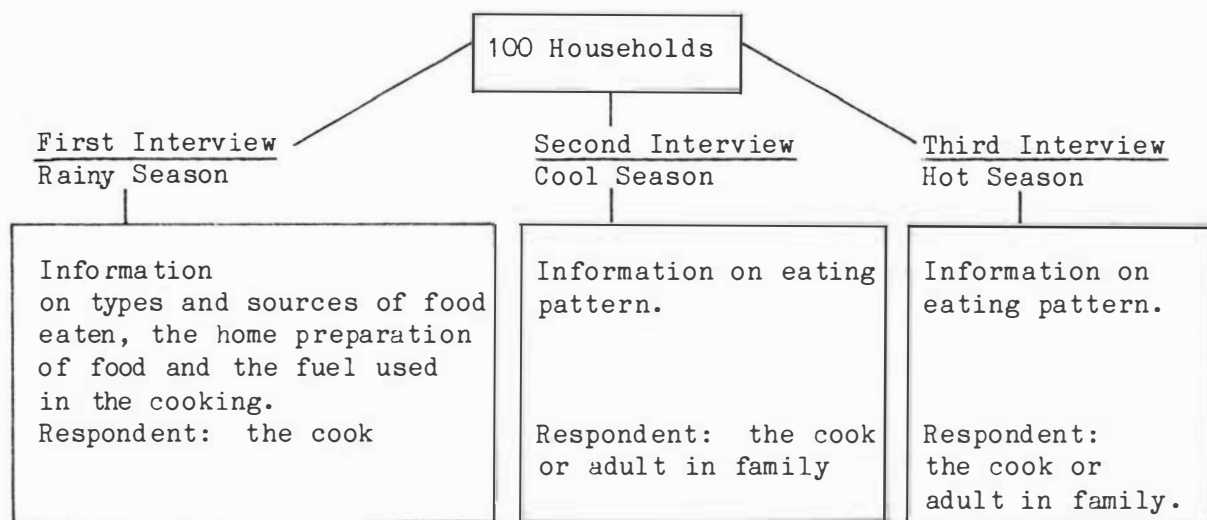


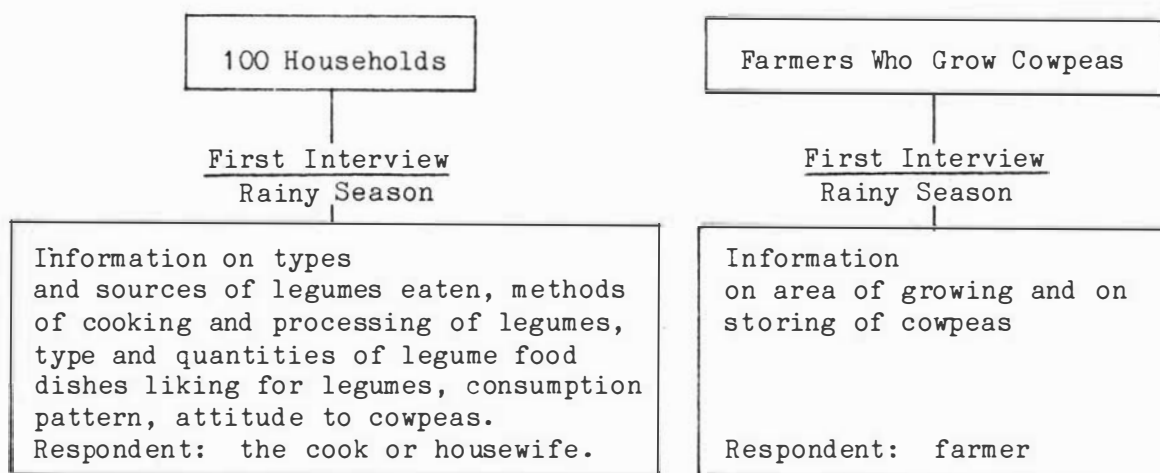
Figure 3: Organization Steps For All Surveys

The questionnaires used in the two surveys and in the collection of household information were prepared and pretested by using local workers in the university and then modified. These questionnaires were then explained to the interviewers on the training day. The interviewers were instructed to start the interview in the evening when all members of the household were present and interview a particular person for each different survey. The plan for conducting the survey is shown in Figure 4.

THE GENERAL SURVEY ON THE FOOD EATEN



THE SURVEY ON LEGUME EATEN GROWN AND STORED



COLLECTING OF HOUSEHOLD INFORMATION

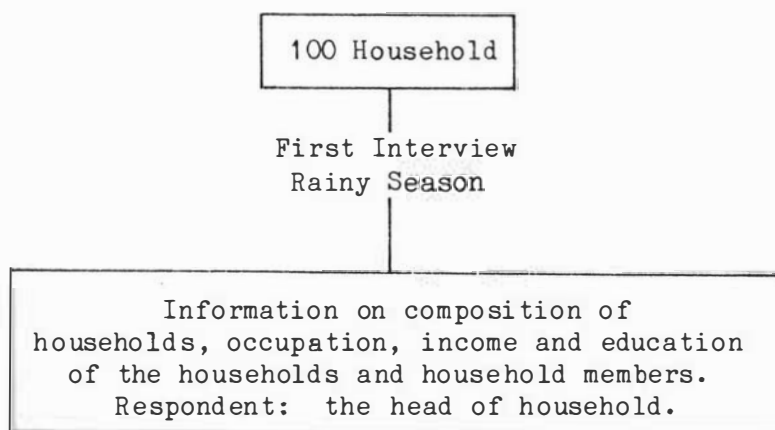


Figure 4: A Plan for Conducting the Interviews

All surveys were conducted in the rainy season, starting the day after the training. The survey on the eating pattern throughout the year was conducted again in the cool and hot seasons in the same 100 households. During the surveys, the field supervisor visited the interviewers and checked the recorded data. Additional interviews were required for the uncompleted questionnaires.

The data were transferred onto master sheets, edited and tabulated. The quantity of legumes and legume dishes recorded in different units were standardised and converted into unit weights in grams. Names of the dishes were standardised as different villages sometimes call the same dish by different names.

3.5 THE GENERAL SURVEY ON FOOD EATEN

Information was collected at the first interview in the rainy season on the types and source of food eaten, the home preparation of food, the fuel used in the cooking and the eating pattern.

Foods were divided into categories: meat, fish and poultry, vegetables, fruit, insects and wild animals. The cooks of the 100 households were asked to list the kinds of foods they had eaten in each category and how they had obtained these foods. Check lists of foods and sources were provided for the interviewers for recording during the interviews. The four "sources" listed were grown, bought from market, found around the villages and from neighbours.

The cooks were asked how they preserve the following categories of food for their own use: rice, legumes, vegetables, fish, meat and fruit.

A check list of fuels was prepared for the information collected on fuel used for household cooking.

For the eating pattern throughout the year, data on food and food dishes eaten during two days in the cool and hot seasons were corrected again twice at the second and third interviews. The interviewers recorded the names of foods and food dishes the cook or the housewife cooked for the family or had eaten during the past two days on the forms provided. Foods in each meal were classified into different categories as rice, dry main dishes, liquid main dishes, sauces, vegetables eaten with sauce or main dish, desserts, fruits, snacks and drinks.

Foods eaten by children aged 1-5 years which were different from the adults' foods were collected during the survey. This was to find out the eating pattern of the children which was needed for the planning of the menu for the whole family.

3.6 THE SURVEY ON LEGUMES EATEN, GROWN AND STORED

There were eight topics of information collected in the survey:

3.6.1 Types, Frequency and Quantities of Legumes

Types of legumes eaten by the villagers, frequency of eating and amount eaten were collected from the 100 households. A check list of legumes were provided in the questionnaires. The frequency of eating legumes was divided into: rarely, once a month, once a week, two or three times per week and everyday. The cooks or housewives were asked to estimate the quantity of legumes they had eaten during the time they had indicated. Estimation in the unit of a dessert cup was recommended.

3.6.2 Sources of Legumes Eaten in Villages

Two groups of villagers were interviewed. The first group was the 100 households, they were asked how they had obtained the legumes they had eaten. The second group was the farmers in the villages who were or had been growing cowpeas. Who had been growing cowpeas was usually known by the villagers who lived in the village and could be enquired from the village headman. The information on the area of growing was also collected.

3.6.3 The Storing of Cowpea Seeds

The methods of storing the harvested seeds, the problems encountered during storage, the period that they were usually stored and how they used the seeds were collected from the farmers who were growing or had grown cowpeas.

3.6.4 The Methods of Cooking and Processing Legumes

The cooks and the housewives of the 100 households were interviewed for the methods they had used for the cooking of different types of legumes and whether they had ever processed legumes.

3.6.5 Types and Quantities of Legume Food Dishes

The cooks or housewives were firstly asked to name the legume dishes that normally were eaten. Then they were presented with a list of legume dishes and asked did they eat any of these. They were asked to estimate the quantity of the legume dishes they had eaten in the period of one week or one month. And finally they were asked to list the most frequently eaten legume dishes.

3.6.6 Consumption Pattern of Legumes and Legume Dishes

Types of meals using legumes and times of day when legumes were eaten were collected from the cooks or housewives of the 100 households.

3.6.7 Liking of Legumes and Legume Dishes

The cooks or housewives were asked how much they liked legumes and legume dishes. The degree of liking of legumes were classified as like very much, like moderately, like slightly and dislike, and the degree of liking for legumes dishes and products were classified into like, neutral and dislike. A list of legumes, legume dishes and legume products were given in the questionnaires. Information on attitude of liking and disliking of the household members were also collected.

3.6.8 Attitude to Cowpeas

Information was also collected from the cooks or housewives of the 100 households on the general attitudes to fresh cowpea pod and to cowpea seeds, on the knowledge, experience of eating and opinion of the cooking, nutritional value and taste.

4. FOOD EATEN IN VILLAGES IN KHON KAEN PROVINCE, NORTHEASTERN THAILAND

4.1 TYPES AND SOURCES OF FOOD EATEN

The foods eaten in the Multiple Cropping Villages and the Other Villages in the survey were compared. The foods were divided into four groups - meat, fish and poultry; vegetables; fruits; insects and wild animals and the foods eaten in these groups are shown in Tables 7, 8, 9, 10.

Table 7: Meat, Fish and Poultry Normally Eaten in the Households

MULTIPLE CROPPING VILLAGES		OTHER VILLAGES	
Meat/Fish/ Poultry	% Of Households serving meat/ fish/poultry	Meat/Fish/ poultry	% Of Households serving meat/ fish/poultry
Beef	100	Beef	92
Chicken	94	Chicken	90
Pork	92	Pork	84
Catfish	80	Catfish	82
Carp	76	Carp	80
Frog	66	Frog	74
Small toad	60	Small Toad	70
Duck	58	Duck	68
Shrimp	56	Snail	66
Snail	54	Field-crab	60
Field-crab	52	Shrimp	60
Buffalo	52	Buffalo	52
Mackerel	50	Mackerel	48
Bullfrog	32	Egg	44
Whitefish	32	Puntius(fish)	44
Climbing perch	26	Bullfrog	36
Minnow	24	Snakefish	28
		Climbing perch	28

Meat, Fish and Poultry Eaten by Less than 20% of the Households

Rat, bird, turtle, squid.
Fish: minnow carp, bagridae, pa soi sipat-siam, panin, pangasius, puntius, pa rod, snake fish, and dried fish.

Rabbit, bird, turkey, wild chicken, wild pork, mouse, turtle, squid.
Fish: pa soi, bagridae, pa rod, coby, natopterdae, pa nin, minnow carp, minnow, white fish.

Table 8: Vegetables Normally Eaten in the Households

MULTIPLE CROPPING VILLAGES		OTHER VILLAGES	
Vegetables	% of Household Serving Vegetables	Vegetables	% of Household Serving Vegetables
Chinese Cabbage	92	Chinese Cabbage	90
Young Lead Tree Leaf	90	Spring Onion	86
Sping Onion	80	Young Lead Tree Leaf	66
Ivy Gourd	74	Ivy Gourd	62
Cabbage	52	Cabbage	62
Garlic	42	Water Convolvulus	56
Green beans	42	Coriander Leaf	52
Coriander Leaf	38	Pumpkin	36
Water Convolvulus	36	Water Lily Stem	34
Mint	26	Garlic	32
Lemon Leaf	22	Bamboo Shoot	30
		Gourd	26
		Cucumber	24
		Water Hyacinth Stem	22
		Acacia Leaf	22

Vegetables Eaten by Less than 20% of the Households

Pumpkin shoot, acacia, lettuce, water mimosa, water hyacinth stem, spinach, piper sarmentosum, sweet basil, chilli, squash, gourd shoot, tomato, "pag Whawn" - leaf of native tree, malabar-night shade leaves, cumin, celery, corn, lemon, lemon grass, bamboo shoot, pumpkin, ginger, cowpea, pag kig, water fern, collards, bitter melon, egg plant gourd, cucumber, neem, cork wood flower, water lily stem, greater galangal.

Pumpkin shoot, bottle gourd, Indian pennywort, "pag-gradoon" - leaf of native tree, tomato, sweet basil, spinach, holy basil, celery, "pag tuw" - leaf of native tree, algae, cauliflower, egg plant, water hyacinth stem, sweet basil, collards, neem, cork wood young leaves, lemon grass, "pag whawn" - leaf of native tree, garlic, leaves, greater galangal.

Table 9: Fruit Normally Eaten in the Households

MULTIPLE CROPPING VILLAGES		OTHER VILLAGES	
Fruit	% of Households serving fruit	Fruit	% of Households serving fruit
Custard apple	80	Rambutan	80
Rambutan	72	Mandarin	70
Mandarin	54	Longan	66
Mango	54	Custard apple	66
Banana	48	Mango	62
Longan	44	Guava	58
Guava	40	Sapodilla	44
Sapodilla	34	Banana	36
Tamarind	34	Tamarind	34
		Papaya	32
		Jackfruit	28
		Coconut	28

Fruits Eaten by Less than 20% of the Households

Aztec kwamochill, Corambola, Myrobalan, Durian, Water melon, Coconut, Jujube	Corambola, Water melon, grape Musk melon, Star gooseberry, Pomelo, Olive, Logekoer
Wild Almond, Logekeer, Jackfruit, Magleum (native myrobalan), Papaya, Jambolan, Pineapple, Longsat, Pomelo, Rampi, Grape.	Longan, Jujube, Rampi, Pineapple, Pomegranate, Durian, Myrobalan Indian Gooseberry.

Table 10: Insects and Wild Animals Normally Eaten in the Household

MULTIPLE CROPPING VILLAGES		OTHER VILLAGES	
Insects	% of Households Serving Insects etc	Insects	% of Household Serving Insects etc
Skink	72	Skink	42
Cricket	44	Giant water-bug	34
Chameleon	42	Grasshopper	28
June beetle	24	June beetle	26
Locust	22	Crickets	27

Insects etc Eaten by Less than 20% of the Households

Metallic wood borer, rat, ant-egg, silk worm pupae, true water beetle, giant water-bug	True water beetle, mygale, monitor-lizard, cicada, winged-termite, chameleon, metallic wood borer.
--	--

4.1.1 Meat, Fish and Poultry and Other Animals

The types of meat, fish and poultry normally eaten in the households in the Multiple Cropping Villages and the Other Villages were similar except that the Other Villages ate more varieties of fresh water fish, this was probably because one of the Other Villages (Ban Huey Sai) is located beside a dam. Beef, chicken, pork and catfish were the most popular, being mentioned by more than 80% of the households. Beef was more popular than chicken and pork. Table 7 shows the types of meat, fish and poultry eaten by the households. This category of food was obtained as follows: beef and pork from buying; chicken and duck from raising, catfish, snake head fish, frog, small toad, snail, shrimp and crab by fishing and hunting. The ways of obtaining meat, fish and poultry and other animal foods in the Multiple Cropping villages and the Other Villages were similar.

4.1.2 Vegetables

The most frequently eaten vegetables in both the Multiple Cropping Villages and the Other villages were: chinese cabbage, young lead tree leaf, spring onion, ivy gourd, cabbage, garlic, water convolvulus, water lily stem, bamboo shoot and coriander leaf. Legumes eaten were green bean and cowpea; these were only eaten in the Multiple Cropping Villages. Chinese cabbage and spring onions were the most popular vegetables. Villagers normally grew or bought chinese cabbage, spring onion, coriander leaf, garlic, string bean, pumpkin and gourd and usually bought cabbage and cucumber. Vegetables like young lead tree leaf, ivy gourd, water convolvulus, water lily stem and water hyacinth stem were growing wild around the village. The Multiple Cropping Villages grew less vegetables than the Other Villages except for string beans.

4.1.3 Fruits

Custard apple was eaten by the highest number of households in the Multiple Cropping Villages while rambutan was eaten by the highest number of households in the Other Villages. This was surprising as rambutan is not a local fruit but during the survey period rambutan was abundantly sold in the market and taken by truck to the villages.

Fruits listed by large numbers of households were grown in the villages and available in the villages and in the market during the time of the survey. Fruits normally eaten by the villagers are shown in Table 9. Fruits commonly grown by most villagers, like banana, were only eaten by 48% of the households in the Multiple Cropping Villages and 36% in the Other Villages. Papaya was eaten less than 20% in the Multiple Cropping Villages and 32% in the Other Villages. Guava was eaten moderately in both Multiple Cropping Villages and the Other Villages.

4.1.4 Insects and Wild Animals

Small lizard, cricket, giant-water-bug, chameleon, grasshopper, june beetle and locust were the most popular insects and reptiles normally eaten. The villagers in the Multiple Cropping Villages ate more of these animals than the Other Villages (Table 10). This may be due to the geographic location and traditional eating habits of the Multiple Cropping area. Mostly the villagers obtained insects and reptiles and other wild animals by hunting.

4.1.5 Conclusions

Generally the type of foods and the sources of foods in the two groups of villages were similar. There were only slight differences in some food items but these were mainly due to the locality of villages. This was generally true for the type of fish eaten; one village was situated by a dam and was considered to be a fishing village so many varieties of fish were eaten. Catfish, the most common fish, is not readily available in every village so the consumption of it varies.

Although beef has nearly always to be bought by the villagers, it is still the most common meat eaten. Poultry and pigs can be raised by the villagers but there appeared to be a preference for beef.

Fruits eaten depends on the season. In the rainy season, during the survey period, custard apples were available in considerable quantity in the villages and in the markets. In other seasons, different types of fruit are eaten.

4.2 THE EATING PATTERN THROUGHOUT THE YEAR

Foods eaten in two days by 100 households in 10 villages were classified into different food categories: rice, dry main dishes, liquid main dishes, sauces, vegetables eaten with sauce, desserts and snacks, fruits and drinks. They were then divided into different meals: breakfast, lunch and dinner, between meals and before breakfast. Foods classified as dry main dishes were food dishes cooked without adding liquid, e.g. steamed, roasted or fried. Food classified as liquid main dishes were food dishes to which soup, water or coconut milk were added.

4.2.1. Rice

Rice was eaten in different main meals by every member of the households. Two types of rice were eaten, the steamed glutinous rice and the cooked ordinary long grain rice. Glutinous rice was eaten by 98% of households at breakfast, 95% at lunch and 94% at dinner.

4.2.2 The Number of Foods Eaten

Two hundred and sixty foods had been eaten in two days by 100 households in three seasons. They were 81 dry main dishes, 48 liquid main dishes, 14 sauces, 57 vegetables, 37 desserts and snacks, 18 fruits and 5 drinks. The foods in the different food categories eaten in the rainy, cool and hot seasons are shown in Table 11.

Table 11: Foods Eaten in Different Food Categories in Three Seasons
(Food Eaten in Two Days by 100 Households)

Food Dishes	Rainy Season	Cool Season	Hot Season	All Seasons
	(Number of Varieties)			
Dry main dishes	27	43	57	81
Liquid main dishes	25	24	35	48
Sauces	12	10	9	14
Vegetables	25	31	43	57
Desserts and snacks	14	15	16	37
Fruits	11	8	9	18
Drinks	3	4	5	5
Total	117	135	174	260

More varieties of food, especially in the dry main dishes, liquid main dishes and vegetables, had been eaten in the hot season (174 varieties) than in the cool season (135 varieties) or in the rainy season (117 varieties). This probably was due to the scarcity of food in the hot season and abundance of food in the rainy season.

The foods in each food category eaten at breakfast, lunch and dinner were similar for all seasons - rainy, cool and hot (Table 12). Few foods had been eaten between meals, 4-5 varieties before breakfast. 9-10 varieties mid morning and 11-15 varieties mid afternoon meal.

Table 12: Foods Eaten at Different Meals in Three Seasons
(Food Eaten in Two Days by 100 Households)

Food Categories		Rainy Season	Cool Season	Hot Season
		(Number of Varieties)		
Dry main dishes	B*	27	33	41
	L	24	29	36
	D	23	32	40
Liquid main dishes	B	19	19	26
	L	18	19	23
	D	17	21	21
Sauces	B	11	10	7
	L	11	9	6
	D	8	7	8
Vegetables	B	17	22	31
	L	16	23	22
	D	25	24	29
Desserts & snacks	B	5	3	14
	L	9	8	13
	D	7	8	3
Fruits	B	9	5	8
	L	6	9	8
	D	6	4	7
Drinks	B	1	2	3
	L	1	1	3
	D	1	-	4
Foods Eaten:				
Before breakfast		14	5	4
Mid morning		10	9	10
Mid afternoon		15	15	11

*B - Breakfast, L - Lunch, D - Dinner

4.2.3 The Number of Households Eating Different Food Categories

The number of households eating food in the different food categories during the surveys in the rainy, cool and hot seasons were compared (Table 13). It was found that in the rainy season, more food was eaten by the households than in the other seasons; and also in the hot season than in the cool season. The total number of foods eaten in the 7 categories in the rainy season, cool season and hot season were 2144, 1781 and 2020 respectively. Vegetables were eaten by a greater number of households in the rainy, cool and hot seasons than the other food categories. Second were sauces in the rainy season and dry main dishes in both cool and hot seasons. Liquid main dishes was next to sauces and dry main dishes in all seasons. Fruits were eaten by a larger number of households than desserts and snacks. Drinks were taken by only a few households. The number of households who ate dry main dishes, liquid main dishes, desserts and snacks in the hot season was higher than in the rainy and the cool seasons; vegetables, sauces, and fruits were eaten by a larger number of households in the rainy season than the other seasons. More vegetables and fruits are available in the rainy season so villagers therefore had eaten more of these foods. Sauces were eaten with vegetables, so sauces were eaten by a larger number of households in the rainy season than the other seasons.

Table 13: Households Eating Different Foods in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season				Cool Season				Hot Season			
	B*	L	D	(Total)	B	L	D	(Total)	B	L	D	(Total)
	(Number of Households)											
Dry main dishes	124	198	130	(452)	133	203	134	(470)	147	207	157	(511)
Liquid main dishes	87	66	93	(246)	66	49	87	(202)	96	84	111	(291)
Sauces	180	125	178	(483)	154	84	147	(385)	123	71	128	(322)
Vegetables	217	244	238	(699)	184	213	186	(583)	199	204	208	(611)
Desserts & snacks	14	22	14	(50)	5	15	15	(35)	31	46	12	(89)
Fruits	68	76	70	(214)	28	39	39	(106)	60	56	80	(196)
Drinks	2	3	4	(9)	2	1	7	(10)	4	-	4	(8)
Total for each season				2144				1781				2020

*B - Breakfast, L - Lunch, D - Dinner.

4.3 THE MEAL PATTERN

During the two days of the survey in all seasons, all of the households ate three meals a day. Food was seldom eaten between meals.

4.3.1 Foods Eaten in Main Meals

Foods eaten by a household was calculated from the total number of households eating foods in each category at breakfast, lunch, and dinner during the survey in rainy, cool and hot seasons. Frequency of different categories of foods eaten by a household are shown in Table 14. The pattern of foods eaten in each meal was similar in all three seasons but the pattern of food eaten at different meals was slightly different. Breakfast and dinner were similar but for lunch more dry main dishes were eaten than liquid main dishes and sauces. Villagers usually had their breakfast and dinner at home and ate lunch in the field. Dry main dishes, which probably were easy to prepare at the field or brought from home, were eaten more at lunch. Desserts and snacks were rarely eaten. Less than one fruit a day was eaten.

Table 14: Frequency of Different Categories of Food Eaten by a Household in One Day
(Average from Food Eaten in Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Mean
(Dishes per day per household)				
<u>Breakfast</u>				
Dry main dishes	0.62	0.66	0.74	0.67
Liquid main dishes	0.44	0.33	0.48	0.42
Sauces	0.90	0.72	0.62	0.75
Vegetables	1.08	0.92	1.00	1.00
Desserts and snacks	0.07	0.03	0.16	0.09
Fruits	0.34	0.14	0.30	0.26
<u>Lunch</u>				
Dry main dishes	0.99	1.02	1.07	1.03
Liquid main dishes	0.33	0.25	0.42	0.33
Sauces	0.63	0.42	0.36	0.47
Vegetables	1.22	1.07	1.02	1.10
Desserts and snacks	0.11	0.08	0.23	0.11
Fruits	0.38	0.20	0.28	0.22
<u>Dinner</u>				
Dry main dishes	0.65	0.67	0.79	0.67
Liquid main dishes	0.47	0.44	0.56	0.49
Sauces	0.89	0.74	0.64	0.75
Vegetables	1.19	0.93	1.04	1.05
Desserts and snacks	0.07	0.08	0.01	0.03
Fruits	0.35	0.20	0.40	0.32

4.3.2 Food Eaten Between Meals

Five to six percent of households had eaten food before breakfast, 14-16% had eaten during the morning and 20-31% had eaten during the afternoon. Number of households eating food between meals in different seasons are shown in Table 15. Types of food eaten are shown in Table 16. Foods eaten before breakfast were mainly drinks, during morning were mainly fruits and main dishes, during afternoon were mainly main dishes, fruits and desserts. The amount of water drunk was not determined in the survey.

Table 15: Households Eating Food Between Meals
(Total Number of 100 Households Interviewed)

	Rainy Season	Cool Season	Hot Season
	% Households Eating		
Before breakfast	5	6	6
During morning	14	16	15
During afternoon	20	31	24

Table 16: Foods Eaten Between Meals
(Total Number of 100 Households Interviewed)

	Rainy Season	Cool Season	Hot Season
<u>Before Breakfast</u>	Drinks (3) Fruits (1) Vegetables (1)	Drinks(4) Desserts (2)	Drinks (5) Desserts (1) Fruits (1)
<u>During Morning</u>	Main dishes (2) Desserts (3) Fruits (9) Drinks (1)	Main dishes (2) Desserts (2) Fruits (12) Vegetables (1)	Main dishes (11) Desserts (1) Fruits (4) Drinks (2)
<u>During Afternoon</u>	Main dishes (11) Desserts(4) Fruits (7) Drinks (1)	Main dishes(9) Desserts (1) Fruits (6) Drinks (2) Snacks (4)	Main dishes (7) Desserts (2) Fruits (6) Snacks (3)

(Figures in parenthesis are the number of households eating in two days)

4.4 TYPES OF FOOD EATEN

Types of food as food dishes eaten by 100 households in two days in rainy, cool and hot seasons were divided into animal foods, vegetable foods and fruits. Each type of animal food and vegetable food eaten in each food category in the three seasons were compared.

4.4.1 Animal, Fish and Insect Foods

Food dishes eaten in the three seasons were made from the animal food sources as mentioned in section 4.1. Other animal products such as fish sauce and shrimp paste were also eaten as sauces. Table 17 shows the number of dishes in each food category made from each raw material and the number of households eating them in rainy, cool and hot seasons. Fish were eaten by a larger number of households than the other animal foods. Fish were eaten mostly in the rainy season in the form of dry main dishes. Fish were still eaten by a large number of households in the cool season but were eaten least in the hot season. Not many varieties of food dishes were made from fish. There were only 12 dishes made from fish: 7 in the dry main dishes, 4 in the liquid main dishes and 1 in the sauces.

Fermented fish and beef were also frequently eaten but by smaller numbers of households. Chicken, pork and eggs were only eaten by a few households. Fermented fish was eaten mainly in the cool season while beef was eaten in the hot season. Beef was eaten in dry and liquid main dishes and fermented fish in dry main dishes and sauces. The frequency of eating the other animal and fish foods decreased from fermented fish, beef, chicken, pork to eggs. Frog and small toad had contributed to many varieties of food dishes and had been eaten by large numbers of households. Frog and small toad were eaten less in the cool season. Fresh water animals such as shellfish, snail, shrimp and crab were eaten more in the cool and hot seasons than in the rainy season. Larger numbers of households had eaten these fresh water foods than had eaten pork. Other animals such as bird, rat, insects and wild animals were eaten by a large number of households in the hot season than in the rainy and cool seasons. In the rainy season the villagers ate more animal foods than in the cool and hot seasons.

Table 17: Animal, Fish and Insect Food Dishes Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season		Cool Season		Hot Season	
	No. Dishes	No. Households	No. Dishes	No. Households	No. Dishes	No. Households
<u>Fishes</u>						
Dry main dishes	7	175	7	170	6	151
Liquid main dishes	4	120	4	104	3	76
Sauces	1	96	1	60	1	37
TOTAL	12	391	12	334	10	264
<u>Fermented Fish</u>						
Dry main dishes	1	1	1	19	1	15
Liquid main dishes						
Sauces	2	185	3	181	2	160
TOTAL	3	186	4	200	3	175
<u>Beef</u>						
Dry main dishes	4	28	6	55	7	62
Liquid main dishes	4	17	5	16	6	30
TOTAL	8	45	11	71	13	92
<u>Chicken</u>						
Dry main dishes	2	11	2	20	5	12
Liquid main dishes	2	8	3	16	2	21
TOTAL	4	19	5	36	7	33
<u>Pork</u>						
Dry main dishes	4	7	6	9	7	11
Liquid main dishes	1	1	1	1	3	3
TOTAL	5	8	7	10	10	14
<u>Duck</u>						
Dry main dishes	-	-	1	1	1	1
Liquid main dishes	-	-	1	1	1	1
TOTAL	-	-	2	2	2	2
<u>Egg</u>						
Dry main dishes	2	3	1	3	3	7
Liquid main dishes	-	-	1	1	-	-
Desserts	2	8	1	4	1	2
TOTAL	4	11	3	8	4	9
<u>Frog and Small Toad</u>						
Dry main dishes	4	39	5	16	9	34
Liquid main dishes	5	12	3	6	5	9
Sauces	2	9	2	6	2	6
TOTAL	11	60	10	28	16	49
<u>Fresh Water, Snail, Shellfish, Shrimp, Crab and Others</u>						
Dry main dishes	2	2	4	7	3	7
Liquid main dishes	3	3	4	8	4	7
Sauces	2	10	2	8	1	6
TOTAL	7	15	10	23	8	20
<u>Bird, Rat, Insect and Wild Animal</u>						
Dry main dishes	2	2	2	2	5	7
Liquid main dishes	-	-	-	-	2	2
Sauces	-	-	-	-	1	2
TOTAL	2	2	2	2	8	13
<u>Condiment (Fish Sauce and Shrimp Paste)</u>						
Sauces	2	174	2	126	2	111
TOTAL (Animal Food Dishes)						
	58	911	68	840	83	782

4.4.2 Vegetable Foods and Cereal Foods

Vegetables, cereal foods, e.g. noodle, tapioca and cereal puddings and dried legume foods eaten by 100 households in two days in three seasons are shown in Table 18. There were 48 to 52 food dishes from vegetables eaten in the three seasons. Although vegetables were commonly eaten with sauce, they were also cooked into dry main dishes, liquid main dishes, sauces and desserts. Dry main dishes and liquid main dishes made from vegetables had been eaten by a large number of households, particularly in the hot season. Cereals and legumes were made mainly into dessert dishes and eaten mostly in the hot season. The total number of vegetable dishes in the rainy season were 52 dishes eaten by 956 households, in the cool season were 58 dishes eaten by 758 households and in hot season were 72 dishes eaten by 897 households. The number of different vegetable dishes were less than the number of animal dishes but the number of households eating vegetables in the rainy and hot seasons was larger.

Table 18: Vegetable Food Dishes Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season		Cool Season		Hot Season	
	No. Dishes	No. Households	No. Dishes	No. Households	No. Dishes	No. Households
<u>Vegetable</u>						
Dry main dishes	7	160	11	140	9	141
Liquid main dishes	6	46	4	10	5	63
Sauces	3	9	-	-	-	-
Vegetables	25	699	31	583	43	611
Desserts	1	4	-	-	1	7
TOTAL	42	918	46	733	58	822
<u>Cereal (Noodles, Tapioca and Cereal Puddings)</u>						
Dry main dishes	-	-	1	2	1	3
Liquid main dishes	1	2	1	3	2	2
Desserts	9	36	10	20	4	45
TOTAL	10	38	12	25	7	50
<u>Dried Legume Seed</u>						
Desserts	-	-	-	-	7	25
TOTAL	52	956	58	758	72	897

4.4.3 Fruits

Fruits were eaten as fresh fruits and desserts. There were 12 types of fruits and fruit dishes eaten by 215 households in the rainy season, 8 types of fruits eaten by 106 households in the cool season and 13 types of fruits and fruit dishes eaten by 207 households in the hot season. Numbers of fresh fruits and fruit dishes eaten in the rainy, cool and hot seasons are shown in Table 19.

Table 19: Fruits Eaten in Three Seasons
(Fruits Eaten in Two Days by 100 Households)

	Rainy Season		Cool Season		Hot Season	
	Types	No. Households	Types	No. Households	Types	No. Households
Fresh fruits	11	214	8	106	9	196
Desserts	1	1	-	-	4	11
TOTAL	12	215	8	106	13	207

4.5 TYPES OF FOOD EATEN BY 1-5 YEAR OLD CHILDREN

Children in 45 households (64%) ate exactly the same food as the adult members of the family, children in 22 households (31%) ate some of the adults' food and children in 3 households (4%) ate differently from adults. Food eaten by children in 25 households, additional to the adults' food or totally different from the adults food are shown in Table 20. Milk was drunk throughout the day but less frequently during the cool and hot seasons than during the rainy season. Fish was the main meat and was eaten by children in every meal. Fish was eaten less in the hot season. Egg, chicken, beef and pork were eaten in some meals but not in every meal. Beef was eaten more in the cool season. Bread and desserts were eaten in some meals. Fruits were seldom eaten by children. Although children in 22 households ate some of the adult food and children in 3 households ate differently; only a few kinds of animal foods, vegetables and fruits were eaten by children. A large number of children (64% of children) ate the same food as adults which

was shown earlier to contain a large proportion of vegetables and little fruit. It could be assumed that children aged between 1-5 year old during the time of this survey may not have received adequate quality protein, vitamin and mineral intakes.

Table 20: Types of Food Eaten by 1-5 Year Old Children

Meal Time	Rainy Season	Cool Season	Hot Season
Early Morning	Milk (17)* Egg (1) Fruits (2) Soft Drink (1)	Milk (7) Roasted Small Toad (1) Dessert (1)	Milk (2)
Breakfast	Milk (2) Fish (6) Egg (1) Fermented Fish Sauce (1) Bread (4) Dessert (2) Ovaltine (2)	Fish (8) Beef (3) Pork (1) Papaya Salad (1) Bread (1)	Milk (1) Fish (1) Egg (1) Rice Porridge (1) Bread (1) Fruit (1)
During Morning	Milk (11) Bread (2) Dessert (2) Fruits (2) Ovaltine (3)	Milk (6) Fish (2) Bread (1) Fruits (1)	Fish (1) Rice Porridge (1) Bread (1)
Lunch	Milk (9) Fish (5) Beef (1) Chicken (1) Bread (1) Desserts (4) Fruits (1) Soft Drink (2)	Milk (2) Fish (8) Egg (3) Beef (5) Pork (2) Papaya Salad (3) Snack (1)	Milk (1) Fish (4) Beef (1) Desserts (1) Fruits (1)
During Afternoon	Milk (11) Fish (1) Desserts (2) Fruits (2) Soft Drink (5)	Milk (6) Fish (2) Bread (1) Snack (1)	Milk (2) Beef (2) Fruits (1)
Dinner	Milk (7) Fish (5) Egg (3) Bread (2) Fruits (2) Ovaltine (1)	Milk (1) Fish (11) Egg (6) Beef (3) Pork (1) Bread (1) Fruit (1)	Fish (3) Egg (2) Rice Porridge (2) Fruits (1)
Supper	Milk (17) Soft Drink (1)	Milk (6) Fish (2) Dessert (1) Snack (1)	Milk (3)

* (Figure in parenthesis shows the number of households).

4.6 TYPES OF NORTHEASTERN COOKING

Most of the foods were cooked by roasting or boiling. Only a few foods were fried. Oil and fat are not commonly used in cooking. Food was fried "kuir", in a small quantity of water instead of oil. Foods were cooked on a stove made of clay. It was found that wood was used by 61% of the households, and charcoal by 85% of the households as a main source of fuel for cooking. In the Multiple Cropping Villages, two households used electric stoves and five households used gas stoves. There were only a few cooking utensils (Figure 5): pot, pan, village style steamer, mortar and roaster. The steamer was a bamboo container placed on top of the low and narrow shaped pot which was used for boiling water. Villagers steamed their glutinous rice on the steamer. An earthen mortar was also one of the necessary cooking utensils. Villagers not only used a mortar to pound food, they also used the mortar for mixing foods together e.g. for making papaya salad and various kinds of "soop". Foods were roasted on top of an iron screen and placed on a stove or foods were placed and tied on a bamboo shoot and roasted on charcoal.

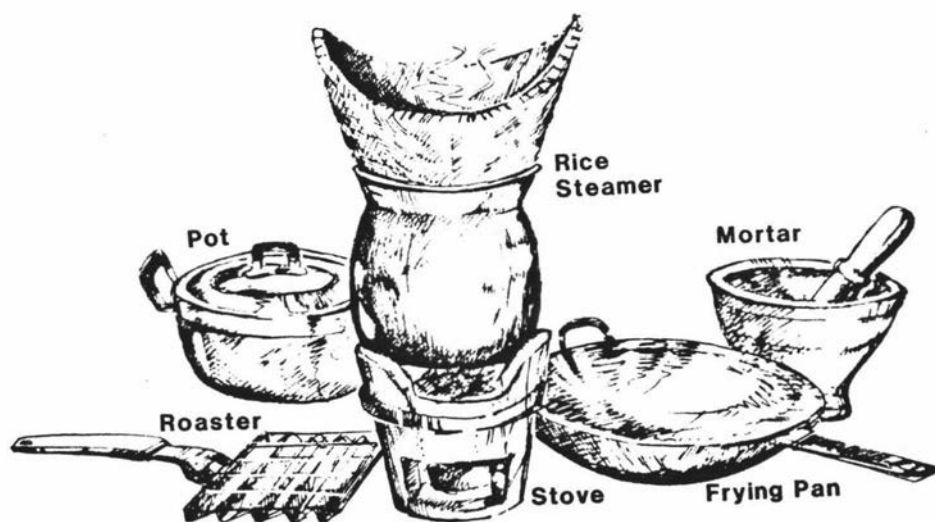


Figure 5: Northeastern Cooking Utencils

The methods of coking the different types of main dishes are described in Table 21. The details of each method of cooking are presented in the Appendix 2.

Table 21: Types of Northeastern Cooking

Type of Cooking	Method of Cooking	Main Food Used in Cooking
<u>Dry Main Dishes</u>		
"Larb"	Quick cooking of minced meat or fish by stirring in pot and seasoning with "Larb" ingredients.	Beef or pork or chicken or duck or fish or shellfish or birds.
"Somtam"	Mixing of fresh vegetables with flavouring.	Green papaya or cucumber or stringbean or cowpea pod
"Soop"	Boiling and mashing of vegetable and seasoning.	Bamboo shoot or egg plant or stringbean or mushroom or immature jackfruit.
"Moke"	Roasting or steaming of foods wrapped in banana leaf.	Fish or frog or small toad or bamboo shoot.
"Roasted"	Roasting on charcoal.	Fish or chicken or beef or pork or frog or small toad.
"Goy"	Seasoning of raw meat or fish with "Larb" ingredients.	Shrimp or beef or fish or frog.
"Kuir"	Frying with water	All meats and vegetables.
"Pla"	Roasted or raw beef, cutting into pieces and seasoning.	Beef or shrimp or shellfish.
<u>Liquid Main Dishes</u>		
"Toum"	Boiling meat or fish in boiling water, adding flavours.	Chicken, or beef or fish or beef viscera or frog or duck or small toad.
"Kang"	Boiling of meat or fish with vegetables, in boiling water adding spices and flavouring.	Fish or beef or chicken or bamboo shoot or mushroom.
"Hot Sour Soup"	Boiling of fish and vegetables in boiling water adding spices, tamarind, and flavouring.	Fish and vegetable.
"Aom"	Boiling of meat or fish in small quantity of boiling water, adding spices and flavouring.	Beef or fish or chicken or small toad.
<u>Sauces</u>		
"Pore"	Roasting or boiling or steaming of fish or other foods, then grinding with spices and added flavours.	Fish or frog or small toad or shrimp or crab.
"Namprig"	Grinding and mixing of the ingredients.	Shrimp paste or fermented fish, chilli, and garlic.
"Jeaw"	Chopping fermented fish and grind mixing with other ingredients.	Whole fermented fish, chilli, garlic.

4.7 KINDS OF FOOD DISHES EATEN

The principal kinds of food dishes eaten in two days in the rainy, cool and hot season are shown in Tables 22, 23, 24, 25, 26, and 27. Kinds of food eaten by less than five households in all seasons are shown in Appendix 3.

4.7.1 Dry Main Dishes

"Roasted" fish was the most popular dish eaten in every meal in the three seasons. "Somtam" papaya eaten for lunch only and eaten by the largest number of households was in every season. The other fish dishes were also eaten more frequently in every meal and every season than the other food dishes. "Larb" fish and fried fish were eaten by a large number of households at breakfast and dinner only. Steamed fish was eaten in the cool and hot season but not in the rainy season. This probably is due to many reasons, such as preferring the larger size fish and variety of fish found in the cool and hot seasons. Vegetables used in steaming with fish were also available in the cool season and the hot season. Fermented fish was eaten at breakfast and dinner; it was mostly eaten in the cool season. In the rainy season, a large quantity of small fish was found and villagers often made them into fermented fish which was ready to eat by the cool season. The other popular dishes eaten in all meals and all seasons were "roasted" beef, "roasted" chicken, "roasted" small toad, and "larb" beef. (See Table 22).

Table 22: Dry Main Dishes Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Total
(Number of Households)				
<u>Breakfast</u>				
"Roasted" fish	29	39	26	94
"Moke" fish	16	5	2	23
"Larb" fish	8	8	6	22
Fried fish	7	6	9	22
"Soop" bamboo shoot	13	5	3	21
"Larb" beef	5	6	9	20
Steamed fish	0	8	12	20
"Roasted" beef	2	10	7	19
Fermented fish	1	6	8	15
"Moke" frog	3	2	7	12
"Somtam" papaya	6	1	4	11
"Roasted" chicken	2	5	2	9
"Roasted" small toad	5	2	1	8
"Soop" egg plant	2	1	4	7
"Roasted" frog	4	1	2	7
Boiled egg	1	2	3	6
<u>Lunch</u>				
"Somtam" papaya	100	101	97	298
"Roasted" fish	27	35	19	81
"Somtam" legumes*	13	8	5	26
"Roasted" beef	2	13	10	25
"Moke" fish	11	3	3	17
Fried fish	4	2	6	12
"Roasted" chicken	3	5	3	11
"Roasted" small toad	5	3	3	11
"Larb" beef	3	3	3	9
Fried beef	3	2	4	9
"Larb" fish	3	2	3	8
"Moke" frog	1	0	7	8
"Roasted" frog	7	0	1	8
"Somtam" cucumber	0	5	3	8
<u>Dinner</u>				
Roasted fish	32	26	28	86
"Moke" fish	17	3	7	27
"Larb" fish	11	6	9	26
Fried fish	5	9	12	26
"Somtam" papaya	11	5	8	24
Steamed fish	0	14	9	23
"Roasted" beef	3	10	8	21
"Larb" beef	6	4	9	19
"Soop" bamboo shoot	9	3	7	19
Fermented fish	0	12	6	18
Fried egg	6	5	4	15
"Roasted" chicken	2	9	3	14
"Roasted" small toad	7	2	5	14
Fried beef	2	3	5	10
"Moke" frog	4	2	1	7

*Legumes are green cowpea and stringbean pods.

4.7.2 Liquid Main Dishes

"Kang" fish was the most popular liquid main dish eaten in every meal in the rainy and cool seasons. "Kang" fish was eaten by a smaller number of households in hot season. "Toum" fish was the next popular dish and was preferred to be eaten at dinner than at breakfast and lunch, particularly in the cool and hot seasons. "Kang" mushroom was eaten only at breakfast and eaten by a larger number of households in the hot season. "Kang" bamboo shoot was eaten in all meals; it was eaten less in the cool season. "Kang" chicken was eaten at breakfast and dinner; it was eaten by a larger number of households in the hot season than in the rainy and cool seasons. "Toum" beef and "Toum" viscera were eaten by a larger number of households for breakfast and lunch than dinner. It was eaten in all seasons. (See Table 23).

Table 23: Liquid Main Dishes Eaten in Three Seasons
(Food Eaten Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Total
(Number of Households)				
<u>Breakfast</u>				
"Kang" fish	30	28	9	67
"Toum" fish	14	5	9	28
"Kang" bamboo shoot	9	2	14	25
"Kang" mushroom	3	1	13	17
"Kang" chicken	2	8	6	16
"Toum" beef	2	3	7	12
"Toum" viscera	5	1	2	8
"Kang" small toad	3	1	3	7
<u>Lunch</u>				
"Kang" fish	18	16	7	41
"Toum" fish	10	3	14	27
"Kang" bamboo shoot	12	2	7	21
"Toum" beef	4	1	7	12
"Toum" viscera	1	2	3	6
"Kang" beef	1	2	3	6
"Kang" hot sour soup	2	1	2	5
<u>Dinner</u>				
"Kang" fish	26	31	21	78
"Toum" fish	20	17	15	52
"Kang" bamboo shoot	13	1	21	35
"Kang" chicken	3	4	10	17
"Kang hot sour soup"	4	3	3	10

4.7.3 Sauces

Chilli in fish sauce was the most popular at every meal and during every season; "Namprig" fermented sauce was the second most popular. The other popular sauces eaten were "Jeaw" whole fermented fish and "Pone" fish. (See Table 24).

Table 24: Sauces Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Total
(Number of Households)				
<u>Breakfast</u>				
Chilli in fish sauce	46	45	36	127
"Namprig" fermented fish	50	37	30	117
"Pone" fish	43	33	14	90
"Jeaw" whole fermented fish	17	23	37	77
"Namprig" shrimp paste	10	2	0	12
Chilli in fermented fish sauce	0	10	0	10
"Pone" shrimp	4	1	4	9
<u>Lunch</u>				
Chilli in fish sauce	45	31	24	100
"Namprig" fermented fish	40	22	13	75
"Jeaw" whole fermented fish	14	18	24	56
"Pone" fish	13	3	8	24
"Namprig" shrimp paste	4	2	0	6
"Pone" crab	2	4	0	6
<u>Dinner</u>				
Chilli in fish sauce	52	46	50	148
"Namprig" fermented fish	46	50	32	128
"Pone" fish	40	24	15	79
"Jeaw" whole fermented fish	18	13	24	55
"Namprig" shrimp paste	17	0	1	18
"Pone" frog	3	0	4	7
Chilli in Fermented fish sauce	0	7	0	7
"Pone" small toad	1	4	0	5

4.7.4 Vegetables

Young lead tree leaf was the most popular in the rainy and hot seasons. Chinese cabbage was eaten in the cool season. Egg plant, waterconvolvulus, cucumber, bamboo shoot, ivy gourd leaf, spring onion, coriander leaf, neem leaf, cabbage, water fern and young cork wood leaf were the popular vegetables eaten in all meals. The frequency of eating these vegetables depended on the season of their availability.

Table 25: Vegetable Eaten with Sauces Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy	Cool	Hot	Total
	(Number of Households)			
<u>Breakfast</u>				
Young lead tree leaf	72	22	56	150
Chinese cabbage	21	70	10	101
Egg plant	37	6	17	60
Water convolvulus	13	5	35	53
Cucumber	19	3	10	32
Coriander leaf	10	12	1	23
Neem leaf	1	14	6	21
Bamboo shoot	17	0	4	21
Ivy gourd leaf	1	2	15	18
Leaf mustard	0	17	0	17
Spring onion	0	9	3	12
Young cork wood leaf	4	3	4	11
Cabbage	0	7	2	9
Water fern	0	1	7	8
Pumpkin shoot	7	0	0	7
Young cadone tree leaf	0	1	4	5
<u>Lunch</u>				
Young lead tree leaf	100	46	88	234
Chinese cabbage	15	70	7	92
Water convolvulus	27	16	41	84
Egg plant	24	4	15	43
Cucumber	11	4	9	24
Spring onion	0	22	1	23
Bamboo shoot	15	0	5	20
Ivy gourd leaf	4	1	7	12
Water fern	6	0	5	11
Neem leaf	0	9	1	10
Leaf mustard	0	10	0	10
Coriander leaf	1	4	4	9
Young cork wood leaf	2	0	6	7
Water lily stem	7	0	0	7
Water mimosa shoot	0	1	5	6
<u>Dinner</u>				
Young lead tree leaf	79	18	60	157
Chinese cabbage	22	68	12	102
Egg plant	37	7	18	62
Water convolvulus	12	6	37	55
Cucumber	11	8	14	33
Ivy gourd leaf	9	1	18	28
Bamboo shoot	22	0	4	26
Spring onion	1	15	2	18
Leaf mustard	0	16	1	17
Coriander leaf	7	5	3	15
Neem leaf	0	12	1	13
Young cork wood leaf	4	1	5	10
Water fern	1	0	9	10
Water mimosa shoot	1	1	5	7
Water lily stem	5	0	2	7
String bean	7	0	0	7
Young cadone tree leaf	1	2	3	6
Ganjong bulb	0	4	1	5

4.7.5 Desserts and Snacks

Only a few kinds of desserts and snacks were eaten. The most popular desserts - extruded starch pudding (loard chong) were eaten in three meals but were only eaten by a small number of households particularly at breakfast and dinner. The other desserts eaten were sago pudding, blackbean boiled in syrup, egg cake, groundnut brittle, and pumpkin in coconut milk. These desserts were eaten mostly in the hot season. Many other kinds of desserts and snacks were eaten but were eaten by only one or two households.

Table 26: Desserts and Snacks Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Total
(Number of Households)				
<u>Breakfast</u>				
Extruded starch pudding (loard chong)	6	0	5	11
Sago pudding	2	0	4	6
Black bean boiled in syrup	0	0	6	6
Egg cake	3	0	2	5
<u>Lunch</u>				
Extruded starch pudding (loard chong)	9	1	21	31
Egg cake	2	3	2	7
Sago pudding	3	0	3	6
Ground nut brittle	0	0	5	5
<u>Dinner</u>				
Extruded starch pudding	3	3	5	11
Pumpkin in coconut milk	0	0	5	5

4.7.6 Fruits

Not many varieties of fruits had been eaten. Custard apple was eaten in the rainy season, mango in the hot season, watermelon mostly in the cool season, banana in all seasons, guava in the rainy and hot seasons and musk melon in the rainy season. These fruits were eaten in all meals. The other varieties of fruits available in different seasons were only eaten by a few households.

Table 27: Fruits Eaten in Three Seasons
(Food Eaten in Two Days by 100 Households)

	Rainy Season	Cool Season	Hot Season	Total
	(Number of Households)			
<u>Breakfast</u>				
Custard apple	46	0	0	46
Mango	0	1	40	41
Watermelon	2	20	2	22
Banana	9	5	5	19
Guava	3	0	6	9
<u>Lunch</u>				
Custard apple	49	0	0	49
Mango	0	1	33	34
Watermelon	2	24	4	31
Guava	13	0	4	17
Banana	4	4	8	16
Musk melon	6	0	0	6
<u>Dinner</u>				
Custard apple	49	0	0	49
Mango	0	0	45	45
Banana	12	12	15	39
Watermelon	1	24	9	34
Guava	2	0	5	7
Musk melon	5	0	0	5

4.8 HOME PRESERVATION OF FOODS

Villagers preserved foods at home by simple methods. Rice was stored in the barn, legume seeds were kept in dry pod form or in containers, vegetables were dried or pickled. Fish were dried and fermented, meat was dried, fruits were pickled. The number of households in the Multiple Cropping Villages and the Other Villages who mentioned preserving are shown in Table 28.

Table 28: Preservation of Food at Home

Methods of Preservation	Multiple Cropping Villages	Other Villages	All Villages
		% of Households	
<u>Storage of Rice</u> in barn	98	88	93
<u>Legumes:</u>			
Keep seed in container	24	68	46
Keep seed in dried pod	28	10	19
<u>Vegetables:</u>			
Dried vegetables	6	24	15
Pickled vegetables	10	32	21
<u>Fish:</u>			
Dried fish	38	68	53
Fermented fish	76	70	73
<u>Meat:</u>			
Dried meat	40	66	53
<u>Fruit:</u>			
Pickled fruit	8	12	10

4.9 CONCLUSION

Steamed glutinous rice was the main rice eaten. Fish and fermented fish were the main animal foods eaten in different kinds of food dishes. Vegetables also contributed largely to the diet. There seems to be a seasonal effect on the food eaten. Fish was eaten more in the rainy and cool seasons. When fish was less eaten in the hot season, other varieties of animal meat were eaten. This was a similar pattern to vegetable eating. In the rainy season some kinds of vegetable were abundant but were less available in the hot season and other varieties of vegetables were eaten to replace them. Fruits were not commonly eaten by villagers, even in season they were not often eaten. Most children aged 1-5 years old ate the same food as adults. Only a few households gave extra foods to the children. Villagers did not commonly eat food between meals. They also did not often eat snacks, desserts or drink any kinds of special drinks. Not many cooking methods were used because most villagers only had a simple charcoal stove and only a few cooking utensils. High fat content foods were seldom eaten and fat or oil were not often used in cooking. Few foods were also cooked with coconut milk. This reveals the reason for the low intake of fat in the Northeastern diet, as has been reported.

5. LEGUMES EATEN

This chapter describes the types of legumes eaten and grown by villagers in the Multiple Cropping Villages and the Other Villages, the methods of storing, cooking and processing dry legumes and the types of legume dishes commonly eaten.

5.1 TYPES, FREQUENCY AND QUANTITY OF LEGUMES EATEN

Legumes eaten by all villages were groundnuts, string beans, local cowpeas, black beans, mung beans, hyacinth beans, and soybeans. Table 29 shows the percentage of households in the Multiple Cropping Villages and the Other Villages eating different legumes and the frequency of eating each legume.

Only three legumes - cowpeas, groundnuts, and string beans - were eaten every day but by only a very small number of households. String beans were eaten at least once a week by 62% of the households, groundnuts by 44%, cowpeas, mung beans and black beans by about 30%. Red beans and soybeans were eaten at least once a week a week by only between 15-20% of households. Large numbers of households rarely ate soybeans and hyacinth beans. Generally villagers in the Multiple Cropping Villages ate legumes more often than other villages.

Table 29: Households Eating the Different Legumes
(Total Number of 100 Households Interviewed)

	Soybean	Cowpea (local)	Mung- bean	Black Bean	Red Bean	Ground Nut	String Bean	Hyacinth Bean
<u>% of Households Eating Legumes</u>								
All villages	21	87	57	61	32	93	93	40
Multiple Cropping Villages	16	92	52	56	18	96	90	28
Other Villages	26	82	62	66	46	90	96	56
<u>Frequency of Eating Legumes</u> (% of Households)								
<u>All Villages</u>								
Rarely	67	46	54	46	40	35	25	90
Once a month	19	20	16	23	38	18	13	10
Once a week	14	21	19	26	19	25	28	0
Two or three times/week	0	11	11	5	3	22	29	0
Every day	0	2	0	0	0	2	5	0
<u>Multiple Cropping Villages</u>								
Rarely	87.5	42	54	46	33	21	11	86
Once a month	0	17	19	29	33	17	18	14
Once a week	12.5	24	15	18	22	30	33	0
Two or three times/week	0	15	12	7	11	30	36	0
Every day	0	2	0	0	0	4	2	0
<u>Other Villages</u>								
Rarely	58	51	55	45	43	47	38	92
Once a month	33	22	13	18	39	20	8	8
Once a week	9	17	23	33	18	20	23	0
Two or three times/week	0	7	9	4	0	13	23	0
Every day	0	3	0	0	0	0	8	0

The quantities of legumes eaten in the 10 villages are shown in Table 30. In total, the villagers ate 1416 g of groundnuts, cowpeas, mung beans and string beans per household per month; they ate more groundnuts (620g) than string beans (433g) than cowpeas (212g) than mung beans (151g). The pattern of eating the four legumes in the 10 villages were different (Table 30). The villages whose total

consumption were high were Ban Jode, Ban Koksri, Ban Had, Ban Wang Yawl and Ban Huey Sai. Those villages that ate low quantities of the four legumes were Ban Maung, Ban Pasan, Ban Na Dee, Ban Nong Pai and Ban Huey Tuey. Generally the Multiple Cropping Villages ate more groundnuts, cowpeas and string beans but less mung beans than the Other Villages.

Table 30: Quantities of Legumes Eaten
(Total Number of 100 Households Interviewed)

Villages	Groundnut	Cowpea	Mung Bean	String Bean	Total
(Grams per Household per Month)					
<u>Multiple Cropping Villages</u>					
Ban Jode	1479	163	87	856	2585
Ban Kok Sri	886	557	46	346	1835
Ban Maung	146	306	16	376	844
Ban Pa San	213	132	12	8	365
Ban Had	1078	300	546	873	2797
Average	760	292	141	492	1685
<u>Other Villages</u>					
Ban Wang Yawl	823	76	29	400	1328
Ban Huey Sai	1034	278	576	830	2718
Ban Na Dee	283	42	20	27	372
Ban Nong Pai	244	28	169	428	869
Ban Huey Tuey	13	236	4	183	436
Average	479	132	160	374	1145
Average for All Villages	620	212	151	433	1416

5.2 SOURCES OF LEGUMES EATEN IN THE VILLAGES

The two main sources of legumes were "growing" and "buying". A small number of households also obtained legumes from a neighbour. Legumes grown were cowpeas, groundnuts, string beans, hyacinth beans and pigeon peas. Legumes bought were soybeans, mung beans, black beans, red beans, and bean sprouts.

5.2.1 Growing of Legumes

The legumes that had been grown at sometime by the highest percentage of households both in the Multiple Cropping and the Other Villages were cowpeas, groundnuts, string beans and pigeon peas (Table 31). The highest percentage (about 50%) of the households grew cowpeas, the lowest percentage (about 1%) grew soybeans. The Other Villages grew more black beans, red beans and hyacinth beans than the Multiple Cropping Villages.

Table 31: Growing of Legumes
(Total Number of 100 Households Interviewed)

Legume	Multiple Cropping Villages Growing Legumes	Other Villages Growing Legumes
	(% of Households)	
Soybean	2	-
Cowpea	56	44
Mung bean	16	6
Black bean	4	20
Red bean	4	22
Groundnut	52	46
String bean	50	48
Hyacinth bean	6	42
Pigeon pea	42	60

In interviewing the farmers, it was found that in 1977, 12 households in the Multiple Cropping Villages grew cowpeas, total area 7.25 rais (6.25 rais = 1 hectare) but in 1978 only 3 households total area 2.75 rais. Ten households planned to grow cowpeas in 1979 and the expected area was 7.25 rais. In the Other Villages, a greater number

of households grew cowpeas than in the Multiple Cropping Villages. In 1977 and 1978, 13 households had grown cowpeas but the area of growing was only 3.95 rais in 1977 and 4.20 rais in 1978. Twelve households planned to grow cowpeas in 1979 with the area of planting 2.2 rais. Cowpeas grown in the Multiple Cropping Villages were the new introduced variety - the red cowpeas 6-1 US and the local cowpeas, while in the Other Villages it was only local cowpeas.

5.2.2 Buying and Selling of Legumes

The villagers usually buy legumes from the other villagers in their own villages or from the market. When legumes are in surplus or the farmers need some cash they usually sell their produce to the middle man or the agricultural extension officer. Most of the buyers usually come to the villages or otherwise the farmer will bring their produce to town and sell to the shops. The red cowpeas 6-1 US grown in the Multiple Cropping Villages were sold back to the Cropping System Project at Khon Kaen University.

5.3 STORING OF COWPEA SEEDS

A large number of households did not store cowpeas. The methods of storing cowpea seeds for seed production were (ranked by number of households concerned): in cotton bag, in pods and hung up in bundles, in bamboo basket or kerosene tin, mixed with insecticide and stored in cotton or plastic bag, in plastic bags and in paper bags. For storing cowpea seeds for consumption the mentioned were: in plastic bags, in jute bags, in whole pods, in kerosene tin or bamboo basket, in cotton bags and dried in sunlight.

It was found that 5 households in the Multiple Cropping Villages and 17 households in the Other Villages had insects attack the cowpea seeds. They normally threw away the damaged cowpea seeds or mixed the seeds with insecticide or dried them in the sun. The longest period for which cowpeas had been stored for consumption was 4 months.

5.4 METHODS OF COOKING AND PROCESSING LEGUMES

The methods used in cooking different types of legumes were simple: roasted, fried, fresh immature pods, made into salad used as flavouring, fried with meat, made into soup, made into porridge, made into hot curry, boiled in water, boiled in syrup, steamed, made into paste, boiled with coconut milk. The households using the different methods of cooking legumes are shown in Table 32. The two most common cooking methods in the Multiple Cropping Villages and the Other Villages were "boiled" and "boiled in syrup". Roasting was common for cooking ground nut. Many legumes as the fresh green pod, were eaten uncooked.

The only method for processing legumes was roasting and grinding into a powder to be used as flavouring in cooking. Only 8% of the households did this.

Table 32: Methods of Cooking Legumes

Legume	Method of Cooking					
	Roasted	Fresh	Salad	Boiled	Boiled in Syrup	Others
(% of Households)						
<u>Multiple Cropping Villages</u>						
Soybean	4	-	-	8	12	8
Cowpeas	-	50	88	52	22	48
Mung beans	-	-	2	26	16	14
Black beans	-	-	-	20	50	10
Red beans	-	-	-	-	16	-
Groundnuts	92	22	-	176*	6	24
String beans	-	72	90	38	10	66
Hyacinth beans	-	6	2	14	-	32
Pigeon peas	-	58	4	12	-	4
Bean sprouts	2	20	-	4	-	76
<u>Other Villages</u>						
Soybean	-	-	-	4	30	4
Cowpeas	-	66	54	68	8	64
Mung beans	-	-	-	14	28	8
Black beans	-	2	-	16	62	18
Red beans	2	-	-	12	52	6
Groundnuts	126*	6	-	166*	2	26
String beans	-	92	74	46	4	36
Hyacinth beans	-	22	2	38	-	42
Pigeon peas	-	68	2	-	2	10
Bean sprout	-	24	-	6	-	52

*Groundnuts were roasted and boiled and used in dessert and snacks.

5.5 TYPES AND QUANTITIES OF LEGUME FOOD DISHES

The types of legume food dishes eaten by the villagers were found by two interviewing methods - a "cafeteria" list type structured question and an open question. The most commonly eaten legume dishes were in agreement with each other and are shown in Table 33.

Table 33: Types of Legume Food Dishes
(Total Number of 100 Households Interviewed)

Name of Food	Multiple Cropping Villages	Other Villages	All Villages
	(% of Households)		
String bean salad	68*(76)**	70 (78)	69 (77)
Boiled groundnut	30 (52)	20 (38)	25 (45)
Fresh string bean pod	2 (6)	36 (28)	19 (17)
Fresh cowpea pod	2	16	9
Cowpea salad	14 (28)	18 (8)	16 (18)
Fried string bean	4 (16)	8 (36)	6 (26)
Fried bean sprout	2 (12)	8 (14)	5 (13)
Boiled mung bean in syrup	4	6	5
Boiled black bean in syrup	0 (38)	8 (34)	4 (36)
Boiled red bean in syrup	0	6	3
Boiled groundnut in syrup	2	0	1

Other Legume Dishes Mentioned:* Roasted groundnuts, bean porridge, stringbean hot curry, steamed fish with bean, bean sour soup, steamed glutinous rice with black beans.

* data collected by a "cafeteria" list type structured question.

** data collected by an open question.

The most common legume dishes were: stringbean salad, boiled groundnuts (in pods), fresh bean pod, fried bean sprout and green cowpea pod salad. The "fresh bean pod" could be stringbeans, cowpeas and other legumes such as pigeon peas. The legume commonly used in "legume boiled in syrup" was mung beans. Dishes made from soybeans were not mentioned by any villagers. The legume dishes of the Multiple Cropping Villages were similar to those of the Other Villages but the Multiple Cropping Villages ate more cowpea salad.

The average quantities of legumes eaten in all villages ranked from highest quantity to lowest quantity were stringbean salad (348 g/month), boiled groundnut in pod (332 g/month), legume boiled in syrup (112 g/month), fresh bean pod (90g/month), cowpea salad (89g/month), fried bean sprout (48g/month) and fried string bean (46g/month). The total amount of legumes eaten per month was 1065g. The total quantity of legume dishes eaten in the Multiple Cropping Villages was higher than the Other Villages, approximately by twice quantity. Villages eating legume dishes in the quantities higher than the average were Ban Jode, Ban Koksri and Ban Had in the Multiple Cropping Villages and Ban Huey Sai in the Other Villages (Table 34).

Table 34: Quantities of Legume Dishes Eaten
(Total Number of 100 Households Interviewed)

Villages	Spring Bean Salad	Boiled Ground nut	Legume Boil in Syrup	Cow- Pea Salad	Fresh Bean Pod	Fried Bean Sprout	Fried String Bean	Total
(Grams per Household per Month)								
<u>Multiple Cropping Villages</u>								
Ban Jode	596	609	51	92	180	-	-	1528
Ban Koksri	493	475	286	78	4	48	102	1486
Ban Maung	556	132	17	-	-	76	91	872
Ban Had	756	836	223	355	-	143	-	2313
Ban Pasan	8	520	17	33	-	15	-	593
Average	482	514	119	111	37	56	39	1358
<u>Other Villages</u>								
Ban Wang Yawl	152	286	44	-	126	14	126	748
Ban Huey Sai	250	440	389	112	556	-	-	1747
Ban Na Dee	88	4	35	-	26	-	55	208
Ban Nong Pai	392	-	40	-	-	180	81	693
Ban Huey Tuey	188	18	11	220	-	11	-	480
Average	124	150	104	67	142	41	53	771
Average for All Villages	348	332	112	89	90	48	46	1065

5.6 CONSUMPTION PATTERN OF LEGUME AND LEGUME DISHES

The legumes used in different types of meals - main dishes, desserts and snacks - are shown in Table 35. Legumes consumed mainly as main dishes were cowpeas, string beans, hyacinth beans and bean sprout; as desserts were soybeans, mung beans, black beans and red bean; as snacks were pigeon peas and groundnut. It was also found that most of the legumes listed except hyacinth beans and bean sprout, were mainly consumed at lunch. Hyacinth beans and bean sprout were consumed at breakfast. However, the other legumes were also consumed at dinner and breakfast as shown in Table 36. These patterns of legume consumption were similar in both Multiple Cropping Villages and the Other Villages.

Table 35: Types of Meals Using Legumes
(Total Number of 100 Households Interviewed)

Legume	Main Dishes	Desserts	Snacks
<u>% of Households</u>			
Soybean	-	20	1
Cowpea	74	3	4
Mung bean	9	52	-
Black bean	1	59	1
Red bean	1	34	-
Pigeon pea	26	-	30
Groundnut	5	7	87
String bean	85	1	5
Bean sprout	59	-	6

Table 36: Time of Day When Legumes Eaten
(Total Number of 100 Households Interviewed)

Legume	Type of Village	Times of Having Meal with Legumes			
		Break- fast	Lunch	Dinner	After Dinner
		% of Households			
Soybean	Multiple Cropping	2	8	2	6
	Other Villages	-	24	2	2
Cowpea	Multiple Cropping	28	72	30	4
	Other Villages	50	30	10	-
Mung bean	Multiple Cropping	10	22	14	14
	Other Villages	2	38	16	10
Black bean	Multiple Cropping	8	42	12	6
	Other Villages	-	40	14	10
Red bean	Multiple Cropping	-	16	4	-
	Other Villages	4	20	8	16
Groundnut	Multiple Cropping	24	50	56	38
	Other Villages	8	28	36	24
String Bean	Multiple Cropping	34	72	34	4
	Other Villages	68	42	22	-
Hyacinth Bean	Multiple Cropping	4	12	14	-
	Other Villages	44	10	16	-
Pigeon pea	Multiple Cropping	8	50	8	-
	Other Villages	12	62	10	2
Bean sprout	Multiple Cropping	22	20	42	2
	Other Villages	54	22	22	4

5.7 EATING OF LEGUMES THROUGHOUT THE YEAR

The legumes eaten at breakfast, lunch and dinner in different seasons are shown in Table 37. Fresh string beans were the most common then boiled groundnuts, black beans boiled in syrup, fresh cowpea pods, "samtam" string beans, roasted groundnuts, mung beans boiled in syrup and red beans boiled in syrup. There were seasonal variation on consumption of only green legumes (fresh string beans and fresh cowpea pods) which were eaten more in the rainy season than the other seasons.

Table 37: Legumes Eaten in Three Seasons
(Legumes Eaten in Two Days by 100 Households)

	Rainy			Cool			Hot			Total
	B	L	D	B	L	D	B	L	D	
(Number of Households Eating)										
Fresh string bean	24	22	27	5	11	12	5	10	13	129
Boiled groundnut	5	7	17	7	2	13	-	4	4	59
Black bean boiled in syrup	1	3	6	0	1	1	6	3	1	22
Fresh cowpea pod	2	4	4	-	-	2	5	1	3	21
"Somtam" string bean	1	3	-	5	4	-	-	6	-	19
Roasted groundnut	-	1	2	-	2	3	-	1	3	12
Groundnut brittle	3	-	-	-	1	-	2	2	-	8
Mung bean boiled in syrup	-	2	-	-	-	-	1	1	3	7
Red bean boiled in syrup	-	1	-	-	1	1	1	-	2	6
Steamed glutinous rice dough stuffed with mung bean (Too pab)	-	-	-	-	-	-	4	-	-	4
"Somtam" cowpea	-	3	-	-	-	-	-	-	-	3
Fresh pigeon pea pod	1	-	-	1	1	-	-	-	-	3
Fresh hyacinth bean pod	-	-	-	-	1	-	-	1	-	2
Mung bean sweet paste	-	-	-	-	-	-	2	-	-	2
Mung bean paste coated with egg yolk	-	-	-	-	-	2	-	-	-	2
Sago with black bean	-	-	-	-	1	-	-	-	-	1
Sago with mung bean	-	1	-	-	-	-	-	-	-	1
Mung bean pudding (toa soun)	-	-	-	-	-	-	1	-	-	1

B = Breakfast, L = Lunch, D = Dinner

5.8 LIKING OF LEGUMES AND LEGUME DISHES

A high percentage of households indicated that they liked groundnuts and string beans very much and liked moderately cowpeas, mung beans, black beans, red beans, hyacinth beans, pigeon peas and bean sprouts. A large percentage of households indicated they disliked soybeans. A larger percentage of households in the Multiple Cropping Villages indicated dislike of soybean, red bean, hyacinth bean and pigeon pea than in the Other Villages. The percentages of households in the Multiple Cropping and the Other Villages indicating the degree of liking for different types of legumes are shown in Table 38.

Table 38: Degree of Liking of Legumes
(Total Number of 100 Households Interviewed)

	Dislike	Like Slightly	Like Moderately	Like Very Much	No Answer
	% of Households				
<u>Soybean</u>					
Multiple Cropping	48	14	28	6	4
Other Villages	18	16	36	24	6
<u>Cowpea</u>					
Multiple Cropping	4	8	52	32	4
Other Villages	6	10	60	20	4
<u>Mung bean</u>					
Multiple Cropping	14	10	48	28	-
Other Villages	8	12	36	34	10
<u>Black bean</u>					
Multiple Cropping	14	8	46	30	2
Other Villages	4	10	22	54	10
<u>Red bean</u>					
Multiple Cropping	32	12	30	18	8
Other Villages	8	14	48	30	-
<u>Groundnut</u>					
Multiple Cropping	0	2	10	88	-
Other Villages	0	0	12	80	8
<u>String bean</u>					
Multiple Cropping	2	-	22	74	2
Other Villages	4	4	22	68	2
<u>Hyacinth Bean</u>					
Multiple Cropping	34	22	32	8	4
Other Villages	6	20	54	12	8
<u>Pigeon Pea</u>					
Multiple Cropping	42	25	19	5	9
Other Villages	9	16	34	14	27
<u>Bean Sprout</u>					
Multiple Cropping	14	10	46	14	16
Other Villages	2	4	18	48	28

The households in the Multiple Cropping Villages and the Other Villages indicated similar opinions on liking of legume dishes and legume products. Generally most of the legume dishes were liked by a large percentage of households, but some legume products such as fermented whole beans, fermented bean curd, bean curd, soybean sprouts were only liked by a small number of households. Legume dishes, mainly in the dessert category, sold in the market, were also liked by only a small number of households. When ranking the legume dishes (Table 39), it was found that legume dishes such as bean sprout, boiled groundnuts, roasted groundnuts, fried bean, bean boiled in syrup, bean boiled in coconut milk and steamed glutinous rice with beans were liked by most of the households.

Table 39: Ranking of Liking of Legume Dishes and Products
(Total Number of 100 Households Interviewed)

Legume Main Dish	Legume Snack	Legume Dessert
Bean sprout (85%)*	Boiled groundnut (97%)	Bean boiled in syrup (97%)
Silver noodle (79%)	Roasted groundnut (94%)	Bean boiled in coconut milk (94%)
Bean sauce (63%)	Fried bean (80%)	Steamed glutinous rice with beans (90%)
Bean porridge (62%)	Soybean milk (33%)	Groundnut brittle (77%)
Soy sauce (69%)		Tao Soun (70%)
Steamed curry cowpea (51%)		Roasted glutinous rice and beans (63%)
Bean seasoned ground beef (36%)		Bean sweet paste (52%) (52%)
Fermented whole bean(33%)		Toasted custard (50%)
Fermented bean curd (28%)		Steamed bean gel with coconut (35%)
		Tao Pab (35%)
		Tao Hoey (22%)
		Tao Tod (17%)

* Numbers in parenthesis are % of households liking legume dishes and products.

The reasons for liking and disliking legume foods for the Multiple Cropping Villages, and the Other Villages were similar. The main reasons for liking was "delicious", the other reasons were, easy to buy, nutritious, easy to cook, reasonably priced, cheap and "fatty" taste. The reason for disliking were "fatty" taste, not available and not "delicious".

5.9 THE ATTITUDES TO COWPEAS

Cowpeas were known to most of the households. Few households did not know cowpea fresh pods, had never eaten fresh pods and did not know where to get fresh pods and dried seeds (2,4 and 8% of households respectively). Although most of the households had known cowpeas but 42% had never eaten dried cowpea seeds. The majority of the households believed that fresh cowpea pods, cowpea seeds and cowpea sprouts were easy to cook and very versatile. Only 4% and 8% respectively found cowpea seeds and cowpea sprouts difficult to cook. A large number of households (62%) thought fresh cowpea pods nutritious but fewer households (38%) thought cowpea seeds nutritious. Cowpea fresh pods and cowpea seeds were thought to be "delicious" by 80% and 60% of households respectively.

5.10 ACCURACY OF SURVEY

The survey on the quantities of legumes and legume dishes eaten was used to prove the accuracy of the survey. The data on the quantity of different types of legumes eaten and the quantity of different types of legume dishes eaten were obtained from separate interviews but when comparing the quantities concerned in the different villages, they were similar.

5.11 CONCLUSION

The villagers in Multiple Cropping and Other Villages were familiar with legumes of each type but they did not eat or grow them in large quantities. Most of the villagers seldom ate legumes but they said they liked to eat legumes and legume foods. In some villages, legumes and legume dishes were eaten in large quantities. The highest quantities of legumes and legume dishes consumed per household per month were 2979g and 2313g respectively; the smallest quantities were 372g and 208g. Therefore it should be possible to increase the level of legumes eaten in the lowest consumption villages. Villagers have a positive attitude to legumes and they also know how to cook legumes so it would not be too difficult to encourage villagers to increase their consumption of legumes.

The legumes eaten more frequently and consumed in larger quantities by most of the villagers were cowpeas, groundnuts, string beans. Cowpeas were grown more often than other legumes in the Multiple Cropping Villages but less frequently in the Other Villages. This likely shows the effect of the Khon Kaen Cropping Project. Cowpeas and stringbeans were eaten as fresh pods and were cooked into many varieties of dishes but groundnuts were mainly roasted and boiled.

The information from the survey would confirm the possibility of increasing the consumption of legumes by encouraging more use of cowpeas. During the time of the survey the new variety of cowpeas, red cowpeas 6-1US was in its initial stage of introduction but it was still grown by more households in the Multiple Cropping Villages than the other legumes. This was an encouraging fact. These cowpeas could therefore be a legume to introduce to the Other Villages. Villagers could grow and cook for themselves, thus increasing the household consumption of legumes and improving the nutritional status.

There were many varieties of legume dishes that could be used as a basis for the development of cowpea dishes. New dishes from cowpeas could be developed by using cowpea seeds to replace the other legume seeds in the most commonly eaten legume dishes, or by cooking cowpeas using the common village cooking methods or by using cowpeas to improve the nutritional value of the commonly eaten foods.

Villages had used legumes in many forms as whole seeds, fresh pods, roasted and ground into powder. Cowpeas could be used in those forms in the developed dishes. The villagers would be able to cook cowpeas by themselves and therefore consume them more frequently.

6. THE FOOD EATING PATTERN IN NORTHEASTERN VILLAGES

The surveys confirmed that the diet of the villagers in Northeastern Thailand was mainly cereals and vegetables. Steamed glutinous rice was the main staple food. Fish was the main animal food but it was not eaten everyday by every family. High fat foods were less frequently eaten; and fat was rarely used in cooking. Green vegetables were the most commonly eaten vegetables. Some of the vegetables eaten by large numbers of households were leaves of trees such as lead tree and native trees. Fruits were eaten less frequently than vegetables, the varieties eaten by a large number of households were the fruits available in season. Fruits commonly grown and available all year round, such as banana and papaya, were eaten less frequently and were not eaten at all by some households. Legumes were eaten but they were mostly eaten as green legumes, in the immature state.

Food supplied to the family depended mainly on what was found wild around the village and what was grown. Few foods were bought. Most of the households were self supporting in food. Foods such as fish, fresh water animals and wild animals were obtained from finding, fishing and hunting. Vegetables were mostly grown but were also collected from the village surroundings. Fruits were grown. Most of the households grew their own glutinous rice.

There was no regular supply of food all year round except for glutinous rice, which was stored for eating throughout the year. Most foods were seasonal, for example in the rainy season, fish and vegetables were available and eaten in large quantities. Fish and vegetables were less available in the hot season and therefore more varieties of food were eaten in the hot season to give the quantity of food necessary. Villagers only preserved dried chillies, pickled or dried bamboo shoot and fermented fish.

The eating patterns were found to be almost identical for each of the three seasons only the frequency of eating the different foods varied with the season. Foods were traditionally cooked in simple style - roasted on charcoal, steamed, boiled and fried with a small quantity of water. Frying in oil was less frequently used.

The eating pattern of the villagers in the 10 villages in Khon Kaen Province was found to be similar to those of villagers in other

Khon Kaen areas as reported by Kumazawa et al, (1974) and to those of villagers in Nong Kohn village in Ubol Province as reported by Valyasevi et al, (1967). They had reported the nutritional deficiencies in the diet of those villagers. Therefore it can be assumed that the present villages also have an inadequate diet.

In the survey, it was found that most children aged 1-5 years old ate the same food as the adults. This definitely showed that they would not receive sufficient nutrients for their requirements unless they were allowed to choose the higher nutritious foods in the particular meal. It had been realized that supplementary foods are needed especially for the vulnerable groups (Valyasevi, 1980 and Dhanamitta et al, 1981). But as food was prepared and eaten together by the whole family and children also ate the same food as adults, it would be better if food could be planned for the whole family, taking into consideration the nutrient requirements of the individual members of the family including the children. This would ensure that all of the villagers would receive adequate nutrient supply and thus improve the diet of the whole village.

Villagers were self supporting in food. They had little money to buy food, although they had realized the need for food supplements. Therefore a food supplement has to be available in the village and a regular supply for villagers in all seasons.

The survey on food legumes eaten in 10 villages in Khon Kaen Province showed the potential of using legumes as a supplementary food. Various types of legumes have been grown and eaten although not in large quantities. Legumes have been eaten as dried seeds and as green vegetables and cooked into many legume dishes. Villagers also used legumes in the powder form by roasting the beans and grinding into a powder. Therefore legumes would be a suitable food to supply all year to supplement the commonly eaten foods. They are a cheap protein food and can be stored for long periods of time. In the survey, cowpeas were found to be the most commonly eaten legume with peanuts and stringbeans. The new variety of cowpea - red cowpea 6-1 US, had been introduced for intercropping with the main field crops such as cassava by the Cropping System Project of Khon Kaen University. This new variety gives a higher yield and has a shorter production period and is more suitable for intercropping than the local cowpea variety. It was found that during the survey, cowpeas were grown more frequently in the Multiple Cropping Villages than in the Other Villages. This particular

variety of cowpea should be encouraged for other villages to grow. If they could not grow them for eating all year at least they could supplement the other protein foods when there are scarce.

A design for using cowpea in the balanced daily menu for a whole family is required to improve the nutritional intake of the Northeastern villagers. The information on the commonly eaten foods in the villages, the source and availability of these foods, the village food habits and eating patterns obtained from this survey could then be used for designing acceptable cowpea supplementary foods and a balanced daily menu. Cowpea supplementary foods in the form of various cowpea dishes would be more appropriate than a single nutritious food. Such cowpea dishes as main dishes, desserts and snacks could be eaten in various meals in the daily menu with the commonly eaten foods and would be readily accepted by the villagers. The design should also consider the other nutrients in the daily requirements. Although emphasis should be placed on overcoming protein-energy malnutrition, satisfaction of all other important nutrient requirements should be considered. A variety of foods which are good sources of important nutrients has to be incorporated. The availability of such foods in the villages is another factor needing consideration. Perhaps the planning of a daily nutrient balanced menu for a family, in which the menu would consist of cowpea dishes and the local popular foods would be the most appropriate to improve the diet of the northeastern villagers.

PART TWO:

DEVELOPMENT OF COWPEA DISHES AND 7-DAY
MENU FOR VILLAGERS IN NORTHEASTERN THAILAND

It would be most appropriate in the development of foods based on red cowpeas to complement the local food raw materials or to replace some raw materials in commonly consumed local foods with cowpeas. The foods containing cowpeas could be developed as food dishes to eat with other local dishes in the daily meals. A nutritionally balanced menu could be planned using the local foods and the cowpea foods. This approach would be valuable for long term, nutritional improvement of the diet of the villagers.

With the availability of computer systems and with the increased application of mathematical programming, the development of protein rich foods from cowpeas, with optimum use of cowpeas and highest protein content within the consumers' acceptability, can be developed by the use of linear programming. This quantitative technique can also be used for planning a nutritionally balanced diet.

This section describes the development of cowpea food dishes and the planning of a 7-day nutritionally balanced menu.

In the development of cowpea food dishes, various ideas of food dishes in which cowpeas could be used were systematically selected. The recipes of the final food dishes selected were formulated for the maximum protein content by the application of linear programming. The maximised protein dishes were finally tested for their acceptability to the villagers.

The 7-day menu was planned for a family of 7 persons. The menu contained cowpea dishes, commonly eaten Northeastern dishes, fruits and vegetables in the menu components of the Northeastern meal pattern. The quantities of food in each menu were planned to supply the daily requirements of 26 nutrients for a family of 7 persons. The 26 nutrients were energy, protein, fat, dietary fibre, 3 minerals, 9 vitamins and 10 essential amino acids. The menu components and quantities of food in the menu were planned by the use of integer programming.

7. METHODS OF PLANNING DIETS

In the past, the planning of diets and nutritional food products was an art and customarily either depended on a trial and error process or on logical planning to satisfy the diet, the product concept, specification and the acceptability to the consumers. It was often tedious and time consuming. Today with the advance in mathematical programming models and the new developments in electronic data processing software and also the declining costs of electronic computation, the optimum diets and the nutritional food products can be planned or formulated to satisfy the required nutrition and the desired attributes the consumers expect with the minimum cost.

7.1 THE DEVELOPMENTS IN DIET PLANNING

Early diet planning selected food in the form of purchased food to feed a grown man or a family (Stigler, 1945, Smith, 1959). Kinds and quantities of foods selected provided adequate nutritional requirements for a certain period and at lowest cost. The problem was solved by the use of linear programming with the objective function to minimise cost and with minimum nutrient requirements as constraints. The diet selections represented a minimum cost, and satisfied nutritional requirements but could be unpalatable and did not produce acceptable meals. This early work on the diet problem has been reviewed by Smith (1963).

The next stage was the development of menu planning by the use of the computer for planning institutional meals. Two approaches were reviewed by Eckstein (1973) - the menu planning by the random approach and the menu planning by the mathematical programming technique. In the random approach, a menu item is selected and tested to determine whether it meets predetermined acceptability criteria when paired with other items selected (Eckstein, 1967). In 1964, Balintfy recognised that the menu planning problem in selection of menu items to produce a complete meal could be solved by using integer programming. Since then Balintfy and his co-workers, Glue and Ligett, have developed two types of hospital menus: non selective and selective menus (Balintfy, 1964; Glue and Liggett, 1966). The non-selective menu is one in which no

options, such as choice of vegetables are allowed. The selective menu offers a choice of items from the given menu components, e.g. two choices of vegetables. In their models, not only the nutritional requirements was considered to minimize cost, but the menu structure, and the frequency of serving each menu item were also included. This work led to the development of the Computer Assisted Menu Planning (CAMP) systems (Balintfy, 1969). The computer information system for planning selective and non-selective menus were widely used in hospital menu planning. This mathematical programming model for menu planning has been refined and several computerized menu planning methods have been developed. At the present stage, the menus are planned not only to minimize cost but can also be planned to maximise the consumer preference and to fit with the consumers budgets (Balintfy, 1976).

Linear programming had been used in various nutritional product formulations to meet the nutritional requirements with minimum cost, in selection of food raw materials for optimum use of limited resources at minimum cost, in planning food supplies of nations and the world based on meeting nutritional criteria at lowest cost, in formulation of commercial food products to meet the product's functional property requirements, and consumer acceptability requirements at the minimum cost. These application of linear programming in formulation and planning food products were reviewed by Edwardson (1974) and Edwardson et al. (1980). The development work in diet planning since 1945 is summarised in Appendix 4.

7.2 IMPORTANT FACTORS IN DIET PLANNING

In planning a diet or formulation of a food product, various factors need to be considered and if it is going to be used in numeral computation, they also need to be quantified and included in the mathematical model.

7.2.1 The Consumer

One needs to know at the beginning who is the consumer of the food product and the diet to be planned. Once the consumer is identified, then the information on their nutrient requirements, food habits, food preferences, meal patterns and budget can be collected and be used in the planning.

7.2.2 Nutritional Requirements

According to Smith (1974), the nutritional composition of a satisfactory diet is usually described by listing the quantities of the principal nutritional elements that the diet should contain. Some nutrients known to be essential to good nutrition are omitted from such a listing, either because the quantities needed are not known or because a diet that is adequate with respect to some ten or 20 principle nutrients, if it is sufficiently varied, is usually adequate with respect to the remainder. The nutritional allowances are usually specified as minimum quantities; excess of individual nutrients are not ordinarily harmful unless they are unusually large. Eckstein (1973) stated that when the nutrient levels are allowed to exceed requirements by an unspecified amount below an arbitrarily selected upper bound, the quantities of most nutrients are random. Scarce nutrients are provided in minimal quantities. Perhaps diets should be planned to meet RDA in the long run, i.e. over a week or so, rather than daily. Balintfy and Prekopa in 1966 as mentioned in Eckstein (1973) had analyzed the types of random variation that account for variability in the nutrient composition of meals. They demonstrated that the nutritive composition of meals is related to variability in (a) inherent nutrient composition of the ingredients, (b) portion size and plate waste, and (c) the nutrient contribution of items combined as meals. However, they state that the lack of adequate data on nutrient composition, (i.e. range, mean, standard deviation, variance and co-variance) creates problems in forecasting the nutritional adequacy of menus planned manually or by computer. Much research is required to develop data of this nature.

The principle nutrients considered in most of the diet planning are energy, protein, fat, fibre, carbohydrate, calcium, iron, thiamine, riboflavin, niacin, ascorbic acid and vitamin A. Unklesbay and Unklesbay (1978) have planned menus for elderly people in which 17 nutrients were considered. Edwardson (1974) and Anderson (1975) formulated nutritional food products which will meet the requirement of 26 nutrients, and Chittaporn (1977) formulated baby food products in which 43 nutrients were included in the constraints.

The protein quality of the diet has received considerable attention. As pointed out by Smith (1974) for planning a least cost

diet both quality and quantity of protein must be determined simultaneously. Otherwise it will rule out opportunities to economise by consuming a smaller quantity of higher quality or a large quantity of lower quality protein. He presented a diet model that determines a least cost diet in which the quality and quantity of the protein are jointly and optimally determined. Edwardson (1974), Anderson (1975) and Chittaporn (1977) included a linear relationship of protein quality and quantity in their linear programming formulation in which the amino acid pattern was defined as the protein pattern found in hen's egg. Pinto (1971) optimized a protein rich mixture for the best amino acid pattern by using FAO (1957) amino acid pattern.

The level of nutrients are sometimes related to each other, e.g. the B vitamins and protein; protein and energy. This problem has been included in the diet model by stating some of the allowances in the ratio form or by requiring that a certain allowance be satisfied exactly, so that quantity in the diet becomes a known constant (Smith, 1974). Examples of these nutrient relationships have been shown by Edwardson (1974).

Another problem has been pointed out by Balintfy (1979) that the relationship between the nutrient composition of the ingredients and that of the food served cannot readily be expressed quantitatively because of the mass of data and computation involved in the institutional menu planning. But for a single product the problem is less complicated. Chittaporn (1977) has incorporated the nutrient constraints by allowing for the effect of processing loss in her formulation of a baby food product.

Balintfy (1979b) has pointed out the inherent conflict between food preference and nutrition. In the preference maximised menu planning when items were selected on the basis of preference and energy content alone, the preference - maximised menu fell short by 40 percent of the RDA allowance, in this case of two micro nutrients: calcium and riboflavin. Secondly, when 40 percent of the RDA allowances were enforced along with the previous constraints, total preference dropped to 80% of the previous level.

Anderson (1975) used the technique of goal programming, which is a modification and extension of linear programming, to optimise the nutritional balance of a selected mix of foods. It achieves this through replacement of cost maximisation in the objective function by the total deviation of the nutrients from the pre-specified levels

required for optimum nutritional balance. A target cost can be defined as a constraint, to ensure that the mixture selected is affordable.

7.2.3 Acceptability

There are many factors related to the acceptability of food products and diets. These factors are palatability, appearance such as colour and shape, texture and shape, consumption habits, variety or monotony of the diets, preference, compatibility of food raw materials or menu items when they are formulated or presented together, and cost. Information on these factors needs to be collected and if included in the formulation or diet planning, the food products or the diets obtained would be most likely acceptable to the consumer.

Acceptability of any menu is related to a combination of the preference ratings of the individual dishes (Peryam, 1959). Acceptability can be determined as a simple preference rating or by the proportion of the families/households purchasing the food (Smith, 1963). Eckstein (1967) rated foods on the proportion of the population that found them acceptable, from "acceptable to some" (25-50%), "acceptable to most" (50-75%), to "acceptable to all" (>75%).

Acceptability can be achieved by removing unpopular or unfamiliar foods from the menu and by relating the frequency of serving to the acceptability of the items. Another way to enhance acceptability of a menu is to offer selection (Balintfy, 1975); the most popular form provided two choices per course.

7.2.4 Palatability

Palatability was one of the objectives that the early diet planners wished to achieve besides meeting the nutrient requirements. Smith (1959) attained palatability in the diet planning by setting up maximum limits (to prevent satiation) and minimum limits (to ensure that common food preferences are not ignored) and complementary restrictions in recognition of the fact that some foods are more palatable in combination than they are alone. A few foods that turn out to be a particularly economical means of obtaining the objective set forth in the model are liable to be present in excessive quantities, so a maximum limit will be needed on these commodities. Many of basic ingredients are essentially raw materials, not palatable

in themselves and only acceptable as food when combined with the other ingredients, e.g. wheat flour with baking powder, flour and yeast. Complementary foods, e.g. bread and butter, sauerkraut and frankfurters, corned beef and cabbage are more palatable as combinations than as individual ingredients.

When food was in the form of a menu item, palatability was less of a problem. Balintfy (1964) prepared menus from accepted recipes and these can be regarded as palatable per se., his objectives of palatability in menu planning were carried through by imposing formal requirements on the structure of menu components and also on the variety of menu items within the components. According to Smith (1963), a palatable diet is the diet that provides satisfaction of the common tastes and habits. Variety is a great help in making a diet palatable.

7.2.5 Food Attributes

The overall acceptability depends on the acceptance of the different attributes of the food such as texture, flavour and colour. Food combinations can be varied in colour, texture, flavour or shape and it is important to find acceptable sensory properties.

In menu planning, colour, flavour and texture can be classified and the maximum number of times each category appears on the dinner plate can be specified. For example, Balintfy (1967) classified dominant colours as red, orange, white, yellow, brown, purple and multicolour; flavour as bland, mild and strong; texture as liquid, soft, crisp and chewy; and temperature of serving as hot, room temperature and cold. Eckstein (1967) to avoid monotony, set the maximum numbers of times soft, chewy and crisp textures should be selected and set shape constraints to ensure variety e.g. a maximum number of 2 "slices" per meal.

The texture and flavour can also be constrained by setting limits on the different ingredients (Carmel, 1976), or by using consumer panels to set the constraints on the food attributes (Chittaporn, 1977).

7.2.6 Monotony and Food Preference

Food acceptance and consumption are inversely related to monotony. Monotony is a psychological construct representing the dissatisfaction which arises from frequent or cyclic repetition of food items (Eckstein, 1973).

As reviewed by Balintfy et al. (1974 and 1975), monotony, as a response to the frequency of eating the same food item repetitively, decreases the preference for that food. It was found that increasing the frequency, i.e. repetition, of serving tends to reduce the utility of the food as measured by preference or palatability scores on a hedonic scale. The question arises as to what frequency of serving a set of food items will "please" an individual or a population. This information was obtained by using a questionnaire designed to determine preferred frequency rating for any number of menu items. From the frequency rating that determined how often an item was preferred to be eaten in a given time period, the corresponding "separation rating" of the item could also be computed expressing the preferred number of time intervals in terms of days or meals for consecutive servings of given items. The average or median separation rating of a population for an item was then used in mathematical menu-planning models as an entry restriction or boundary constraint, which assured that the separation of items on the menu schedule was never less than the value indicated by the rating of the population.

There are three ways of controlling frequency: set a limit on frequency of consumption over a unit time; set "separation day" limit - the minimum (or maximum) number of days that must elapse before an item can be served again; set the repetition intervals - the overall and meal component intervals. The overall restriction was designed to prevent serving a given "kind" in any form, at any meal within the specific time interval, e.g. apple will not be selected more than once in a three day period. If apple juice is selected for Monday breakfast, apple sauce or baked apple etc. might be selected for Thursday lunch or any succeeding meal, but not before this. In addition, the meal component interval restriction prevents serving a given "kind" as the same meal component within another specific time interval. Apple dessert items such as Apple Crisp and Apple Pie could not occur more than once in an eight day meal period (Eckstein, 1973). A menu planning system for preference maximisation based on time

related preference has been pilot tested and research is still progressing on many aspects of this problem (Balintfy, 1979b).

7.2.7 Food Compatability

Compatability is another feature of an acceptable diet. Combinations of foods and the special enhancement or detracting of menu acceptability is due to the presentation of two foods together rather than separately and this can not be easily approached within the traditional framework of Linear Programming since no analytical procedures have been proposed which account for compatability (Moskowitz and Klarman, 1977).

In Balintfy's (1969) multi-stage menu planning, the preference level of the meals is maintained in his model by avoiding incompatible combinations of menu items within meals and between meals.

Anderson (1975) analysed the compatability of 40 raw materials by using Non-metric Multi-dimensional Scaling (MDS). This analysis was then incorporated in the linear programming model to formulate a Thai food dish by optimising acceptability and at the same time satisfying the nutrient requirement. His development was reviewed by Edwardson et al, (1980).

Moskowitz and Klarman (1977) approached the analysis of food compatabilities and menu planning by a three step procedure: multi-dimensional scaling, regression analysis and cluster analysis, and produced quantitative representations of compatabilities. The menu planners could then estimate which foods go best with many other foods. Multi-dimensional scaling was used to produce a geometric map of foods so that compatible foods are located close together. The regression analysis indicated the degree to which pairwise compatabilities of two items predict compatability of triples of items. Cluster analyses produced combinations of foods located close together in the space, which are thus compatible with each other.

7.2.8 Meal Patterns

The early diet planning failed to consider how a person eats - it only considered the total quantity of foods in the purchased form. The latest diet planning takes into consideration the eating patterns of the consumers.

Balintfy in 1964 planned the diet in the form of menu planning in which meal pattern and meal structure were taken into consideration. The structural requirements are the customary array of components in menus. These can be for instance, appetiser, entree, cereal, bread and beverage for breakfast and appetiser, entree, starch, vegetable, salad, dessert, bread and beverage for dinner and similarly for supper. More or less of these components make up the structure of menus, depending upon the habits and standards of households and institutions (Balintfy, 1964). It is also necessary to consider how food is consumed in each meal, e.g. in the USA, the currently accepted meal pattern is breakfast, lunch and dinner, with approximately half of the energy provided at the evening meal (Eckstein, 1973).

7.3 QUANTITATIVE TECHNIQUES USED IN DIET PLANNING

Selection of food raw materials or planning of diets by quantitative techniques has become well known and widely used. The most useful and popular technique is linear programming. It has been used in planning food items in purchased form (Smith, 1959, 1961), for selection of raw material (Edwardson 1974; Anderson, 1975; Chittaporn, 1977), for formulation of nutritional food products, in the formulation of food mixtures or food products (Pinto, 1971; Kansra et al, 1974; Carmel, 1976) and in single stage menu planning (Balintfy, 1970, 1976). Although linear programming has been satisfactorily used for planning optimum diets, it has difficulty in handling some other quantitative criteria such as selection of one menu item from each menu component to form a satisfactory menu structure or selection of a choice of menu items. The first case has been handled by the use of zero-one integer programming (Balintfy, 1964) and the latter case by stochastic zero-one programming. Variable portion size of menu items can be planned in the menu by the use of quasi-integer programming (Armstrong and Sinha, 1974). The menu planning problem with preference maximisation objective can be formulated as a non-linear programming problem (Balintfy, 1976). Goal programming has been used to optimise the nutritional balance of a selected mix of food (Anderson, 1975). Non-metric multi-dimensional scaling has been used to derive acceptability scale values for input into the linear programming for selection of acceptable and nutritious combinations of food raw materials (Anderson, 1975).

Three examples of mathematical programming models commonly used for food selection and menu planning are presented below.

7.3.1 Linear Programming in Raw Material Selection

The research at Massey University, New Zealand, by Edwardson (1974), Anderson (1975) and Chittapporn (1977) demonstrated the value of linear programming in diet selection for developing countries. The linear programming used in all three studies is shown below:

$$\text{Minimise } \sum_{j=1}^n C_j X_j$$

$$\text{Subject to } \sum_{j=1}^n a_{ij} X_j \begin{matrix} < \\ > \end{matrix} b_i \text{ for } i = 1, 2, 3, \dots, m$$

$$\text{and } X_j \geq 0$$

Where m is the number of nutrients or rows.

n is the number of food raw materials or columns.

a_{ij} is the number of nutrients i in one unit of food raw materials j .

b_i is the specific number of units of nutrient i required.

C_j is the cost of raw material j .

X_j is the number of units of raw material j in the solution.

The linear programming models were therefore set up to select nutritious combinations of raw materials to satisfy specific nutritional requirements at the lowest cost. The three linear programming models of Edwardson (1974), Anderson (1975) and Chittaporn (1977) were much larger models than previous linear programming models. Edwardson (1974) considered 170 foods and 26 nutrients, Anderson (1975) considered 151 foods and 26 nutrients, and Chittaporn (1977) considered 96 foods and 43 nutrients. The models also included interrelationships between nutrients in which constraints were input for expressing e.g. level of fat and energy, calcium and phosphorous, thiamine, riboflavin and niacin and energy, and amino acid and protein defined as the pattern found in hen's egg. The setup in the linear programming matrix of these nutrient interrelationships has been described by Edwardson et al, (1980).

7.3.2 Menu Planning by Linear Programming

A menu planning problem with a linear food cost minimising objective function and linear constraints was defined by Balintfy (1976) as shown in the following page. The model is the single stage menu planning, solving by linear programming with bounded variables.

$$\begin{array}{ll} \text{Minimise} & C^T X \\ \text{Subject to} & \text{(i) } IX \leq d, \\ & \text{(ii) } AX \geq B, \\ & \text{(iii) } MX \leq S, \\ & \text{(iv) } RX \geq D, \end{array}$$

- Where C^T is the n-vector of unit portion costs of menu items.
 d is the n-vector representing the upper bounds on menu item frequency in the solution.
 A is the $m \times n$ matrix of the nutrient composition of menu items with an a_{ij} element indicating the amount of nutrient i in one portion of menu item j .
 B is the m -vector of the nutrient allowance for some reference person for s days.
 M is a (K_{xn}) zero-one matrix containing staggered rows of unit coefficients corresponding to the availability of items for given courses.
 S is a K -vector of components s or $2s$ for non-selective

menu indicating the number of items needed for a course for a cycle of s days.

- R is an $(L_{\times n})$ matrix of coefficients for assorted attribute constraints, production constraints etc. which define feasibility conditions for scheduling the items for meals.
- D is an L -vector defined by the constraints above.
- X is the vector notation for the menu plan which is fully defined by the values of the components of X compared with the j . The component of X in the solution is not zero, x_j represents the number of portions of menu item j to be allocated for s days.

In the above definition of x_j and its role with respect to the feasibility of scheduling requires that all the components of x be integers. In practice, the problem is not too serious because s can be rather large. Menu cycles of 60 days or 90 days are common, so the number of portions to be represented by x_j components can be large integers where the effects of rounding is relatively minor.

A common shortcoming of single stage models is that the menu items still have to be scheduled on a meal by meal basis. The relations between planning and scheduling are difficult to formulate mathematically and at present only heuristic methods are available for scheduling such plans.

7.3.3 Menu Planning by Integer Programming

In the multi-stage non-selective menu planning, one menu item is to be selected from each of several menu components to satisfy not only the nutrient requirements but also the menu structure and acceptability. The menu was then scheduled meal by meal, day by day listing items over time.

The multi-stage approach to menu planning, as explained by Balintfy (1976), concentrates on a cycle length of one day or one meal at a time in solving a system essentially equivalent to the single phase menu planning in Section 7.3.2. In this formulation, the components of his S vectors are units, and the set of structural constraints of Section 7.3.2 [(iii) $MX \leq S$] will become multiple choice constraints. Consequently, the problem becomes a zero-one integer programming problem to be solved in successive stages on a meal by meal and day by day basis.

The mathematical programming part of the CAMP (Balintfy, 1969) package optimises the following integer programming problems in each stage:

$$\begin{aligned} &\text{Minimise} && C^T x_t, \\ &\text{Subject to} && \text{(i)} \quad A x_t > b, \\ & && \text{(ii)} \quad M x_t = 1, \\ & && \text{(iii)} \quad R x_t < 1, \end{aligned}$$

Where x_t is a zero-one vector; b is the m -vector of dietary allowances for day (or meal) t .

l is a vector of unit components.

M is a zero matrix containing staggered rows of unit coefficients corresponding to the availability of the items for a given courses.

R is a matrix of zero-one coefficients.

The preference level of the meals is maintained in the model by avoiding incompatible combinations of menu items within meals and between meals. Constraints set (iii) of above equation takes care of incompatibility by providing acceptable "packages" of items within a meal.

7.4 CHOICE OF DIET PLANNING METHOD FOR NORTHEASTERN THAILAND

In planning a diet for the Northeastern villages, the diet has to be selected from the raw materials available in these villages, the diet has to provide all the important nutrients needed for the physiological requirements of the villagers, the diet has to be accepted by the villagers, the foods and meals planned in the diet have to fit with the villager's cooking style and eating habits and the diet has to have a low cost.

There are problems in planning such a diet. Firstly, among the various raw materials available in the villages, there are not many foods which are good sources of nutrients. Fish is the main source of protein and is eaten only in a small quantity and not by every family. Eggs are rarely eaten and few are available. Green and yellow vegetables are not available all year round. Fruits are seldom eaten. Fat and oil are not common in cooking and not often available. The available foods and the villager's present diet are not providing an adequate nutritional intake for the villagers. Food supplement is needed. Cowpeas as a cheap source of protein is planned as a food supplement. This leads to the second problem, of how cowpeas could be best used. Cowpeas could be planned to complement existing raw materials or as a replacement for raw materials in commonly eaten dishes and thus cowpea supplemented foods could be accepted by the villagers. Thirdly, although the cowpea supplemented foods could overcome the protein problem, the diet should also be satisfactory for all other important nutrients as well. There are seven important nutritional problems in the Northeast: protein - energy malnutrition, thiamine, riboflavin and vitamin A deficiencies, iron deficiency anemia, iodine deficiency goitre and urinary bladder stone disease. These nutrients in deficiency need to be found in the diet. This made the problem more complicated, as the diet had to be selected from limited nutrient resources and yet had to supply large quantities of the nutrient requirements and retain the acceptability and be at the lowest cost.

This problem is large to be handled by manual or by trial and error methods. It becomes a quantitative problem as firstly it has to optimise the selection of raw materials and cowpeas for the highest protein value within the acceptability levels desired by the villagers and secondly it needs to select a diet to satisfy several nutrient

requirements at the lowest cost. This problem perhaps could best be solved by the use of linear programming because of the wide application of linear programming in selection, formulation and planning of diets. Linear programming has a capacity to handle large problems and this model could be incorporated and modified to meet some of the specific requirements of the problem. The research by Edwardson (1974), Anderson (1975) and Chittaporn (1977) at Massey University have demonstrated the value of linear programming in diet selection for developing countries. Based on this previous work, linear programming was selected as the mathematical basis for the development of cowpea dishes and the menu planning for villagers in Northeastern Thailand.

8. DEVELOPMENT OF COWPEA DISHES

Cowpeas were to be used to supplement the diet of the Northeastern villagers. The cowpea supplemented foods were to be used by housewives and food vendors in the villages. They could be eaten with other foods in every day meals or by themselves in between meals. It was thought that the cowpea supplemented foods should be in the form of food dishes that the housewives and the food vendors could easily cook. The ideal cowpea dishes should be high protein, low cost, easy to prepare, easy to find ingredients for cooking and eaten very often (i.e. popular foods). There were two special features considered during the development of the acceptable cowpea dishes - the nutritional value with special emphasis on protein and the new use of a food raw material, the cowpea. The increase in protein content in the dishes could be formulated by increasing the level of cowpeas in the recipe, but this might not be acceptable to the villagers. The villagers do not very often eat legumes in the dry form, and too much cowpeas in the dishes might lower the acceptability.

Two techniques were used in the development of acceptable cowpea dishes: the product development system for the selection and screening of cowpea dishes and linear programming for the formulation of high protein recipes within the acceptability range.

8.1 CHOICE OF COWPEA VARIETY USED IN THE DEVELOPMENT OF COWPEA DISHES

In Khon Kaen villages, there were two varieties of cowpeas grown by the villagers, the local variety and the red cowpea 6-1 US variety introduced by the Cropping System Project, Khon Kaen University. The local variety has been grown and is known by most villagers and perhaps would also be known and grown by other villages in Northeast Thailand. The red cowpea variety has been recently introduced to five villages in Khon Kaen Province for use in the Multiple Cropping System. Red cowpea 6-1 US was preferred in the cropping system to the local cowpea as it gives slightly better production yield, is earlier maturing and is photo period sensitive. Therefore red cowpea could be used in more crop rotations. Local cowpea is a climbing type, it is therefore not suitable for inter-cropping with cassava or kenaf. It is also takes

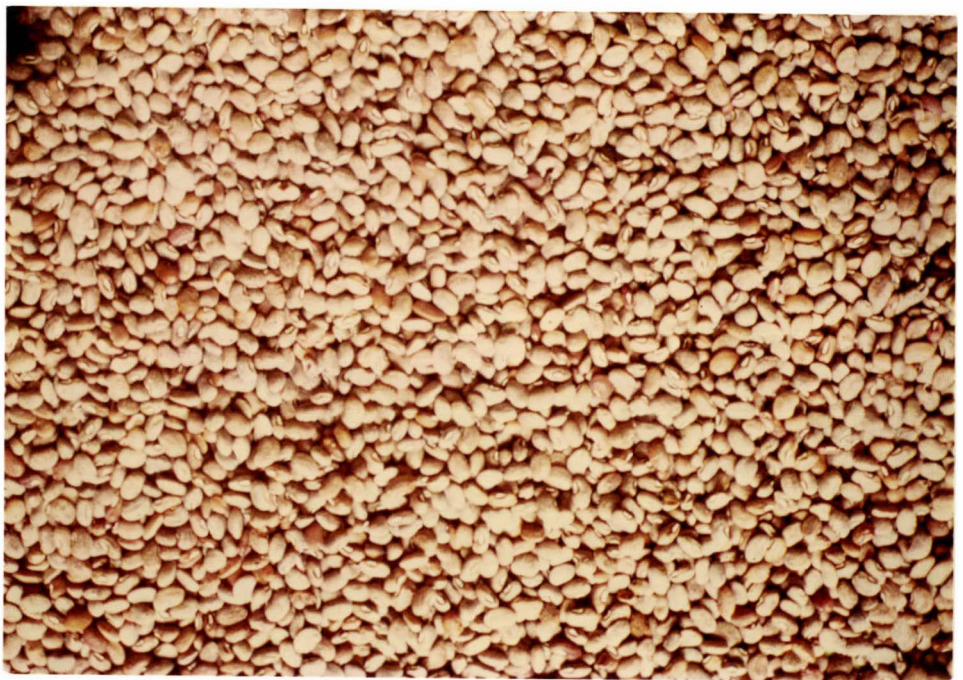
longer to mature than red cowpea and is photo period sensitive. Therefore the red cowpea was the better prospect from the production point of view. But as cowpeas were to be used as a source of protein and for the villagers to eat and cook at home, the nutritional value especially protein content, the cooking and eating quality of local cowpea and red cowpea needed to be compared. Red cowpea is higher in protein content, energy and ash but lower in crude fibre content and trypsin inhibitor activity than local cowpea (Appendix 5). Therefore from the nutritional point of view red cowpea was better than local cowpea it would also give higher protein per unit farm area than local cowpea. Villagers usually eat local cowpeas in the form of immature fresh pods, local cowpea immature pod is more attractive than red cowpea pod, more tender and succulent while the red cowpea pod was small and tougher. Red cowpea seeds are more attractive than local cowpea seeds, as they are in red and glossy while the local cowpea seeds are grey-brown with tiny black spots (Figure 6). Local cowpea seeds are larger in size than red cowpea. Therefore for cooking the whole seed with seed coat, red cowpeas would be preferred and more acceptable than local cowpeas, but if using dehulled seed, both the red cowpeas and local cowpeas would be acceptable. Red cowpea can be cooked quicker than local cowpea as it takes only 30 minutes to boil red cowpea so that 50% of the seeds are split, but it takes 60 minutes to boil local cowpea until 50% of seed are split. Therefore the red cowpea would be preferred by the housewife as she would not need such a long time to cook them, and therefore would save fuel.

Although red cowpea has not been widely introduced to the other villages, it was a better prospect at this stage. It was decided to use red cowpea in the development of cowpea dishes and the nutritionally balanced menu. Various introduced varieties have been tested in production trials at Khon Kaen University and although a few varieties have been successful in the trial productions, they have not been tested widely in the villages. Therefore only red cowpeas were used in this research.

Figure 6: Photographs of the Two Varieties of Cowpea Seeds
(Vigna unguiculata)

A : Red Cowpea 6-1 US

B : Local Cowpeas



8.2 THE SELECTION AND SCREENING OF COWPEA DISHES

Once the aims for the cowpea dishes had been set, then the ideas for cowpea dishes were collected, analysed and screened. Suitable dishes were then developed and tested for their acceptability. The outline of the steps used in selection and screening of cowpea dishes is shown in Figure 7.

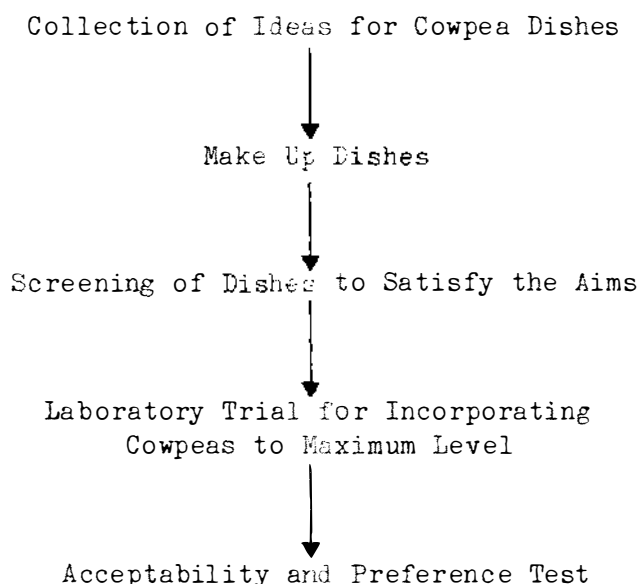


Figure 7: Outline of Selection and Screening of Cowpea Dishes.

Fifty dishes that could be made from cowpeas were collected from local recipes, by brainstorming and from interviewing university workers who lived in the villages. Preliminary cooking trials were conducted to evaluate the suitability for incorporation of cowpeas, and laboratory panels were used to judge the initial acceptability of the dishes with the cowpeas.

Six factors were then used to screen the 50 cowpea dishes. These factors were:

(a) Protein content. The protein content was considered in terms of protein consumed by a person in one serving and in a week. The protein content of each dish was calculated from the main ingredients. The protein content of red cowpea used in the calculation was 24.6%. The serving quantity for one person and frequency of serving in a week was estimated and the protein content per serving and consumption in one week were then calculated.

(b) Cost of ingredients used in the dish. The cost was classified

into: cheap, moderate and expensive.

(c) Cooking. Each dish was evaluated as to whether it was easy, moderate or difficult to cook.

(d) Raw material availability. The ease of obtaining in the village the ingredients of each recipe was rated as easy, moderate or difficult to obtain.

(e) Dish improvement. This was the ease of increasing cowpeas or other ingredients to improve the nutritional value without affecting the eating quality of the dishes.

(f) Suitability of the dish for villagers. Dishes were rated according to their suitability for household and for food vendor uses; for their similarity to village present foods and cooking.

A panel of three persons was used to evaluate each dish according to the 6 factors and they screened the 50 ideas down to 25 ideas.

The recipes for the remaining 25 ideas were then reformulated to increase the level of cowpea in the recipe as much as possible. If cowpea seed was used in the recipe and the level could not be increased, cowpeas in a powder form was added to the recipe. Recipes were also improved for eating quality e.g. more ingredients were added to improve the flavour and texture of the cowpea dishes. The resulting reformulated dish might be less in protein content than the unimproved recipe. The laboratory taste panel was used to judge the acceptability of the cowpea dishes during the reformulation.

Ten village housewives from the University Experimental Farming Village were used for : testing the reformulated cowpea dishes , ranking the dishes according to their preferences , asking opinion on how to improved the cowpea dishes and for suggestions on the dishes that could be eaten more frequently.

8.3 THE SELECTED COWPEA DISHES

The 25 main dishes and the 25 snack foods and desserts are shown in Tables 40 and 41 with their protein contents, serving quantities and frequency of serving.

Table 40: Cowpea Main Dishes - Protein Content, Protein Contribution from Cowpeas, Serving Quantity and Frequency of Serving

Name of Dish	Protein Content %	Protein From Cowpeas %	Serving Quantity g/person	Serving Frequency No. /Week/ Person
1. Cowpea sprout curry (Kang Ped Toa Ngok)	7.2	19	145	1
2. Cowpea curry (Kang Pa Toa Pum)	9.1	38	98	1
3. Fried pork and cowpea ball (Tod Mun Toa)	18.5	40	33	1
4. Cowpea and fermented fish hot sauce (Namprig Plara Toa)	11.3	35	39	14
5. Fried cowpea sprouts (Pad Toa Ngok)	9.8	61	99	2
6. Seasoned minced beef and cowpeas (Larb Nou)	15.7	10	88	3
7. Steamed cowpeas and bamboo shoot (Mog Nor Mai Toa)	6.7	54	68	2
8. Steamed fish, cowpeas and bamboo shoot (Mog Nor Mai Pla)	10.1	36	68	3
9. Seasoned mashed cowpeas (Soop Toa)	6.1	24	63	3
10. Cowpea and fish hot sauce (Pone Pla)	15.9	15	39	2
11. Cowpeas and pumpkin hot soup (Aom Toa Pum)	5.3	34	138	2
12. Fried cowpeas and noodle (Pad Kimao)	8.5	37	390	1
13. Fried rice noodle and cowpeas (Pad Thai)	9.0	41	340	1
14. Bamboo and cowpeas spiced soup (Kang Normai Yanang)	4.6	63	120	1
15. Soybean curd and cowpea sprout (Kangjhud Toa Ngok)	4.5	28	134	1
16. Noodle and cowpea curry (Kheaw teaw kagk)	5.6	27	342	1
17. Fried rice with fermented pork sausage and cowpeas (Kao Pad Sai Krok)	8.9	32	374	1
18. Vermicelli in cowpea curry (Kanom Jeen Namprig)	3.8	12	327	1
19. Salty bamboo shoot and cowpea soup (Kang Palo)	6.4	37	147	1
20. Cowpea and shrimp hot sauce (Namprig Pao)	15.3	31	30	1
21. Fried cowpeas with ginger and pork (Pad Khing Toa Kub Moo)	8.0	61	95	1
22. Fried cowpeas and ginger (Pad Toa Kub Khing)	8.4	83	71	1
23. Cowpeas and pork sausage (Sai Krog Moo)	10.7	33	70	1
24. Steamed cowpea curry (Hao Mog Toa)	11.8	18	93	1
25. Fried bamboo shoot and cowpeas (Pai Normai Toa)	6.3	47	104	1

Table 41: Cowpea Snacks and Desserts - Protein Content,
Protein Contribution from Cowpeas, Serving Quantity and
Frequency of Serving

Name of Dish	Protein Content %	Protein From Cowpeas %	Serving Quantity g/person	Serving Frequency No. /Week/ Person
1. Fried cowpea paste (Kai nog Kata)	5.5	87	75	7
2. Steamed glutinous rice stuffed with cowpeas (Kao Tom Pad)	3.4	35	60	3
3. Fried banana coated with cowpea batter (Kloy Tod)	2.7	25	65	7
4. Fried cowpea crust (Krob Kem)	6.8	35	60	3
5. Cowpea paste coated with egg yolk (Med Kanoon)	4.8	52	60	3
6. Steamed sago stuffed with cowpeas (Sago Sai Toa)	3.8	80	70	4
7. Cowpea and sago pudding (Sago Toa Gang Boid)	2.8	64	130	3
8. Cowpea pudding (Toa Soun)	2.7	80	150	4
9. Cowpeas wrapped in glutinous rice dough (Toa Pab)	5.8	50	120	3
10. Cowpea sweet paste (Toa Pum Guan)	3.1	62	100	1
11. Fried cowpea (Toa Pum Tod)	11.2	90	40	1
12. Wrapped and fried cowpea snack (Fried Pour Pial)	8.5	40	50	1
13. Steamed cowpea custard (Sunkaya toa)	5.0	48	70	1
14. Stuffed cowpea dumpling (Boe Loi Toa)	2.7	39	150	2
15. Cream puff stuffed with cowpeas (cream puff)	6.1	60	40	1
16. Fried chinese ball (Salapao Sai Toa)	5.7	36	80	3
17. Baked cowpea custard (Khanom Moe Kang)	4.2	86	80	1
18. Fried cowpeas stuffed in wheat dough (Pan Sib)	7.2	48	100	1
19. Cowpea pie (Pie Toa)	5.2	43	50	1
20. Cowpea doughnut (Doughnut Toa)	6.9	46	90	2
21. Cowpea stuffed noodle (Kao Taew Lord)	6.3	46	100	2
22. Boiled sweet glutinous rice and cowpeas (Khao Niag Piag)	2.0	62	150	3
23. Fried cowpeas and pork sandwich (Khanom Pung Na Moo)	7.9	38	128	2
24. Roasted cowpeas stuffed in glutinous rice (Kao Niag Ping)	2.3	48	60	4
25. Steamed cowpeas stuffed in glutinous rice flour (Khanom Tein)	2.9	53	60	1

These dishes were evaluated and screened, by a panel of 3 persons (see Appendix 6). Dishes were dropped if they were expensive, difficult to cook, difficult to find ingredients, the recipe could not be improved or was not suitable for the villagers' use or low in protein content. Dishes number 1-14 in the main dish category were kept and dishes numbered 15-25 were dropped. In the snack and dessert category, numbers 1-11 were kept and numbers 12-25 were dropped. This made up the total number of 25 dishes.

The recipes of these 25 cowpea dishes were reformulated. Pumpkin was used to replace bamboo shoot in the main dish recipe number 14 (bamboo shoot and cowpeas spiced soup) and the name of the dish was changed into pumpkin and cowpeas spiced soup. The dishes were then judged by 10 villagers for acceptability and they were ranked according to preference. The protein content and protein contribution by cowpea in each dish and the preference ranking are shown in Tables 42 and 43.

Table 42: Selected Cowpea Main Dishes- Their Protein Content, Protein Contribution from Cowpeas and Preference Ranking

Name of Dish	Protein Content %	Protein Contribution from Cowpeas %	Preference Ranking
1. Seasoned minced beef and cowpeas	15.7	15.8	1
2. Fried pork and cowpea ball	13.8	41.0	3
3. Cowpea and fish hot sauce	8.7	22.7	10
4. Cowpea and fermented fish hot sauce	8.5	34.8	14
5. Fried cowpea sprouts	8.2	70.1	12
6. Fried rice noodle and cowpeas	7.3	47.6	5
7. Fried cowpeas and noodle	6.8	42.6	4
8. Seasoned mashed cowpeas	5.4	71.9	8
9. Cowpea curry	5.1	36.4	11
10. Steamed fish, cowpeas and bamboo shoot	4.9	34.9	7
11. Cowpea sprout curry	4.7	29.4	2
12. Cowpeas and pumpkin hot soup	3.8	33.8	13
13. Steamed cowpeas and bamboo shoot	3.5	63.5	9
14. Pumpkin and cowpeas spiced soup	3.3	79.1	5

Table 43: Selected Cowpea Desserts and Snacks - Their Protein Content, Protein Contribution from Cowpeas and Preference Ranking

Name of Dish	Protein Content %	Protein Contribution From Cowpeas %	Preference Ranking
1. Fried cowpea paste	5.1	86.7	6
2. Steamed glutinous rice stuffed with cowpeas.	4.2	49.2	11
3. Fried banana coated with cowpea batter	3.7	63.0	7
4. Fried cowpea crust	7.5	48.4	5
5. Cowpea paste coated with egg yolk	5.9	53.8	1
6. Steamed sago stuffed with cowpeas	2.8	81.5	8
7. Cowpea and sago pudding	3.4	80.7	4
8. Cowpea pudding	3.6	73.8	2
9. Cowpeas wrapped in glutinous rice dough	7.6	71.9	9
10. Cowpea sweet paste	4.4	71.5	3
11. Fried cowpea	10.3	94.7	10

All of the 25 dishes were accepted by the ten villagers and they suggested some additional main dishes. Two of these main dishes were added to the list because they were commonly eaten. One of these two dishes was seasoned minced fish and cowpeas which was similar to the seasoned minced beef and cowpeas but fish had been used instead of beef. Another one was seasoned grated bamboo shoot and cowpeas, the recipe was similar to steamed cowpeas and bamboo shoot but the dish was boiled instead of steamed. These two dishes were then included in the list of the main dishes. The two noodle dishes - fried cowpeas and noodle, fried rice noodle and cowpeas - although they were ranked high in the preference, were not included in the linear programming because they were less frequently consumed; each one was a complete meal by itself and was not eaten with glutinous rice and was therefore eaten less frequently. The ten villagers did not suggest any additional snacks and desserts. The eleven snacks and desserts in Table 43 were used for further development.

8.4 THE FORMULATION OF COWPEA DISHES BY LINEAR PROGRAMMING

Further formulation research on the 25 cowpea dishes was conducted using linear programming. Linear programming runs were made for each dish; the objective function was protein maximisation. At the same time it was used to calculate the content of 25 nutrients and the cost of each dish. A mathematical programming system - TEMPO on a Burroughs B7700/B6700 computer system was used for computing the linear programming. There were two parts to the linear programming - the organisation of data for the formulation and the running of the TEMPO programme.

8.4.1 Organisation of Data For the Formulation

The following data were collected for input in the TEMPO programme: recipe acceptability and ingredients, cost of ingredients, the 26 nutrient composition of each ingredient used in the recipe.

Recipes: It was important that limits on ingredients used in the recipe be set for the selection of the maximum protein content recipe. The lower limit was set to ensure that the ingredient would be included in the recipe at least at the minimum level. The maximum level of all ingredients was set to prevent the selection of excess quantities of high protein ingredients. Therefore the lower and upper limits were set in the range that would produce an acceptable recipe. These limits were obtained by cooking experiments. The weight of ingredients used in the recipe was presented as the weight of edible portion and the total weight of the recipe, not including water, equalled 100 g. Recipes and the limits of ingredients are presented in Appendix 6 (Table 6.2).. List of food raw materials used in the formulation of cowpea dishes is shown in Appendix 7 .

Cost: Costs of ingredients purchased in Khon Kaen market in 1978 were used for the calculation of cost per 100 g edible portion. The percentage of edible portion of raw materials used in the calculation was obtained from FAO (1972) food composition tables and from actual measurement. Costs of ingredients are shown in Appendix 18.

Nutrients: the 26 nutrient composition of a 100 g edible portion of each ingredient used in the recipes was required. The 26 nutrients and their units were: energy (kcal), digestible protein (g), fat (g), dietary fibre (g), calcium (mg), phosphorus (mg), iron (mg), vitamin C

(mg), vitamin A (IU), thiamine (mg), riboflavin (mg), niacin (mg), vitamin B6 (mg), vitamin B12 (mg), pantothenic acid (mg), folic acid (mg) and ten essential amino acids: isoleucine, leucine, lysine, methionine, cysteine, phenylalanine, tyrosine, threonine, tryptophane and valine in mg. They are presented in Appendix 18. The digestible protein was calculated by multiplying the total protein with a correction factor - the coefficient of protein digestibility. The coefficient of protein digestibility of the Atwater System (FAO/WHO, 1973) was used in which the coefficient of digestibility of egg and meat products was 97%, fruit 85%, legumes 78%, vegetables 65-74%, cereals 84-98%. Most of the data for dietary fibre content in food ingredients was obtained from Paul and Southgate (1978). The dietary fibre in the uncommon vegetables used in the recipes were estimated and the crude fibre contents of similar vegetables were used as the basis for the estimation. Most of the energy, protein, fat, mineral and vitamin data were obtained from FAO (1972), the amino acids from FAO (1970). The nutrients and amino acid contents of the ingredients that could not be found in FAO (1972) and FAO (1970) were obtained from Paul and Southgate (1978) and Division of Nutrition (1970). Folic acid content of some vegetables was obtained from data of Kumazawa et al (1974).

8.4.2 TEMPO Input Data Preparation (Burroughs Corporation, 1975)

Input data for TEMPO is divided into five sections: ROWS, COLUMNS, RHS, RANGES and BOUNDS. Input data is prepared in the following manner:

- (a) ROWS: The ROWS section names each row and indicates whether the row activity is to be less than (L), greater than (G), or equal to (E) the right hand side element.

The activity is

$$\sum_j A_{ij} X_j$$

Objective rows are defined as non computation rows (N).

- (b) COLUMNS: The COLUMNS section names each column and indicates the nonzero elements of the matrix.
- (c) RHS: The RHS section names the right hand side(s) and indicates the nonzero elements of the matrix.
- (d) RANGES: The RANGES section specifies the difference of the upper and lower limits of the row activity.
- (e) BOUNDS: The BOUNDS section specifies upper and lower column bounds.

The input data for the protein maximisation formulation of the cowpea recipes was prepared on cards for the computer to read and process. Nutrients, costs and weights were put in the ROW section, food ingredients in COLUMNS and ingredient limits in the BOUNDS section. RHS section was needed for the problem constraints and for TEMPO to set up the problem. RHS of energy, weight and cost were set in this problem. Name of nutrients and ingredients punched on cards in the ROWS and COLUMNS sections were an abbreviation of the alphabetic letters, not more than 8 letters. The data cards for nutrients and weights of the ingredients were punched in the following form:

COWPEASD	CAL	321
COWPEASD	PROT	19.20
.		
COWPEASD	COST	0.40
COWPEASD	WT	1.0

COWPEASD = cowpea seed, CAL = energy, PROT = protein

WT = weight, unit weight = 100 g

The recipe was prepared in the BOUNDS section with upper and lower limit ranges of each ingredient.

8.4.3 The Problem Solution

For TEMPO to develop a problem solution, two input files are necessary.

- (a) CARD: This file contains the control program.
- (b) CARDIN This file contains the problem data.

The control program was set as follows:

```
ZNAME      = "COWPEA 7"
ZDATA      = "COWPEA 7"
INPUT
BCDOUT
ZOBJ       = "PROT"
ZRHS       = "RHS1"
ZBNDST     = "BNDST"
SETUP(MAX)
PRIMAL
OUTPUT
EXIT
```

The TEMPO procedure - PRIMAL - used the revised simplex method and product form of the inverse to obtain the optimal solution to the Linear Programming problem. The 25 protein maximised recipe problems were optimised.

Incremental reduction in cost was also made for each dish to provide alternative lower protein recipes. This was done by using the POST OPTIMAL ANALYSIS - PARRHS - of the TEMPO procedure. PARRHS procedure performs parametric programming on the right hand side. PARRHS is used post-optimally to examine a series of related problems by replacing the original right hand side (cost) by the right hand side plus a multiple of the change column. The multiple is the parameter Z PARAM. Each value of the parameter defines a different problem. PARRHS determines a series of solutions by increasing Z PARAM from zero to a specified maximum. A cost parameter was set at a 0.2 interval and the maximum at 1.0. That is the cost in the original right hand side was reduced by a unit of 0.2 multiply the original cost. If the solution could not be obtained within the 0.2 interval of parameter, then the parameter was changed to 0.1 interval instead of 0.2.

8.5 THE EVALUATION OF THE COMPUTERISED RECIPES

The protein content, the cost, the form and quantity of cowpeas used in the protein maximised recipes of the 25 recipes are shown in Tables 44 and 45. The 26 nutrients and recipes of the protein maximised cowpea dishes obtained from the linear programming are shown in Appendix 8 and the post optimal analysis are shown in Appendix 20. The cowpeas used in the 25 recipes were in 6 forms as follows; whole seed, young pod, dehulled seed, sprout, powder (roasted and ground) and flour.

Table 44: Cowpea Main Dishes - Protein Content, Cost, Form and Quantity of Cowpeas Used in the Protein Maximised Recipes

Name of Dish	Protein Content %	Cost/ 100g Bahts	Form of Cowpeas	Quantity of Cowpeas Used in Recipe (g/100g (ingredient))
Seasoned minced fish and cowpeas	14.68	4.47	Powder* and whole seed	8.1,4.1
Seasoned minced beef and cowpeas	14.01	2.38	Powder and whole seed	8.1,4.1
Fried pork and cowpea ball	10.91	1.39	Whole seed	26.1
Cowpea and fish hot sauce	9.13	1.54	Powder	9.7
Cowpea and fermented fish hot sauce	8.49	0.95	Powder	14.7
Cowpea sprout curry	5.86	1.13	Sprout	25.0
Fried cowpea sprouts	5.27	0.55	Sprout	70.0
Steamed fish, cowpeas and bamboo shoot	5.18	1.06	Whole Seed	8.3
Cowpea curry	5.00	0.64	Whole seed and pod	7.3,6.9
Seasoned mashed cowpeas	4.88	0.67	Pod,powder,whole seed	60.1,5.4,4.8
Seasoned grated bamboo shoot and cowpeas	4.18	0.79	Whole seed	10.3
Steamed cowpeas and bamboo shoot	3.72	0.62	Whole seed	10.3
Pumpkin and cowpeas spiced soup	3.68	0.28	Whole seed and powder	12.7,1.7
Cowpeas and pumpkin hot soup	3.57	0.71	Whole seed	5.8

* Cowpea powder was made by roasting the bean and grinding the powder.

Table 45: Cowpea Desserts and Snacks - Protein Content, Cost, Form and Quantity of Cowpeas Used in the Protein Maximised Recipes

Name of Dish	Protein Content %	Cost/ 100g Bahts	Form of Cowpeas	Quantity of Cowpeas Used in Recipe (g/100g (ingredient))
Fried cowpea	8.71	0.52	Dehulled seed	28.5
Cowpea paste coated with egg yolk	6.97	0.81	Dehulled seed	10.3
Fried cowpea crust	6.78	0.75	Flour*	16.3
Cowpeas wrapped in glutinous rice dough	6.08	0.95	Dehulled seed	11.4
Steamed glutinous rice stuffed with cowpeas	5.46	0.59	Whole seed	13.1
Cowpea sweet paste	4.91	0.82	Dehulled seed	5.9
Fried cowpea paste	4.43	1.03	Dehulled seed	13.0
Cowpea and sago pudding	3.76	0.43	Whole seed	13.2
Fried banana coated with cowpea batter	3.72	0.62	flour	11.4
Steamed sago stuffed with cowpeas	3.18	0.94	Dehulled seed	8.1
Cowpea pudding	2.91	0.39	Dehulled seed	6.6

* Cowpea flour was made by roasting the bean in low heat for 15 mins., roughly grinding and separating the hull by hand winnowing, then grinding the dehulled seed with stone mortar into fine powder and sieving through 80-100 mesh sieve.

The computerised recipes of maximum protein were tested for acceptability. Ten Northeastern panelists were asked to judge the acceptability of each dish on a 7-point hedonic scale and to comment on palatability. Where improvement in palatability was considered necessary, the comments from the taste panel were used to select more acceptable, recipes from the parametric cost formulation. These recipes were then readjusted if there was any improvement in palatability needed. The 26 nutrients were then recalculated for the readjusted recipes. The acceptability of the protein maximised recipes judged by a 10 member Northeastern taste panel is shown in Table 46.

Table 46: The Acceptability of the Protein Maximised Cowpea Recipes
(Mean Scores of 10 Member Taste Panel of Villagers)

Name of Dish	Acceptability Score*	Name of Dish	Acceptability Score*
<u>Main Dishes</u>		<u>Snacks and Desserts</u>	
Seasoned minced fish and cowpeas	5.7	Fried cowpeas	4.6
Seasoned minced beef and cowpeas	5.7	Cowpea paste coated with egg yolk	5.8
Fried pork and cowpea ball	4.8	Fried cowpea crust	5.9
Cowpea and fish hot sauce	5.9	Cowpeas wrapped in glutinous rice dough	5.2
Cowpea and fermented fish hot sauce	5.5	Steamed glutinous rice stuffed with cowpeas	5.4
Cowpea sprout curry	5.0	Cowpea sweet paste	5.7
Fried cowpea sprouts	4.2	Fried cowpea paste	5.2
Steamed fish, cowpeas and bamboo shoot	4.6	Cowpea and sago pudding	5.0
Cowpea curry	4.8	Fried banana coated with cowpea batter	5.8
Seasoned mashed cowpeas	4.2	Steamed sago stuffed with cowpeas	4.5
Seasoned grated bamboo shoot and cowpeas	4.0	Cowpea pudding	5.4
Steamed cowpeas and bamboo shoot	4.3		
Pumpkin and cowpeas spiced soup	4.8		
Cowpeas and pumpkin hot soup	5.4		

* hedonic score (7 = like very much, 1 = dislike very much)

One dish of the 25 dishes was less acceptable. This dish was "seasoned grated bamboo shoot and cowpeas" as the dish was too thick, more water needed to be added. The taste panel also commented on two dishes - "steamed fish cowpeas and bamboo shoot and "steamed cowpeas and bamboo shoot". There was too much shallot, galangal and lemon grass. The recipes of these two dishes from the post optimal analysis had less shallot, galangal and lemon grass, and so they then were chosen to replace the protein maximised recipes. The taste, panel recommended a more sour taste for "seasoned mince beef and cowpeas"; more water needed to be added to "seasoned minced fish and cowpeas"; and to "fried pork and cowpea ball" in the main dishes.

For the snacks and desserts, the taste panel recommended a reduction in the quantity of shallot in the recipes and that more water be added to "cowpea and sago pudding" and "cowpea pudding". It was

also noticed during the cooking that more water needed to be added in the recipes of "cowpea paste coated with egg yolk", "steamed glutinous rice stuffed with cowpeas" and "cowpea sweet paste" as water evaporated out during the cooking. More oil was absorbed during the frying of "fried banana coated with cowpea batter". The recipes of these dishes were readjusted and the nutrient contents and costs then recalculated and they are presented in Appendix 8.

The developed cowpea dishes were finally prepared for the housewives and food vendors. A recipe book was prepared (Home Processed Legume Project (Thailand) ,1981 Appendix 17). The recipes were prepared for a 5-6 person serving quantity. Pictures of these 25 cowpea dishes are shown in Figure 8. The ingredients used in recipes were in two units: weight in g and Thai village measures. The analyses of protein, crude fibre, fat, ash and energy content were made for each dish and presented in the recipe book. It was also suggested that other legumes such as mungbeans, blackbeans and local cowpeas could be used in these cowpea recipes.

1. Cowpea Curry
(Kang Ped Toa Pum)
2. Cowpea Sprout Curry
(Kang Ped Toa Ngok)
3. Pumpkin and Cowpeas Spice Soup
(Kang Fugtong Toa)
4. Cowpeas and Pumpkin Hot Soup
(Aom Toa Pum)
5. Seasoned Mashed Cowpeas
(Soop Toa)
6. Seasoned Grated Bamboo Shoot
and Cowpeas
(Soop Nor Mai)
7. Fried Pork
and Cowpea Ball
(Tod Mun Toa)

Figure 8: Photographs of the 25 Cowpea Dishes



Figure 8 (Cont.)

8. Cowpea and Fermented Fish Hot Sauce
(Namprig Plara Toa)

9. Cowpea and Fish Hot Sauce
(Pone Pla)

10. Fried Cowpea Sprouts
(Pad Toa Ngok)

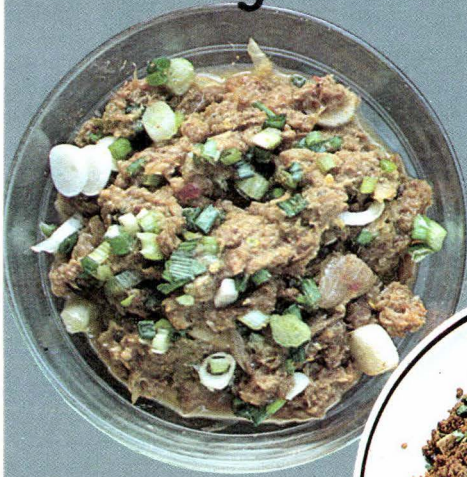
11. Seasoned Minced Beef and Cowpeas
(Larb Nou)

12. Seasoned Minced Fish
and Cowpeas
(Larb Pla)

13. Steamed Cowpeas
and Bamboo Shoot
(Mog Nor Mai Toa)



9



8



10

11



12



13



Figure 8 (Cont.)

14. Steamed Fish, Cowpeas
and Bamboo Shoot
(Mog Nor Mai Pla)

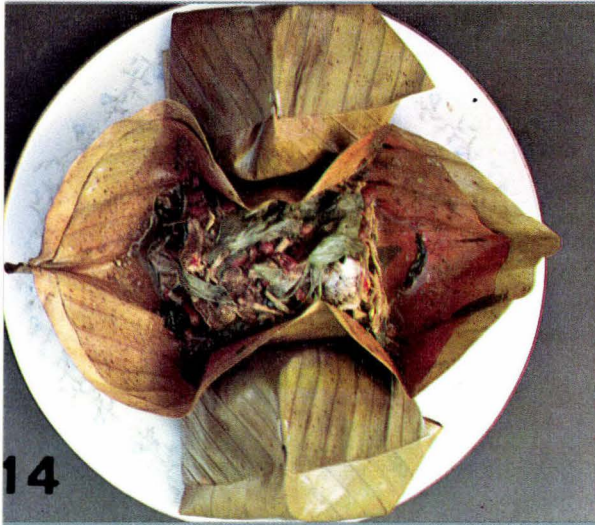
15. Fried Cowpea Crust
(Krob Kem)

16. Fried Banana Coated
with Cowpea Batter
(Kloy Tod)

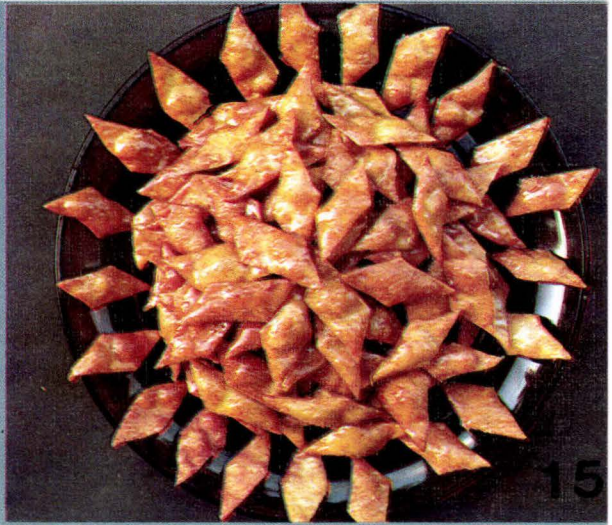
17. Steamed Glutinous Rice
Stuffed with Cowpeas
(Kao Tom Pad)

18. Fried Cowpea Paste
(Kai Nog Kata)

19. Cowpea Pudding
(Toa Soun)



14



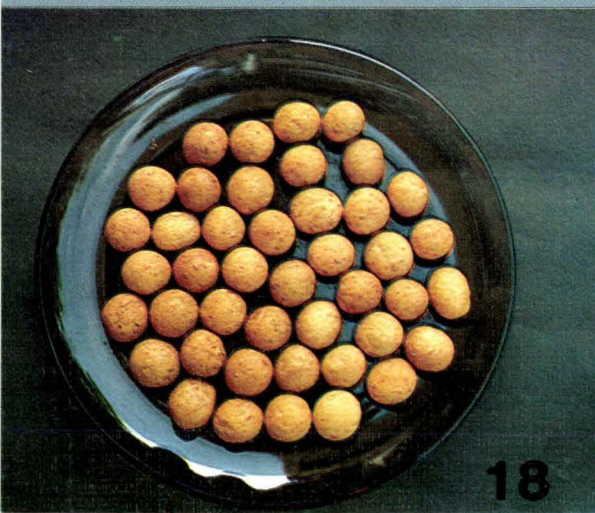
15



16



17



18



19

Figure 8 (Cont.)

20. Cowpeas Wrapped in
Glutinous Rice Dough
(Toa Pab)

21. Cowpea Sweet Paste
(Toa Pum Guan)

22. Fried Cowpea
(Toa Pum Tod)

23. Cowpea Paste Coated
with Egg Yolk
(Med Kanoon)

24. Cowpea and Sago Pudding
(Sago Toa Gang Boid)

25. Steamed Sago Stuffed
with Cowpeas
(Sago Sai Toa)



21



22



23



24



9. MENU PLANNING BY LINEAR PROGRAMMING

The cowpea dishes developed for maximised protein content were planned to increase the protein in the diet of the Northeastern villagers. These high protein supplementary cowpea dishes may not provide by themselves the necessary nutrients for the daily requirements. Commonly eaten foods were then selected so that, when consumed together with the cowpea supplemented dishes, they should provide adequate nutrients. This selection of commonly eaten foods and the cowpea dishes for daily consumption led to the development of menu planning, in which the menu was designed to provide adequate daily nutrients at the lowest cost and at the same time to retain the acceptability of the food and the menu. A planning of such a menu was achieved by using linear programming and mixed integer programming.

There were other important factors which needed to be considered and then incorporated in the linear programming. These factors were: For whom should the menu be planned? How would it be planned to provide the most suitable menu for the Thai villagers? What were the nutrients and their requirements? What kinds of foods should be selected? How can the menu be made acceptable? These factors were quantified, if possible, and included in the model. It was also important that the planned menu be tested for suitability and acceptability.

9.1 FACTORS FOR CONSIDERATION

9.1.1 The Consumer

It had been decided that the menu should be planned for the whole family rather than for an individual. In the Northeastern village, the whole family eat together. It had been also shown that the diet of the Northeastern family was inadequate in the nutrients supplied. It was then assumed that all members of the family needed adequate nutrient supplement. The "average" number of people in a village household was used as a basis for the planning. From the survey of food eating habits of 100 households in 10 villages, Khon Kaen Province in 1978, it was found that there were on average 6.63 persons in a household with

an average household composition as shown in Table 47. The rounded up number of 7 was used for the number of persons in a family and the composition of a family was designed as shown in Table 48.

Table 47: An Average Household Composition of 10 Villages, Khon Kaen Province

Age	Male	Female
(Number of Persons Per Household)		
>15	1.85	1.94
5-15	1.02	0.97
1-5	0.35	0.36
<1	0.09	0.05

Table 48: Composition of Family for Designing a Menu

No. of Persons	Age
1 Child	1-3
1 Boy	10-12
1 Girl	10-12
2 Men	20-30, 40-49
2 Women	20-30, 40-49

This "designed family" was then used for the calculation of nutrient requirements and quantity of food planned in the menu. It should be noted at this stage that the planning was based on the average number in families in 10 villages in Khon Kaen Province and it was assumed that this figure would also represent the whole Northeastern region or would be close to the true figure. The menu was planned for the whole region. Adjustment would need to be made for a larger or smaller family or for a family containing a pregnant or lactating women.

9.1.2 The Meal Pattern

From the survey of eating habits in the 10 villages in Khon Kaen Province, it was found that the villagers ate three meals a day - breakfast, lunch and dinner. Eating between meals was not a common practice. Food eaten in the main meal can be divided into 6 different categories: glutinous rice, dry main dish (e.g. fried, roast, salad), liquid main dish (e.g. soup), sauces, vegetables eaten with sauce or main dish, fruit, desserts and snacks. It was noted from the survey that glutinous rice and vegetables were eaten in each meal but dry main dishes, liquid main dishes and sauces were not eaten at each meal. The average number of times a household ate food in the different categories are shown in Table 49.

Table 49: The Number of Times a Family Eats Different Categories of Food in Different Meals - "A Survey Pattern"
(Total Number of 100 Households Interviewed)

	Breakfast	Lunch	Dinner	Total/Day
(Average Number of Times per Family)				
Glutinous rice	0.98	0.95	0.94	2.87
Dry main dishes	0.67	1.03	0.67	2.37
Liquid main dishes	0.42	0.33	0.49	1.24
Sauces	0.75	0.47	0.75	1.97
Vegetables eaten with sauce or main dishes	1.04	1.10	1.05	3.19
Fruits	0.26	0.22	0.32	0.80
Desserts and snacks	0.09	0.11	0.03	0.23

From the survey results, it would be more appropriate if the menu was planned for a whole day instead of an individual meal. In a day, it was planned that glutinous rice be eaten 3 times with 2 kinds of dry main dish, 2 kinds of liquid main dish, 2 kinds of sauces and 3 kinds of vegetables. At least one kind of fruit should be included. Although desserts and snacks were eaten less, they should be included in the menu. This would increase the quantity of food eaten and thus supply more nutrients, especially if the desserts and snacks are supplemented with cowpeas. If desserts and snacks were not commonly

eaten in the main meal, they could be eaten in-between meals.

This planning of food for a whole day would not only represent the food eating pattern of the Northeastern villagers but would also give a flexibility for the villagers to choose what food they would like to eat in different meals and which are convenient to cook. Food left from one meal could be eaten in another meal of the same day. Food wastage would not only be uneconomic but it would also mean that the nutrient intakes would not be at the levels planned.

9.1.3 The Nutrient Requirements

Three considerations were needed before the nutrient requirement constraints were put in the linear programming model. They were: the planning period for the nutrient requirements, the type of nutrients required in the model and their recommended quantities.

It was reported that the efficiency of nitrogen utilization, or the quantity of the dietary protein needed is influenced by the frequency of meals with which it is consumed (Levielle, 1974; Ozelei et al., 1977). This meant that a menu should be planned in such a way that the protein content of the food should be distributed throughout the meals and preferably also in between meals. This could be achieved by planning each separate meal to meet the specific protein and other nutrient requirements. Such planning was not possible in the case of the Northeastern meal pattern, in which each food category is not eaten in every meal. Planning separate meals would also not be economical, as these would be excess quantity of food planned for each meal so that the scarce nutrients meet the minimum requirements. Less excess of food would result if the menu was planned for a whole day and met the daily requirements. There would also not be a need for a balanced diet for each meal and therefore there would not need to be an excess quantity of food for each meal.

Planning a weekly menu to meet the nutrient requirements for the entire week would be even more economical. But it would not guarantee that a person would eat all the food as planned. If he or she had missed a meal or a particular food high in certain nutrients, then he or she would not receive adequate nutrients for the entire week. Therefore it was wise to plan a daily menu and meet all the nutrient requirements for a day.

Twenty six nutrients were selected for inclusion in the Linear Programming. These were protein, energy, fat, dietary fibre, calcium, phosphorous, iron, vitamin A, vitamin C, thiamine, riboflavin, niacin, vitamin B6, vitamin B12, pantothenic acid, folic acid, and 10 essential amino acids. Protein, energy, vitamin A, thiamine, riboflavin and iron were the important nutrients reported to be deficient in the Northeastern diet. Fat was included because the present Northeastern diet was low in fat content. Calcium and phosphorus are related to the bladder stone disease and their ratio in the diet was significant. The other water soluble vitamins - niacin, vitamin B6, pantothenic acid, folic acid and vitamin C - were also considered as they are essential in the diet and needed for physiological functions. Dietary fibre was included as the Northeastern diet consisted of large quantities of vegetable and native leaves; excessive quantity consumed may cause nutritional failure so limits were included on dietary fibre. The 10 essential amino acids were included to give the standard for the protein quality. It was also reported elsewhere that proteins from food legumes are low in methionine and the menu had to be designed to counteract this and give a balanced protein intake. Although there was a report of goitre-iodine epidemic in the Northeast, iodine was not considered as it would not be present in the local food raw material. Iodine could be obtained from fortified salt, which would be recommended that villagers use.

The daily requirements of the 26 nutrients for a family of 7 persons were planned and are explained in Appendix 9. The nutrients in relationship with other nutrients were considered and their limitation requirements were set, these are shown in Table 50. The level of each nutrient requirement input in the linear programming model was the sum of the nutrient requirements for each individual member of the family and are shown in Table 51. Protein and energy requirements were set at the minimum level, and their requirement relationship was specified and set at the minimum level. Fat requirement was expressed as a relationship to the energy requirement and was set at minimum and maximum levels. Dietary fibre and Vitamin A were planned at two levels, the minimum and maximum requirement. Calcium requirement was set at both minimum and maximum level. Phosphorus requirement were set only at minimum requirement and at the same level as calcium. Calcium-phosphorus ratio was also specified. Iron requirement was set at the minimum level. Vitamin A requirement was set at minimum and

maximum level. Thiamine, riboflavin and niacin requirements were set at minimum requirements and the relationship to the total energy intake were also specified. The other vitamin requirements were set at a minimum level. A minimum requirement of 10 essential amino acids were set at the level of 80% of the FAO/WHO (1973) amino acid pattern.

Table 50: The Nutrients in Relationship with Other Nutrients and Their Limitation Requirements

Nutrient	Relationship with other nutrients	Unit of Relationship	Limitation Requirement
Protein	Energy	Energy from protein as % of total energy	Greater than 10%
Fat	Energy	Energy from fat as % of total energy	Greater than 20% Lower than 35%
Calcium	Phosphorus	Calcium:Phosphorus ratio	One to one
Thiamine	Energy	mg/1000 kcal	Greater than 0.4
Riboflavin	Energy	mg/1000 kcal	Greater than 0.55
Niacin	Energy	mg/1000 kcal	Greater than 6.6
Isoleucine	Protein	mg/g protein	Greater than 32
Leucine	Protein	mg/g protein	Greater than 56
Lysine	Protein	mg/g protein	Greater than 44
Methione & cystine	Protein	mg/g protein	Greater than 28
Phenylalanine & tyrosine	Protein	mg/g protein	Greater than 48
Threonine	Protein	mg/g protein	Greater than 32
Tryptophane	Protein	mg/g protein	Greater than 8
Valine	Protein	mg/g protein	Greater than 40

Table 51: Nutritional Constraints and Limitation of Requirements for a Family of Seven Persons for One Day

NUTRIENT	REQUIREMENT	
	Lower Limit	Upper Limit
Energy (kcal)	15,580	-
Digestible protein (g)	283	-
Dietary fibre (g)	98	243
Calcium (mg)	3,400	10,500
Phosphorus (mg)	3,400	-
Iron (mg)	98.28	-
Vitamin C (mg)	300	-
Vitamin A (IU)	14,650	-
Thiamine (mg)	6.23	-
Riboflavin (mg)	8.57	-
Niacin (mg)	102.83	-
Vitamin B6 (mg)	11.4	-
Vitamin B12 (μ g)	12.9	-
Pantothenic acid (mg)	47	-
Folic acid (μ g)	1,100	-

9.1.4 Acceptability of the Menu

Menu acceptability could be tested after the menu had been completely planned but it was decided that it would be better if it was considered at the initial stages of planning. Acceptability could be incorporated in the linear programming model in many ways as has been already reviewed in section 7.2.3.

In the case of planning the menu for the Northeastern villagers, the menu was to be planned for a whole day and the meal pattern was not very complex as all the dishes could be eaten with glutinous rice and the vegetables could also be eaten with sauces and with the main dishes. For example, if in the menu no vegetable was selected, then sauce could still be eaten with glutineous rice (a common practice in Northeastern villages); but vegetables could not be eaten alone with glutineous rice unless they were cooked into dishes or they were eaten with the main dishes. Although there might be some particular preference to eat a certain kind of food with the other foods, this kind of preference was not the same for all the Northeast, it varied from village to village and from area to area. When a diet was planned

for the whole Northeastern population, a study of food dish compatibility would be difficult and would not be justified for the entire population, although it might improve the acceptability of the diet planned in some areas. Therefore food compatibility was not included. As all the food dishes, fruits and vegetables selected for the menu were commonly eaten and the recipes of the food dishes were acceptable and they were selected in the menu according to the menu pattern, then the planned menu would be presumed to be compatible and acceptable. Therefore acceptability was incorporated in the menu planning with linear programming by firstly selecting the commonly eaten foods and raw materials, secondly formulating acceptable recipes, thirdly planning the menu in the Northeastern style daily eating pattern and finally testing the acceptability of the planned menu.

9.1.5 Food Input for Linear Programming

There were 4 alternative ways in which foods could be input into the linear programming model for the selection of a Northeastern diet.

Firstly, all of the food raw materials could be input and be selected on the basis of nutritional requirements and lowest cost but under this system, there was no guarantee that the selected raw materials would combine to make acceptable food dishes and make up the usual eating pattern.

Secondly, all of the food dishes, fruits and vegetables eaten in the Northeast could be input, this would eliminate the possibility of being unable to make the selected raw materials into acceptable food dishes. But this could result in the selection of unpopular dishes or a popular dish rarely eaten or incompatible dishes at the same meal.

Thirdly, the most popular dishes, fruits and vegetables commonly eaten in the Northeast could be input and information provided on the relative preferences for each dish and the acceptability of various dishes in combination at the same meal. Since the dishes, fruits and vegetables which were being consumed everyday were not providing an adequate nutritional intake for the villagers, it was unlikely that the linear programming would be able to select a better combination of dishes to meet adequately the nutrient requirements in the quantities of the foods normally consumed.

Fourthly, the high protein cowpea dishes could be input to supplement the most popular dishes, fruits and vegetables and the

recipes of the most popular dishes could be protein maximised. All of the 25 protein maximised cowpea dishes could be input to the linear programming model as they are already accepted by the villagers. The most popular common dishes were developed in the same way as the cowpea dishes in the protein maximised recipes and tested for their acceptability with the villagers. This provided a better basis for selection as the commonly eaten dishes had an improved nutritional composition and the high protein cowpea dishes could be selected to supplement the common dishes.

This last approach was then used as a basis for selecting food dishes, vegetables and fruits to input in the linear programming.

Thirty one food dishes (13 dry main dishes, 12 liquid main dishes, and 6 sauces), 29 vegetables and 6 fruits were selected from the lists of food normally eaten by 100 households in the three seasons - rainy, cool and hot obtained from the survey. Dessert dishes were not selected as they were rarely eaten. In the menu planning it was intended that one dessert should be included in the menu and be selected from the cowpea dishes. From the survey results it was found that villagers commonly boiled legumes in syrup as a dessert dish. The common legume used is blackbean. Cowpea could be used instead of blackbean. Therefore one dessert dish, cowpea boiled in syrup was added to the cowpea desserts and snacks developed in section 8.4. This made 26 cowpea dishes to be input in the linear programming model with the other commonly eaten foods. Total foods to be selected were 92 food items and steamed glutinous rice (Appendix 7).

9.1.6 Consumption Quantity

The quantity of total food planned for a daily menu was important; if there was too large a quantity of food, it was likely that not all food would be consumed. This was not only an economic loss but it also meant that most of the nutrients would be less than planned, resulting in inadequate intake of nutrients. If the quantity was too small, although it would insure that all of the food was consumed, the volume of food intake would be too small so that the family would feel that they had not eaten enough food, and might refuse to follow the menu.

Different kinds of food were also eaten in different quantities. Some foods could be eaten in a quantity larger than normally eaten but some could not. The quantity of such food dishes, vegetables and

fruits eaten by a family in a meal and the total quantity consumed in a day had to be determined and limits set up. Only the maximum limits for the quantities of specific foods could be used in the linear programming model. In TEMPO, if lower limits were set for any food item, that food item would always be selected.

9.2 DATA COLLECTION

Data on the 26 nutrient compositions, costs and consumption quantities for the 51 food dishes, 29 vegetables and 6 fruits and total food consumption for a family in one day were put into the linear programming model.

9.2.1 Nutrient Composition

Data on the 26 nutrient compositions of the 25 cowpea dishes were obtained from section 8.4 of the protein maximised recipes (Appendix 8) and the composition of "cowpeas boiled in syrup" by calculation. The nutrient composition of 29 vegetables and 6 fruits were obtained the same way as the food ingredients used in the cowpea dishes (Appendix 18). Cooking losses of nutrients were not considered in this linear programming planning. The 26 nutrient compositions of the 22 commonly eaten dishes needed to be calculated. It was decided to use the computer for the calculation and at the same time to formulate the protein maximised recipes for the highest protein in the recipe. In these 31 dishes, there were 9 dishes in which one raw material was fried or steamed or roasted, e.g. roasted frog. There remained 22 dishes to be formulated. The recipes for these 22 dishes were collected from the Northeastern housewives. The acceptable minimum and maximum range of ingredients in each recipe was determined in the cooking laboratory. Then each of the 22 recipes was put into the linear programming model to maximise the protein content and to calculate the levels of the other 25 nutrients in the same way as in the protein maximisation of the cowpea dishes described in section 8.4. The recipes, cost and the 26 nutrients composition of these 22 protein maximised common dishes and those of the 9 dishes obtained from calculation are shown in Appendix 8.

9.2.2 Cost

Cost of the 22 commonly eaten food dishes and the 25 cowpea dishes were obtained from the linear programming calculation of the protein maximised dishes. Cost of the other 9 common dishes and the "boiled cowpea in syrup" were calculated from the cost of raw materials used and cost of cowpeas. Cost of raw materials were the Khon Kaen market prices in 1978 and were converted into cost per 100 g of edible raw portion. Khon Kaen market prices were also used for the cost of steamed glutinous rice. Although most of the villagers grow their own glutinous rice and some of the raw material could be obtained at no cost, the objective of the menu planning by linear programming was to select the diet at the lowest cost, so it was therefore decided that cost should be put in for every food raw material using the same price standard, the Khon Kaen market price. Cost of the food dishes are shown in Appendix 8 and cost of steamed glutinous rice, vegetables and fruits are shown in Appendix 18.

9.2.3 The Consumption Quantity

The quantities to be met by the linear programming were set for total food, each dish and each category of food.

The actual quantity of food consumed in a day by one adult man and one adult woman and one girl, aged 26, 21 and 12 years respectively, were measured in the normal household meal situation. The foods consumed were glutinous rice, two dry main dishes, one liquid main dish, two sauces, 6 vegetables and two fruits. Also four adult men and women were asked to estimate the quantity of food they could eat by visually examining the prepared dishes, glutinous rice etc. The results are shown in Table 52.

Table 52: Total Food Consumption per Day of Adult Man, Woman and Child

	ACTUAL CONSUMPTION			ESTIMATED CONSUMPTION		MEAN CONSUMPTION	
	Girl	Man	Woman	Man	Woman	Man	Woman
	(g/day)						
Breakfast	362	608	618	500	387	554	503
Lunch	490	593	548	697	502	645	525
Dinner	540	691	639	862	700	777	670
TOTAL	1399	1872	1805	2059	1589	1976	1698

It was found from Table 52 that on average a woman consumed about 0.85 and a girl about 0.70 of a man's portion. It was then estimated that children aged 1-3 would consume about 0.5 of a man's portion. Based on these estimations it was found that a family of 7 persons of different ages and sex would consume about 5.6 times the portion of one adult man.

In the case of children and women, when food was to be consumed as a family, they might not obtain adequate nutrients as required as they would eat smaller amounts than the adult man. It was assumed that the children and women should eat more of the high nutrient or concentrated food. Therefore to allow enough high nutrient food the maximum limit of food consumption by a family was increased to 7.0 times the quantity required by one adult man.

The quantities of the 57 food dishes, including cowpea dishes, 29 vegetables and 6 fruits, eaten by an adult man were estimated and the quantity estimate of each food was then set at 7 times for the maximum limit of consumption for a family as shown in Appendix 11. This increased quantity also allowed for the weight loss during cooking. The input data of cost and nutrients of each dish were based on linear programming calculation of the raw materials in the protein maximised recipes instead of the final cooked weight but the quantity for each dish consumed by an adult man was determined on the cooked dish.

The quantity of steamed glutinous rice and the total foods eaten by a family in a day were taken from the average quantity of food in Table 52. The estimation for 5.6 and 7.0 portions of steamed glutinous rice were 5,670g and 7,090g respectively and of total foods were 11,200g and 14,000g respectively. Normally villagers consume large quantities of steamed glutinous rice, drastic decrease in consumption might not be accepted by the villagers although a more nutritious diet could be planned, the minimum limit of steamed glutinous rice was therefore then set only 10% lower than normally consumed. The minimum limit and maximum limits for the family, of steamed glutinous rice were therefore set at 5,100g and 7,100g respectively. Allowance was also made for weight loss during cooking in the quantity of total foods consumed. A maximum limit was set at 15,000g instead of 14,000g.

Any food could be selected within the limited quantity and make up the total quantity not in excess of the specific limit, except glutinous rice which was to be selected at least at the minimum level. Similarly, if a particular kind of food was preferred, a lower limit of that particular food then was set in the model. It was thought that by setting a limit of the total quantity of a food in each category the meal pattern could be controlled. Liquid main dish category was chosen for a trial run; the reason for this was that each liquid main dish was consumed in larger quantities than the other dishes and the consumption quantity was more uniform than the other food categories. By setting a minimum weight level of total quantity of liquid main dish at a level larger than the weight of the dish at the largest upper limit, then it would force the linear programming to choose more than one liquid main dish. In this case the minimum level was set at 2000g as the largest upper limit of a liquid main dish was at 1900g.

9.3 LINEAR PROGRAMMING MODEL FOR MENU PLANNING FOR NORTHEASTERN, THAILAND

The linear programming model was set up to select combination of food dishes, vegetables and fruits in the quantities that could be consumed by a family of 7 persons and meet all the specific nutrient requirements at the lowest cost.

9.3.1 The Initial Model

In the initial model, the objective function was set to minimise cost and there was a total of 31 sets of constraints to be met and 93 foods to be selected within their quantity limitations. The 31 sets of constraints were made up of 15 sets of nutrient constraints, 15 sets of nutrient interrelationship constraints and one set of weight constraints. The nutritional constraints and their limitation requirements are shown in Table 50. The Nutrient interrelationship and their limitation of requirements are shown in Table 51. The 93 foods were 31 commonly eaten food dishes, 26 cowpea dishes, 29 vegetables, 6 fruits and steamed glutinous rice (Appendix 7).

The model was set as follows:

$$\begin{aligned} \text{minimize:} & & n & \\ & & \sum_{j=1} & C_j X_j \\ & & & \\ \text{subject to:} & & n & \\ & & \sum_{j=1} & A_{ij} X_j \geq b_i \quad i=1,2 \dots 31 \\ & & & \\ \text{and:} & & x_i & \geq 0 \quad j=1,2 \dots 112 \end{aligned}$$

- C_j = cost of raw material j
 X_j = quantity of raw material j selected
 A_{ij} = level of constraint i in food j
 b_i = requirement level of constraint i

9.3.2 The Relaxed Nutrient Constraints Model

It was found that in the initial model, two constraints were too tight; the lower limit requirement of fat (greater than 20% of energy from fat) and the equality constraint of calcium and phosphorus ratio (1:1) were not met. The initial model was then modified, the lower limit of fat requirement was removed and the constraint of calcium and phosphorus ratio was relaxed; the ratio was set at minimum and maximum requirement as 1:0.8 and 1:2.5 (Ca:P) respectively.

9.4 LINEAR PROGRAMMING INPUT

Input data for linear programming were arranged into five sections: ROWS, COLUMNS, RHS, RANGE and BOUNDS section according to the TEMPO procedure (Borroughs, 1974). Cards were prepared and input into these five sections as: cost and constraints, except those required for nutrient interrelationships, were put in ROW, foods to be selected in COLUMNS, requirement level of constraints in RHS, requirement range of constraints in RANGE and the quantity allowance for food to be selected in BOUNDS section. In the case of constraints on nutrient interrelationship, data were arranged as explained and summarised in Appendix 11, and the input data for setting limits on total quantity of liquid main dish were arranged as one constraint.

There was a total of 2815 cards input in the initial model: 45 cards in ROWS, 54 cards of nutrient interrelationships, 2604 cards of food compositions, cost and weight in COLUMNS section, 9 cards in RHS section, 1 card in RANGE (for dietary fibre) and 102 cards in BOUNDS section, 2817 cards in the relaxed nutrient constraint model as the cards were needed for the modified constraints and 2834 cards in the relaxed nutrient constraint with limit KANGTOT (a limit on total quantity of liquid main dishes) as to select 2 liquid main dishes. A set of control programme cards was needed:

ZNAME = "CPDIET"	ZBNDST = "BNDST"
ZDATA = "CPDIET"	SETUP(MIN)
INPUT	PRIMAL
BCDOUT	OUTPUT
ZOBJ = "COST"	RANGE
ZRHS = "LIMITS"	EXIT
ZRNGST = "RNG"	

9.5 LINEAR PROGRAMMING OUTPUT

Linear programming output of the initial model produced an infeasible solution, as the requirement on the lower limits of fat and calcium:phosphorus ratio were not met. Once these constraints were relaxed an optimum solution was found. A solution of Menu 1 from the relaxed nutrient constraint model and Menu 2, with a limit on KANGTO⁴ added, were found.

9.5.1 The Solution of Relaxed Nutrient Constraint Model - Menu 1

The optimum solution was found and the menu is shown in Table 53 with a cost of 38.39 bahts. Glutinous rice contributed 71% of the cost and 62% of the total quantity. It was selected at the lower limit level. Four food dishes were selected - 3 dried main dishes and one sauce and contributed only 4.6% of the total cost and 5% of total quantity. Ten vegetables were selected and contributed 22% of the cost and 28% of the total quantity. One fruit was selected and it contributed 2% of the cost and 5% of the total quantity. The quantities of food selected are shown in Table 53. The daily nutrient content of the menu is shown in Table 54 and Table 55. The output for energy was slightly above the minimum requirement, the protein-calorie ratio and riboflavin were at the minimum level. Fat content was only 5.6% of the total calories. The Vitamin C and Vitamin A were in excess quantity, especially the vitamin A, the output was 10.3 times of the minimum requirement.

The calcium:phosphorus ratio was at 1:1.5 and the amino acid at 87% of the FAO (1973) pattern; methionine and cystine were the most limiting amino acids.

In menu 1, although 3 dried main dishes were selected, the quantity selected of each dish was small and insufficient for a family of 7 persons. One sauce was selected but there were 10 vegetables in total, a large quantity to eat with this sauce. Some of these vegetables such as water convolvulus, bitter gourd shoot, neem, lead tree young leaves and cowpea young pod, although they could be eaten with larb, the quantity of larb was too small. This menu would not be acceptable to the villagers. It was very cheap as the villagers could grow their own glutinous rice and find most of the foods and food ingredients selected in the menu around their village area without

buying them; they only needed to buy beef.

Table 53: Menu Selection by Linear Programming

MENU 1		MENU 2	
Relaxed Nutrient Constraints Model		Relaxed Nutrient Constraints Model with limit on total quantity of liquid main dishes.	
Food Dish	Quantity g	Food Dish	Quantity g
<u>Rice</u>		<u>Rice</u>	
Steamed glutinous rice	5100.00	Steamed glutinous rice	5100.00
<u>Dry Main Dishes</u>		<u>Dry Main Dishes</u>	
Seasoned minced beef (Larb beef)	6.14	Seasoned minced beef (Larb beef)	34.28
Fermented fish	140.00	Fermented fish	104.26
Roasted small toad	114.59	<u>Liquid Main Dishes</u>	
<u>Sauces</u>		Bamboo Shoot hot soup (Kang Bamboo Shoot)	1700.00
Fermented fish hot sauce (Namprig fermented fish)	150.00	Pumpkin and cowpeas spiced soup (Kang Fungtong toa)	300.00
<u>Vegetables</u>		<u>Sauces</u>	
Water convolvulus	320.00	Fermented fish hot sauce (Namprig fermented fish)	150.00
Malabar-night shade leaves	420.00	<u>Vegetables</u>	
Bitter gourd shoot	70.00	Water convolvulus	320.00
Neem	140.00	Malabar-night shade leaves	420.00
Amaranth bayam	390.00	Spinach	18.77
Cork wood flower	210.00	Bitter gourd shoot	70.00
Water mimosa	140.00	Amaranth bayam	390.00
Pumpkin young shoot	210.00	Cork wood flower	210.00
Leadtree young leaves	200.00	<u>Fruits</u>	
<u>Fruits</u>		Banana	101.90
Banana	410.23		
TOTAL WEIGHT	8230.96	TOTAL WEIGHT	9059.21
COST (BAHTS)	38.39	COST (BAHTS)	40.72

Table 54: Daily Nutrients Provided in the Solution of Menu Planning By Linear Programming

Nutrient	MENU 1		MENU 2	
	Nutrient Content	% of Minimum Requirement	Nutrient Content	% of Minimum Requirement
Energy (kcal)	15581.8	100	15581.8	100
Digestible protein(g)	389.5	181	389.5	181
Dietary fibre (g)	230.6	235*	243.0	248**
Calcium (mg)	5120.4	151	4500.4	132
Phosphorus (mg)	6439.7	189	6925.2	204
Iron (mg)	253.4	258	239.2	243
Vitamin C (mg)	1271.3	424	1260.8	420
Vitamin A (IU)	150897.7	1030	159606.7	1089
Thiamine (mg)	7.4	119	7.2	116
Riboflavin (mg)	8.6	100	8.6	100
Niacin (mg)	112.6	110	124.3	121
Vitamin B6 (mg)	28.6	251	28.3	249
Vitamin B12 (µg)	15.0	116	23.7	184
Pantothenic acid (mg)	48.0	102	50.7	108
Folic acid (µg)	2902.5	264	2810.1	255

* 95% of max. limit

** 100% of max. limit

Table 55: Nutrient Relationships in the Solution of Menu Planning by Linear Programming

Nutrient Relationship	Menu 1	Menu 2
Protein-energy ratio, %	10	10
Energy from fat, %		
Calcium: Phosphorus	1.3	1.5
Thiamine, mg/1000 kcal	0.48	0.46
Riboflavin, mg/1000 kcal	0.55	0.55
Niacin, mg/1000 kcal	7.2	8.0
Isoleucine, mg/g protein	44 (110)	42 (105)
Leucine, mg/g protein	88 (126)	89 (127)
Lysine, mg/g protein	48 (87)	51 (93)
Methione and cystine, mg/g protein	31 (89)	30 (86)
Phenylalanine and tryosine, mg/g protein	36 (90)	37 (93)
Tryptophane, mg/g protein	25 (250)	25 (250)
Valine, mg/g protein	56 (112)	58 (116)

Figures in parenthesis represent the percentage the amino acid contents were of the the FAO (1973) amino acid pattern.

9.5.2 The Solution of Relaxed Nutrient Constraint with Limit on Liquid Main Dishes Model - Menu 2

Optimum solution was also found in this model with a cost of 40.72 bahts. Glutinous rice was selected at the lower limit and contributed 56% of the total cost and quantity. Two dry main dishes and two liquid main dishes and one sauce were selected and together contributed 30% of the total cost and 25% of total quantity. The quantity of two liquid main dishes were selected at the minimum limit set. Seven kinds of vegetables were selected and contributed 13% of total cost and 18% of total quantity. One kind of fruit was selected and contributed about 1% of total cost and total quantity. The quantity of each food selected shown in Table 53. The daily nutrient content of the menu was similar to Menu 1 and is shown in Table 54 and Table 55. Dietary fibre was at the maximum limit and the vitamin A content was very high. The riboflavin content was still at the lower limit.

Menu planning by this model did not produce better nutrient balance than the Menu 1 although cost was higher and a higher total quantity of food was selected. This model offered a better menu structure than the previous one. More food dishes and a larger quantity were selected. Only for one dish - seasoned minced beef the quantity was still insufficient for all family members. Although 7 vegetables were selected, the quantity was not too excessive except for one vegetable, Neem. About one third remained uneaten when this menu was tested with 2 families. The vegetables could also be eaten with the two dried main dishes selected. This menu would then be more acceptable than menu 1.

It was thought that by setting a limit like KANGTOT the number of dishes could be planned. In this case although two liquid main dishes were selected, the total quantity was selected at the minimum limit set in the model. This meant that the selection of the number of dishes in each category depended on the minimum total quantity set and it was not certain that it was always under control.

9.6 CONCLUSION

Linear programming was found useful for planning a low cost daily menu with the necessary nutrient requirements and an adequate quantity of foods but it selected an unacceptable menu. It did not select the foods and food dishes in the different food categories required for the eating pattern of the Northeastern villagers. The daily menu must fit with the villager's eating pattern if it is to be acceptable and adopted by the villagers. Using mixed integer programming as an extension to linear programming should give a more acceptable menu with a specific meal pattern. This method selected specific foods in each food category to build up the complete daily menu. It could be used to select daily menus in sequence so that a 7-Day menu plan was produced. If necessary this could be extended to produce individual daily menus for two weeks or a month.

There were problems in selecting a suitable menu by linear programming. Firstly, it was only possible to design a low fat diet - only 5-6% of the energy were from fat - because a feasible solution could only be obtained by removing the lower fat limit of 20% of total energy. This limitation of fat might have been caused by the lack of high fat raw materials and foods in the Northeastern villages. There is a need for further study to increase fat intake may be by using fat in cooking or having more coconut milk available for cooking. Certainly there needs to be a study to find a feasible solution with a higher fat constraint in the linear programming model. Vitamin A contents on the other hand were too high, perhaps caused by the large quantity of vegetables selected. For long term planning intake of Vitamin A should be limited by, placing constraints on the upper level.

The quantity of glutinous rice was at the minimum set in the programme but it contributed to 50% of the total weight of the daily food intake. This seems rather high, although near the amount at present eaten in the villages, and the menu could be re-designed. A study could be made of the effect of decreasing the quantity of glutinous rice on the cost of the menu and on the inclusion of scarce raw materials.

Other problems requiring further study are: the minimum amount of each food which can be used, i.e. what amount is it practical for the housewife to cook and serve?, the nutrient loss during cooking - would it be more useful to use foods as served, instead of as the basic

raw materials in the present model?, the number of foods and food dishes in the model - are 91 dishes too many when only selecting 11 foods and food dishes? what is the optimum number of foods and food dishes to be included in the model?

To conclude, a useful linear programming method was developed but it needs further study to find the optimum use for it in village menu planning, in particular addition of mixed integer programming might give a more acceptable menu.

10. PLANNING 7-DAY MENU BY MIXED INTEGER PROGRAMMING

Daily menu planning by using linear programming for villagers in North-Eastern Thailand, although it consisted of normal Northeastern dishes and cowpea dishes, inadequately represented the Northeast meal pattern. Menu planning by linear programming failed to select a required number of food items in a specific food category as required in the menu structure. This made the planning of the menus for the remaining days of the week more difficult. The menu structure was not controlled. Menu structure could be obtained by the "rounding off" of the number of food items selected from the linear programming solution and then scheduling them. But the menu would have to be planned for a longer period e.g. 30 or 60 days to make the "round off" to the nearest integer have a non-significant effect on the nutritional value of the menu. In planning a weekly menu, the accuracy of "round off" is questionable; the difference between 2 and 3 dishes may affect significantly not only the cost but also the nutrient requirement.

When a specific number of food items require to be selected from different categories, the mathematical programming problem must then be solved as an integer problem. Integer constraints are imposed on the activity and in the TEMPO system, the branch and bound algorithm mixed integer programming is used to solve the resulting problem from the optimum solution in linear programming.

10.1 TEMPO MIXED INTEGER ALGORITHMIC PROCEDURE

(BURROUGHS CORPORATION, 1974)

Beginning with an optimal solution to the linear programming problem (integer constraints ignored), the algorithm proceeds to choose one of the integer variables violating the integral requirements and constructs subproblems which are linear programming problems, then estimates which subproblem (called a branch) is more likely to lead to a good integer solution and stores the less good problems in a work file. It then optimises the chosen branch; that is, solves the linear problem with the new bounds. If the subproblem is infeasible then it picks the next best available branch and optimises it. If the

subproblem is optimal and the solution is the best integer solution found to date, a new cutoff, the solution value is available. The algorithm then proceeds to pick another best available branch on the file, optimises and another optimal solution is obtained; the objective maybe above the cutoff of the previous integer solution. If there are no viable branches on the file, then the programme terminates. The best integer solution found to date is the optimal solution to the integer programming problem. The optimization is achieved by parametric programming on the bounds. Because a projected objective is available at each parametric iteration, a branch can be dropped when its projection is greater than the cutoff.

An integer problem is analysed to determine matrix structure. Ordered sets such as: $X_1 + X_2 + \dots + X_J \leq 1$ (X_1, X_2, \dots, X_J are bivalent) are handled in an algorithmically effective way. In TEMPO, integrality should be demanded of as few activities as possible. Whenever possible, tight bounds and constraints should be imposed on the integer activities. Even small integer programming occasionally leads to long run times.

The preparation for INPUT of a data deck for an integer program is identical to preparation of the data deck for a linear program, with the exception of integer marker cards. Marker cards are required to distinguish integer activities from continuous activities.

10.2 SCHEME FOR SELECTION OF SPECIFIC NUMBER OF DISHES FOR THE MENU PLANNING BY MIXED INTEGER PROGRAMMING

Considering one category of food dish - dry main dishes - two kinds of dry main dishes were to be selected from the total number of dry main dishes. If DRYMD was abbreviation of dry main dishes, the scheme for selection of dry main dishes was set as follows:

a) Limits on total dry main dish intake

Upper limit \geq DRYMD A + DRYMD B + ... + DRYMD N \geq lower limit

then DRYMDTOT = DRYMD A + DRYMD B + ... + DRYMD N

Cards were arranged as:

in COLUMNS section

DRYMD A	DRYMDTOT	1.0
DRYMD B	DRYMDTOT	1.0
.		
.		
DRYMD N	DRYMDTOT	1.0

in ROWS section

L DRYMDTOT and limit on total dry main dishes were put in RHS section

b) Lower limit on each dry main dish

$$100 \geq \text{DRYMD A} + 100 \text{ BDRYMD A} \geq 20$$

$$100 \geq \text{DRYMD B} + 100 \text{ BDRYMD B} \geq 20$$

.

.

$$100 \geq \text{DRYMD N} + 100 \text{ BDRYMD N} \geq 20$$

where 20 was the lower limit for each dry main dish

100 was a large number (not specific)

BDRYMD A to BDRYMD N were Boolean variable (0,1)

then if $\text{BDRYMD A} = 1$, $\text{DRYMD A} \geq 0$

i.e. DRYMD A must equal 0

if $\text{BDRYMD A} = 0$, $\text{DRYMD A} \geq 20$

then

$$\text{CDRYMD A} = \text{DRYMD A} + 100 \text{ BDRYMD A}$$

$$\text{CDRYMD B} = \text{DRYMD B} + 100 \text{ BDRYMD B}$$

.

.

$$\text{CDRYMD N} = \text{DRYMD N} + 100 \text{ BDRYMD N}$$

Cards were arranged as:

in COLUMNS

DRYMD A	CDRYMD A	1
BDRYMD A	CDRYMD A	100

in ROWS

G CDRYMD and limit on each dry main dish was put in
RHS section.

c) Selection for a specific number of dry main dishes
(two dishes were to be selected)

$$\text{BDRYMD A} + \text{BDRYMD B} + \text{-----} + \text{BDRYMD N} = \text{N} - 2$$

where N was the number of available dry main dishes. Hence two of the BDRYMD variables must equal 0 and therefore two dry main dishes would be selected at levels greater or equal to lower limit (20).

then

$$\text{BDRYMDTOT} = \text{BDRYMD A} + \text{BDRYMD B} + \text{---} \text{BDRYMD N} = \text{N} - 2$$

Cards were arranged as:

in COLUMNS section

BDRYMD A	BDRYMDTOT	1.0
BDRYMD B	BDRYMDTOT	1.0
.		
.		
BDRYMD N	BDRYMDTOT	1.0

in ROWS section

E BDRYMDTOT

and the number of dishes to be selected was put in RHS section.

The schemes for the other categories of food items were the same. The programme was run as mixed integer and the integer marker card was put between the (a) and (b) cards in COLUMNS section. There must be a limit placed on the tolerance. This is normally 0.01 and then an integer variable is defined as 0.99 to 1.01 or not exactly one. The control card ZTOLIN was used at 0.001 instead of 0.01 to give an integer value nearer to one. If an integer variable differed from an integer value by less than ZTOLIN, the variable was assumed to be integer.

10.3 THE MEAL PATTERN

Two types of meal pattern were considered and used in the menu planning - they were the "survey" pattern and the "preference" pattern. The "survey" pattern was derived from the results of the survey on food eating habits throughout the year in ten villages in Khon Kaen Province. The pattern required 2 dry main dishes, 2 liquid main dishes, 2 sauces, 3 kinds of vegetables eaten with sauces and main dishes, 1 kind of fruit, 1 dessert and steamed glutinous rice. The survey pattern represented the factual villagers' eating habits, but it might not be the pattern they would prefer. The "preference" patterns were considered for the better acceptability of the menu and was obtained by interviewing 28 families in Ban Koksri and Ban Maung.

Table 56: The Number of Times a Family Chose to Eat Different Categories of Foods in Different Meals - "A Preference Pattern"
(Total Number of 28 Households Interviewed)

	Breakfast	Lunch	Dinner	Whole Day
	(Average Number of Times Per Family)			
Dry main dishes	0.68	1.50	0.86	3.04
Liquid main dishes	1.07	0.57	1.18	2.82
Sauces	0.68	0.36	0.61	1.65
Vegetables	1.39	1.86	1.54	4.79
Fruits	0.93	0.82	0.71	2.46

The housewives of these 28 families were asked to choose from the cards of food items presented to them what they would like their families to eat for breakfast, lunch and dinner. The list of dry main dishes, liquid main dishes, sauces, vegetables and fruits eaten by 100 households in the three seasons were used for the selection. The "preference" meal pattern was derived from the average number of foods chosen in different meals by a family as shown in Table 56. The kind of food and the number of families choosing each food for breakfast, lunch and dinner are presented in Appendix 10. It was decided that 3 dry main dishes, 3 liquid main dishes, 2 sauces, 5 vegetables, 2 fruits and 1 dessert should be included in the "preference" meal pattern with steamed glutinous rice.

10.4 THE REVISED DATA FOR INPUT MENU PLANNING BY MIXED INTEGER PROGRAMMING

Four factors had been reconsidered and the data then was revised to input in the mixed integer programming. These were: number of food items for the selection, the nutrient composition of food items, nutrient constraints, and the quantity limits of the food items.

10.4.1 Food Selection

In the menu planning by linear programming, 66 food items of commonly eaten food dishes, vegetables, fruits and 26 cowpea dishes were input for the linear program selection. It was thought that this number, a total of 92 food items was too large for the selection and the less commonly eaten foods might be selected, thus making the menu less acceptable. Only food items consumed by the majority of the households should be used for the selection. Food items which had been eaten by at least 18 households in the survey were selected. There were 45 food items, including 14 dry main dishes, 6 liquid main dishes, 6 sauces, 13 vegetables, 5 fruits selected to input in the mixed integer program. A dessert dish, sweet noodle pudding, made from tapioca, was not included although more than 18 households ate it. Village food vendors usually bought the noodle from Khon Kaen market and only prepared the pudding. This dish therefore was not suitable for the housewives in the village to make for their families. There were also 12 cowpea dessert and snacks to be selected so therefore this dessert dish was not included.

There were then 44 commonly eaten food items and 26 cowpea dishes, total of 70 food items to be selected. They were classified in different categories as 22 food items in dry main dishes, 10 in liquid main dishes, 8 in sauces, 13 in vegetables, 5 in fruits and 12 in desserts as shown in Appendix 7.

The schemes for menu structure planning a first day menu in "survey" and "preference" meal patterns could then be planned. For example the scheme for selecting 2 dried main dishes in the "survey" meal pattern - $BDRMDTOT = N - 2$, in this case, N (total number of dried main dishes) was 22 dishes, therefore BDRMDTOT was set at 20. The menu structure for the other food categories was set the same way as shown

in Appendix 11 (Table 11.1).

10.4.2 The nutrient composition

The nutrient compositions of food dishes were revised as the nutrients lost during cooking were taken into consideration. Loss of vitamins and amino acids at different cooking temperatures and times were derived from the data in the literature reviewed by Chittaporn (1977) and applied to the Northeastern cooking as shown in Table 57.

Table 57: Loss of Vitamins and Amino Acid at Various Temperatures and Times of Cooking (Derived from Chittaporn, 1977)

Nutrient	Frying in Oil 150°C, 10 min	Deep Frying 190°C, 5 min	Charcoal Roasting 75°C, 45 min	Steaming 90°C, 30 min	Boiling 100°C 45 min
(%loss from original concentration)					
Vitamin A	12.50	37.70	0.30	0.81	2.51
Thiamine	77.56	100.00	1.04	2.83	10.61
Riboflavin	14.59	22.05	3.38	4.77	10.61
Niacin	13.16	100.00	0.15	0.36	1.30
Vitamin C	43.13	92.37	0.97	2.51	8.03
Vitamin B6	13.16	36.66	0.59	1.17	3.42
Vitamin B12	39.23	95.37	0.53	1.39	4.96
Pantothenic acid	15.30	44.07	0.45	1.00	3.13
Folic acid	96.39	100.00	3.17	7.53	26.93
Isoleucine	15.30	48.53	0.02	0.08	0.39
Leucine	6.74	37.70	0.05	0.15	0.57
Lysine	9.49	39.23	0.15	0.39	1.29
Methionine	13.88	63.07	0.09	0.29	1.12
Cystine	59.20	100.00	0.01	0.02	0.10
Phenylalanine	1.73	4.07	0.15	0.26	0.68
Tyrosine	6.58	42.18	0.03	0.10	0.40
Threonine	2.06	7.97	0.01	0.02	0.07
Tryptophane	4.70	11.71	0.30	0.53	1.45
Valine	2.79	5.02	0.49	0.64	1.56

It was found that loss of vitamins and amino acids was less than 10%, except for folic acid, in frying and boiling. Cooking by frying in oil (150°C, 10 min) and deepfrying in oil (190°C, 5 min) had a greater effect on all vitamin and amino acid loss than the other methods of cooking.

Nutrient loss in soaking of glutinous rice for long periods before steaming was taken from the data on nutrient loss of washing rice. Cheigh (1978) found that loss of nutrients on washing of 50-90% polished Japonica and Indica rice was as follows: total solid 1-2%, protein 5-7%, calcium 18-26%, iron 19-47%, thiamine 22-40%, riboflavin 11-24%, niacin 36-45%. The high levels of these data were taken for calculating the nutrient loss for glutinous rice. Nutrient loss on steaming of glutinous rice, as well as steaming and boiling of the other dishes, were ignored as the losses of vitamin and amino acids were less than 10%. Allowance was made for loss of folic acid; in the nutrient constraint for folic acid, addition of 20% was added to the minimum requirement. There were seven common dishes and cowpea dishes for which the method of cooking was frying in oil and deep frying: fried fish, fried beef, fried pork and cowpea ball, fried cowpea, fried cowpea paste. Data on nutrient losses in Table 57 were used to calculate the nutrient composition of these dishes (Appendix 8). There were five boiled vegetables: bamboo shoot, ivy gourd, leaf mustard, neem and corkwood young leaf. Nutrient composition of boiled bamboo shoot was taken from FAO (1972) food composition table. Nutrient loss of similar vegetables was derived from FAO (1972) food composition tables and used for calculating the other four vegetable nutrient compositions; except for vitamin B6, vitamin B12, folic acid and pantothenic acid for which data of Paul and Southgate (1978) were used. The nutrient composition of the 70 food items and steamed glutinous rice are shown in Appendix 8 and 18.

10.4.3 The Nutrient Constraints

Nutrient constraints for vitamin A, fat and folic acid were revised for the mixed integer programming. The revised nutrient constraints are shown in Table 58. In the linear programming model there was no upper limit for vitamin A intake and the solution from linear programming produced a diet with vitamin A content of 159,606 IU which was too high a level. The upper limit for vitamin A requirement was put in for mixed integer programming. A RDA 1974 recommendation for vitamin A was considered, as the level of vitamin A intake recommended was higher than the Thai recommendation. It was decided to use two thirds of the level of RDA 1974 vitamin A recommendation for the lower limit and three times the recommendation for the upper limit

for the vitamin A requirement of a family of 7 persons. The lower limit of 20% energy for fat in the linear programming had produced an infeasible solution and the solution from linear programming with no lower limit on fat requirement produced only 6% of energy from fat. The lower limit must be put in the model or otherwise the diet selected would be a low fat diet. The limit of 2g of fat per 100 kcal would be a reasonable requirement thus the lower limit of % energy from fat was set at 18%. Addition of 20% on the folic acid requirement was put for the lower limit for folic acid, this was to allow for the cooking loss of folic acid in the steamed glutinous rice and the other dishes.

Table 58: A New Revised Nutrient Constraint for Planning a Daily Menu for a Family of Seven Persons

Nutrient	Lower Limit	Upper Limit
Energy (kcal)	15580	-
Digested protein (g)	283	
Dietary fibre (g)	98	243
Calcium (mg)	3400	10500
Iron (mg)	98.28	
Vitamin C (mg)	300	
Vitamin A (IU)	18200	54600
Thiamine (mg)	6.23	
Riboflavin (mg)	8.57	
Niacin (mg)	102.83	
Vitamin B6 (mg)	11.4	
Vitamin B12 (μ g)	12.9	
Pantothenic acid (mg)	47	
Folic acid (μ g)	1332	
Isoleucine (mg/g protein)	32	
Leucine (mg/g protein)	56	
Lysine (mg/g protein)	44	
Methionine + cystine (mg/g protein)	28	
Phenylalanine + Tyrosine (mg/g protein)	48	
Threonine (mg/g protein)	32	
Tryptophane (mg/g protein)	8	
Valine (mg/g protein)	40	
Protein-energy ratio (%)	10	
Phosphorus/calcium ratio	.8	2.5
Thiamine/energy (mg/1000 kcal)	.0004	
Riboflavin/energy (mg/1000 kcal)	.00055	
Niacin/energy (mg/100 kcal)	.0066	
Energy from fat, %	18	35

10.4.4 The limit quantity on food intake

Limits on quantity of food items, total food in each category and total food in the menu were set for the mixed integer programming.

The lower limit on quantity of food items consumed by a family of 7 persons were required for the mixed integer programming. The quantity of 5 times the quantity consumed by adult man was used as the lower limit on each food item for the family of 7 persons and were input in the RHS section. Upper limit of 7 times was used and input in the BOUNDS section. These limits on food items are shown in Appendix 11. The lower limit of steamed glutinous rice was reconsidered as it was selected at the lower limit in the linear programming solutions. Perhaps this lower limit might be too large a quantity. The quantity was then tested with four families. Each family with 7 members as planned was given 5100 g of glutinous rice and the other food in the menu planned by the linear programming. Two families consumed all of the steamed glutinous rice and indicated that they would require more, one family about 500 g more and the other family about 1 kg more. The other two families could not consume all the rice, on average 600 g of steamed glutinous rice remained uneaten. The reason that they could not consume all of the glutinous rice was not because the quantity was too large but in the menu there were too many kinds of vegetables. From this result it was decided that the lower limit on steamed glutinous rice would remain the same.

The upper quantity limit was set for each category of foods. For example, in the liquid main dish, two dishes were required. The upper quantity limit on liquid main dishes was then taken from the quantity of the two dishes eaten at the highest amount, 1750g and 1750g respectively. Therefore the upper limit on quantity was taken as the sum, i.e. 3500g. The upper limit for dry main dishes (DRYMDTOT), for liquid main dishes (KANGTOT), for sauces (SAUCETOT), for vegetables (VEGETOT), for fruits (FRUITOT) and for desserts (DESTOT) used for planning the 7 day menus are shown in Appendix 11 (Table 11.2).

The limit on total food was revised. In the linear programming model an upper limit of 15,000g was set as most of the data input for nutrient composition of food dishes and vegetables were in the uncooked form. These data had been revised for the mixed integer programming and nutrient loss during cooking had been allowed. Therefore the limit on total quantity of foods could be reduced. Ten percent of the

average quantity eaten by a family of 7 persons was used for the upper limit. Thus the upper limit of total weight of 14,000 g was set in the mixed integer model.

10.5 PLANNING A WEEKLY MENU

A weekly menu was developed by planning on a day by day basis. Once the first solution was obtained for the first day's menu, the second day's menu was then planned by deleting the food items already selected. Some food items could be eaten more than once a week and this was taken into consideration in planning the 7 day menus. A survey on frequency of the 69 food items eaten in a week was conducted with 28 families in two villages in Khon Kaen Province. Data obtained from this survey, as shown in Appendix 10, was used for planning the 7 day menus. Food items which were selected in the menu, were allowed to be selected to the maximum frequency of eating in a week, then they were removed from the programme.

10.6 TRIAL RUNNING OF MIXED INTEGER PROGRAMMING FOR MENU PLANNING

There were two meal patterns for menu planning, the "survey" pattern and the "preference" pattern. All of the input data in these two patterns were similar only the limit on the number of food items for each category and the limit on the total quantity of food in each category were different. There were 128 rows and 289 variables in the problem, with 2671 cards input and 70 integer variables.

In running the mixed integer programming an optimal solution to the linear programming problem is required before entry to mixed integer programming procedure (MXINT). For this reason PRIMAL is called in the above program. PRIMAL ignores the integer marker cards.

The running of the mixed integer programming for an optimum solution could take a long computer time and it would take even longer for the running for the following day's menu as less food items remain to be selected. Modified procedures for obtaining an optimal solution were also used in running the mixed integer programming. They are as follows: ZALPHA; ZJUST; ZBIOBJ; ZFREQ1; ZDOFQ1. Their descriptions are given in Appendix 11.

Trial runs were conducted for "preference" pattern and for "survey" pattern as are summarised in Tables 59 and 60. The solution

for each trial are presented in Appendix 11. Foods were selected as planned for each meal pattern.

Table 59: Trial Runs of Mixed Integer Programming for Day 1 Menu Planning on Preference Pattern

	Cost of Menu (Bahts)	Processing Time (sec)
<u>A. With no upper bound on food items</u>		
<u>One run</u>		
ZALPHA=20, ZJUST=7	75.64	867.61
ZALPHA=20, ZJUST=14	75.09	716.72
ZALPHA=20, ZJUST=35	74.09	1574.52
<u>Two run</u>		
ZALPHA=20, ZJUST=7 and ZBIOBJ=75.63 ZJUST=2	74.71	571.78
<u>B. With upper bound on food items*</u>		
ZALPHA=20, ZJUST=5	76.08	453.52
ZALPHA=20, ZJUST=5 ZBIOBJ=76.08, ZJUST=5	73.51	4401.56

* double of the upper limit in linear programming.

However, each run took a long running time. Efforts were made to shorten the running times but the final optimal solution of the runs, that is that no more valid nodes could be found, were difficult to obtain in the short time. In the two runs of the "preference" pattern with ZALPHA = 20, ZJUST = 35 AND ZBIOBJ = 76.08, ZJUST = 5, after they were running for 1574 and 4401 sec respectively, the final solutions still were not reached.

Table 60: Trial Runs of Mixed Integer Programming for Menu Planning On Survey Pattern

	Day 1		5 Day Menus	
	Cost (bahts)	Processing Time (sec)	Cost (bahts)	Processing Time (sec)
A. One or several runs for each menu until final optimal solution was obtained.	64.11	703.29	355.46	6775.42
B. One step running for each menu with modified ZALPHA=20 ZJUST=7	65.75	225.16	366.28	1668
C. Two step running for each menu 1st run ZALPHA=20, ZJUST=7 2nd run ZBIOBJ=" <u>X</u> "* and ZJUST=2	64.51	607.58	360.59	3932.66

* "X" = Optimum solution on first step running.

As more food items were required for the "preference" pattern and the solution of the first day menu of this pattern selected large quantities of the food items, larger than the upper limit, it was thought that the upper limit on food items should be input for the pattern, to control the quantity of each food selected. Double the upper limit decided in linear programming was input in the mixed integer programming. It was found that with upper limit on food items, it took longer to obtain the solution. Therefore it was decided not to attempt to plan the 7-Day menu on the "preference" pattern.

In the "survey" pattern, the final optimum solution of Day 1 was found after 703 seconds of running time with no modified command; but it was taking longer, even when the modified commands were used, for the second, third, fourth and fifth menu. After running the sixth menu for 2169 seconds, the final solution of no more valid nodes still was not obtained. One step running and two step running of the survey pattern was compared. In the one step running, the command ZALPHA=70, ZJUST=2 was used. The two step running used the solution of the first step use of running for ZBIOBJ and run only for ZJUST=2. The two step running produced an optimum solution not too far from the final optimum

solution and reduced significantly the processing time, therefore the two step running was used for planning the 7-day menus on the "survey" pattern.

10.7 SELECTION OF 7-DAY MENU BY MIXED INTEGER PROGRAMMING

There were two programmes used in the two step running of mixed integer, in the first running ZALPHA was set at 20 and ZJUST was set at 7, in the second running ZBIOBJ was set at the solution of the first running and ZJUST was set at 2 and the running was continued from the first step. The cards of the two programmes were set as shown in the following:

First Running

```
ZNAME="CPDIET"
ZDATA="CPDIET"
INPUT
BCDOUT
ZOBJ="COST"
ZRHS="LIMITS"
ZRINGST="RNG"
ZBNDST="BNDST"
ZTOLIN=0.001
SETUP(MIN)
PRIMAL
OUTPUT
ZFREQ1 = 50
ZDOFQ1 = LEXIT
ZALPHA = 10.0
ZJUST = 7.0
MXINT
OUTPUT
EXIT
LEXIT:
SAVEFILE (SUMMARY)
RETURN
```

Second Running

```
ZNAME="CPDIET"
ZDATA="CPDIET"
INPUT
ZOBJ="COST"
ZRHS="LIMITS"
ZRINGST="RNG"
ZBNDST="BNDST"
ZTOLIN=0.001
SETUP(MIN)
PRIMAL
ZFREQ1 = 50
ZDOFQ1 = LEXIT
ZBIOBJ = "X"
ZJUST = 2.0
MXINT
OUTPUT
EXIT
LEXIT:
SAVEFILE (SUMMARY)
RETURN
```

Once the first solution was obtained, cards for the selected food items were removed and the limit on number of food items which could be only selected once and limit on total quantity of food in each food category were revised. These revised input data are shown in Appendix 11 (Table 11.2).

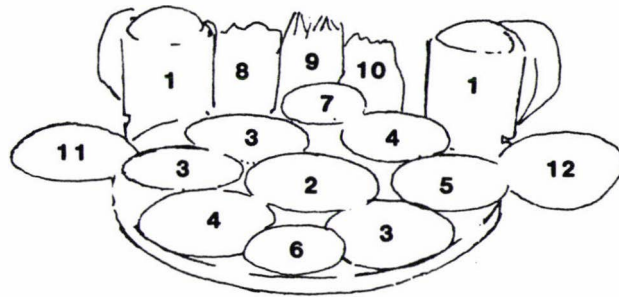
It was found that food items selected in the first solution could be used for Day 1 and Day 2 menus as whole fermented fish, roasted frog, fried cowpea sprout and cowpea sprout curry, could be eaten for a maximum of two days in a week and the other food items could be eaten more than two days. These three food items were then removed for the Day 3 menu planning. By following this system, the menus for 7 days were planned. The printout of data input and solution of the two steps running of mixed integer programming planning Day 1 is shown in Appendix 21.

10.8 MENUS FOR 7 DAYS

The solution of menu planning by mixed integer programming for 7 days is shown in Table 61 and Figure 9, the distribution in cost and quantity of food in different categories of the 7-Day menu is shown in Table 62, the nutrient compositions are shown in Appendix 11, and the percentage of nutrient requirement constraints from the solutions of the menus are shown in Table 63.

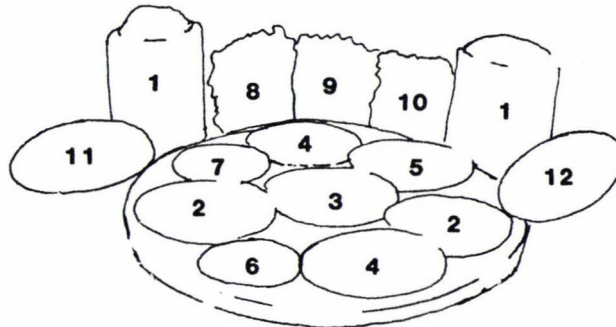
Table 61: Solution of Menu Planning by Mixed Integer Programming:
The Menu and Cost

DAY 1-2		g	DAY 5		g
Steamed glutinous rice		5100	Steamed Glutinous rice		5100
Whole fermented fish, roasted		414	Roasted beef		250
Fried cowpea sprouts		929	Fried beef		426
Mushroom hot soup		1150	Beef soup		1250
Cowpea sprout curry		1161	Pumpkin and cowpea spice soup		618
Chilli in fish sauce		40	Chilli in fermented fish sauce		30
Chilli in fermented fish sauce		30	Cowpea and fermented fish sauce		55
Water convolvulus, raw		316	Chinese cabbage, raw		255
Spring onion, raw		125	Egg plant, raw		1308
Neem, blanched		368	Cork wood young leaves blanched		467
Banana		500	Banana		905
Steamed sago stuffing with cowpea		250	Steamed glutinous rice stuffed with cowpea		300
Total Quantity (g)		<u>10383</u>	Total Quantity (g)		<u>10964</u>
Cost (Bahts)	64.51		Cost (Bahts)	77.00	
DAY 3			DAY 6		
Steamed glutinous rice		5100	Steamed glutinous rice		5100
Fried beef		885	Roasted beef		1054
Seasoned mashed cowpea		400	Steamed cowpea and bamboo shoot		766
Mushroom hot soup		1150	Cowpea curry		500
Pumpkin and cowpea spiced soup		600	Cowpea and pumpkin hot soup		700
Chilli in fish sauce		91	Chilli in fermented fish sauce		30
Cowpea and fermented fish hot sauce		305	Cowpea and fermented fish hot sauce		288
Water convolvulus, raw		250	Chinese cabbage, raw		513
Coriander leaves, raw		75	Coriander leaves, raw		75
Neem, blanched		368	Cork wood young leaves, blanched		268
Custard apple		250	Banana		1032
Steamed sago stuffing with cowpea		384	Cowpea and sago pudding		800
Total Quantity (g)		<u>9858</u>	Total Quantity (g)		<u>11126</u>
Cost (Bahts)	77.41		Cost (Bahts)	85.02	
DAY 4		g	DAY 7		g
Steamed glutinous rice		5100	Steamed glutinous rice		5100
Fried beef		605	Roasted beef		1462
Seasoning mashed cowpea		832	Roasted small toad		225
Beef soup		1250	Cowpea curry		500
Pumpkin and cowpea spice soup		600	Cowpea and pumpkin hot soup		700
Chilli in fish sauce		40	Fermented fish hot sauce		274
Chilli in fermented fish sauce		30	Cowpea and fermented fish hot sauce		55
Chinese cabbage, raw		927	Chinese cabbage, raw		1047
Water convolvulus, raw		409	Egg plant, raw		300
Egg plant, raw		340	Coriander leaves, raw		182
Banana		500	Custard apple (sugar apple)		250
Steamed sago stuffing with cowpea		250	Steamed glutinous rice stuffed with cowpea		360
Total Quantity (g)		<u>10883</u>	Total Quantity (g)		<u>10095</u>
Cost (Bahts)	77.17		Cost (Bahts)	88.54	



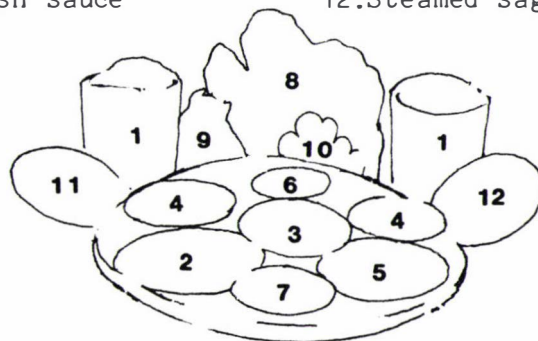
Days1-2

- | | |
|--------------------------|--------------------------------------|
| 1.Steamed glutinous rice | 7.Chilli in fermented fish sauce |
| 2.Whole fermented fish | 8.Water convolvulus |
| 3.Fried cowpea sprouts | 9.Spring onion |
| 4.Mushroom hot soup | 10.Neem |
| 5.Cowpea sprout curry | 11.Banana |
| 6.Chilli in fish sauce | 12.Steamed sago stuffed with cowpeas |



Day 3

- | | |
|----------------------------------|--------------------------------------|
| 1.Steamed glutinous rice | 7.Cowpea & fermented fish hot sauce |
| 2.Fried beef | 8.Water convolvulus |
| 3.Seasoned mashed cowpeas | 9.Coriander leaves |
| 4.Mushroom hot soup | 10.Neem |
| 5.Pumpkin and cowpeas spice soup | 11.Custard apple |
| 6.Chilli in fish sauce | 12.Steamed sago stuffed with cowpeas |



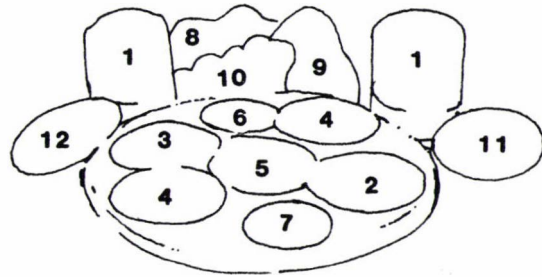
Day 4

- | | |
|-----------------------------------|--------------------------------------|
| 1.Steamed glutinous rice | 7.Chilli in fermented fish sauce |
| 2.Fried beef | 8.Chinese cabbage |
| 3.Seasoned mashed cowpeas | 9.Water convolvulus |
| 4.Beef soup | 10.Egg plant |
| 5.Pumpkin and cowpeas spiced soup | 11.Banana |
| 6.Chilli in fish sauce | 12.Steamed sago stuffed with cowpeas |

Figure 9: Photographs of the 7-Day Menu

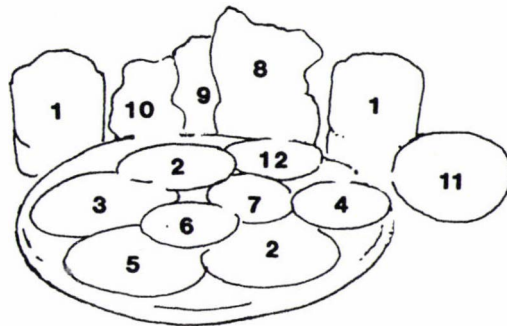


Figure 9: (Continued)



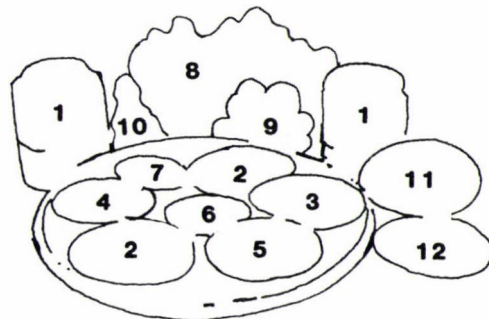
Day 5

- | | |
|-----------------------------------|--|
| 1.Steamed glutinous rice | 7.Cowpea & fermented fish hot sauce |
| 2.Roasted beef | 8.Chinese cabbage |
| 3.Fried beef | 9.Cork wood leaves |
| 4.Beef soup | 10.Cork wood leaves |
| 5.Pumpkin and cowpeas spiced soup | 11.Banana |
| 6.Chilli in fermented fish sauce | 12.Steamed glutinous rice stuffed with cowpeas |



Day 6

- | | |
|----------------------------------|-------------------------------------|
| 1.Steamed glutinous rice | 7.Cowpea & fermented fish hot sauce |
| 2.Roasted beef | 8.Chinese cabbage |
| 3.Steamed cowpeas & bamboo shoot | 9.Coriander leaves |
| 4.Cowpea curry | 10.Cork wood leaves |
| 5.Cowpeas & pumpkin hot soup | 11.Banana |
| 6.Chilli in fermented fish sauce | 12.Cowpea and sago pudding |



Day 7

- | | |
|------------------------------|--|
| 1.Steamed glutinous rice | 7.Cowpea & fermented fish hot sauce |
| 2.Roasted beef | 8.Chinese cabbage |
| 3.Roasted small toad | 9.Egg plant |
| 4.Cowpea curry | 10.Coriander leaves |
| 5.Cowpeas & pumpkin hot soup | 11.Custard apple |
| 6.Fermented fish hot sauce | 12.Steamed glutinous rice stuffed with cowpeas |



There were 29 food items and steamed glutinous rice selected for the 7-day menus. Among these were 11 cowpea dishes, 3 dry main dishes, 4 liquid main dishes, 1 sauce and 3 desserts. The distribution in cost and quantity of food in different categories are shown in Table 62.

Table 62: Distribution in Cost and Quantity of Food in Different Categories in 7-Day Menu

	Day 1-2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean+S.D.
% of Total Cost							
Rice	35.6	29.6	29.7	29.8	27.0	25.8	29.6+3.4
Dried Main Dishes	14.3	38.2	31.0	27.2	43.3	45.7	33.3+11.7
Liquid Main Dishes	37.8	18.1	20.3	20.4	9.6	9.0	19.2+10.5
Sauces	1.3	5.1	1.1	1.2	3.7	3.2	1.6+1.7
Vegetables	5.4	3.7	13.1	14.2	6.8	12.1	9.2+4.5
Fruits	3.7	3.0	3.1	5.6	5.8	2.6	4.0+1.4
Desserts	1.8	2.3	1.5	1.5	3.7	1.3	2.0+0.9
% of Total Weight							
Rice	49.1	51.7	46.9	46.5	45.8	50.5	48.4+2.4
Dry Main Dishes	12.9	13.0	13.2	6.2	16.4	13.7	12.6+3.4
Liquid Main Dishes	22.3	17.8	17.0	17.0	10.8	11.9	16.1+4.2
Sauces	0.7	4.0	0.6	0.8	2.8	3.3	2.0+1.5
Vegetables	7.8	7.0	15.3	18.5	7.7	15.1	11.9+5.0
Fruits	4.8	2.5	4.6	8.3	9.3	2.5	5.3+2.9
Desserts	2.4	3.9	2.3	2.7	7.2	3.0	3.6+1.9

Steamed glutinous rice was selected at the lower limit but contributed significantly to the daily menu. It was selected in the largest quantity compared with the other food categories, on average it cost 30% of the total cost and was 48% of the total quantity. Steamed glutinous rice cost more than the other food in Days 1-2 menu. Food in dry main dishes category was the most expensive food in the menu, on average it cost 33% of the total cost and contributing to 12.6% of the total quantity. Food in liquid main dishes category was the third expensive group in the menu, cost 19% of total cost and contributing to 16% of total quantity. Vegetables were the fourth in cost and quantity contributing to the menu, on average, 9% of total cost and 12% of total quantity. Sauces and desserts were the cheapest and contributed in smallest quantity to the menu.

Some food items had been selected at their lower limit quantities and also some had been selected in larger quantities than their estimated upper limit (7 times the quantity an adult man would consume). In the planning for the 7-day menu on the "survey" pattern, upper bound of the food items were not input in the model so as to allow the menu to be selected at lower cost and shorten the mixed integer programming processing time. As most of the food items selected in extra quantity were selected in only one to three times the estimated quantity, this quantity was considered not too large and it was assumed that the family would be able to eat all the amount. Whole fermented fish was selected in Day 1 menu at five times the estimated quantity. This quantity was still considered not too excessive. Whole fermented fish had been estimated for a family to eat in small quantities because of their eating habits and also because fermented fish was too salty. If the fermented fish was to be made less salty, the quantity could be easily consumed by the family.

The total quantity of food selected for each day in the 7-day menu averaged about 72% of the upper limit of total quantity constraints and about 90% of the estimated quantity of food a family of 7 persons would consume in a day. Therefore it would be likely that all the food would be consumed.

The total cost of the menu for the whole week was 534 bahts. This amount would seem to be high for the low income family. For the integer programming, every food raw material had to be costed and the Khon Kaen market price in 1978 was used. In the villages, cost of some food might be cheaper and in fact not many foods would need to be bought as villagers grow their own rice and vegetables and some foods they could gather wild. Glutinous rice contributed 30% of the total cost and vegetables contributed 9%. If half of the other food could be obtained free, therefore only 30% of food needed to be bought for the family. It means that only 160 bahts would be required for a week's food for a family of 7 persons.

Table 63: Percentage of Nutrient Requirement Constraints From The Solution of 7-Day Menu Planning by Mixed Integer Programming

	Day 1-2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean
Energy	120	116	118	120	128	117	120
Protein	165	176	180	176	201	201	183
Fat	100	109	111	106	114	125	111
Dietary fibre	235 (95)	239 (96)	247 (99)	219 (88)	240 (97)	230 (93)	237 (95)
Calcium	126	100	100	100	103	101	105
Iron	231	161	132	248	205	115	182
Vitamin A	300 (100)	300 (100)	300 (100)	300 (100)	300 (100)	300 (100)	300 (100)
Thiamine	120	116	118	120	128	117	120
Riboflavin	121	117	118	120	128	117	120
Niacin	145	155	118	120	128	130	133
Vitamin C	172	154	302	121	170	285	208
Vitamin B6	281	296	305	324	310	278	300
Vitamin B12	336	203	158	133	219	232	214
Pantothenic Acid	149	157	140	143	146	142	146
Folic Acid	134	189	220	136	193	151	170
% of Amino Acid Pattern (FAO, 1973)							
Isoleucine	118	116	115	118	127	121	119
Leucine	131	131	129	133	134	131	132
Lysine	126	80	87	96	123	125	106
Methionine } Cystine }	99	87	86	89	94	95	91
Phenylalaine } Tyrosine }	138	126	120	125	128	127	127
Threonine	113	105	97	101	104	100	103
Tryptophane	247	211	197	200	197	178	205
Valine	127	120	114	120	121	113	119

(in the parenthesis are % of upper limit)

The menu planning by mixed integer programming produced a solution on daily nutrient requirement at the lower limit of fat content and at upper limit of vitamin A content. The lower limit of fat was 18% of the total energy and upper limit of vitamin A of 54600 IU were put in the mixed integer programming to force the selection of fat at least at the lower limit and vitamin A at most at the maximum limit. These two nutrients were not controlled in the linear programming and the menu produced by linear programming was low in fat content and too excessive in vitamin A. The solution on energy and protein on average was

respectively 120% and 183% above the requirements. Dietary fibre content in each menu was high and nearly reached the upper limit. Calcium content was at the lower limit for Days 3, 4 and 5 menu. Phosphorus content was high and the ratio of phosphorus to calcium was in the high level and at the upper limit for Day 6 and Day 7 menu. Iron was on average 182% of the requirement.

Thiamine and riboflavin content for each menu were above the requirements, on average about 120% of the requirement, but their ratio to calorie was at the lower limit for all of the 7 days' menus. All the other vitamins were more than adequate, specially vitamin B6 which was on average 300% of the requirement, as shown in Table 66. The lower limit on each of amino acid requirement was set at 80% of the FAO(1973) amino acid pattern. Methionine, cystine and lysine were the most limiting amino acids in the 7 Day Menus. On Day 1-2, Day 4, Day 5, Day 6 and Day 7, methionine and cystine were the most limiting amino acids and were at only 99, 86, 87, 94, 95 and 91% of the FAO (1973) amino acid pattern respectively and in Day 3 lysine was the most limiting amino acid and was at 80% of the pattern.

Comparing the menus for the 7 days Day 1-2 menu was better than the other menus in terms of protein quality, calcium content was higher and Day 1-2 menu had also the lowest cost.

10.9 CONCLUSION

Using linear programming followed by mixed integer programming, a method was developed for systematic food selection for a daily menu and for a weekly selection of daily menus. The optimum solution for the linear programming model was used as the starting point for the mixed integer programming. There was difficulty in finding the optimum solution in the integer programming so a quick method was developed to get a "near to optimum" solution. This was a "two-step" method, in the first step producing 7 near optimum solutions and then in the second step using the best of these solutions (i.e. the one with the lowest cost) as the control level and running the programme until it produced two solutions with still lower costs. The best of these solutions was chosen as the daily menu. For the practical selection of the daily menu this was satisfactory as very little improvement in optimisation i.e. decrease in cost was obtained in the later solutions, but there does need to be a more detailed theoretical study to find an improved method of solving the mixed integer problem.

For the seven day menu selection, a step wise method of running the linear programming/quick mixed integer method was used. After selection of the menus for the first two days, the cards were removed for the foods which could not be repeated in the next day's menu because of the restrictions of the villagers' eating pattern. Then the linear programming/quick mixed integer method was used again to produce a solution - the menu for the third day. This process was continued until the complete 7-Day menu was selected. This step-wise selection worked very satisfactorily. The 7-Day menus thus planned satisfied the nutrient requirements, offered a 7-Day menu similar to the normal eating pattern incorporating the most commonly eaten foods and the acceptable cowpea dishes. This 7-Day menu should be highly accepted by the villagers.

11. THE 7-DAY MENU FOR THE INTRODUCTION

After obtaining the details of the 7-Day menu by mixed integer programming, the next stage of the research was to test for the acceptability of the menu and at the same time introduce the cowpeas, the cowpea dishes and the 7-Day menu to the villagers. But before conducting this research, it was necessary to convert the output of the 7-Day menu from the optimum solution of the mixed integer programming to a form that the villagers could use and cook by themselves. The menu from the optimum solution was in grams of steamed glutinous rice, cooked dishes, cooked vegetables and the edible portion of fresh vegetables and fruits. These had to be converted to the kinds and quantities of ingredients used in each recipe of the selected dishes, the quantities of raw materials needed for the selected quantity of steamed glutinous rice, cooked and fresh vegetables and fruits, so that the menu could be prepared by the villagers.

The quantities of the food ingredients and raw materials used in the 7-Day menu for a family of 7 persons were prepared in the units which are used by the villagers. For example, one medium sized catfish of 0.5 kg, five lemons, one handful of mint leaves, one spoon (village common spoon) of fish sauce, one cup of cowpea seeds (village common cup). were used in the recipe. These weights or measurements had to be carefully standardised and adjusted so that the dishes cooked by the villagers would be very similar to the dishes planned by the computer, otherwise the family of 7 persons would not receive the nutrients in the same quantities as planned and the dishes might not be acceptable or taste the same as the original recipe. Recipes and methods of preparation of the cowpea dishes, the common dishes, and the other foods in the menus were prepared for the introduction. The menus were then prepared in the laboratory following these recipes to determine the method of preparation and to check the accuracy of the converted units.

The quantity of cowpea seeds needed in cooking the 11 cowpea dishes selected in the 7-Day menu was calculated, as shown in Table 64. A total of 1690 g cowpea seeds per week was required to feed a family of 7 persons. This amount of cowpea seeds provided 9% of total protein and 4% of total energy provided in the 7-Day menu. The cowpea dishes

contributed significantly in both the protein and the energy in the 7-Day menu. The 11 cowpea dishes provided 17% protein and 12% energy; steamed glutinous rice provided 45% protein and 67% energy; animal food dishes provided 28% protein and 13% energy; vegetable food dishes, vegetables and fruits provided 10% protein and 8% energy in the 7-day menu respectively.

Table 64: Quantity of Cowpea Seeds Used in the 7-Day Menu

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total
	(grams)							
Dry main dishes	234	234	19	40	-	72	-	599
Liquid main dishes	104	104	69	69	71	77	77	571
Sauces	-	-	100	-	23	53	10	186
Desserts	41	41	63	41	26	96	26	334
Total	379	379	251	150	120	298	113	1690

A leaflet was made which contained photographs of the 11 cowpea dishes, the 7-Day menu and the quantity of food used in the menu, as well as the nutrient content of the menu. It was distributed to various government organisations, home economic extension departments, health workers in the villages, and village leaders, as it aimed to widen the utilisation of cowpea and the 7-Day menu. This leaflet was prepared in Thai (as shown in pocket inside the back cover of the thesis).

The cowpea dishes and the 7-Day menu were then prepared for the introduction to the villagers. There were three ways in which the cowpea dishes and the 7 day menus could be described to the villagers during the introduction: food display, cooking demonstrations and circulation of a leaflet.

In the food display, the 7-Day menu could be prepared and displayed in the exact quantity planned for a family of 7 persons. Recipes of cowpea dishes and the other dishes in the 7-Day menu could be displayed by laying out the ingredients in the exact quantities used in the recipes. Color photographs of the 7-Day menu could also be

displayed at the village's meeting place. These would help the illiterate housewives to remember the recipes and the menu.

Two types of cooking demonstration could be used for introducing the cowpea dishes and the 7-Day menu: human cooking demonstration and video cooking demonstration. Only the cowpea dishes should be demonstrated to the villagers, the other foods in the menus were already known how to prepared and only the final dishes should be shown. The cooking demonstration intends to give the housewives more confidence in the cooking of cowpea dishes and the 7-Day menu and to encourage them to try the dishes at home.

Although the cowpea dishes and the nutritionally balanced menus were successfully developed and ready to be introduced to the villages, the long term successful use of the cowpeas and the 7-Day menu by the villagers to improve their nutritional status depended on how these cowpea dishes were going to be introduced in the villages, how the villagers would be told and convinced and then realise the importance of the balanced diets and the need to grow cowpeas for their own consumption. The method of introducing these needed to be studied so that the most suitable method of introducing the cowpeas into a nutritionally balanced menu to the Northeastern villages could be developed.

PART THREE:

INTRODUCTION OF COWPEAS IN A NUTRITIONALLY
BALANCED MENU TO SIX VILLAGES IN KHON KAEN PROVINCE

The aim of this study was to develop a suitable method of introducing the low cost and nutritionally balanced menu and the new cowpea dishes to the Northeastern villagers and to determine the effectiveness of the method firstly in gaining acceptance of the menu, and secondly in increasing the use of cowpeas in the diet.

The specific aims were:

1. To develop appropriate introduction models by using different methods in the 4 stages of the adoption process for new foods - awareness, interest, evaluation, trial and adoption;
2. To determine which of these introduction models was the most effective in gaining the acceptance and the adoption of the new cowpea dishes and the menu;
3. To determine which method at each step of the introduction had the most impact in the introduction system;
4. To determine the importance of planning the introduction methods as 4 stages of the adoption process;
5. To determine the acceptability of the new cowpea dishes and the menu by the villagers and the problems in preparing and cooking the dishes and the menu;
6. To determine the changes in behaviour and attitudes to the new cowpea dishes and the menu;
7. To determine the most suitable and effective model to recommend for a regional launching programme for the menu and the cowpea dishes.

12. METHODS OF INTRODUCING NEW FOODS

Any innovation when introduced into a community has to pass through different stages before it is accepted and used by the majority of the people in the community. The adoption process consists of a sequence of decision making and behaviour stages, usually called awareness, interest, evaluation, trial and adoption. It was necessary to study the basic theory of the adoption process in order to develop a method for the introduction of the balanced menu to the villages.

There are two groups who introduce new food products to a community - the commercial food processing and marketing companies and the international and government agencies. The food companies are interested in introducing a new food to expand the sales of the company and most likely the profits. They have introduced many successful products throughout the world in both urban and rural communities and in developed and developing countries. Over the years, they have developed a system of launching new products into a market which is based mainly on consumer studies and on modern communication methods. The agencies have been concerned in introducing new foods to improve the nutritional status of the community. In the past, this was often food given in aid programmes but today, it is usually a food which can be grown in the community. The introduction methods are based on nutritional education. The methods used by both these groups were studied so as to develop suitable methods for the Northeastern villages.

The evaluation techniques and indicators used to measure the effectiveness of such introduction programmes were also studied as methods led to be developed to evaluate the effectiveness of the introduction of the 7-Day menu and the cowpeas.

12.1 THE ADOPTION OF INNOVATIONS

The diffusion of innovation consists of two parts: the diffusion process and the adoption process (Rogers, 1962). The diffusion process is the spread of a new idea from its source of invention or creation to its ultimate users or adopters. The adoption process is the mental process through which an individual passes from first hearing about an

innovation to final adoption.

The adoption process was conceptualised by Rogers (1962) in five stages: awareness, interest, evaluation, trial and adoption. At the awareness stage, the individual is exposed to the innovation but lacks complete information about it. He then becomes interested in the innovation and seeks information about it at the interest stage. At the evaluation stage, the individual mentally applies the innovation to his present and anticipated future situations, and then decides whether or not to try it. The individual uses the innovation on a small scale in order to determine its utility in his own situation at the trial stage. At the adoption stage the individual decides to continue the full use of the innovation.

In 1971, Rogers and Shoemaker introduced refinements to this traditional process and developed four functions of the innovation - decision process:

The knowledge function occurs when the individual is exposed to the innovation's existence and gains some understanding of how it functions.

The persuasion function occurs when the individual forms a favourable or unfavourable attitude toward this innovation.

The decision function occurs when the individual engages in activities which lead to a choice to adopt or reject the innovation.

The confirmation function occurs when the individual seeks reinforcement for the innovation-decision he has made, but he may reverse his previous decision if exposed to conflicting messages about the innovation.

Engel et al. (1968) explained the concept of adoption of new products by consumers in the marketing system with a general model of consumer buying behaviour based on the consumer's decision process and the consumer's learning process. The decision process consists of five processes linked in sequence: problem recognition, alternative evaluation-internal search, alternative evaluation - external search, purchases, outcomes. The learning process is the process by which consumer preferences are constantly modified and updated. There are five components of the learning process. Drive is any impelling stimulus that energizes behaviour, Cues and Stimuli are any environmental objects sensed by an organism, Responses includes attitudes, familiarity, perception and other complex phenomena, Reinforcement tends to strengthen the association between stimuli and

responses, Retention refers to the ability of retaining learned material over time.

Markin (1969) said that all consumer behaviour is caused or affected by learning and communication and explained it in a schematic model of consumer behaviour as in Figure 10.

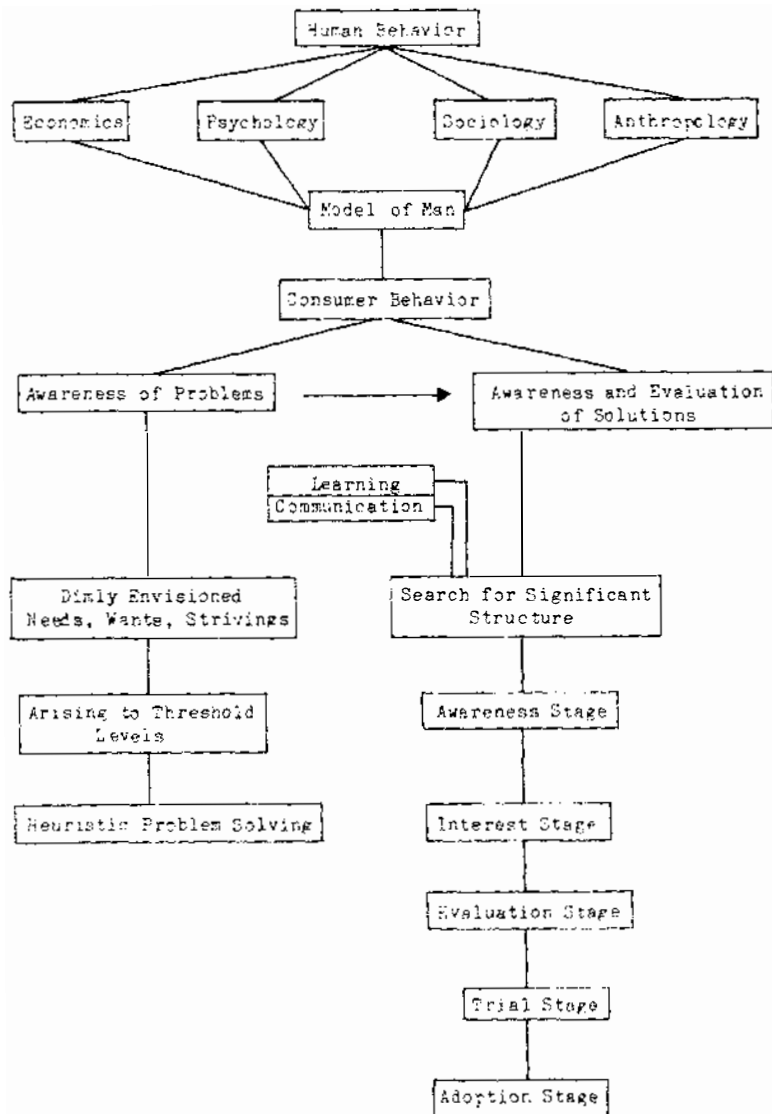


Figure 10: Schematic Model of Consumer Behavior: Its Context and Determinants (Markin, 1969)

There are many other versions of the innovative process, as reviewed by Kleyngeld (1974) and Midgley (1977).

Many factors affect the adoption process (Rogers, 1962; Rogers and Shoemaker, 1971):

- (a) The characteristics of the innovation - relative advantages, compatibility, complexity, tryability, observability.
- (b) The people in the society - innovators, early adopters, early majority, late majority and laggards.
- (c) The community - traditional and modern.
- (d) Culture - resistant or encouraging to technological development.
- (e) Effective communication - person to person, mass communication.
- (f) Time of introduction of innovation.

The type of person and type of community obviously affects the rate of the diffusion and the acceptance of the innovation. The traditional person does not either meet new individuals, recognise new roles or develop new social relationships as well as the modern individual. In the traditional community there is:

- A less developed or less complex technology, subsistence agriculture is the most common occupation.

- Literacy and education at a relatively low level. Communication via word of mouth is more prevalent than by mass media.

- Little communication by members of the social system with outsiders.

- Lack of economic rationality. Primary group relationships such as friendliness and hospitality are highly valued as ends in themselves rather than means to ends.

- Lack of ability to empathise or see oneself in other's roles, particularly the roles of outsiders to the system.

The modern community is more technologically developed, urbanised, educated, rational and inventive. Obviously the modern community will adopt innovations more rapidly than the traditional community.

The time when an innovation is introduced often affects the rate of adoption. If introduced too early, before the community is ready to accept it, adoption is slow. If introduced at a time when a community needs it, adoption can be very fast.

12.2 ADOPTION IN RURAL SOCIETY

Crooch and Chamala (1981) stated that it is unreal and impractical to assume that the diffusion and adoption models defined in developed countries are appropriate and applicable in all situations. Success will not automatically follow from "plugging in" an innovation into a social system.

Agencies introducing new methods to farmers have tended to rely on the "trickle-down" effect to transfer information through the social system. The Agriculture Extension workers tended to concentrate on the progressive farmers and believed that if they could be persuaded to adopt the new technique, the other farmers would follow. It has now been suggested that this does not occur in all communities and that there is not a general expansion of modern farming in the community but only the rise of elitest farmers (McAllister 1981; Roling et al, 1981).

If power is of central concern, individuals or reference groups will attempt to establish a power base and retain it at all costs. Thus a farmer can be motivated to adopt an innovation since it can assist him in retaining his position in the social hierarchy of a community as well as contribute to farm development. Such farmers can withhold, delay or distort information if such behaviour would be to their advantage. If status is more important than development of the farm, it is just as likely that the innovative farmer will discourage the natural diffusion of innovations through the social system to which he belongs. It is suggested that it may not be sensible to introduce innovation through the most innovative farmer.

In Thailand, this is apparently an unacceptable practice, because the culture does not encourage people to be leaders. In general, farmers are hesitant to take the lead for fear of being disliked by others. It is therefore hard to find good leadership, for only those who think that the position will give them enough personal benefit to be worth the risk of being disliked would thrust themselves forward. The basic beliefs and attitudes of the Thai farmers are: (Hein et al, 1980)

- (a) The farmer values "Khon Keng", the person who is able to show that he or she is more able than others, who can beat all others in everything. There is always competition among farmers to be Khon Keng. The individual farmer tends to be rather boastful

- and tries to show off.
- (b) Among Thai farmers, routine community activities can be managed through short term, or rather occasional, co-operation among the community members, but permanent or long term grouping for mutual benefits is difficult to obtain.
 - (c) Like people anywhere who lack necessary technology to master their environment, Thai farmers are ritual bound and superstitious.
 - (d) Envy is one characteristic of all peasantry everywhere and also in Thailand.
 - (e) Thais dislike to show face to face hostilities, or to argue with one another, particularly in formal meetings where people of differing status are present.
 - (f) Because of past abundant natural conditions, farmers love fun (sanuk), in the same way as this is the predominant behaviour of Thai people.

Such characteristics may all have a vital effect on planning the introduction of new foods to the rural Thais.

One must recognise also the importance of the social setting in which people live, especially the importance of the community. Members of a community influence each other in many ways and the channels of influence may be used to block innovations and attempts to introduce change. Almost all communities are composed of smaller social units which are characterised by certain kinds of social relationships and they tend to be regulated according to group memberships. The members of one's circle of companions are regarded as an "in-group". Other people, even some of those who may live in the same area, are viewed as belonging to "out-groups". Groups within communities often have a history of conflict or competition. Unless the agency introducing new ideas is aware of these conflicts, they may become identified with one group and gain the hostility of the others (Dadd and Starr, 1976). The natural groups in Thai villages are formed either through kinship connections or individual attachment to some person who has influence in the village (Hein et al, 1980).

Poor communities, as in Northeastern Thailand, have little control over the conditions which govern their lives. Dadd and Starr (1976) indicated that under conditions in which there are limited productivity and resources, rudimentary technology, high disease and death rates, little political influence and the promise of little change, it should not be expected that innovation will be accepted readily.

12.3 INTRODUCTION OF NEW FOODS

The introduction of new foods by commercial food companies or by agencies follows a general pattern as shown in Figure 11.

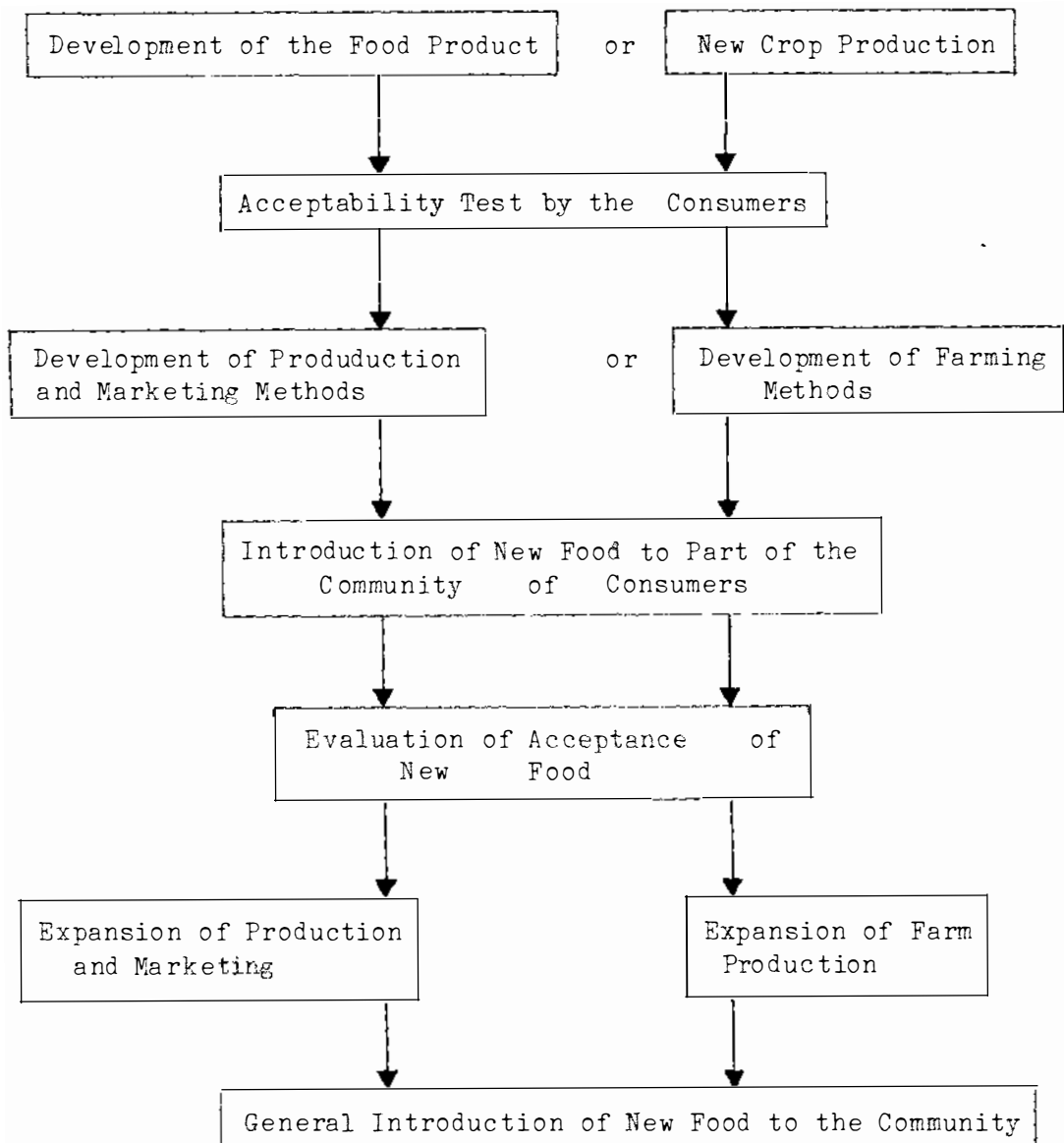


Figure 11: General Outline of Introduction of New Foods

12.3.1 Commercial Methods of Introducing New Nutritional Food Products

The first stage of new product development in the food industry is to study the market and in particular the consumers - to study their need for the products and the qualities that they desire in the products. Then a suitable product can be designed in the laboratory and when it has been shown acceptable in small consumer panels, the next stage is the commercialization of the product. Buildings to house the production line have to be erected, necessary equipment and machines have to be ordered, purchased and installed. Raw materials for the initial period of production are planned and stocked. A complete operation plan for launching the new product has to be developed as well as the business plan with detailed costing and profit analysis. Advertising and promotion has to be planned and organised. Then the product is ready to launch. However before the actual national launch, it may be desirable to carry out a market test to determine what is likely to happen when the product is launched on the market (Skinner, 1972; Hayhurst, 1973; White, 1973). The core of the most important parts of this system is the constant consideration of the consumer.

Because of the successful launching of many food products using these product development techniques, attempts have been made to use them in introducing nutritional products, in particular protein rich food products (Cordaro and Gall, 1975; Orr, 1972, 1977). Forman and Hornstein (1976) reviewed the USID Protein Food Program which was initiated in 1967 and provided grants to United States private food companies to explore the feasibility of initiating protein food enterprises in the developing countries. The rationale for initiating the programme was the belief that technology existed for producing low cost, high protein foods and that the United States food companies could play a key role in bringing such foods to the countries in need. The protein food programme was based on the premise that over the long run malnutrition among the poor could be reduced by the introduction of nutritious, inexpensive, vegetable protein. These foods would be nutritious; patterned to traditional food habits; acceptable to the consumer in terms of taste, texture, odour, appearance and convenience;

and low enough in price to be purchased by the needy. To create these foods required talent in development of new food products, manufacturing know-how, product promotion and product distribution. The protein supplements were derived mainly from soybeans, but also included cottonseed protein, sesame seed protein and high protein wheat fractions.

The companies encountered a number of problems: raw materials were often unavailable, local business opposition was encountered, the new ventures were regarded as threats, the new protein foods faced competition from free food distribution programmes and from availability of non fat dry milk at cut rate prices. Very few products have been produced and marketed successfully; only ProNutro in South Africa and Incaparina in Guatemala are usually cited as being both commercially and nutritionally successful. ProNutro was promoted by a door-to-door sample distribution, advertising on radio and press, demonstration in Bantu townships, mass feeding, advertising in clinics and schools. To give it prestige, it was launched on the South African European market before being introduced to the Bantu. This was one example where the "trickle down" theory was successful, although generally it is not regarded as a useful method of introducing food to poor people.

As described by Icaza (1976), in the initial phase of introducing Incaparina, acceptability tests were run in a community where an integrated health centre was functioning adequately and where acceptance of the health programmes by the community members was evident. Demonstrations by a nutritionist to a group of mothers initiated the acceptability trials. The product then was tested in a group of representative communities. Demonstrators were trained by a nutritionist and equipped with food specially prepared with Incaparina and information was given to community groups. The product was placed for sale in a local store. The promotional campaign was fully supported by the health centre doctors and nurses in their regular work. Acceptability was high. Purchases started and were followed by more stable sales. The product was then introduced on a national scale in local stores. Mass communication media and materials were used together with food demonstrations and group discussions to reach the target audience. Incaparina continues to be sold in Guatemala, and the commercial enterprise in charge of its production had to enlarge its plant in order to satisfy the increasing demand. Due to the world

economic crisis, Incaparina had to increase in price and this made it a little beyond the purchasing power of the people who need it. In 1975, the Guatemala National Health Department decided to subsidise the product, offering Incaparina at a lower price to those mothers who attend the well baby clinics.

Therefore, although private industry has the technical know how and the commercial efficiency to introduce new food products rapidly, its capability of reaching the poorly fed communities especially in rural areas is not great. Generally, the people do not have sufficient money to buy the foods. There is nearly always a need for the government to subsidise the product so that it can be sold cheaply (Mauron, 1975; Cordaro and Gall, 1975).

Systems of studying consumer needs have been described by Blair (1969) and Cummings (1979). Blair discussed a comprehensive long-term research programme which can determine the marketability of a new nutritional product. There are three interrelated stages: desk research, sociological surveys, and market research. Each is designed as an integral step in answering one basic question: "How to position the product in the consumer's way of life?". The major task is to identify and describe, in a changing situation, the varying characteristics of the consumer groups and the factors affecting food marketing and consumption. Desk research is necessary to obtain information about changing food ways. The initial sociological survey investigates the basic factors affecting what people may or may not eat, and which aid or inhibit the introduction of new foods. The second survey would deal with a specific group eg. the preschool infant in the family setting. The findings and insights from the sociological surveys can then be followed up by a number of market research investigations. Their purpose are threefold: to narrow down the crucial questions related to the introduction of inexpensive protein-rich food, to monitor the acceptance of innovations, concepts, and products, and to ascertain the efficiency of learning and behaving processes in regard to new foods.

Cummings (1979) used a new marketing research technique called "Consumer Value Analysis" (CVA) as a testing system in developing and launching a successful new protein product on the market. The main principle of CVA was to go into much more depth with consumers than other research techniques allowed, probing over a long period of time the real attitudes that lay behind the consumers apparent and often

superficial conceptions. The technique was used to develop product concept, brand name, advertising, product testing, package design and the final market mix test before making a decision to launch onto the market.

12.3.2 The Delivery System of Food Aid for Supplementary Feeding Programmes

In the World Food Programme (WFP), foods are provided for pregnant women and nursing mothers, infants, pre-school and primary school children usually in the form of supplementary rations. They are either dried skim milk powder or a protein fortified mix such as corn soymilk or fish, meat and cheese (Ronchi and Lopez, 1976). Different channels of distribution have been tried - schools, health clinics, nutrition rehabilitation centres and feeding centres (Maxwell, 1978). Supplementary food is also handed over to families for consumption at home and often the food intended for the mother and child is divided amongst all members of the family (Gongora and Show, 1977). Retail stores were used in Brazil for the distribution of pasteurised milk as a supplementary food and this proved a practical, inexpensive and fair way of making food available to vulnerable segments of the population (Dutra De Oliveira et al, 1980). In Botswana, supplementary foods were distributed through 312 feeding centres, as uncooked foods, at weekly or even monthly intervals (Stevens, 1978).

An interesting example in India was the Project Poshak (Gopaldas, 1978). The project was a large scale pilot model, and demonstrated the support of health and nutrition education to the supplementary feeding programme. A "take-home" food supplement - Poshak - was distributed every week from the primary health centre. Village level cooking demonstrations were conducted for several weeks before the initial distribution of Poshak to ensure both awareness, continued support of the programme and a favourable attitude to the product. They also served as a forum for discussing the programme with the villagers and creating a congenial atmosphere for the scheduled fortnightly visits of the paramedicals, who would carry out extension and follow up home visits in the villages. Mass media such as pamphlets, posters and films were used to strengthen the impact of the demonstrations. Flip charts of ten nutritional themes illustrated by simple cartoon type pictures in colour were used in educating the illiterate population.

Demonstration of the feasibility of nutritional rehabilitation of severely malnourished children within the child's home was also used as a means of educating the mother and community.

Suggestions have been made to improve the impact of a supplementary programme. Gongora and Shaw (1977) suggested women themselves should be involved in the distribution of foods and the spread of nutrition education and more attention should be given to reaching the family as a whole as well as the use of resources within the household. Maxwell (1978) suggested using local food. There are very good educational reasons, especially in cases where mothers are expected to absorb new food habits and apply them at home. However Ronchi and Lopez (1976) pointed out that the type of foods available to the World Food Programme are relatively limited, and in spite of all efforts, it is not always possible to provide foods which are known to be produced or easily available at low cost in the recipient countries. This situation creates problems in nutrition education, which in principle should be carried out on the basis of locally available foods, to ensure continuation at the end of World Food Programme assistance.

Nutrition education has seldom been included in World Food Programmes owing to inadequate supervisory and specialised staff, lack of equipment and teaching materials, poor distribution infrastructure or faulty project planning and implementation (Gongora and Shaw, 1977). In recent years, attempts have been made to include health and nutrition education components in the World Food Programme, particularly in school meal programmes (Baqchi, 1980).

12.4 NUTRITION EDUCATION

The primary objective of nutrition education is to improve the nutritional status by changing food habits (Sevenhuysen, 1978). It must be related to the social, economic and cultural values of food so that people are motivated to make food choices which will result in their optimal nutrition well-being (Ullrich and Briggs, 1976). It is the process of acquainting people with the value of resources already available to them and persuading them to change existing practices (Berg, 1973). As stated by the Director-General of UNESCO, in his address to the 59th session of the Economic Social Council of the United Nations: "Education and communication must contribute to providing people with the knowledge and know-how which will enable them more effectively to combat, by their own efforts, disease, malnutrition and poor living conditions in general. At the same time, education and communication must enable them to become fully aware of their conditions and of the role which, through their own actions, they can play in the transformation of society" (Cited by Hookham, 1980).

12.4.1 Nutrition Education Programmes

The old formal methods of teaching nutrition are not now accepted and methods based on the social, cultural, environment in the community are recognised to be more effective (Sinclair and Howat, 1980). The educator develops among the population, the conviction that they can act to improve their situation themselves, and do not always have to rely on outside help (Sevenhuysen, 1978; Collins, 1977).

UNICEF has encouraged nutrition education within the non formal education system ranging from adult alphabetization to community participation courses. It has also organised and supported many courses for elected village leaders and community recruited village health workers, promoters, and auxiliaries, who, once trained, have the task of disseminating what they have learned to mothers and other community groups. Practical training is given in food demonstration, home and village gardening, small animal rearing, use of purified water, hygiene, sanitation. UNICEF has developed a Project Support Communication Network which co-operates with governments in the spreading of information regarding health care, nutrition, education, community development, by supplying, or assisting in the development of

educational aids (for example: films, filmstrips, books, posters, etc) and co-operating with various media (Trimmer-Smith and Tepley, 1980).

The real impetus to nutrition education was given with the introduction of the Applied Nutrition Programme (Bagchi, 1980). The ANP is basically an education programme - a programme to show rural communities how to grow and use the foods needed to improve their diets, especially the diets of mothers and children. The programme involves:

- (a) agriculture, to increase food production;
- (b) nutrition education, aimed at teaching better use of available food supplies;
- (c) supplementary feeding of preschool and/or school children (McNaughton, 1978).

The ANP has been a success in Korea where there are about 1500 village nutrition stations. The main functions of the nutrition station are cooking demonstrations and practice, food processing and preservation of local foodstuffs, group feeding during planting and harvesting seasons, child feeding at day care centres and nutrition education. Remote areas are visited by nutrition education vans to provide extension services including nutrition education (Park, 1980).

Mass media (press, cinema and outdoor media) were used in Maharashtra, India (PAG, 1976) to impart nutrition education. The target group for the campaign was those who may be termed the reachable and persuadable. It showed that when imaginatively conceived and creatively used, mass media in India offers an effective means of imparting nutritional knowledge to vast numbers of people and the cost of such teaching is also extremely low. The campaign was least effective in the smallest towns.

12.4.2 Places and People Used in Nutrition Education

Nutrition education can reach individuals and communities through the home, school, daycare centre, mother craft centre, health centre and clinic.

Health centres and clinics are often centres for nutrition education because of the comparative ease of getting the subjects for education sessions and the high acceptability of the education. However they have not always been successful because: the message to be conveyed to the mothers was imparted in the form of "teaching", the

information was in the textbook pattern for developed countries the health workers who acted as educators quite often were ignorant of the cultural basis for food practices in the area, and offered advice which clashed with these, being clinically oriented, the educators usually regarded education as something vague, in contrast to the clear cut clinical work with its visible results. Moreover, an over burdened health worker in a health centre or a clinic regarded nutrition education as an additional and rather undesirable load (Baqchi, 1980).

Home visits give an opportunity to assess the needs of the individual family and also it is much easier to show the mother how to prepare different foods and see how well the mother is able to repeat what she has learned. It was found to be one of the next effective teaching methods when programme aides were used to work with the home maker on a one to one basis. The programme aides make the greatest strides in changing food habits (Oliver, 1967; Spindle et al., 1969; Ullrich and Briggs, 1976).

School is the most important place where throughout the world nutrition education can be taught in nursery, elementary and secondary school through the school curriculum, school feeding or school lunch programme, or school gardening (Ullrich and Briggs, 1976; Baqchi, 1980; Park, 1980). Teachers are among the key persons to incorporate attitudes toward nutrition during the children's formative years. School teachers have also varying degrees of responsibility for non-formal education programmes. They are government-funded persons who could make significant contributions to the improvement of nutrition in the community as suggested by Dwyer (1976).

Dwyer (1976) suggested that besides the school teacher the other 3 types of workers at the local level: the health auxiliary, agricultural liaison and the community development workers could be of assistance to the nutrition education at the village level. The community workers include:

Paraprofessional aides - extension or nutrition aides, health aides, nursery and day-care aides, teacher aides, midwives;

Food Service Personnel - schools, hospitals and nursing homes;

Lay leaders (volunteer and paid) - community service leaders, youth club leaders;

Food distribution personnel - food store and food vendors.

Among the most useful purveyors of nutrition information at the community level are the "nutrition aides" or lay-leaders who have had some personal nutrition experiences or informal training. The paraprofessional who is from the same village, neighbourhood or ethnic background can be very effective in understanding how to establish new eating patterns which will improve the nutritional status of the people being reached (Oliver, 1967; Spindler, 1969).

12.4.3 Methods Used in Nutrition Education

Food demonstration and mass communication techniques are the important methods widely used in nutrition education. Involving people in group discussion and decision is also an effective nutrition education method in persuading change in food habits (Lewin, 1958; Whitehead, 1973). In Indian experiences, oral transmission of message through dramatizations, folk dances, folk songs and puppet shows, have been effective and appropriate to reach illiterate people (Devadas and Chandrasekhar, 1970).

A very simple form of nutrition education is the actual demonstration of the preparation of food and tasting of the finished product. This technique is often used by industry in the introduction of new products, and can be used to promote the introduction of balanced meals or the utilization of newly introduced crops (Raw 1980). Devadas and Chandrasekhar (1970) found that demonstrations were the best method for adult audiences. Demonstrations, especially result demonstrations, offer an opportunity for the nutrition educator to explain in concrete terms the ideas she aims to transfer. They also provide an opportunity for the learner to see, sometimes take part and thus identify himself with the situation. In the case of introducing the use of a new crop, various preparations that could be made out of this new crop were demonstrated in one of their homes. The home maker thus selected invited all the others to her home. Some leaders in the group were invited to try to make the foods. Finally, those who were present were invited to taste the products and judge them. Through all these steps audience members were involved intimately with the demonstration and learning could result. Demonstrations give an opportunity for the people to see, hear and do.

Mass communication techniques, employed mostly by food industries, sometimes are used to promote food products under the umbrella of

solving nutrition in the developed countries (Baqchi, 1980). Manoff (1970) described the first project in nutrition education that used commercial advertising techniques in Ecuador. Parlato (1970) described the use of advertising and mass communication by CARE-India to launch an extensive nutrition information campaign in rural and small town areas in India. But such use of mass media reaches only a very small fraction of the population which badly needs such messages (Baqchi, 1980).

Colle and Fernandez de Colle (1978) reported using a cassette to provide health and nutrition education to the villages in Guatemala. A hired person brought equipment and played the cassette at the "Pila" - an outdoor public laundering centre. The women could listen and receive information while they were working.

Consumer nutrition education can be provided through nutrition exhibitions and food fairs: Hixson (1975) reported the success of Nutrition Expo '74, held in Los Angeles, in providing information to consumer and health professionals. Smitherman (1976) described an Arizona Food Fair in which nutrition education was provided unobtrusively by talks, demonstration and by distribution of education materials. The fair was highly successful.

12.4.4 Effectiveness of Nutrition Education Programmes

There has been disagreement of how effective are nutrition education programmes. Baqchi (1980) cited the comment of the Eighth Report of the Joint FAO-WHO Expert Committee on Nutrition in 1971 that "...there is surprisingly little evidence that existing techniques of nutrition education are effective or represent a good utilization of limited resources, and it appears that some conventional programmes of nutrition education have not succeeded in influencing food habits in the desired manner". McKenzie and Mumford (1965) also concluded from a review of some 26 publications that nutrition education can neither be regarded as always effective nor always ineffective, its impact depending on programme design and personnel. Nutrition education can change dietary habits within carefully defined limits (Whitehead, 1973). Sevenhysen (1978) in his critical reviews of the methods used came to the general conclusion that the information on nutrition used in educational programmes was usually technically correct, but often not sufficiently adapted to the needs or wants of the audience.

If nutrition education is to have an impact, it must utilize a multifaceted approach. It must:

- provide the array of information necessary to make an informed decision;
- give individuals the skill to integrate, synthesize and process the information to acquire a level of understanding which allows them to integrate nutrition information with other relevant information;
- motivate them to act on the information to make intelligent, informed and purposeful food choices (Guthrie, 1978).

Effective nutrition education should be relevant, put across in a meaningful and effective way (Graves, 1979) and should be geared to the needs and problems of the people and carried out with their active co-operation (Devadas and Chandrasekhar, 1970). There must be the interest and involvement of decision makers and problem solving administrative level personnel, co-ordination among the government ministries concerned, active participation and involvement of the community concerned and trained workers at the grass roots level (Parks, 1980).

Davey and McNaughton (1969) in considering the possibility of nutrition education achieving its objective, said that there are 3 stages of inducing change. The first stage is an understanding by the population of the change to be induced, the second stage is an acceptance by the population that such a change is desirable and beneficial to them and the third stage is putting the change into effect. The first aspect involves the decision of what is to be taught. Ordinary people are unlikely to accept changes which even a limited experience tells them are not feasible. The second aspect is to consider very carefully how much nutrition science should be included in a nutrition education campaign for illiterate populations. The number of changes in food consumption which are suggested must be kept to the minimum and should be kept very simple. The changes suggested must be related directly to improving the deficiencies in the diet. The third aspect concerns the method of nutrition education. Nutrition education programmers need to pay more attention to communication techniques, particularly in relation to perception and comprehension by illiterates, and to motivation. They felt that the introduction of the communication techniques used in food promotion into nutrition education campaigns would be well worth a trial.

12.5 COMMUNICATION METHODS

Promotion of a new food product is obviously dependant on communication, whether it by word-of-mouth or by the mass media.

Communication involves three basic elements: a source, a message and a receiver (Crane, 1965; Webster, 1971). A useful outline of Markin (1969) is shown in Figure 12.

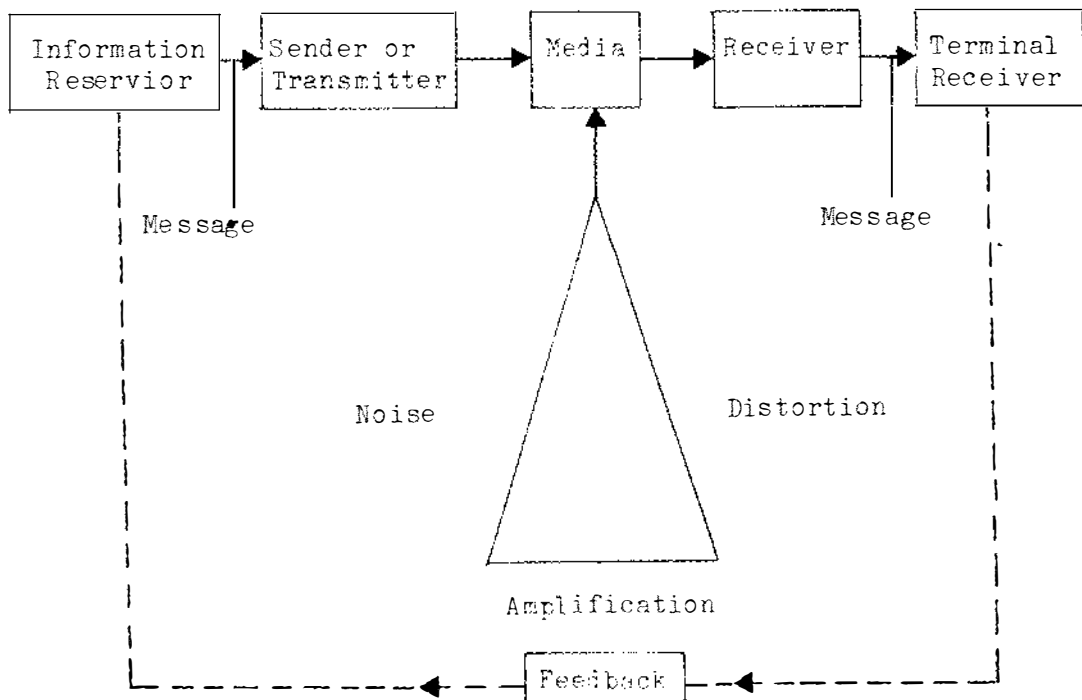


Figure 12: A Simplified Communications System (Markin, 1969)

This shows that the communication has often to go through some media and is not direct. Also that there can be a feedback from the receiver either directly or more often through an information reservoir.

The variables that affect this communication system are many but can be grouped as message variables, media variables and audience variables. Obviously messages can be written or presented in different ways and different types of media can be used. These can to a certain extent be controlled. However there are some variables that cannot be controlled but have to be taken into consideration when planning the

message and the method of communication. Examples of these are: needs and wants, socio-cultural factors, mental state, personality factors, and other internal and external stimuli, such as state of health or pre-occupation with the current thought. Group membership is another variable, influencing the communication process in two ways: by providing standards for evaluating one's attitudes and behaviour; and by acting as a network for the flow of influence and information (Webster, 1971).

12.5.1 Types of Mass Communication

The communication channels used in marketing to reach consumers are shown in Table 65.

Table 65: Channels of Reaching Consumer (Watts, 1970)

Press and electronic media:
newspaper, magazine, journal
radio and television.
Promotion:
Trade promotion: bonus offer, trade coupon, gifts, some product giveaway.
Consumer Promotion: reduced price, sample handout, pack giveaway, coupon, consumer competitions.
Demonstrations:
Exhibition demonstrations
In-store demonstrations
Club/institute demonstration
Open air show or fetes
At home demonstrations
Direct mail
Information service
Education
Exhibitions
Clubs, societies and institutions

Mass communication in developing countries can be done through a wide variety of media ranging from the face to face media, such as the school system, the various extension services and the more informal communication channels in traditional society, to the technological mass media such as radio, T.V., newspaper (PAG, 1973).

Ascroff (1976) explained that, traditionally, the field of diffusion of innovation distinguishes between two broad categories of

communication based on the media they use. Those using predominately face-to-face media are known as interpersonal communications, and in the rural context, generally are extension agents. Those who use print and electronic mass media usually are called mass communicators. In less developed countries, these two role-players are totally different from each other in terms of background and training. Extension agents are generally rural-oriented, with a strong background in such disciplines as agriculture, health, education, or community development. They may have received a modicum of practical training in audio-visual methods but little training in ways of changing basic behaviour of people. They are, first and foremost, technologists, innovation experts. Mass communicators, on the other hand, are generally urban-oriented, trained in the techniques and technology of media management and operation, or in the production of messages for mass consumption. They may have some theoretical training in mass-media technique and tactics for changing people's beliefs, attitudes, and behaviour, but little practical training. They, too, are technologists, mass-media experts.

Both these roles are necessary, but there is a missing role which emphasizes the knowledge and skills of how to change people's behaviour in desirable directions. Such a role already exists in commerce and industry, where specialists in communications, called commercial advertisers, are skilled in the knowledge of how to motivate individuals and masses to adopt the manufacturer's new products.

12.5.2 The Organisation of the Communication Programme

Firstly in organising a mass communication programme one must state the objective of the mass communication programme. PAG (1973) advise to define the objectives of mass communications in a way which is consistent with its potentials, eg. transfer of specific nutrition knowledge or information to a specific part of the population.

Secondly one must know the definition of the target audiences, eg their age, socio-economic status, family pattern, language, food pattern, habits, this is indispensable to appropriate message design, message testing and media selection. There are also a number of intermediate audiences who can act as change agents in the change process, in which they can be reached by one or more mass communication channels, eg. retailers and food vendors.

Thirdly, the message design, it is the communicator's job to translate the information carefully and clearly to serve a specific objective into a communication unit - mass media message. The message construction is dictated by the communication methods used and also the differing concepts of foods, the local customs, beliefs and attitudes. The successful message design depends on the understanding of and respect for the psychology of the recipient at the village level (PAG, 1973).

Fourthly the mass communication is chosen by comparing different methods by the number of people who receive the message and the quality of the message that is received. Face-to-face communication has greater personal persuasiveness but it tends to take too long where a large number of people have to be reached. Mass media is faster and also can deliver the same message to all the consumers (Manoff, 1974). However, in less developed countries the mass media achieve only limited penetration deep into the rural areas where the bulk of the population is located. Television is restricted to urban areas, by virtue of high receiver cost and lack of rural electrification; the print media also are largely urban and in addition, radio is not yet in every rural home (Ascroft, 1976). Experience has shown that instead of using one type of media, a two step system is more effective. Research on the diffusion of innovations and the study of mass communication effects yield ample evidence to indicate that mass communications can create awareness and understanding of a nutritional innovation. But this research also shows that when the potential adopter of an innovation approaches the adoption decision, he turns to personal channels. Thus it becomes imperative that mass communication is not used alone. The effect may be only to create awareness and understanding where the objective is to generate change. Awareness is relatively easier to create than behaviour change.

Lastly, who communicates to rural people is often more important than what is communicated. One source may be believed and another rejected. Some sources are deemed more credible than other because of their perceived trustworthiness, competence, or social acceptance. In less developed countries the social acceptability of a source is frequently more important in credibility than are competence and trustworthiness combined. The trained communicator is sensitive to the need to find acceptable sources for the messages he wishes to transmit. A useful strategy is to recruit rural persons, already perceived as

credible, to serve as primary sources of communication. Social leadership figures may be selected to serve as discussion leaders, and given direction in the fundamentals of the innovations to be diffused. When technical detail needs to be added, or if questions arise that the leader can not handle, the young experts, who stand by as resource people, are summoned to fill in the gaps and conduct demonstrations.

12.6 EVALUATION OF NUTRITION PROGRAMMES

Formal evaluation means a systematic process of collecting and analyzing data related to the planning and executing of a programme and, especially to the measure of its progress, its results and its side-effects (Latham, 1972). Latham stated that evaluation should:

- permit a realistic definition of objectives and sound programme planning founded on reliable baseline data;
- provide continuous information which will indicate whether modifications are needed as programme activities move through their various phases, and if so modifications should be introduced;
- verify the adequacy of methods and techniques being used, including techniques of co-ordination, and to aid in the development of new ones, as required;
- disclose evidence of behavioural changes in individuals and groups as a result of the programme and indicate the degree of the programme's acceptability to the local population within the context of prevailing educational levels, existing or newly created modifications and sociocultural patterns;
- determine, generally, the extent to which the programme is achieving or has achieved the objectives established for it including costs.
- contribute to the development of responsible participation and increased job satisfaction of staff at all levels, thus stimulating work efficiency and morale; and, finally,
- assist in ensuring the interest, involvement and responsibility of individuals and groups for whom the programme is intended or who are able to contribute to it.

In nutrition education, evaluation was rather haphazard in the early studies. Guthrie (1978) said that nutrition education research

from 1900 to 1970 had been directed more to the dissemination of nutrition information with the assumption that improved knowledge would be reflected in improved behaviour. The methodology to evaluate the effect of education on behaviour did not exist in this period. But more systematic methods are now being developed. It is important to identify the important indicators and find a method of measuring these indicators.

12.6.1 Evaluation Indicators

The effects of a nutritional programme can be measured at four levels - knowledge, attitudes, beliefs and values; food consumption decision; nutrition intake and lastly nutrition and health status (Sims and Smicklas-Wright, 1978). As it is difficult to determine behaviour change and relatively easy to measure cognitive knowledge, a considerable amount of the evaluation of nutritional educational programmes has been on knowledge gain (Guthrie, 1978; Sims and Smicklas-Wright, 1978; Wolf, 1980). If the indicator be nutrition awareness then the number of people contacted is a proper measure (Gift et al, 1972), for example the number of training courses and the number of people trained (Bagchi, 1980).

The problem of choosing an appropriate measure of change in food selection behaviour is more complicated but it can be based on observed or reported food selection. Techniques for measurement of change in attitudes or the establishment of future behaviour are extremely limited even when used under expert guidance. Often subjective indices have to suffice. Willingness on the part of the learner to pass information along to his neighbour, agreement to participate in a series of meetings, or consent to try a new food or changes in shopping practice are indeed tiny signs of progress but they give evidence of a positive response. Accumulated over time, such indicators can provide perspective on the effect of a program with individuals, or when summarized, the effect with a group (Gift et al., 1972). When considering the production component, the indicators were easily identified as the number of kitchengardens, the family units with poultry farms, etc. Increased consumption levels of particular food may measure an improved nutrition (Ritchie, 1967). Significant changes in the nutritional status have been shown by increase in heights and weight of children and even some biochemical parameters like

haemoglobin (Baqchi, 1980). Height and weights have been reliably shown to be sensitive to improved protein-calorie nutrition in preschool children; height is more sensitive than weight. Morbidity and mortality appear to be poor and insensitive indicators of nutritional status in the preschool years, although infant mortality may ultimately prove to be a useful indicator where medical care is otherwise adequate (Habicht and Butz, 1979).

It is important that a base line be determined before starting the programme or otherwise it will not be possible to determine adequately the effect of the programme. Two kinds of information are required. First, it is necessary to know who are the people to be served by the programme. What are their ages, sex, social background, previous educational history, etc. Such information is necessary to describe adequately the group to be served. Secondly, it is necessary to know the initial status of such people with regard to what they are supposed to learn. Are they already proficient? If not, what is their initial degree of proficiency (Wolf, 1980). Then a plan for the nutrition education programme can be developed around realistic concepts of behaviour to be modified, which will produce a desired change. These concepts should be listed in relation to the needs for change indicated in the baseline data. Concepts should be action oriented statements such as "to increase the feeding of pulse to weaned children" and must also be attainable within the context of the community for which they are planned (Ullrich and Briggs, 1976).

Other measurements that are important are (Wolf, 1980):

Execution of the programme: information about the way in which a nutrition education programme has been carried out is crucial. If the programme that was carried out differs markedly from what was intended, then it is important to know this and the reason for it. Failure to gather information about how faithfully the intended programme has been carried out can lead to the issuing of evaluative judgements about a programme that may be substantially different from what educators thought was being evaluated.

Costs: it is important to know how much the programme actually costs. A nutrition education programme that is tried out on an experimental basis could be so costly that no matter how effective it is bringing about desired changes in people, large-scale implementation would be prohibitive.

Supplemental information: there are three sub-classes of information involved; first, opinions and reactions of various persons concerned with the programme being evaluated, secondly supplemental learning; and thirdly side-effects of the programme.

Opinion and reaction information about a nutrition education programme being evaluated can be critical. One must make provisions for securing information regarding local acceptance of the programme. Attempts should also be made to obtain information about what people are learning as a result of a nutrition education programme other than what was specifically intended. Educational programmes can have side-effects too. Follow up studies are needed to identify what might be happening to persons who have gone through a particular nutrition education programme.

12.6.2 Evaluation methods

Few evaluation studies have been made of nutrition education programmes. This is due partly because purely technical devices for use in nutrition evaluation have not been fully developed (McKenzie and Mumford, 1965). And in spite of attention given to the methodology of evaluation from the middle of 1960's on, and the organisation jointly by the FAO and WHO of technical meetings and regional seminars to provide orientation with regard to putting this methodology into practice, there has been very little formal evaluation of the FAO's technical assistance in nutrition education and training (McNaughton, 1980). Bagchi (1980) also stated that there is an absence of a simple method for evaluation and even the field-guide for the evaluation of nutrition education developed by AID in 1975 would hardly be suitable for assessing the effectiveness of such programmes.

As reviewed by Hennigan et al. (1979) there are a number of major methods that may be used to gather measurements, each of which may incorporate a variety of techniques such as the administration of formal tests, direct physical measurement, and other kinds of systematic observation. Some of the techniques that have been used are: interviewing, has been used for pre and post test of nutrition knowledge related to the programme or for the consumption of demonstrated food; surveying e.g. survey of food buying habit, food consumption, increase in purchase of certain food in the market,

increase growing of certain foods, and dietary survey; and observation, for example photographic record of meal chosen in a school canteen, plate waste in the school lunch programme and also direct physical measurement of the feeding programme (McKenzie and Munford, 1965; Ullrich and Brigg, 1976).

Three evaluation methods have been generally identified: experimental, statistical and expert judgement (Riecken, 1979). According to Hennigan et al. (1979), in the experimental approach, two or more randomly chosen groups are compared at different levels of the "treatment" in the experiments or one group receives the "treatment" and the other group does not. In this way all the non treatment variables are said to be experimentally controlled. The statistical control approach is characterised by the use of statistical adjustments to control for the influence of nontreatment variables. When it is impractical or impossible to create randomly equivalent comparison groups, but the treatment, non treatment and outcome variable can be measured for individuals who have received different amounts of exposure to the treatment, then the evaluator can analyse the statistical relationship between relevant variables under various assumptions about the casual order of the variables. Expert judgement is a form of evaluation by gathering experts opinions about the merits of a particular project. Each of these methods has certain advantages and certain disadvantages, so that choice of an appropriate method is not simple (Riecken, 1979).

Once the idea or information has been gathered, it is necessary to analyse the resulting data both qualitatively and quantitatively to determine what is being evaluated, the effect it is having and the cost associated with the enterprise. Once analysed, however it is necessary to synthesize the results into a series of judgements about the worth of the programme and to make recommendations with regard to future action (Wolf, 1980).

12.7 CONCLUSION

Various workers studying the methods of introducing new foods and methods used in nutrition education have found and recommended important facts and factors which would be useful for the planning of the introduction of the 7-Day menu and the cowpeas to the villages in Northeastern Thailand.

The food marketing and the nutrition education experts have pointed out the importance of studying the consumers and their behaviour and planning the method of introduction to fit with the needs and wants of the people in the communities. It is necessary to make people understand what we want them to change, motivate them to change and put the change into effect. But this takes time and depends on the characteristic of the innovation, type of people and communities, method of communication also method and time of the introduction.

Certain methods and channels of communication have been found to be useful and give more impact when they are used at different stages of the adoption process, i.e., mass communication is effective for creating awareness, face to face communication has greater personal persuasiveness, food demonstration, people participation and group participation are useful and effective at the later stage of adoption process to gain trial and acceptance. The importance has been recognised of the knowledge and skills of "how to change people's behaviour in desirable direction" which is the knowledge and skill of the food company. The commercial system studying the consumer's needs, and in particular the new marketing system based strongly on consumer studies, described by Cummings (1979), may be valuable to follow. But it has been found that the techniques used in the developed countries are not always applied to the rural society of the developing countries. The villages in Northeastern Thailand have their own village life style and there is a need to adapt the commercial product launching system to fit with this lifestyle.

It is also important that nutrition education must be given to the villagers, to provide them with the "knowledge and know-how" of the new 7-Day menu and the cowpeas so they can help themselves to improve their nutritional status in the future. It is also important that the villagers must have at the very beginning of the introduction a good impression of the 7-Day menu, the cowpeas and the way they have been introduced. A suitable introduction method that fits with the culture,

beliefs and attitudes of the Northeastern villagers is therefore required for the successful introduction. Communication techniques and communication channels suitable for the Northeastern villages where most of the population are illiterate are needed so that the food and nutrition information can be communicated rapidly, with technical correctness and with greatest influences.

It could be assumed before the villagers would accept and adopt the 7-Day menu and the cowpeas they would pass through the same sequence of decision making and behaviour stages as in the adoption process developed for new food products. The method of introducing the 7-Day menu and the cowpeas could therefore be planned to develop in a sequence of methods following the four stages of the adoption process: awareness, interest, evaluation and trial. Firstly, a method should be developed to pass the information of the 7-Day menu and the cowpeas to the villagers so that the villagers would become aware of the new development; secondly develop a method that could provide information on the 7-Day menu and the cowpeas in great detail, so that the villagers became more interested and they could compare the new foods to their own life values and past experience and see the advantages of the new foods; thirdly, the method should be developed so that the recipes could be demonstrated to the villagers as well as the cooking procedures and the ingredients used in the 7-Day menu and the cowpea dishes so that they could make their own evaluation of the 7-Day menu and the cowpeas, and understand that the foods in the 7-Day menu were their own popular foods and they could find raw materials available in their own villages; fourthly, develop a method that could encourage villagers to try cooking by themselves at home. Once they had tried cooking the menu and the dishes, they should have more confidence and confirm their decision to adopt the 7-Day menu and the cowpeas and they might also persuade other villagers to cook the dishes.

There is therefore a need for careful selection and development of methods of introduction for introducing new foods to the Northeastern villages. It is also necessary that the selected and developed methods be evaluated for the most suitable and effective method. The methods could be selected and developed to suit the Northeastern social life, from the most successful methods of introducing new food products used by commercial food companies, and from the most successful methods used in the field of nutrition education and agricultural extension programmes.

13. THE METHODS USED IN INTRODUCING 7-DAY MENU AND COWPEAS TO SIX VILLAGES

13.1 WORKPLAN

Three introduction models were developed as the initial stage for the planning of the introduction of the 7-Day menu and the cowpeas dishes into the Northeastern villages. There were four steps for each one of the models, as described in the "adoption process". Working procedures were designed for each of the four steps. The overall plan for the introduction of the 7-Day menu and the cowpeas to the Northeastern villagers is shown in Figure 13.

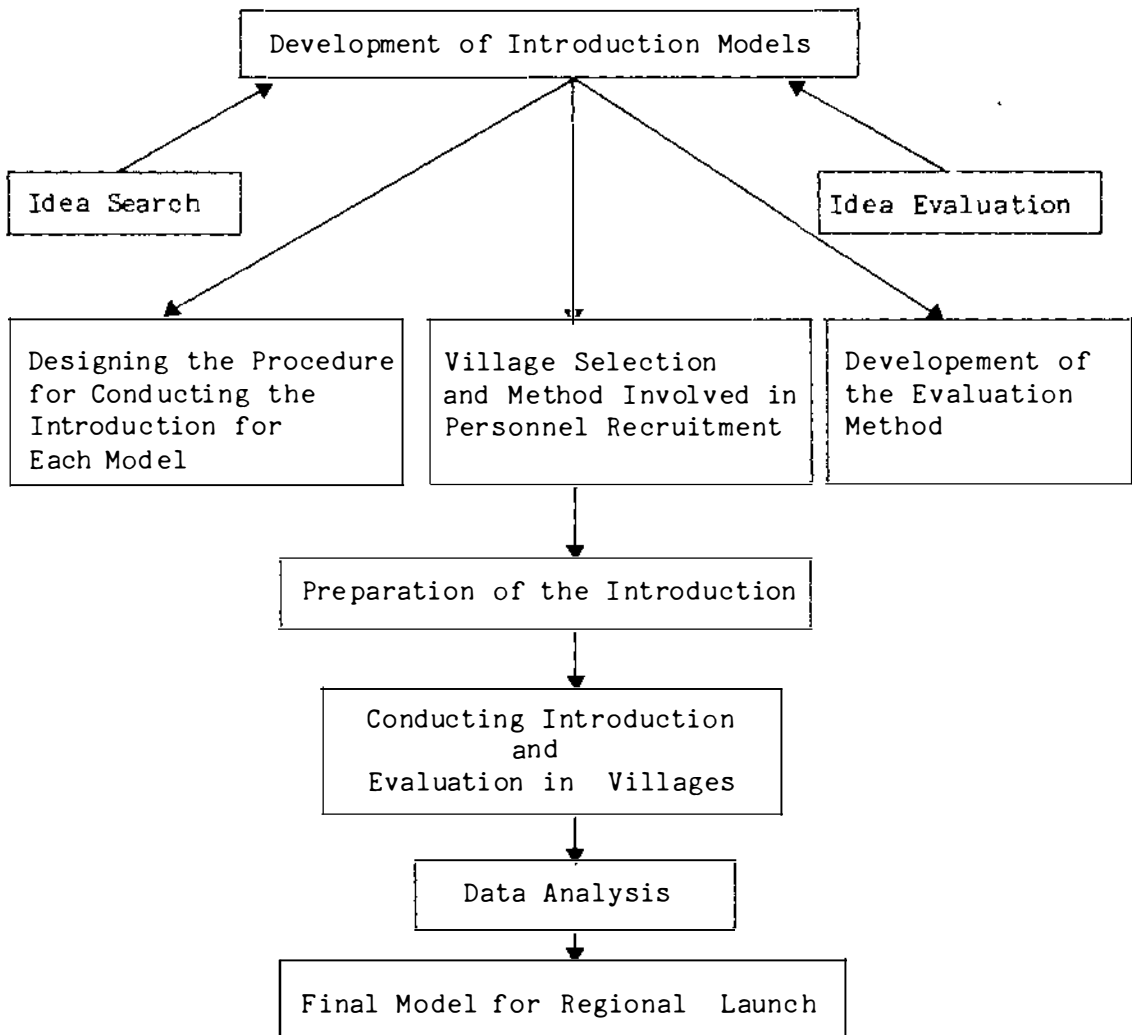


Figure 13: The Overall Work Plan for the Introduction of Low Cost and Nutritional Balanced Menu to the Villagers

Six villages were selected from the project's ten villages for the introduction. Village personnel involved in the introduction, the group discussion leaders and the contact persons, were recruited. The methods used to evaluate the introduction models and to determine the reactions of the villagers to the 7-Day menu and the cowpeas dishes were also developed.

The food raw materials needed for the introduction were purchased. The recipes and cooking procedures were developed and video tapes were made based on the nutritional information and the cooking procedures. The introduction and the evaluation were then scheduled. The introductions were conducted over 4 months from August to November 1981. Data were collected and analysed. The most successful introduction model then obtained.

13.2 THE DEVELOPMENT OF THE INTRODUCTION MODELS

The introduction models were developed in the systematic steps shown in Figure 14. Firstly, ideas for introduction methods were gathered by brainstorming. They were then allocated into the four stages of the adoption process. These methods are shown in Figure 15. A brief description of these methods is given in Appendix 12.

The methods in the four stages were combined to make up suitable introduction models, e.g. one introduction model was a combination of radio in the awareness stage, television in the interest stage, printed material in the evaluation stage and cooking at home at the trial stage. This combination was proposed as it was considered possible to conduct this introduction in Northeastern villages. A total of 250 introduction models were made up. They were then screened using four screening steps in a non statistical screening method to eliminate some of the introduction models with less potential.

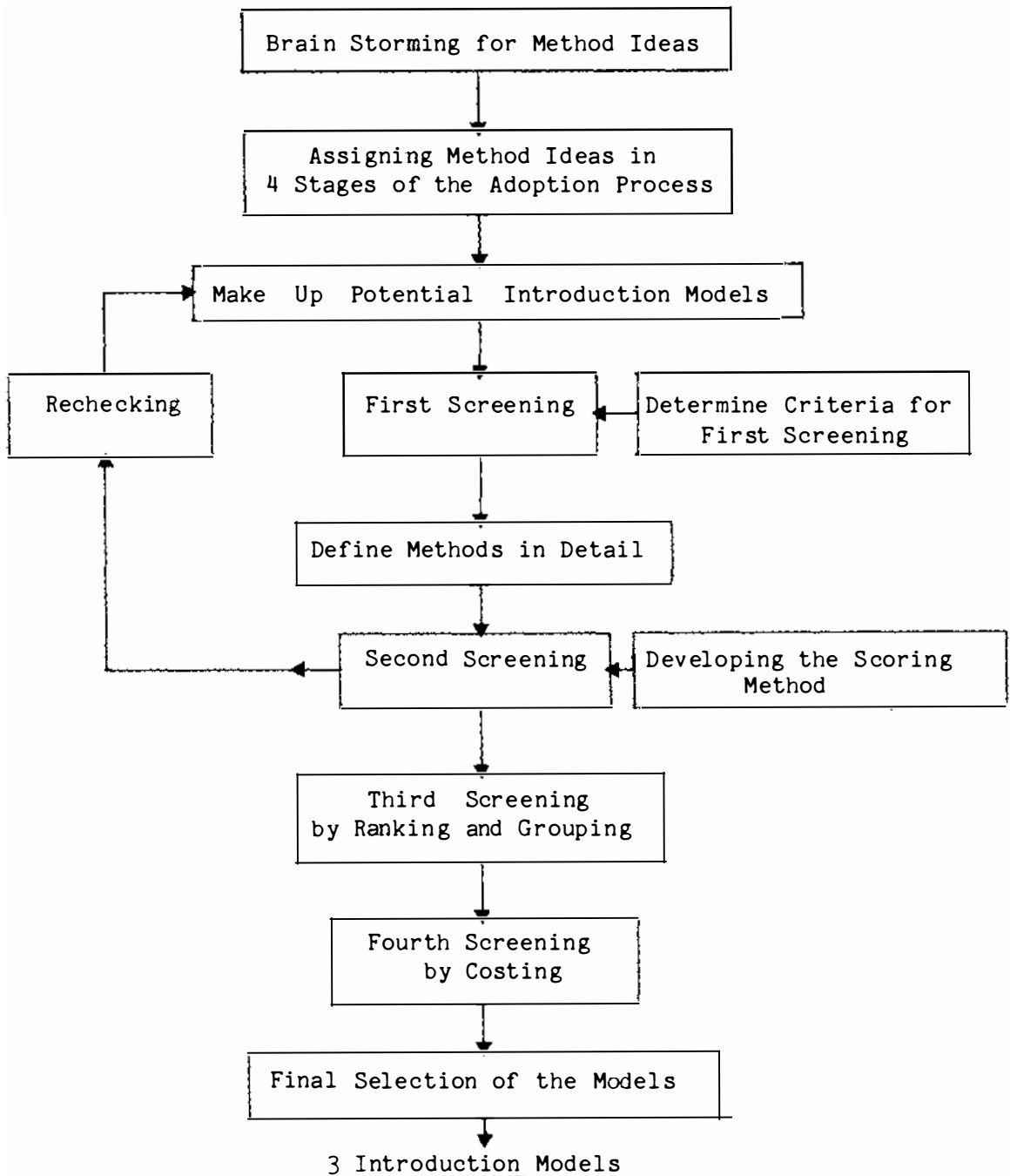


Figure 14: The Systematic Steps in the Development of the Introduction Models

In the first screening, the criteria which affected the effectiveness of the introduction method were collected (as shown in Appendix 13) and the 7 most important criteria were chosen and used in the screening. These criteria are given in Table 66. The introduction models were screened by "pass" or "fail" to meet these criteria. When the 4 methods in the model supported each other and met all of the 7 criteria, the model "passed" the screening and was chosen; otherwise, the model was dropped. In total, 82 models were chosen at this stage

of screening. For further screening of the remaining 82 models, it was necessary to define the introduction methods in more detail to enable a more accurate judgement to be obtained in the second screening. The detailed description of the methods is shown in Appendix 14.

<u>Awareness</u>	<u>Interest</u>	<u>Evaluation</u>	<u>Trial</u>
Radio	Television	Printed Material	Cooking at Home
Group Discussion	Film, Filmstrips Slides	Cooking Demonstration	Competition for Best Dish
Posters	Group Discussion	Video Demonstration	Competition for Number of Households Cooking
Personal Contact Home	Pictures of Menu&Dish	Food Vendor Demonstration	Competition for Best Cook
Personal Contact Food Shop	Food Party	Famous People Demonstration	Teach School Children Cooking
Cassette Tape	Competition for Question		Men's Meeting Cooking
Shop Display	Competition for Song		Cooking at University
Food for Monk	Famous People Talk		Demonstration in Village
Teach Health At School	Food in Hospital		

Figure 15: Method Ideas Obtained From Brainstorming

Table 66: The Criteria for "Pass" and "Fail" Screening of Introduction Method Combinations

The compatibility with village's life, beliefs and style.
 The attraction of large village audience attention.
 The accuracy of the information diffused by the method.
 The reassurance of the information, in giving the villagers a feeling of certainty and confidence.
 The number of villagers reached.
 The diffusion effect.
 The opportunity of the villagers to participate.

In the second screening, combinations of two screening procedures were used, these were "criteria scoring" and "method compatability". In the "criteria scoring" the most important criteria were again chosen and given a weight score. The criteria and their weight score are shown in Table 67. The scale of 0 - very poor to 1.0 - very good were assigned to each criterion, the scales were also quantitatively and qualitatively defined for each criterion, as shown in Appendix 13. Each of the procedures in the introduction model was then judged against the scales and scored accordingly. The scores of the 4 procedures were summed and the average value was determined. These scores were "criteria scoring" for each model.

Table 67: The Criteria Scoring System

<u>Criteria</u>	<u>Score</u>
Number of villagers reached	20
Cost of using particular method	15
Compatability of method and message to the village system	15
Attract attention	15
Reassurance of the message	15
Participation of the villagers	10
Strength of information	<u>10</u>
	100

In the "method compatability", ten compatability factors were chosen and used for the screening. The ten compatability factors are given in Table 68. Each of the compatability factors were scored on a one to ten scale. The model was judged whether the 4 procedures in the model were compatible to each other in increasing effectiveness of each of the compatability factors. The degree of increasing effectiveness for each compatability factor was assigned on a scale from 0.1 - very poor to 1.0 - very good in increasing effectiveness. When a model was judged very good in increasing effectiveness in 5 compatability factors and average in increasing effectiveness in the other 5 compatability factors, then the model gained a "compatability score" of 0.75.

Table 68: Method Comatability

The degree which one method is compatible with another method when used in combination, resulting in increasing effectiveness of:

- (1) Villager's attending - attending is the process during which the individual becomes actively aware of the message.
 - (2) Villager's interesting - the process in which the individual is stimulated enough to gather detailed information about the message.
 - (3) Villager's learning (and remembering) - the process in which the villagers related the message to themselves and stored the information. The villagers understand the message and can retain the message.
 - (4) Villager's motivating - the process that takes place in the individual's mind and leads him towards some action. That is the desire to "try", "involve" and "participate".
 - (5) Villager's participating - the process of acting, involvement and cooking the menu.
 - (6) Media's persuasive and convincing effect. Persuading is part of the communicating process which asks audience members to re-evaluate their beliefs, attitudes, opinions before they act. The media should be able to persuade and convince villagers to cook the menu.
 - (7) Media's reassuring effect - the degree that media and message give the villager the feeling of confidence and certainty in cooking the menu.
 - (8) Media's diffusion effect - the process through which individual who has heard of the message passed the message to another people so that those who has adoptd the menu influences those who has not yet adopted it.
 - (9) The combine total audiences reach - this refer to the total number of the villages reach by the media combinations.
 - (10) The media's duplication effect - the degree which diffent media make repeated impression (convincing) on the same villages.
-

The screening judgement was based on the total score of the model. The total score was the "criteria score" multiplied by "comatability score". The total score level at 60 was used to judge whether the combination would "pass" or "fail" the screening. A total of 23 models remained at this stage of the screening.

In the third screening, the 23 models were ranked according to their total score and grouped into groups at 3 score intervals as given in Table 69 and in the histogram Figure 16. As a large score gap was found between the score above and below 63, it was decided to take the top 15 models with total scores over 63.

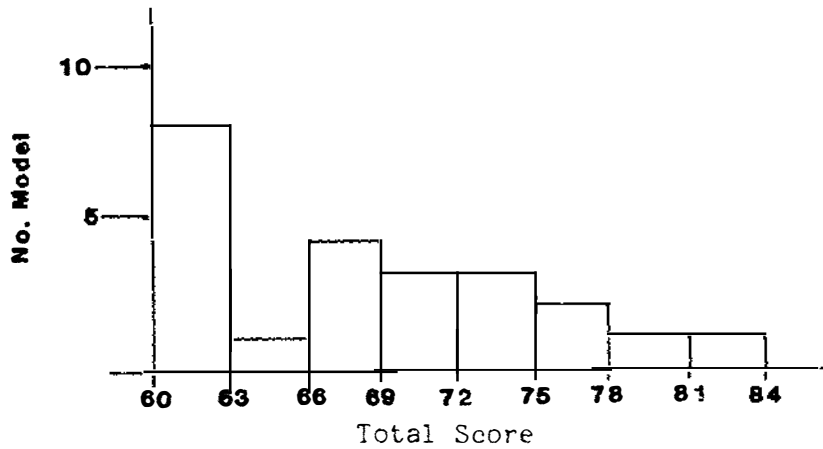


Figure 16: Grouping of Introduction Models

Table 69: Ranking of Introduction Models

Ranking Order	Models	Criteria Score	Compatibility Score	Total Score
1	GD-FP-CD-BD	84	.98	82.3
2	GD-FP-CD-BC	82	.98	80.4
3	GD-FP-CD-NH	81	.95	77.0
4	GD-FP-CD-AH	85	.90	76.5
5	PC-FP-CD-BD	82	.90	73.8
6	GD-FP-VD-BD	84	.87	73.1
7	PC-FP-CD-BC	81	.90	72.9
8	GD-FP-VD-AH	85	.85	72.3
9	PC-FP-CD-AH	83	.85	70.6
10	PC-FP-CD-NH	79	.88	69.5
11	FM-GD-CD-BD	81	.85	68.9
12	FP-FP-CD-AH	81	.85	68.9
13	PC-FP-VD-BD	82	.83	68.1
14	PT-FP-CD-AH	81	.83	67.2
15	PC-FP-VD-AH	83	.78	64.7
16	PT-GD-CD-BD	79	.80	63.2
17	CS-FP-CD-BD	83	.75	62.3
18	PT-GD-CD-BD	78	.80	62.4
19	PC-GD-CD-AH	82	.75	61.5
20	PC-GD-VD-BD	81	.75	60.8
21	CS-FP-VD-BD	83	.73	60.6
22	SD-FP-CD-BD	75	.80	60.0
23	GD-FS-CD-BD	80	.75	60.0

Keys

GD = Group Discussion	FS = Film/slides
PC = Person Contact	BD = Competition for Best Dish
FM = Food for Monk	BC = Competition for Best Cook
CS = Cassette Tape	CD = Cooking Demonstration
PT = Poster	VD = Video Cooking Demonstration
SD = Shop Display	NH = Competition for Number of Householders Cooking
FP = Food Party	AH = Cooking At Home

In the fourth screening, the cost of introducing each method in the model was estimated and the total costs of the models were compared. As the cost of introducing food to the monk was higher than the other methods the model using this method was eliminated. Only 3 models could be handled in the village trial. Three models had to be selected from 14 models of equal chance of potential success. The 3 models were selected by taking into consideration; firstly the method in each stage of the adoption process of the top scored model, and secondly number of occurrences of each of the introduction methods in the 14 models. The 3 models chosen were: the models of rank 1, rank 7 and rank 8. These 3 models then were used as the introduction models for the village trial and are given in Figure 17.

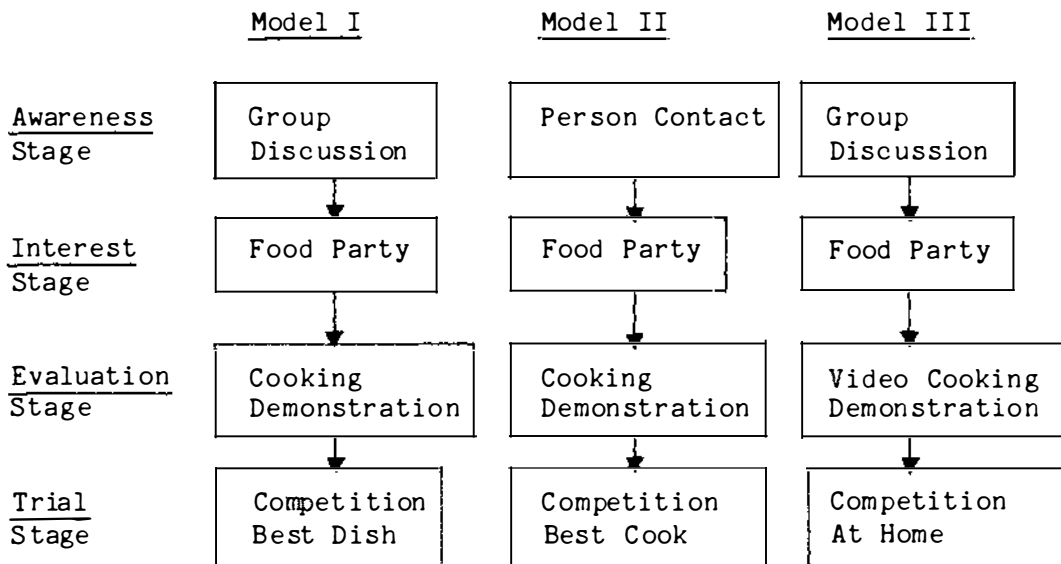


Figure 17: The Schemes for the Three Introduction Models

In the first model - Introduction Model I, the group discussion method were used in the awareness stage, the food party method was used in the interest stage, the cooking demonstration was used in the evaluation stage and the competition for best dish was used in the trial stage. In the second model -Introduction Model II, the person contact method was used in the awareness stage, the food party method and the cooking demonstration were used in the interest and evaluation stages as in the first model but for the trial stage the competition for best cook was chosen. The third model - Introduction Model III, was similar to the first model except that the cooking demonstration was replaced by a video demonstration and in the trial stage, cooking at home was used.

13.3 DESIGNING THE PROCEDURE FOR CONDUCTING THE INTRODUCTION

Each of the introduction models consisted of four steps. The eight methods in the four steps of the three introduction models were designed in detail. These were: group discussion and person contact which were in the awareness stage; food party which was in the interest stage; cooking demonstration and video cooking demonstration which were in the evaluation stage and competition for best dish, best cook and cooking at home which were in the trial stage.

In designing the procedure, emphasis was placed on: (1) simple information, repeated as much as possible and building up the information as the introduction steps went on; (2) the methods in each of the introduction steps were linked, the method in the previous step was used as a channel for the next steps by informing the villagers of the schedule and activity of the next step; (3) a relaxed and friendly atmosphere; (4) giving fun and entertainment if possible and (5) giving prizes, and compliments to the villagers.

13.3.1 Group Discussion

Group discussion was the first step in the awareness stage which was used in both introduction model I and model II. The aim of the method was to get as many villagers (householders) as possible to be aware of the cowpea dishes and the menu. The information was firstly given to a group of 10 villagers (see section 13.4.2) who had been invited for training at the University. On their return to the village, they were instructed to organise a group discussion with another 10 villagers from different households. These 100 villagers and the 10 original villagers were instructed to pass on the information to the other remaining villagers either in their own households or in other households.

The training at the university was on one day, so as to allow the villagers to return to their villages on the same day. The aim was that the participants should gain knowledge on the following points: recognize the malnutrition problem in the Northeastern Thailand, know the importance of the balanced diet, understand the development of cowpea dishes and the menu, co-operate in spreading the information and persuade the other villagers to try the menu. The training method used was group discussion leading to decision technique.

In the morning session, the group discussion leaders were encouraged to discuss among themselves the types of food they would prefer to eat. The need of eating the three important food groups - protein foods, the fruits and vegetables and the energy foods and the kinds of food grown and available in the villages were discussed. The groups then were persuaded to grow cowpeas as a source of protein food. They were motivated by showing them slides and pictures of malnutrition in children and adults. The malnutrition cases were then related to the likelihood of these cases occurring in their villages. The balanced diet, the 7-day menu and the problem of cooking cowpeas for a daily meal were explained. They were encouraged to discuss the need to cook the cowpeas for their families within the near future eg. within a week after the training. The group discussion procedure developed is shown in Appendix 15.

The group discussion leaders were shown how to prepare and cook the three cowpea dishes and the other dishes for the Day 1-2 menu and ate these dishes for their lunch on the training day. After lunch, they were told how to organise and conduct a group discussion meeting in the villages similar to that which was conducted at the University. The group discussion leaders were given a list of sub-group names and a form to complete indicating the amount of interest of their group members according to: not interested, interested and very interested.

The group discussion leaders in each of the villages elected their group head, and two assistant heads. They were told of the coming activities and the schedule of these activities to be conducted by the project in their villages.

Before they returned to the village, they were given the following materials; an instruction sheet on how to conduct a group discussion meeting, shopping bags or caps for their group members. The group leader themselves received a T-shirt with the project's logo "Eating Cowpea every day makes you happy and strong," the recipes and cooking procedure for the 7-Day menu and the cowpea seeds for growing and cooking. The food party form for the villagers to fill in were handed to the group discussion leader. This form was intended to inform the villagers of the coming activity and also to evaluate the diffusion of information.

13.3.2 Person Contact

Person contact was the first step of the introduction in the awareness stage of introduction model II. The aim of this step was to obtain the maximum number, if not all, of the householders in the villages to be aware of the cowpea dishes and the menu developed by the University. The information was delivered to every householder by a contact person who went around and talked to every household in the village.

Two contact persons (see section 13.4.3) for each village were invited to the University for a day's training. The training was conducted in a similar manner as the group discussion-decision method. The contact persons were trained in the technique of how to pass the information to every village household. The contact person was instructed to visit the householders in the evening when the villagers came back from the field. The leading conversation was started off with "what are you cooking" or "what are you going to eat". The conversation was then continued to the type of food they should be eating. The contact persons were told to relate what they had learned or seen at the University to the villagers. It was ensured that the contact persons had learned and understood the subject correctly in order that they could be able to pass on the correct information, or otherwise incorrect information would be passed on.

The contact persons received a gift for their work (a water cooler), a T-shirt to wear when going around the village, cowpea seeds to grow and cook at home, recipes and cooking procedures for the 7-Day menu, an instruction sheet on how to pass information, the schedule of the activities and the invitation forms for food party to distribute.

13.3.3 Food Party

Food party was the second step of all the introduction models. The aim of this step was to have as many as possible of the villagers to learn more about the new development by having a live cooking demonstration and also a video cooking demonstration. The food party was set up in a similar manner to the food fair or food display and testing in supermarket (Watts, 1970).

Foods in the "first day menu" were prepared and cooked in the village on the day of the food party. The quantity of twenty times the

amount recommended for a family of 7 persons in one day was cooked and the party was held in the evening in the village. Food was served in the village's style.

An exhibition was set up to provide information on nutrition and on cooking of the cowpea dishes and the first day's menu, eg. using the photographs of protein and vitamin deficiency in children and adults to show the villagers what would happen if a person does not eat good food; and photographs of the three food groups and the 7-Day menu for the good food the happy family should be eating. The first day's menu with the recommended quantity for a family of 7 persons was displayed. Recipes of cowpea dishes and the other dishes in the menu were displayed by laying out the ingredients in the exact quantity used in the recipes. These were intended to help the illiterate housewives remembering the recipes and the menu. A photograph of the cowpea plant, a chart of how cowpeas are grown and a picture chart on how to prepare cowpea sprouts were also displayed.

During the party, the group discussion leaders, or the contact persons, and the village head man were asked to speak on the loud speaker to explain the event of the evening.

Cowpea seeds were handed out. The direction sheets on how cowpea is grown and the recipes and cooking procedures for the days 1-2's menu were distributed. The villagers were informed about the cooking demonstration and the cooking competition in the villages of model I and model II. Prizes were given, they were: one ice container to each of five adults and one set of writing books and ruler to each of ten children whose names were drawn from a lottery using the food party forms. Movies were shown and the party was concluded.

13.3.4 Cooking Demonstration

Cooking demonstration was the third step of introduction model I and model II. The aim was to encourage as many as possible of the villagers who came to the cooking demonstration, to carry the ideas back home and try themselves to cook the demonstrated dishes and the menu at home.

Once the villagers had watched the demonstration and helped in the cooking, they would have confidence in their cooking. The cooking demonstration was conducted in a way that was considered to not contradict their beliefs and attitudes. It was expected that when

their attitudes was favourable they would accept the cooking of cowpea dishes and the menu.

The cooking demonstration was conducted in the following ways: the cooking was made as simple as possible and kept in the village style of cooking. The speed and efficiency of demonstration was taken into consideration, the ingredients were set out in the manner that they were easily seen and remembered by the villagers. The units of measurements were those commonly used by the villagers, eg cup, tablespoon unit etc.; the cooking utensils were those the villagers used at home. The quantities used in the demonstrations and the recipes handed out were those planned for a family of 7 persons. For a family of 3-4 members, they were informed to cook half of the quantities.

It was ensured that everybody in the audience had a chance to participate in the cooking. Two sets of food raw materials were prepared, one set was laid out for the demonstration and the other was for the villagers to practice cooking. During the demonstration, the villagers were also asked to help in preparing the ingredients and the cooking. Nutrition and food hygiene were also taught while demonstrating the cooking. The language spoken by the demonstrator was the Northeastern dialect. The cooking demonstrations were held in the evening. The cooking of the 11 cowpea dishes was in three sessions two weeks apart.

The first session demonstrated three cowpea dishes: cowpea sprout curry, fried cowpea sprout and steamed sago stuffed with cowpea. The sprouting of cowpea was displayed. The other Northeast dishes in the days 1-2's menu were cooked beforehand. At the end of the cooking demonstration, the days 1-2 menu was laid out and the audience was invited to eat. They were also informed that the menu for the second day of the week was the same dishes as the the first day menu.

The second session demonstrated four cowpeas dishes in the days 3,4 and 5 menus: seasoned mashed cowpeas, pumpkin and day's 3 cowpeas spiced soup, cowpeas and fermented fish hot sauce, and steamed glutinous rice stuffed with cowpeas. The days 3,4 and 5 menus were laid out.

The third session demonstrated four cowpea dishes in the day 6 and day 7 menus: steamed cowpeas and bamboo shoot, cowpea curry, cowpeas and pumpkin hot soup, and cowpeas and sago pudding.

At the end of each cooking demonstration session, audiences were

informed of the coming activities. In INTRODUCTION MODEL I, the audiences were told of the dishes to be completed for the best dish competition, the criteria for judging and the prizes. Two bags of cowpea seeds were given to the villagers who intended to enter the competition. One bag was intended for them to practice the cooking at home, and the other bag was for the cooking in the competition. In INTRODUCTION MODEL II, the audience and the contact person who was to supervise the competition for best cook were informed of how to enter the competition for the best cook, the judging method and the prize. The villagers who indicated they would enter the competition were given cowpea seeds. Cowpea seeds were also put aside with the village headman for the other villagers who did not come to the cooking demonstration but who might want to enter the competition.

13.3.5 Video Cooking Demonstration

The video cooking demonstration was the third step in the INTRODUCTION MODEL III. The aim was to encourage the villagers to cook the cowpea dishes and the menu at home through the video shows. The cooking demonstration of the cowpea dishes photographed on video was conducted in the same way as the cooking demonstration in the village.

The audiences could only see the cowpea dishes and the menus on the video, they were not able to taste the dishes and practice the cooking. Three video programmes were prepared and produced, each was for 20-30 minutes.

The first programme began with a tale of a happy family who lived in a village in Khon Kaen Province, the father grew cowpeas in the field and the mother always cooked good food for the family. While she was cooking cowpeas, the neighbour passed by, wanted to know where the housewife had learnt how to cook the cowpea dishes. The next day the housewife took that neighbour to the cooking demonstration which was held in their village. The main theme of the cooking demonstration started with the name and photograph of the 3 cowpea dishes being demonstrated and was intended to show the audiences what they would be seeing in the cooking demonstration. At the end of the cooking demonstration on video, the finished dishes and the days 1-2's menu were shown to the video audience. The programme concluded with cowpea seeds and the recipe sheet being handed out for the audience to cook at home.

The second programme started with the neighbour in the first programme picking the mature cowpea pods in the field and another neighbour passed by and wondering whether these pods were the cowpeas she had heard about. Then the first neighbour took the second neighbour to the cooking demonstration conducted in another village. The theme of the programme was similar to that of the first programme with the 4 cowpea dishes in the days 4,5 and 6 menus being demonstrated.

The third programme started with a pickup truck loaded with villagers heading for Khon Kaen University to see the cooking demonstration of the 4 cowpea dishes in the days 6 and the day 7 menus demonstrated in the University's kitchen laboratory. The programme concluded with the villagers being asked to choose the food in the menu for each meal.

The video shows were in the evening and the video cooking demonstration was shown twice during the intermissions of the main movies. The main movies were used to attract the villagers to the gathering. At the end of the video demonstration show, the cowpea seeds, recipe sheets and some ingredients were handed out to the villagers who indicated their intention to cook at home. The audiences were informed of the next video show.

13.3.6 Competition for Best Dish

The competition for best dish was the last step of the Introduction Model I. The aim was to activate the villagers who had tried cooking the cowpea dishes at home to keep on cooking or to activate the villagers who had seen the cooking demonstration to cook for themselves and their families at home. To encourage a large number of villagers to enter the competitions, attractive prizes were offered and a friendly atmosphere was kept at the competition. Every villager who entered the competition received a T-shirt. The first winner received a set of 3 cooking pans, the second winner received a set of 3 dinner plates and an ice container and the third winner received a set of 3 dinner plates and a soup bowl.

There were three competitions, each was held two weeks after the cooking demonstrations of the competition dishes. The first and the second were held on the same day as the second and the third cooking demonstrations respectively. For each of the competitions, villagers

had to cook two cowpea dishes at home namely one main dish and one dessert dish, and bring them to the competition. The judging committee judged on three criteria, appearance - the resemblance to the demonstrated dish, the taste and the correct amount of the basic ingredients in the recipe. In the first competition, the group discussion leaders, even though they were given the seed to cook, were not allowed to enter the competition as they had been trained at the University and had seen the cooking demonstration and they also cooked for the food party.

13.3.7 Competition for Best Cook

The competition for best cook was the last step of the Introduction Model II. The aim of this stage was to activate the villagers to cook the cowpea dishes and the menus at home more frequently and to develop the habit of cooking cowpeas. The best cook here was the person who most frequently cooked cowpea dishes for their family, it was based on the number of the cowpea dishes being cooked. Contact persons were asked to keep the records.

Three competitions were organised based on cooking cowpea dishes in the first, second and third cooking demonstrations. Two sets of prizes were given, one for the person cooking the greatest number of dishes at each demonstration and one for the person cooking the greatest number of dishes over the whole time from the food party to the end of the introduction. A T-shirt was given to every person who had cooked the highest number of dishes in each of the three competitions. There were many prizes for the second set ranging from the cooking pans, shopping baskets, cooking bowls to dinner plates.

13.3.8 Cooking at Home

The "cooking at home" was the last step of the Introduction Model III. The aim of this stage was to activate the villagers to cook the cowpea dishes at home and continue so it became a habit. The other ingredients that the villagers could not obtain as they were not available in the village were given besides the cowpea seeds.

At the end of the video cooking demonstrations, the villagers were encouraged to cook at home the demonstrated dishes and the other dishes that appeared in the menus. Cowpea seeds and recipe sheets were handed

out to those who wanted to cook. Sago was given at the end of the first and third cooking demonstration as it could not be found in the villages in large quantity at that time. The group discussion leaders were instructed to visit the villagers and help in their cooking.

13.4 VILLAGE SELECTION AND METHOD INVOLVED IN PERSONNEL RECRUITMENT

13.4.1 The Village Selection

Two villages were selected for each introduction model, one from the multiple cropping villages and the other from the other villages. The villages with the smaller number of household were selected for the person contact method. Ban Koksri and Ban Huey Tuey were chosen for the first model, Ban Pasan and Ban Nong Pai for the second model and Ban Maung and Ban Wang Yawl for the third model. Ban Jode and Ban Had were selected as the control villages in which there were no introduction of cowpeas, cowpea dishes and the 7-Day menu to these villages. But the villagers in these villages were interviewed for the knowledge, growing and eating of cowpeas, for comparison with the villages where cowpeas, cowpea dishes and the 7-Day menu had been introduced.

13.4.2 The Group Discussion Leader Selection

The group discussion leaders were selected according to the following criteria: from different locations in the village; the person who was responsible for cooking for family; could cook well; active person; popular in the village and a respected person. The selection was assisted by the village headman, the assistant headman and the school teacher in the village.

The group discussion leaders in Ban Koksri were seven middleaged housewives and three young girls, Ban Huey Tuey were all young girls, Ban Maung were nine middleaged housewives and one young girl, Ban Wang Yawl were five young girls, three housewives and one shop keeper man.

13.4.3 The "Contact" Person Selection

Two contact persons were assigned for each village. The contact persons for Ban Pasan were the two assistants of the village headman

and for Ban Nong Pai were the school teacher who did the 1978 survey and the assistant of the village headman.

13.4.4 Contacting the Selected Person

The group discussion leaders and the contact persons were contacted a week prior to the start of training. The need for their assistance was explained and they were asked to indicate their willingness to take part. Their part in the programme was explained and the trips to bring them to Khon Kaen University were organised.

The group discussion leaders were also asked to choose their sub-groups. The name of a person in the sub-group was handed to the group discussion leaders on that day. These sub-group members were to be contacted later once the group discussion leader had returned from training but some might have been contacted earlier.

13.4.5 The Sub-Group Discussion Selection

The sub-group discussion consisted of 100 persons for each village, they were selected in the following manner: firstly a map of the village was drawn and the location of the 10 group discussion leaders were located. The village was divided into 10 sections, each contained one group discussion leader in it. Then the group discussion leaders were asked to choose 10 persons within their own area, hence the 100 persons were obtained.

13.5 THE DEVELOPMENT OF THE EVALUATION METHOD

13.5.1 Introduction

Two evaluation systems were used to measure the effectiveness of the introduction models - firstly the data evaluation and secondly the economic evaluation. The data evaluation was a systematic process of data collection and it was built in with the introduction. Data on change of individual or group behaviour and attitudes to the new cowpea dishes and the menu were collected at different stages of the introduction models. These data were used as indicators in determining effectiveness of the introduction models. It was then necessary to define what types of data or what indicators were the models to be

used, in order that the products could be compared and the most effective method determined. The economic evaluation was the costing of the introduction model. This would determine the final recommended model.

13.5.2 The Collecting of Data

The data to be collected and the indicators for the evaluation were:

The Amount of Information and the Quality of Information Learned at Kohn Kaen University and the Action Taken: The group discussion leaders and the contact persons were interviewed two weeks after the end of training, on the food party day and before the food party. They were asked to identify the picture of the protein foods, energy foods, protective foods, protein malnourished people, thiamine deficiency symptoms, vitamin A deficiency symptoms, cowpea sprout curry and cowpea seeds among the other pictures; the total number was 14 pictures. These were used to determine amount and quality of information learnt. The cooking of cowpea dishes by the group discussion leaders and the contact person was recorded to determine the action taken.

The Number of People in the Villages who Had Become Aware of the Information: The number of people who had become aware of the information was collected:

- (a) the number of villagers whom the group discussion leaders and the contact person had informed. These were collected from the form filled in by the group discussion leaders and the contact persons.
- (b) The number of villagers who came to the food party. If they had not filled in the form they were asked to do so at the food party. In the food party form, the villagers were asked to indicate the date and the person from whom they had learned the information. The results were used for determining the diffusion rate.

The Amount of Information Transmitted to the Villagers and Their Action: The amount of information transmitted by four sources was collected. The sources were:

- (a) the group discussion leaders,
- (b) the contact person,
- (c) the display of information at food party,
- (d) the group discussion leaders or the contact person and the display

at food party.

Two samples of 20 villagers were interviewed in each village. The first was the group of villagers who were among the 100 villagers (in Model I and III). They were interviewed on two occasions: first was on the food party day for the information learned from the group discussion leaders or the contact person, and another was on the first cooking demonstration day for the additional information learned at the food party.

The second group was the villagers who had come to the food party and were not group discussion members or had not been informed by the contact person. They were interviewed on the first cooking demonstration day for the information learned at the food party.

The questions were whether the villagers had known about: the 7-Day menu, the list of foods in the 7-Day menu; the main food components in the menus: new dishes made from cowpeas; whether they had cooked the cowpea dishes and the menus. They were asked to identify 8 pictures from the 14 pictures on the nutritional differences etc.

The Acceptability of the Cowpea Dishes and the Menu: The preference hedonic 7 point scale was used for the acceptability test on the 11 cowpea dishes and the 7-Day menu. The villagers who had experiences of eating or cooking the dishes and the menu were interviewed with the use of pictures of the cowpea dishes and the menu. They were asked to indicate their preferences of the cowpea dishes and the menu, choices of food in the menu for each meal, opinions about the preparation, ability to find the raw materials during the year, possibility of cooking the dishes and the menu all year round. After all the cowpea dishes and the menu had been demonstrated, the villagers were asked to rank the 7 day's menus according to their preferences.

The Number of Households Who Cooked the Cowpea Dishes and the Menu in their Homes: Based on the villagers who had received cowpea seeds for cooking at home, the number of households cooking cowpea dishes and the menu were followed during the following periods: two weeks after the training; one week after food party; two weeks after the first, second and the third cooking demonstration, two weeks and two months after the end of introduction.

Number of Households Using Cowpeas Before and After Introduction: The data for the number of households using cowpeas before the introduction was collected by:

(a) asking village head man to indicate number of villagers who had grown cowpeas in the last two months,

(b) asking the shopkeepers whether they had sold cowpeas,

(c) asking the villagers who came to the food party whether they had cooked cowpeas during the last two weeks.

The number of households using cowpeas two weeks and two months after the end of the introduction was collected by interviewing all the households and asking whether they had eaten cowpeas during the weeks before the interviews.

The Amount of Cowpeas Eaten Before the Introduction, During the Introduction and After the Introduction: The amount of cowpeas eaten before the introduction was collected by interviewing the villagers who came to the food party as to whether they had cooked cowpeas during the last two weeks and to indicate the amount of cowpeas used.

The data on cowpeas eaten during the introduction and two weeks after the end of introduction were gathered by checking whether the villagers who had received cowpea seeds for cooking at home had used them all.

The amount of cowpeas eaten during the two months after the end of introduction were obtained from the sheet on which the households recorded the kind of cowpea dishes and the amount of cowpeas cooked.

The Knowledge and Attitudes to Cowpea at the Beginning of the Introduction and at the End of the Introduction: The knowledge of and attitudes to cowpeas were obtained by interviewing a group of 30 villagers, the group discussion leaders and the contact persons. They were interviewed one week before the training took place and two weeks after the end of introduction. The villagers in the first interview were randomly sampled. For the second interview, they were the villagers who had cooked cowpeas and were also in the first group interviewed.

They were asked in the first and second interviews whether they knew cowpeas, whether they had ever grown or eaten cowpeas, whether it was easy or difficult to grow cowpeas, to indicate how they eat cowpeas, whether they liked cowpeas or not and to indicate the reason; the frequency of eating cowpeas; the way cowpeas could be cooked; whether they ate cowpeas everyday and the reason for not eating cowpeas everyday; whether they thought cowpeas were a good food or not a good food and the reason for it; how did they rank the following food in their preference: meat, fish, egg, milk, soybeans, mung beans and

cowpeas.

Additional questions were asked in the second interview and they were: whether they know the methods that cowpeas could be cooked; the frequency that they cooked cowpeas and to state the reason for not cooking more often; which cowpea dishes did they cook most often, to indicate who ate the cowpeas, whether there were any disadvantages in growing and cooking cowpeas; whether there was any problem in sprouting cowpeas; whether they grew cowpeas for eating and to indicate what they thought the problem would be to grow cowpeas for eating.

13.5.3 The Costing

Costs of running the introduction of the three models were calculated. There were: cost of visiting villages, this included transportation and staff time; cost of training the group discussion leaders and contact persons at Khon Kean University; cost of gifts given to the group discussion leaders, contact persons and subgroup villagers; cost of food at the food party; cost of display in the food party; cost of entertainment at the food party; cost of cowpea seeds handed out throughout the introduction; cost of running cooking demonstrations in the villages; cost of running video cooking demonstrations in the villages; cost of prizes given in the cooking competition and cost of other food ingredients given after the video cooking demonstration. The details of costing are shown in Appendix 16(16E). They were based on the actual costs in August-November 1981 except the transportation cost which was taken for a typical village distance of 50 km from the University instead of the distance from the actual six villages to Khon Kaen University.

13.6 CONDUCTING INTRODUCTION AND EVALUATION IN VILLAGES

The introduction models were tested simultaneously in the six villages. The activity of each step in the introduction of the three models was carried out within the same week in each village. Dates of each step to be carried out were assigned. The evaluations were also carried out along with introduction during the same period. Each of the six villages were assigned to one particular day of the week throughout the introduction e.g. Ban Koksri on Monday, Ban Huey Tuey

on Wednesday etc for the ease of appointment and to prevent confusion. The schedule of introduction and interviewing in six villages are shown in Table 70.

Table 70: The Schedule of Introduction and Interviewing in the Six Villages

Week 1	Approaching and interviewing villagers
Week 2	Training the group discussion leaders and the contact person at Khon Kaen University
Week 3	Organising for food party
Week 4	Food party and interviewing villagers
Week 5	Cooking demonstration and interviewing villagers
Week 7	Cooking demonstration, cooking competition and interviewing villagers
Week 9	Cooking demonstration, cooking competition and interviewing villagers
Week 11	Cooking competition and interviewing villagers
Week 13	Interviewing all households
Week 21	Interviewing all households

One week prior to the introduction the group discussion leaders and the contact persons were approached, the data on knowledge and attitude of villagers to cowpeas at the beginning of the introduction were collected during the week 1. The start of week 1 was on August 10, 1981. The actual introduction proceeded from week 2 to week 11. The total introduction period was 10 weeks. The finishing date was October, 24, 1981. Two evaluations were still continued thereafter at week 13 and week 21. Two months were needed for the preparation for the start of the introduction.

Most of the introduction activities took place in the village temple and the house of the village head man or the assistant head man.

14. THE RESPONSE OF VILLAGERS TO THE 7-DAY MENU AND THE COWPEAS

A systematic process of collection of data to evaluate the responses of villagers to the introduction of the 7-Day menu and the cowpea dishes was developed. The data collected was used to indicate the awareness of the villagers to the new 7-Day menu and to evaluate the villagers' interest in and knowledge gained of the information transmitted. As well the data was used to evaluate the acceptance of the 7-Day menu and the 11 cowpea dishes by the villagers. Finally the data were used to indicate the willingness of the villagers to participate in the introduction of the new 7-Day menu to their villages.

14.1 AWARENESS AND INTEREST STAGES

The three steps - training at Khon Kaen University, contacting the villagers and the food party - were used to create awareness in the villages and to gain the interest of the villagers so that they would try cooking cowpeas and also try the menu. Training and the food party were the same in all villages but two methods were used to contact the villagers; in Ban Pasan and Ban Nong Pai, two village assistant leaders contacted the villages and in all the other village, ten people were trained and each contacted 10 villagers.

In the evaluation, the important points studied were the rate of diffusion of information, the information pathways and the amount of information transmitted. Firstly, the number of people made aware of cowpeas and their level of interest in cowpeas was determined.

14.1.1 People Aware and Their Initial Interest

"Awareness" was measured by the people who filled out the form to say they would attend the food party, and also by the number of people who attended the food party. The total numbers for each village are shown in Table 71. The percentage of the adults who filled in the form i.e. those adults who had been told by the contact people varied between villages, about 45% in three villages and about 20% in the other three villages. In two of the high "awareness" villages, the contacting had been done by two of the village assistant leaders; in

the third high "awareness" village, although 10 villagers as group discussion leaders had been the contact persons, they had been organised by the village headman. These results show the importance of using persons such as the village headman, his assistants and the school teacher to make the villagers "aware".

Table 71: The Number of People in the Villages Aware of the 7-Day Menu and the Cowpeas

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Total
People completed the form	167 (23)*	270 (48)	131 (46)	207 (44)	151 (17)	148 (24)	1074 (30)
People came to food party	138 (19)*	155 (28)	89 (31)	122 (26)	100 (11)	87 (14)	691 (20)
Households represented at food party	95 (55)**	91 (76)	53 (75)	69 (66)	95 (61)	73 (59)	476 (64)
Adults aged over 14 in the village	721	558	283	473	904	613	3552
Households in the village	172	120	71	104	155	123	745
People contacted by the group discussion leader & contact person	100	100	80	100	100	90	578

* in the parenthesis shows % of total adults in the village.

** in the parenthesis shows % of total households in the village.

The number of people who came to the food party in all villages was less than the number first made "aware", the high "awareness" groups dropping to 26, 28, 31% of the total adults and the low "awareness" groups to 11, 14 and 19%. However the number of households in the villages actually represented at the food party was quite high - 66, 75, 76% for the high "awareness" group and 55, 59, 61% for the low "awareness" group. It could be assumed that by using these training and contacting methods between 50 and 75% of households in a Northeastern Thai village can be made "aware". The group discussion leaders and the contact people were asked to evaluate the magnitude of the villagers' interest in the 7-Day menu and the cowpeas and this is

shown in Table 72. Except for one village, there was interest in the 7-Day menu and the cowpeas. This was one of the villages where the contact person was a man and he had to contact a large number of the villagers.

Table 72: Magnitude of Interest at Beginning of Introduction

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Mean
	(% of Contacted People)						
Very interested	41	60	21	57	62	38	47
Interested	59	40	58	43	34	53	48
TOTAL Interested	100	100	79	100	96	91	95
Not interested	-	-	21	-	4	9	5

14.1.2 The Diffusion Rate of the Information

On the food party form, the villagers were asked to indicate the date they had learned about the 7-Day menu and this dates was used to determine the diffusion rates of the information shown in Figure 18.

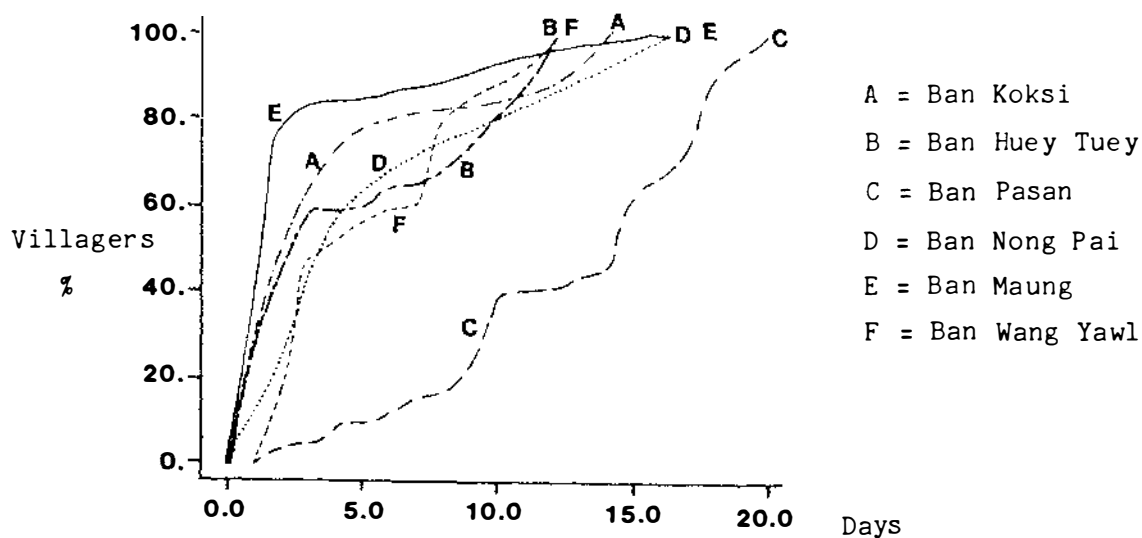


Figure 18: Diffusion of Information

It was found that within the total number of people who had become aware of the information, all persons became aware by approximately day 14 after the training of group discussion leaders and contact persons at Khon Kaen University. From Figure 18, 75% of people had become aware of the information by day 7. Thus the diffusion rate was initially higher in the first 3 days, this was especially true for the group discussion leaders i.e. for Ban Koksri, Ban Huey Tuey, Ban Maung and Ban Wang Yawl. After day 5 the rates of diffusion decreased. The rates of diffusion were very similar except for Ban Pasan. Here, the assistant headman said he could not easily contact the villagers because they were away from home.

The main sources of information on the 7-Day menu were either the group discussion leaders or the contact persons (Table 73). However there were 10-25% of the villagers attending the party who obtained information from other sources i.e., the information was second hand.

Table 73: Source of the Information

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl
(% of People Completed the Form)						
Group discussion leader	97	80			89	82
Contact person			75	85		
Others	3	20	25	15	11	18

14.1.3 Knowledge at the Food Party

Information was transmitted in awareness stage by the group discussion leader and the contact person, to determine the effectiveness of this stage all of the villagers coming to the party were asked two simple questions. For the first question, villagers were asked if they would list the foods in the menu for day 1,2. If they could list all they were classified as can list all, and if they could list part of the menu they are classified as can list some but not all, or otherwise they were classified as cannot list. For the second question villagers were asked whether they knew about the 7-Day menu, the answers were yes or no. The results are given in Table 74.

Table 74: Knowledge of the Menu

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong	Ban Pai Maung	Ban Wang Yawl	Mean +SD
(% of All Adults Answering)							
<u>A. Knowledge of Days 1-2 Menu</u>							
Can list all	26	1	45	0	28	0	
Can list some but not all	38	7	25	9	22	2	
Cannot list	36	92	30	91	50	98	
Total Number answering	(99)*	(155)	(89)	(121)	(100)	(87)	
<u>B. Heard of 7 Day Menu</u>							
Yes	20	16	34	21	47	25	27+11
No	80	84	66	79	53	75	73+11
Total Number answering	(102)*	(155)	(89)	(120)	(100)	(87)	

* Only 99 of 138 adults who came to the food party were interviewed, as most of the villagers came to the party nearly at the same time there was not enough time to interview all before the party.

The percentage of villagers who knew the 1-2 days menu was extremely variable. There were two distinct groups of villages, those villages with high percentage of can list all and can list some but not

all which were Ban Koksri, Ban Pasan and Ban Maung, and those villages with low percentage which were Ban Huey Tuey, Ban Nong Pai and Ban Wang Yawl. This perhaps was due to the fact that the group discussion leader in Ban Huey Tuey and Ban Wang Yawl were young girls and contact person in Ban Nong Pai use a school teacher and a village assistant headman. They might have less power and less interest in the subject than the group discussion leaders who were an older women as in Ban Koksri and Ban Maung and contact person in Ban Pasan who were both village assistant headman. The percentages of villagers who had heard of the 7-Day menu were more consistent and were on average 27%. It was concluded that this information was poorly transmitted except for one village Ban Maung.

14.1.4 Comparison of Knowledge of "Sub Group" and "Food Party Group"

To compare the effectiveness of the information transmitted by the group discussion leader and the contact person with the information displayed at the food party, two groups of villagers were interviewed:

(a) The "Sub Group" villagers, who had the information from either the group discussion leader or the contact person, were interviewed at the food party before the party began.

(b) The "Food Party" villagers, who had come to the food party but had no contact with the group discussion leader or the contact person. They were assumed to have their information only from the food party. They were interviewed one week after the food party at the first demonstration.

All were asked for their knowledge on the 7-Day menu, the cowpea dishes and the nutrition knowledge.

When the two groups - "Sub-Groups" and "Food Party" - were interviewed, they had a better knowledge of the menus. An average $66_{\pm 25}\%$ and $93_{\pm 3}\%$ of the "Sub Group" and the "Food Party" group respectively knew about it (Table 75). The villagers in both groups knew little about cowpea is the main components of the menu except for groups in Ban Koksri and Ban Nong Pai. A small percentage of these villagers had tried to cook some of the dishes in the 7-Day menu 6% and 12% respectively for the "Sub Group" and "Food Party" group. Obviously the group discussion leaders and the "contact" persons did increase the knowledge of those they contacted directly and the food party gave a

further impression of the information so that by the end of the food party nearly all knew of the 7-Day menu. The Food Party was more useful at giving information than the contact person and the group discussion leaders.

Table 75: The Amount of Information Transmitted to the Villagers in the "Sub Group" and the "Food Party Group"
(Mean of Percentage in Groups in Each Village)

	"Sub Group" % Mean \pm SD	"Food Party" % Mean \pm SD
<u>7 Day Menu</u>		
Knew menu existed	66 \pm 25	93 \pm 3
Knew cowpeas is the main component	4 \pm 8	15 \pm 30
Had cooked the menu	6 \pm 4	12 \pm 9
<u>New Cowpea Dishes</u>		
Knew new cowpea dishes in the menu	57 \pm 13	69 \pm 18
Had cooked a cowpea dish	5 \pm 7	8 \pm 8
<u>Nutritional Properties</u>		
Choosing correct protein group	51 \pm 31	73 \pm 15
Correct answers on function of proteins	61 \pm 13	70 \pm 15
Knowing functional properties of nutrients	68 \pm 12	79 \pm 23
<u>Tried Sprouting Cowpeas</u>	10 \pm 9	11 \pm 13

To the question whether they knew the new cowpea dishes in the menu on average 57% and 69% of the "Sub Group" and the "Food Party" group knew them. But only a small percentage of them had tried to cook the new cowpea dishes (5% and 8%) respectively (Table 75). Only a small percentage of both groups had tried to sprout cowpeas (10% and 10% respectively). Again in all cases the knowledge of the "Food Party" group was higher than the "Sub-Group" this shows that the Food Party was a better method of giving information.

To obtain more information on the knowledge of the villagers on 7-Day menu and the new cowpea dishes, these villagers in the "Sub Group" and "Food Party Group" who indicated that they knew the 7-Day

menu were asked to name the foods in the 7-Day menu. Also these villagers who indicated that they knew the new cowpea dishes were asked to name the dishes. It was found that both Groups could indicate only some of the food in Days 1-2. They could not indicate any others in the 7-Day menu. The villagers in the "Food Party Group" had more information as indicated by the higher percentage of them to be able to indicate the food in Days 1-2 than the "Sub Group" (Table 76) This was as expected as the "Food Party Group" had actually eaten the food in Days 1-2 menu so that they could remember them more than the "Sub Group".

Table 76: The Percentage of Villagers in the "Sub Group" and "Food Party Group" in Six Villages Able to Indicate the Food In Days 1-2

	Ban Koksri	Ban Huey	Ban Tuey	Ban Pasan	Ban Nong	Ban Pai	Ban Maung	Ban Wang	Yawl	Mean +SD
"Sub Group" Villagers	31	4	32	21	15	1				14 ₊₁₁
"Food Party" Villagers	68	39	83	85	63	21				59 ₊₁₇

From the interviews with the two groups of villagers ("Sub Group" and "Food Party Group") it was learnt that these who indicated that they knew the new cowpea dishes named the three cowpea dishes fried cowpea sprout, cowpeas sprout curry and steamed sago stuffed with cowpeas; these dishes were in Days 1-2. On average 32% of the "Sub Group" villagers and 36% of "Food Party Group" villagers mentioned these 3 cowpea dishes. Another two cowpea dishes in the menu were mentioned by a few villagers in two villages. They were steamed glutinous rice stuffed with cowpeas and steamed cowpeas with bamboo shoot. More "Food Party Group" villagers could name the three cowpea dishes in Days 1-2 menu than the "Sub Group" villagers. This was because the "Food Party Group" villagers had actually seen the dishes displayed and tasted these foods while the "Sub Group" villagers had only heard from the group discussion leader and the contact person, although some of these might have helped in the preparation of food in

Days 1-2 for the party. If they had been interviewed later they might have remembered them better.

Table 77: Recognition of Pictures on Dietary Needs and Nutritional Deficiencies

	Group Discussion "Sub-Group" "Food Party" Leaders and Contact Persons At Khon Kaen					
	(Number & Percentage of Group Who Recognised)					
	No	%	No	%	No	%
Protein foods	29	67	76	63	78	79
Energy foods	21	49	53	44	68	69
Fruit & vegetable foods	15	35	51	43	56	57
Protein deficiency	29	67	88	73	76	77
Thiamine deficiency	20	47	46	38	58	59
Vitamin A deficiency	21	49	21	18	40	40
Cowpea sprout curry	42	98	85	71	83	84
Cowpea seed	42	98	112	93	95	96
Total Number of Villagers	43	100	120	100	99	100

The villagers in both groups showed that they had considerable knowledge of food protein 51% and 73% respectively for the two groups chose correctly the food protein from the three food groups. And 61% and 70% respectively gave the correct answer for functional property of protein food group and 68% and 79% respectively knew the functional properties of nutrients.

The group discussion leaders and the contact persons trained at Khon Kaen University and both the "Sub-Group" villagers and the "Food Party" villagers were asked to identify eight pictures from the 14 pictures. The mean results, in Table 77, showed the pictures were very effective. In most cases by a high percentage were identified. There was not a great deal of difference in recognition between the groups. However the results show that the villagers in "Food Party" were more capable than the "Sub Group" as demonstrated by the higher percentage of them who gave the correct identification of the pictures.

14.1.5 Conclusion for the Awareness and the Interest Stage

In conclusion, the villagers knew about the seven day menu but could not indicate that cowpea was the main component of the menu. The villagers might have been confused as in each of the daily menus, there were only 3-4 cowpea dishes (in total 12 kinds of food), and the questions themselves were difficult for the villagers to answer and they could not relate the cowpea to the menu. Few of the villagers had tried to cook cowpea dishes or to sprout cowpeas. This may have been due to two reasons, the first reason is that the villagers might have had no cowpea seed to cook, as cowpea seeds were not given to the "Sub-Group" villagers. The second reason is that at the beginning of the introduction, the information was given only with the aim to gain the awareness and interest of the villagers. Information on the nutritional subjects was well transmitted by the group discussion leaders and contact person, more than fifty percent of the "Sub Group" villagers could answer the questions and could identify the pictures. However the villagers learned more of the nutritional information by seeing the photographs displayed at the food party (Figure 19A) as indicated by the higher number of "Food Party Group" villagers correctly answering the questions or identifying the pictures. Food party proved to be the better method for giving information and gathering a large number of villagers who became interested in the 7-Day menu and the cowpeas. Housewives could also learn to cook the Days 1-2 menu and the cowpea dishes at this stage when they were helping cook food for the party (Figure 19B).

A. Food and Nutritional Display at Ban Wang Yawl

B. Preparation and Cooking of Food in Days 1-2
Menu for Party at Ban Nong Pai

Figure 19: Introduction of 7-Day Menu and Cowpeas in Villages



14.2 EVALUATION AND TRIAL STAGES

Two things were introduced to the villagers for evaluation - the seven day menu and the cowpea dishes. These were mentioned firstly by asking for preferences when they were introduced, secondly by determining the choice of dishes in the 7-Day menu and thirdly by finding the attitudes on the cooking of the 7-Day menu and the cowpea dishes, and finally by determining the number of villagers who cooked the cowpea dishes.

14.2.1 The 7-Day Menu, The Acceptability and Choice of Dishes

At the end of the introduction, the villagers were asked to rank the 6 different daily menus according to their preferences (Table 78). The ranking was, from highest preference to lowest preference: Days 1-2, Day 3, Day 6, Day 4, Day 5, Day 7. Days 1-2 menu was ranked significantly higher than the other menus.

Table 78: Preference Ranking of 7 Day Menu

	Days 1-2	Day 3	Day 4	Day 5	Day 6	Day 7
Ban Koksri (11)						
Total Ranking	26	33	39	38	46	94
Rank Order	1	2	4	3	5	6
Ban Huey Tuey (16)						
Total Ranking	44	48	55	70	51	66
Rank Order	1	2	4	6	3	5
Ban Pasan (9)						
Total Ranking	24	32	35	41	24	33
Rank Order	1	3	5	6	1	4
Ban Nong Pai (21)						
Total Ranking	70	70	73	83	73	72
Rank Order	1	1	4	6	4	3
Ban Maung (27)						
Total Ranking	80	100	109	94	93	91
Rank Order	1	5	6	4	3	2
Ban Wang Yawl (13)						
Total Ranking	33	44	47	39	59	51
Rank Order	1	3	4	2	6	5
Total Rank	277	327	358	365	346	407
Rank Order	1	2	4	5	3	6

(Figure in parenthesis is the number of villagers)

The acceptability of the Days 1-2 day menu was also scored as a hedonic scale, by the people trained at Khon Kaen University, the villagers who had eaten at the food party and the villagers who had cooked some of the dishes in the menu at home. The other menus Day 3,4,5,6,7 were scored for acceptability by the villagers who had cooked at home. All of the menus were highly accepted by the villagers as they were rated highly liked (average of 6.1-6.2 on the total 7-hedonic score). The results are shown in Appendix 16(16A). There were no significant differences between the scores for the 6 menus but there was highly significant differences between the individual villages in the judgements.

There was little difference in the preferences scoring by the villagers at the food party and after they had cooked the dishes as can be seen in Table 79. However, there was a notable difference between the people trained at Khon Kaen University and the villagers.

Table 79: Preferences of Dishes in 1-2 Day Menu
(Average Score and Preference Ranking)

	Trained People at Khon Kaen		Villagers at Food Party		Villagers Who Cooked at Home	
	Score	Rank	Score	Rank	Score	Rank
1. Whole fermented fish	37	7	48	6	43	7
2. Fried cowpea sprout	36	9	58	3	59	1
3. Mushroom hot soup	57	1	68	1	59	1
4. Cowpea sprout curry	51	2	60	2	54	3
5. Chilli in fish sauce	44	4	48	11	42	9
6. Chilli in fermented fish sauce	37	7	42	9	39	10
7. Water convolvulus	51	2	48	6	51	4
8. Spring onions	36	9	42	9	47	5
9. Neem	34	11	43	8	45	6
10. Banana	39	5	52	4	43	7
11. Steamed sago stuffed with cowpeas	38	6	49	5	36	11

It was noted that steamed sago stuffed with cowpeas became the least popular after cooking, may be because of the difficulty in cooking the dish. On the other hand, cowpea sprout increased in popularity after cooking.

Table 80 : Preferences of Dishes in Menus
(Average Score and Preference Ranking)

	Days 1-2		Day 3		Day 4		Day 5		Day 6		Day 7	
	S	R	S	R	S	R	S	R	S	R	S	R
1. Whole fermented fish, roasted	43	7										
2. <u>Fried cowpea sprouts</u>	59	1										
3. Mushroom hot soup	59	1	57	1								
4. <u>Cowpea Sprout Curry</u>	54	3										
5. Chilli in fish sauce	42	9	45	6	44	6						
6. Chilli in fermented fish sauce	39	10			39	11	42	9	41	9		
7. Water convolvulus, raw	51	4	47	5	41	9						
8. Spring onion, raw	47	5										
9. Neem, blanched	45	6	40	9								
10. Banana	43	7			41	9	46	6	42	7		
11. <u>Steamed sago stuffed with cowpeas</u>	36	11	40	9	44	6						
12. Fried beef			57	1	54	2	42	9				
13. Seasoned mashed cowpeas			49	3	50	3						
14. <u>Pumpkin and cowpeas spiced soup</u>			43	7	50	2	49	4				
15. <u>Cowpea and fermented fish hot sauce</u>							52	2	49	5	45	8
16. Coriander leaves, raw			41	8					36	11	36	11
17. Custard apple			39	11							50	6
18. Beef soup					55	1	61	1				
19. Chinese cabbage, raw					49	5	50	3	52	2	52	3
20. Egg plant, raw					43	8	45	7			49	7
21. Roasted beef							49	4	59	1	62	1
22. Cork wood young leaves							44	8	39	10		
23. <u>Steamed cowpea and bamboo shoot</u>									52	2		
24. <u>Cowpea curry</u>									49	5	54	2
25. <u>Cowpeas and pumpkin hot soup</u>									51	4	52	3
26. <u>Cowpea and sago pudding</u>									42	7		
27. Roasted small toad											42	9
28. Fermented fish hot sauce											52	3
29. <u>Steamed glutinous rice stuffed with cowpeas</u>							40	11			40	10

S = Score, R = Rank.

The villagers were asked for their preferences of food dishes in each menu by scoring preferences as a hedonic scale. The average score and the rank order of preferences of food dishes in each menu are shown in Table 80.

Fried cowpea sprout, mushroom hot soup and cowpea sprout curry were the most popular dishes in the days 1-2 menu; mushroom hot soup, fried beef, seasoned mashed cowpeas in Day 3; beef soup, seasoned mashed cowpeas, pumpkin and cowpea spiced soup in Day 4; beef soup,

cowpea and fermented fish hot sauce, raw chinese cabbage in Day 5; roasted beef, steamed cowpea and bamboo shoot, raw chinese cabbage in Day 6; roasted beef, cowpea curry, cowpea and pumpkin hot soup in Day 7. Beef as beef soup or roasted beef were obviously popular but the most interesting were the preference of the cowpea dishes. On the other hand the dessert cowpea dishes were unpopular - steamed sago stuffed with cowpeas, steamed glutinous rice stuffed with cowpeas. However overall, the dishes in all menus were similarly acceptable, the average score of the dishes only varying between 36 and 61.

Villagers were also asked for the dishes they would choose for each meal throughout the day.

Overall, there was not a pattern of eating the dishes in the menus throughout the day. There were no main meal, as there was little difference in which foods were chosen to eat for breakfast, lunch and dinner. Details of villagers choosing food dishes in the six menus for breakfast, lunch and dinner are shown in Appendix 16 (16B). There were differences in the time food dishes were chosen but there were only a few dishes or foods which were not eaten equally at all meal times. Roasted beef, roasted small toad, and seasoned mashed cowpeas, were mainly eaten for breakfast; fried beef was also mainly a breakfast food on two menus but in menu 5 the pattern was reversed; coriander leaves at lunch and breakfast; cowpeas and fermented fish sauce at lunch; steamed sago stuffed with cowpeas, steamed glutinous rice stuffed with cowpeas and cowpea and sago pudding were mainly lunch or dinner dishes; bananas were eaten more often later in the day (Table 81).

It was also noted from the results that some kinds of dishes and food had exhibited a preference time pattern. The preference time pattern of these dishes and food are shown in Table 81. More villagers chose to eat certain kinds of dishes at a particular time of the day than other times and this occurrence was repeated in the other days e.g., in Days 1-2 villagers chose to eat steamed sago stuffed with cowpea at dinner more than at lunch and breakfast and this was repeated in the same pattern for Day 3 and Day 4. This preference time pattern was found more in the main dishes than sauces and fruit and vegetables sauces.

Table 81: Preference Time of Eating of Dishes in the Menu
(Ranking by the Average Percentage of Villagers in Six Villages Chosing Each Dish)

A. COWPEA DISHES							
Day of Menu	Rank Order			Day of Menu	Rank Order		
	1st	2nd	3rd		1st	2nd	3rd
	<u>Fried Cowpea Sprout*</u>				<u>Cowpea Sprout</u>		
1-2	L	D	B	1-2	B	D	L
	<u>Steamed Sago Stuffed* with Cowpea</u>				<u>Seasoned Mashed Cowpea</u>		
1-2*	D	L	B	3	B	D	L
3	D	L	B	4	B	D	L
4	D	L	B		<u>Cowpea and Fermented Fish Hot Sauce</u>		
	<u>Pumpkin and Cowpea Spiced Soup</u>			3	L	D	B
3	D	L	B	5	L	B	D
4	L	D	B	6	L	D	B
5	L	D	B	7	L	B	D
	<u>Steamed Glutinous Rice Stuffed with Cowpea</u>				<u>Steamed Cowpea and Bamboo Shoot</u>		
5	D	L	B	6	B	D	L
7	D	L	B		<u>Cowpea and Pumpkin Hot Soup</u>		
	<u>Cowpea Curry</u>			6	D	L	B
6	D	L	B	7	D	L	B
7	D	L	B		<u>Cowpea and Sago Pudding</u>		
6	D	L	B				
B. NORTHEASTERN DISHES							
	<u>Whole Fermented Fish</u>				<u>Mushroom Hot Soup</u>		
1-2	L	D	B	1-2	B	D	L
	<u>Chilli in Fish Sauce</u>			3	D	B	L
1-2	B	L	D		<u>Chilli in Fermented Fish Sauce</u>		
3	B	D	L	1-2	B	L,D	-
4	B	L,D	-	4	L	B,D	-
	<u>Fried Beef</u>			5	D	B	L
3	B	D	L	6	B	L	D
4	B	D	L		<u>Beef Soup</u>		
5	L	D	B	4	B	L,D	-
	<u>Roasted Beef</u>			5	D	B	L
5	B	D	L		<u>Roasted Small Toad</u>		
6	B	D	L	7	B	D	L
7	B	D	L				
	<u>Fermented Fish Hot Sauce</u>				<u>Spring Onion</u>		
7	D	B	L	1-2	D	L	B
C. VEGETABLES							
	<u>Water Convolvulus</u>				<u>Spring Onion</u>		
1-2	B	L	D				
3	B	L	D		<u>Coriander</u>		
4	D	L	B	3	D	L	B
	<u>Neem</u>			6	L	D	B
1-2	D	L	B	7	D	L	B
3	L	D	B		<u>Egg Plant</u>		
	<u>Chinese Cabbage</u>			4	D	L	B
4	B	D	L	5	L	B	D
5	L	B	D	7	B	L	D
6	B	D	L				
7	L	D	B		<u>Cork Wood Young Leaves</u>		
	<u>Cork Wood Young Leaves</u>			5	B	D	L
5	B	D	L	6	L	D	B
6	L	D	B				
D. FRUITS							
	<u>Banana</u>				<u>Custard Apple</u>		
1-2	D	L	B	3	L	D	B
4	L	D	B	7	D	B	L
5	D	L	B				
6	D	L	B				

* Data taken from villagers who cooked at home
Keys: B = breakfast; L = lunch; D = dinner

14.2.2 The Acceptability Of The Cowpea Dishes

The reactions of the villagers to the cowpea dishes were determined by firstly asking them for preferences in an interview and by secondly determining the number of villagers interviewed who had cooked the dishes. Table 82 shows the results of the preference test of the cowpea dishes. The cowpea dishes in the Days 1-2 menu, fried cowpea sprouts, cowpea sprout curry and steamed sago stuffed with cowpea were judged by the trained people, the villagers who ate at food party and the villagers who cooked the dishes at home.

Table 82: Acceptability of 11 Cowpea Dishes

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Total Mean Score
	Mean Score on 1 to 7 scale						
Fried cowpea sprouts							
(a)	5.6	5.7	6.5	5.5	3.7	5.2	5.4(48)
(b)	4.9	6.1	5.8	6.0	5.0	5.9	5.6(111)
(c)	5.5	6.1	5.3	5.8	5.0	6.0	5.6(64)
Cowpea sprout curry							
(a)	6.1	6.3	6.0	5.0	5.8	6.1	5.9(48)
(b)	6.6	6.6	5.9	6.0	5.9	6.5	6.3(111)
(c)	6.2	6.7	5.7	6.3	5.9	6.5	6.2(64)
Steamed sago stuffed with cowpea							
(a)	5.7	6.2	6.5	5.0	5.6	6.0	5.8(48)
(b)	6.2	6.3	6.3	6.2	6.0	5.4	6.1(111)
(c)	6.3	6.6	6.5	6.5	6.3	6.0	6.4(64)
Seasoned mashed cowpeas Pumpkin and cowpeas spiced soup	5.2	5.3	6.0	6.6	5.7	5.5	5.7(102)
Cowpea and fermented fish hot sauce	5.8	6.2	6.0	6.4	5.4	5.8	5.9(102)
Steamed glutinous rice stuffed with cowpea	5.6	5.3	5.6	5.9	6.0	5.7	5.7(102)
Steamed cowpea and bamboo shoot	6.2	6.5	6.5	6.5	6.5	6.5	6.5(102)
Cowpea curry	5.7	4.9	6.3	6.4	6.3	5.9	5.9(92)
Cowpea & pumpkin hot soups	5.9	6.0	6.0	6.3	6.0	5.9	5.9(92)
Cowpea and sago pudding	5.9	5.4	6.3	6.2	6.0	6.1	6.0(92)
	6.1	6.3	6.4	6.5	6.4	6.3	6.4(92)

*(a) trained people; (b) villagers who ate at food party;
(c) villagers who cooked at home.

** number in parenthesis are the total number of people interviewed.

It was found that there was no significant difference between the judgement of the three groups on the preference of three dishes: fried

cowpea sprouts, cowpea sprout curry and steamed sago stuffed with cowpeas. However there were significant differences between the 11 cowpeas dishes when judged by the group of villagers who had cooked them at home and there was highly significant differences between the scores of different villages. The most popular dish was steamed glutinous rice stuffed with cowpeas, steamed sago stuffed with cowpeas, cowpea and sago pudding and the least popular fried cowpea sprouts. But there were little differences between all mean scores, the range being 5.4 to 6.5 ie. all were popular.

However, the order of preference did not always relate to the actual dishes eaten by the villagers in the six different menus. The results showed that the ranking of cowpeas dishes depended to some extent on which day of the menu the dishes were presented; eg. steamed sago stuffed with cowpeas was ranked eleventh in days 1-2 menu but in the Day 3, it was ranked ninth. Steamed glutinous rice was the dish least often cooked and yet it had a high preference rating. This might have been caused by the time it took to make. This could also be the reason for the low cooking rate for steamed sago stuffed with cowpea, cowpeas and sago pudding. Fried cowpea sprouts, seasoned mashed cowpeas, cowpea and fermented fish hot sauce were often cooked, although they were slightly lower in preference ranking than the other dishes. This might have been due to the fact that they were easy to cook.

14.2.3 Cooking of the 7-Day Menu

The villagers were asked in an interview if they could find the ingredients for the seven day menu and for their opinions on the cooking of the seven day menu. A consistently high percentage of villagers indicated that the ingredients could be found 97%, 87% and 98% of the villagers indicated that they could find the food ingredients all year round for respectively Days 1-2; Day 3,4,5 and Day 6,7 menus. At the end of introduction, 93% indicated that they could find the ingredients needed for all the menus. Only two villagers said that they could not find chinese cabbage, bamboo shoots, mushrooms, meat, bean curd, cowpea seed, pumpkin, and custard apples.

Before trying to cook the menu it was found that most of the villagers indicated that the menu was either "easy to cook" and "just can cook". Few indicated that some of the 7-Day menus were difficult

to cook (Table 83). However, the Day 6 and Day 7 menus appeared more difficult to cook than the other menus. After the menu had been demonstrated, a high percentage of the villagers who had cooked the cowpea dishes and some part of the menu at home indicated that the 7-Day menu was easy to cook.

Table 83: Ease of Cooking of the 7-Day Menu
(% of People Interviewed)

	Easy to Cook	Can Just Cook	Difficult to Cook
Days 1-2	69	24	7
Day 3	62	34	4
Day 4	64	34	2
Day 5	63	33	4
Day 6	48	51	2
Day 7	46	51	3

Opinions on the continuous cooking of the 7-Day menus were asked from the four groups of villagers; these are given in Table 84. They were asked whether they would cook the 7-Day menu continuously for the whole year, if they said they could not, then whether they would cook continuously for the whole month, and if they still said they could not, whether they could cook for the whole week. The results show that villagers would cook the menu continuously whole week, whole month and whole year on average 13, 33 and 54% respectively. Villagers could not cook continuously for the whole year during the rice planting and harvesting season and they left village for working in town.

Table 84: The Average Percentage of Various Groups of Villagers
Who Would Continue Cooking the 7 Day Menu
(% of People Interviewed)

	Period of Continuous Cooking		
	Whole Week	Whole Month	Whole Year
Trained people interviewed at University	24	49	27
Villagers interviewed at food party	15	26	60
Villagers interviewed after first demonstration	7	17	76
Villagers interviewed at end of introduction	7	38	54

14.2.4 Cooking of Cowpea Dishes

The villagers were asked their opinion about cooking of cowpea dishes. Most of the villagers indicated at the end of the introduction of cowpea dishes that the cowpea dishes were easy to cook and just can cook. Few indicated that some of the dishes and the menu were difficult to cook. The results are shown in Table 85. It should be noted that the dishes that were easy to cook as indicated by larger number of villagers were the dishes introduced earlier.

Table 85: Opinion about the Cooking of Cowpea Dishes
(% of People Interviewed)

	Easy	Just Can Cook	Dificult
Fried cowpea sprout	70	30	0
Cowpea sprout curry	67	30	3
Steamed sago stuffed with cowpea	58	41	1
Seasoned mashed cowpea	57	42	1
Pumpkin and cowpea spiced soup	56	44	0
Cowpea and fermented fish hot sauce	60	40	0
Steamed glutinous rice stuffed with cowpea	55	45	0
Steamed cowpea and bamboo shoot	28	72	0
Cowpea curry	30	65	5
Cowpea and pumpkin hot soup	41	56	3
Cowpea and sago pudding	29	69	2
Sprouting cowpea	49	45	6

14.2.5 Number Attending Cooking Demonstration and Taking Part in the Competition

The number of people attending the cooking demonstration are given in Table 86. The number of villagers who had come to the cooking demonstrations were considered satisfactory especially for the first cooking demonstration. Large numbers of people had come to watch the video cooking demonstration (Ban Maung and Ban Wang Yawl). A large number of villagers in the other villagers attended the first live cooking demonstration, however the number declined in subsequent demonstrations. This may be due to many possible factors including the fact that the cooking demonstrations were held in the monsoon season.

Table 86: Number of Villagers Attending Cooking Demonstration and Taking Part in Cooking Competition

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Total Number
<u>Cooking Demonstration</u>							
Coming to food party	138	155	89	122	100	87	691
Attending first cooking demonstration	42	46	30	71	40*	>70	>299
Attending second cooking demonstration	34	42	50	82	>100	>50	>358
Attending third cooking demonstration	25	43	46	50	>100	>70	>334
<u>Cooking Competition</u>							
First cooking competition	12	10	11	19	-	-	52
Second cooking competition	13	14	21	14	-	-	62
Third cooking competition	17	17	11	35	-	-	80

*Raining on the demonstration day.

Villagers normally work hard in the fields and so were too tired to come or otherwise they were satisfied with seeing one demonstration. The number of villagers who took part in the cooking competition was about one third of the villagers attending the cooking demonstration. The total number of villagers who took part in the cooking competition increased in the subsequent cooking demonstrations.

14.2.6 Conclusion from the Evaluation and Trial Stage

The villagers in the six villages evaluated the 7-Day menu and the 11 cowpea dishes as highly acceptable. This was shown by the high preference mean scores when they judged the menus and the cowpea dishes, and the high ranking choice of the cowpea dishes among the other dishes in the dishes chosen. A high percentage of villagers also had indicated that the 7-Day menu and the 11 cowpea dishes were very easy to cook and they would find ingredients for cooking them all year round and they could continue to cook them for their families throughout the year. The 7-Day menu were introduced as a whole day

food, for the villagers to make their own choice for each meal. This proved to fit in with the villager's style of food choice, it was found that there is not a pattern of eating meals for breakfast, lunch or dinner throughout the day and the villagers did not usually prefer to eat a certain kind of dish for a particular meal. After the food party, large number of villagers attended the cooking demonstration. Most of the audiences in Ban Koksri, Ban Huey Tuey and Ban Pasan were housewives and young girls, in Ban Nong Pai some men were included. The video audiences were men, housewives and young girls and were doubled if the number of children were included. One third of the cooking demonstration audiences entered the cooking competition. These villagers demonstrated an interest in the 7-Day menu and the cowpea dishes and wanted to learn the right method of cooking and to try the cooking themselves. Even though they were very busy with their field work and were tired at the end of the day after working in the field for the whole day, they still came to the cooking demonstration. As on average 47 people came to watch the cooking demonstration, this number was too large for everyone to see the cooking properly and participate in the cooking. As the video cooking demonstration had attracted a large number of villagers including men and children perhaps a combination of a video cooking demonstration and cooking practice at the end might be more useful. A large number of interested people could learn the cooking through the video show and the villagers who liked to learn more could practice at the cooking session after the video show. Video cooking demonstration could also be shown at the food party as the food party had attracted the largest number of villagers.

The introduction of the 7-Day menu to the villagers in the steps according to the stages in the adoption process proved very useful. Firstly it allowed the villagers time to consider and evaluate. If the villagers were interested and liked to learn more, then they had an opportunity to do so by attending the later stage of the introduction. Secondly it allowed the villagers who were not well educated to gradually absorb and learn the information, they might not get the information correctly at the beginning but they would learn all at the end. Thirdly it gave an impact and strength for all information and gave the villagers a reassurance as the introduction was made in a sequence of visits, instead of introducing only one time and never returning.

15. THE EFFECT OF THE TOTAL INTRODUCTION

The effect of the total introduction was found by determining firstly the number of villagers who cooked cowpea dishes, secondly the numbers of the cowpea dishes cooked by the villages, thirdly the number of villagers using cowpeas before and after the Introduction, fourthly the amount of cowpeas used and finally the changes of attitude and knowledge of the villagers to cowpeas for the beginning to the end of the Introduction.

15.1 THE NUMBER OF VILLAGERS WHO COOKED THE COWPEA DISHES

The total number of villagers who cooked cowpea dishes in each village was determined from the number of villagers who cooked at various stages of the Introduction. The rate of the increase in the numbers of the villagers who cooked cowpea dishes was also determined.

15.1.1 The Total Number

The number of householders in each village who cooked the cowpea dishes after various specified periods are given in Table 87. The number of villagers who cooked after the trainings at Khon Kaen university were the villagers who acted as the group discussion leaders and the contact person for the project. From the results it has been shown that there were considerable numbers of villagers who cooked the cowpea dishes prior to the start of the food parties presumably they have had the information from the trained people. Although the cowpea seeds were not distributed at that time it is presumed that the villagers had used their own seeds.

After the food party, however more villagers had cooked cowpea dishes and on average there were 25 householders per village, and 149 householders in six villages who had cooked the cowpea dishes. The numbers were encouragingly high. And after the subsequent cooking demonstrations as shown in Table 87, the numbers had reached the highest peak two weeks after the end of the Introduction. It was shown that there were still significant numbers of villagers who cooked the cowpea dishes when survey was done in the six villages.

Table 87: Number of Households Cooking Cowpeas During the Different Periods of Introduction

	Introduction Model						Total
	I	II		III			
	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	
After training	10	10	2	2	10	9	43
Before food party	12	6	1	5	8	3	35
After food party	23	23	13	28	39	23	149
After first demonstration	15 (12*)	10 (10)	24 (11)	36 (19)	17	10	112
After second demonstration	17 (13)	18 (14)	25 (21)	40 (14)	40	21	161
After third demonstration	12 (7)	17 (17)	11 (11)	36 (35)	40	15	131
Two weeks after end of introduction	29	36	25	45	69	30	234
Two months after end of introduction	18	25	9	32	8	6	98
Total no.** cooking	136	145	110	224	231	117	1061

*Number in brackets is the number of villagers who cooked for the cooking demonstration.

** Some were the same people

Difference between model I, II XXX (significant at 5% level)

Difference between model II, III XXX (significant at 5% level)

Difference between model I, III XXX (significant at 5% level)

The number of households gradually increased reaching a maximum two weeks after the end of the Introduction but then decreased two months after the end of the Introduction. It should be noted that cowpea seeds were not distributed to the villagers after the Introduction. The villagers who cooked cowpea dishes in the few months after the Introduction were presumed to have their own seeds or some remained from the distribution. This would prevent the villagers from carrying on the cooking of the cowpea dishes and so the number of villagers who cooked declined. The number of householders who cooked cowpea dishes were varied from village to village. Ban Maung generally had the highest number cooking at all stages, followed by Ban Nong Pai. The differences between villages may have been caused by the amount of cowpeas distributed as well as the size of the village and the method of introduction. The number of people receiving cowpeas varied as shown in Table 88.

Table 88: Number of People Who Received Cowpea Seeds

	Introduction Model						Total
	I		II		III		
	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	
At training	10	14	2	2	10	9	47
At food party	23	40	13	34	39	25	174
At first demonstration	14	11	23	32	17	10	107
At second demonstration	18	18	26	30	40	24	156
At third demonstration	10	17	10	40	40	15	132
At last competition	11	21	15	35	41	14	137
TOTAL	86	121	89	173	187	97	753

The difference in the number of householders who cooked cowpea between villages also depended on the number of people in the village, the availability of the cowpea seeds in the villages, the number of people receiving cowpea seeds, the number of people who came to observe the demonstration. However the most important factor was seen to be the method of introduction. It was found that there were highly significant differences in the number of householders who cooked cowpea dishes at different periods in the villages in Model I to villages in Model II and villages in Model I to villages in Model III and also village in Model II to village in Model III (using Chisquare test).

15.1.2 The Rate of Increase of the Numbers of Households Who Cooked The Cowpea Dishes

The average accumulated number of households who had cooked the dishes together with the average rates of increase of number of households per week per village for the six villages are given in Figure 20 and Table 89.

From the results it was found that the rate of increase in the number of households who had cooked the cowpea dishes was highest during the weeks 3 and 4 (cooking after the food party) which was 22 households per week per village. The increase in the number of

households during the other weeks remained static at approximately 5-6 households per week per village except week 10. In Ban Nong Pai and Ban Maung there were higher rates of increase than the other villages.

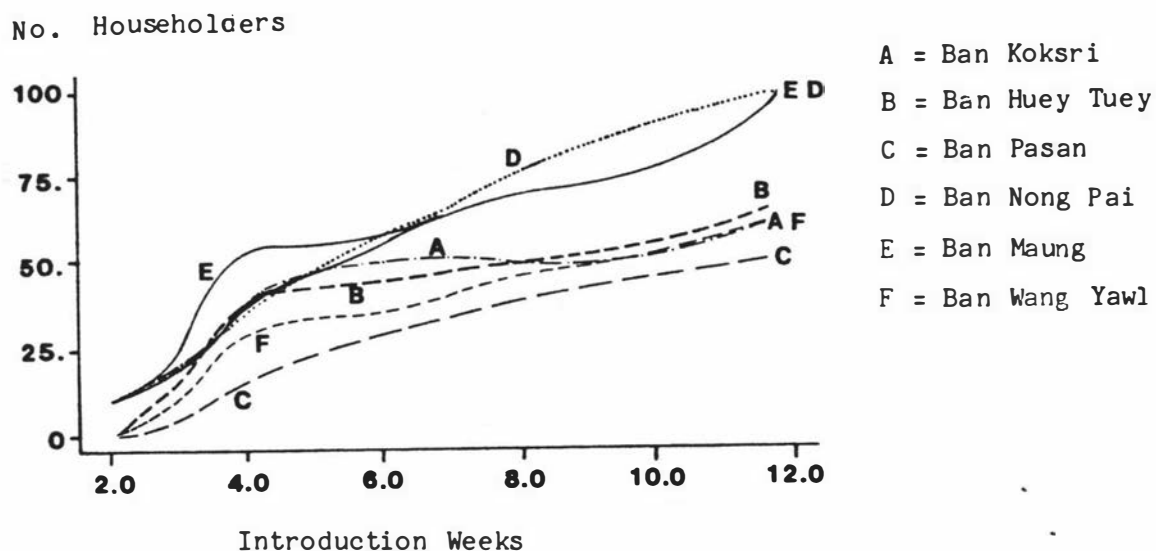


Figure 20: Accumulated Number of Villagers who Cooked Cowpea Dishes

Table 89: The Average Accumulated and the Average Rate of Increase in the Number of Households Who Had Cooked the Cowpea Dishes for the Six Villages

Week in Introduction	For Six Villages			Per Village
	Total Accumulated (Household)	Increase (Household)	Rate of Increase (Household /week)	Rate of Increase (Household/week /village)
2	43	-	-	-
3	78	35	35	5.8
4	212	134	134	22.3
6	268	56	28	4.7
8	333	65	33	5.5
10	363	30	15	2.5
12	438	75	38	6.3

15.2 THE COWPEA DISHES COOKED BY THE VILLAGERS

Kinds of cowpea dishes and the frequencies of cooking them were determined firstly, by interviewing villagers who had received cowpea seeds during different periods of the Introduction, secondly by interviewing every household at the end of the Introduction. The results are given in Table 90.

The villagers had cooked all the 11 cowpea dishes which had been demonstrated. However, besides these dishes, the villagers had also cooked other dishes with cowpeas. Each cowpea dish had been introduced to the villagers at different times therefore, the number of times that the dishes had been cooked were not comparable eg. fried cowpea sprouts, cowpea sprout curry and steamed sago stuffed with cowpeas were introduced during the beginning of the Introduction and the first cooking demonstration. The other dishes, 4 dishes at a time, were introduced during the second and the third cooking demonstrations. In spite of this, steamed glutinous rice stuffed with cowpeas and cowpea fermented fish hot sauce were cooked more frequently. This may be due to the fact that these two dishes were modified from common dishes eaten by the villagers.

Furthermore, it was observed that some dishes were cooked at the beginning of the Introduction before they had been demonstrated e.g. pumpkin and cowpeas spiced soup which was not really a common dish. This shows that the villagers were keen and interested in the menus; these dishes, although they had not been demonstrated, were shown in the photograph of the 7-Day menu which was on display at Khon Kaen University and at the food party.

The other cowpea dishes i.e. dishes which were not in the 7-Day menu, which had been cooked were cowpeas in syrup, raw cowpea sprouts and cowpeas stuffed in glutinous dough there were traditional dishes which used other legume seeds instead of cowpeas. The total number of cowpea dishes cooked were 4423, and those introduced in the 7-Day menu were cooked 4192 times.

Table 90: Cowpea Dishes Cooked by Villagers During the Introduction and at the End of Introduction
(Number of Times Dishes Cooked)

	At the Beginning of Introduction	After Cooking Demonstration	2 Weeks After Introduction	2 Months After Introduction	Total
<u>Cowpea Dishes</u>					
Fried cowpea sprouts	203	245	112	14	574(2)
Cowpea sprout curry*	106	162	56	-	324(7)
Steamed sago stuffed with cowpeas*	78	297	57	7	439(4)
Seasoned mashed cowpeas	-	330	31	5	366(6)
Pumpkin and cowpeas spiced soup*	8	379	49	5	441(5)
Cowpea and fermented fish hot sauce	13	413	45	7	478(3)
Steamed glutinous rice stuffed with cowpeas*	66	421	155	56	698(1)
Steamed cowpeas and bamboo shoot	11	154	33	3	201(9)
Cowpea curry*	1	167	21	2	192(10)
Cowpeas and pumpkin hot soup	-	156	18	-	174(11)
Cowpea and sago pudding*	8	182	98	18	306(8)
Total*	494	2906	675	117	4192
<u>Other Dishes Using Cowpea</u>					
Cowpeas in syrup	38	24	44	38	144(12)
Cowpea stuffed in glutinous rice dough	5	2	14	1	22(14)
Cowpea pudding	4	3	1	-	8(15)
Raw cowpea sprouts	14	8	8	12	42(13)
Cowpea bamboo shoot soup	2	-	-	1	3
Cowpea salad	-	-	2	1	3
Seasoned grated bamboo shoot soup and cowpeas	4	-	-	-	4(16)
Cowpea mushroom mashed	1	-	-	-	1
Raw cowpea pods	1	-	-	-	1
Cowpea sweet paste	1	-	-	-	1
Fried cowpeas	2	-	-	-	2
Total	72	37	69	53	231
TOTAL COWPEA DISHES	566	2943	744	170	4423

*Competition dishes

Figures in parenthesis are the ranking number of the most frequently cooked dish to the lowest frequency of cooking of the cowpea dish.

Comparison can be made between villages and between the models of Introduction. The results in Table 91 show that the total times villagers cooked cowpea dishes were 2804 for model II (Ban Pasan and Ban Nong Pai) as compared to 797 and 811 respectively for Model I (Ban Koksri and Ban Huey Tuey) and Model III (Ban Maung and Ban Wang Yawl).

Table 91: Householders Cooking Cowpea Dishes, from the Beginning of the Introduction to Two Months After the Introduction

	Introduction Model					
	I		II		III	
	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl
	(Total Number of Times)					
11 cowpea dishes in the menu	316	405	1256	1457	553	195
Other dishes using cowpeas	33	43	17	74	33	30
Total Village	349	448	1273	1531	586	225
Model	797		2804		811	

Model I (competition for best dishes), showed no difference from Model III (Cooking at home) for the "total" number of times of cooking the dishes. However, the differences between the totals for the two villages was greater in Model III. Ban Maung had a higher total than the villages in Model I. This may be due to a larger number of villagers in Ban Maung who came to see the video cooking demonstration and so a larger number of villagers receiving cowpea seed resulting in the higher total number of times villagers cooked cowpea dishes. However, Model II was by far the most successful Model having more than twice the number of the other models.

It was also found that the villagers in Ban Pasan and Ban Nong Pai had cooked more frequently after the cooking demonstration than the other villagers (726 times for Ban Pasan and 446 times for Ban Nong Pai). This was due to the effect of "competition for best cook".

Villagers competed with each other on the number of times they cooked the dishes. Villagers in Ban Maung also cooked the 11 cowpea dishes more often (213), than Ban Koksri (87) and Ban Huey Tuey (180). When comparing the models, it was found that the three models were significantly different from each other but there were also significant differences between the villages in each Model after the cooking demonstration (Appendix 16).

The number of times the dishes were cooked was analysed to find if these were caused by the number of households participating or the number of times the dishes were cooked by each household. Table 92 shows the average number of times a household cooked the cowpea dishes within a village: (A) during two weeks after the demonstration; (B) the period from the beginning of the Introduction to the end of the Introduction. Again the villages in Model II, Ban Pasan and Ban Nong Pai had higher cooking times per household than Models I and III. Model I was slightly higher than Model III, confirming that the higher total in Model III was caused by the higher number taking part in Ban Maung. The results show the effect of the method used after the cooking demonstration to encourage the villagers to cook in their homes. It was concluded that the Model II competition for best cook had more villagers cooking more often than Model I competition for best dish, and competition for best dish than cooking at home.

Table 92: The Average Frequency of Cowpea Dishes Cooked by

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl
A. THE TIME PERIOD AFTER COOKING DEMONSTRATION						
Total number of times the cowpea dishes were cooked.	87	150	726	446	213	77
Total number of householders who cooked cowpea dishes	44	45	60	112	97	46
Number of times cooked by a household	2.0	3.3	12.1	4.0	2.2	1.7
B. TOTAL PERIOD FROM THE BEGINNING OF INTRODUCTION TO THE TWO MONTHS AFTER THE END OF INTRODUCTION						
Total number of times the cowpea dishes were cooked	349	448	1273	1531	586	225
Total number of householders who cooked cowpea dishes	136	145	110	224	231	117
Number of times cooked by a household	2.6	3.0	11.6	6.8	2.5	1.9

15.3 AMOUNT OF COWPEAS EATEN BEFORE AND AFTER INTRODUCTION

As it was found that none of the households had cooked or eaten cowpea during the last two weeks before the Introduction and few of the villagers had cooked the cowpea dishes when they were interviewed at the food party, it was presumed that cowpea seeds were not available to most of the villagers to cook the traditional dishes using legumes, e.g. boiled in syrup, during the period prior to the Introduction. Cowpea seeds were only available to them after the Introduction. The total quantity of cowpeas given to the villages in the six villages at different periods of introduction is shown in Table 93.

The villagers in Ban Koksri, Ban Huey Tuey, Ban Maung and Ban Wang Yawl received nearly the same amount of cowpea seed, on average about 400 g. per household. Ban Pasan and Ban Nong Pai received about 650 g. per household, this was to provide enough seed for the villagers in these two villages to repeat the cooking in preparing for the cooking competition for best cook. In the beginning of the Introduction, each villager in each village received equal amounts of cowpea seeds but after the cooking demonstration, villagers in Ban Pasan and Ban Nong Pai received an additional amount.

Given in Table 93, is the amount of cowpeas the villagers in the six villages used in their cooking at different periods. Comparing the average amount of cowpea received per household and used per household (Table 93) it is noted that all villagers except Ban Wang Yawl had used more cowpea seed than had been given to them. It was informed that the villagers in Ban Pasan who entered the competition bought cowpea seed from the other villagers who grew cowpeas. So the villagers also had used other cowpea seeds beside the seeds they were given. These were grown by the villagers by planting their own seeds at the beginning of the Introduction.

Villagers in Ban Pasan and Ban Nong Pai used more cowpea seeds than the other villagers, after the first cooking demonstration. Villagers in Ban Wang Yawl used less cowpea seeds than the other villagers. On average each village used 85 kg of cowpea seed during the time from the beginning of the Introduction to two months after the end of the Introduction. The average used per household was 0.5 kg with the highest amount in Ban Pasan, and the next highest in Ban Nong Pai.

Table 93: Quantity of Cowpea Seed Given and Used for Cooking
(in Kilograms)

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Mean
A. COWPEA GIVEN							
Total cowpea given (kg)	37.54	47.71	57.69	112.64	79.27	43.14	
Household, no.	86	121	89	173	187	97	
Average cowpea/ household(kg)	0.44	0.39	0.65	0.65	0.42	0.44	
B. COWPEA USED							
After training	7.6	9.8	1.5	0.8	6.1	4.4	
After food party	4.4	4.9	2.3	3.5	7.4	6.5	
After first demonstration	4.6	3.4	15.7	12.2	6.4	2.4	
After second demonstration	6.4	6.5	37.4	27.0	17.6	4.9	
After third demonstration	4.6	7.1	19.5	42.4	15.5	2.1	
Two weeks after of introduction	15.7	16.4	18.6	31.9	23.8	10.8	
Two months after end of introduction	1.8	13.0	9.8	14.0	4.9	2.6	
Total used	45.1	61.1	104.8	131.6	81.7	38.3	77.1
Total No. of households	136	145	110	224	231	117	161
Average cowpea used/ household	0.33	0.42	0.95	0.59	0.35	0.31	0.48

When comparing the cowpeas for each Model of the Introduction, in Table 93, the villages in Model II (Ban Pasan and Ban Nong Pai) used more cowpea seeds than villages in Model I (Ban Koksri, Ban Huey Tuey) and villages in Model III (Ban Maung and Ban Wang Yawl). The accumulated data of the quantities of cowpea seeds (kg) used are shown in Figure 21. From Figure 21 it can be seen that the accumulative curves are generally sigmoid with the slow rate of increase during the first week, the rate accelerated during the second week and thereafter the curves flattened out.

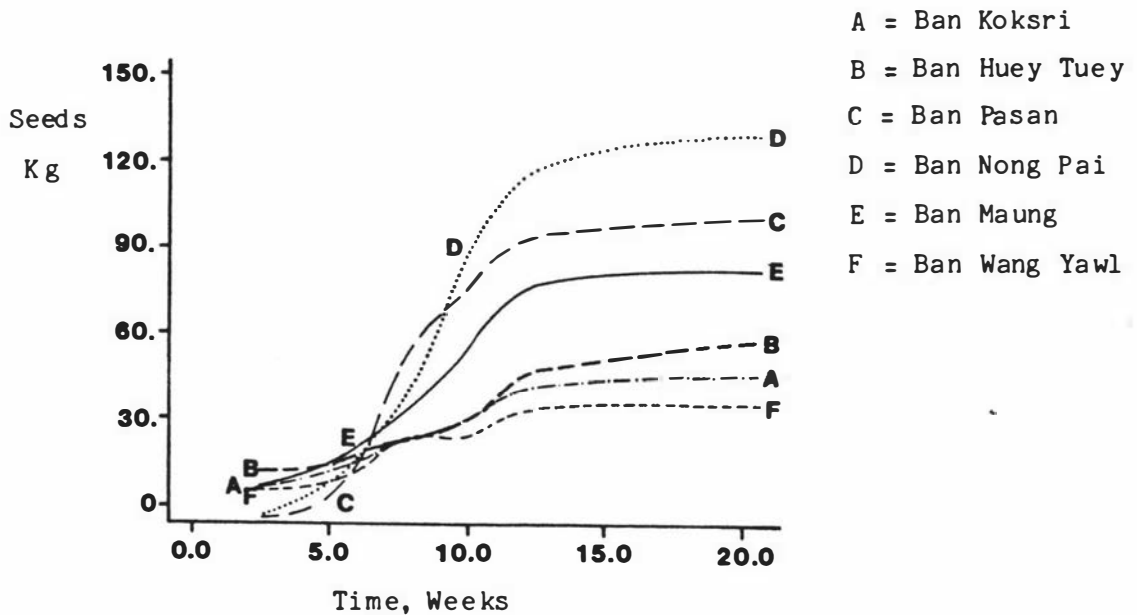


Figure 21: Accumulated Quantities of Cowpeas Used By Villagers in Six villages.

The accumulative curves reach higher for Ban Pasan and Ban Nong Pai than other villages. This reflects the Model used for the Introduction with Ban Pasan and Ban Nong Pai being Model II. For Ban Maung, the accumulative curve was also higher than the other three villages. This was due to the large number of villagers who cooked the cowpea dishes. For Ban Koksri, Ban Huey Tuey and Ban Wang Yawl, the accumulative curves are lower and the rates of increase were approximately constant at about 3 kg per week per village. However after the week twelve there was little increase in the amount of cowpeas used for all villages. This is probably because cowpea seeds were not given to villagers and there was limited amount of cowpea seeds available in villages.

15.4 KNOWLEDGE AND ATTITUDE TO COWPEAS AT THE BEGINNING OF THE INTRODUCTION AND AT THE END OF THE INTRODUCTION

A group of villagers were interviewed one week before the Introduction and two weeks after the Introduction on their knowledge and attitudes to cowpeas.

15.4.1 Knowledge of Cowpeas

Villagers were interviewed at the beginning of the Introduction firstly on their general knowledge of cowpeas, secondly on their knowledge of growing cowpeas and thirdly on their knowledge of cooking cowpeas. At the end of the Introduction the villagers were interviewed again.

On the general knowledge of cowpeas it was found that all of the group discussion leaders in Ban Koksri and Ban Maung, and the contact persons in Ban Pasan, and Ban Nong Pai had known the cowpea before the Introduction. Only 9% of the group discussion leaders in Ban Huey Tuey and 56% in Ban Wang Yawl had known the cowpeas. For both groups, few of them had grown cowpeas except the group discussion leader in Ban Koksri. The two contact persons in Ban Pasan indicated that they used to grow cowpeas for the Cropping System Project. Except for the group discussion leaders in Ban Koksri and Ban Maung and the contact person in Ban Pasan, very few had ever eaten cowpeas before.

The average percentage of villagers who had known, had grown and had ever eaten cowpea before the Introduction were 60%, 28% and 44% respectively. A larger number of villagers in Ban Koksri, Ban Pasan, Ban Nong Pai and Ban Maung had known, grown and eaten cowpeas than in Ban Huey Tuey and Ban Wang Yawl. After the end of Introduction it was found that an average 99% of villagers knew cowpea, 66% were growing or had grown cowpeas and 98% had been eating cowpeas. When comparing the results before the Introduction and after the Introduction, they were found to be highly significant different from each other (Appendix 16 (16D)). Villagers in Ban Had and Ban Jode were also interviewed as controls for comparison. The 7-Day menu and the cowpeas had not been introduced to these villages. It was found that 80% of villagers in both Ban Had and Ban Jode knew cowpea but only 31% had grown cowpea and 61% had eaten cowpea. These two villages were the villages in the Cropping System Project where red cowpea and local cowpea had been

introduced. Cooking demonstration of the use of cowpeas had been performed in these villages in the past.

At the beginning of the Introduction it was found that all of the group discussion leaders and contact persons who had grown cowpeas knew that cowpea were easy to grow. An average of 25% of villagers said cowpea were easy to grow. This number representing 89% of the villagers who had grown cowpeas. At the end of the Introduction, an average of 65% of villagers said cowpeas was easy to grow, this number represented 98% of the villagers who had grown cowpeas. It can be seen that the effect of the Introduction has increasing and encouraging the villagers to grow more cowpeas. As some of the villagers had already known that cowpea was easy to grow. An average of 31% of villagers in the control villages knew that cowpeas were easy to grow. This number represented all of the villagers who had grown cowpeas.

Before the Introduction - on average the group discussion leaders, the contact persons and the villagers knew only 7 dishes in which cowpeas could be cooked. After the Introduction, the knowledge of cooking cowpeas increased, the villagers knew that cowpeas could be cooked into 14 dishes. The villagers in the control villages knew 9 dishes. Before the Introduction, 5 dishes were indicated by the group discussion leaders and contact persons, namely, steamed sago stuffed with cowpeas, seasoned mashed cowpeas, cowpea and fermented fish hot sauce, steamed glutinous rice stuffed with cowpeas, steamed cowpeas and bamboo shoot. And only 2 dishes were mentioned by the group of villagers, namely fried cowpea sprouts and steamed glutinous rice stuffed with cowpeas. The group discussion leaders and the contact persons knew more dishes in the Introduction than the group of villagers, but in fact each dish was mentioned only by one person. After the Introduction, however, all of the introduced cowpea dishes, were known by the group of villagers.

For the other cowpea dishes: Cowpea in syrup, cowpea stuffed in glutinous rice dough, cowpea salad and other miscellaneous dishes were stated by the villagers, both before and after the introduction.

The control group of villagers, however had mentioned steamed cowpeas in glutinous rice dough and miscellaneous cowpea dishes. In conclusion before the Introduction of the cowpea dishes villagers knew only a few dishes in which cowpea could be utilized. These dishes were the traditional dishes in which they have been using other kinds of legumes as well. After the Introduction however, the villagers had

learned a greater variety of dishes. The details are given in the Appendix 16 (16D).

After the end of the Introduction, the villagers in the six villages were interviewed for their knowledge of the method of cooking cowpeas. An average of 94% of villagers in the six villages could list the methods of cooking cowpeas. Fourteen methods of cooking were listed in which 8 methods were the introduced methods. The introduced methods were indicated by a large percentage of villagers (Table 94). Only 7% of the villagers in the control villages could list the methods of cooking cowpeas and twelve methods were mentioned. The introduced methods were mentioned by a smaller percentage of villagers when compared with the group of villagers in the introduced villages. Details of results are given in Table 94.

Table 94: Knowledge on Method of Cooking Cowpea at the End of Introduction
(% of Households in Six Villages)

	Introduced Villages	Control Villages
Total Number Interviewed	205	45
<u>Method of Cooking</u>	(Mean \pm SD)	
Making curry*	58 \pm 28	10
Whole seed stuffed in glutinous rice*	41 \pm 22	31
Minced and stuffing dessert*	40 \pm 21	40
Fried*	40 \pm 22	10
Sprouting*	39 \pm 18	4
Ground and put in hot sauce*	38 \pm 21	
Making pudding*	25 \pm 18	15
Ground and put in soup*	25 \pm 11	10
Boiled in syrup	20 \pm 13	44
Ground and put in curry	15**	-
Steamed or roasted	11**	5
Made into paste	9**	10
Made into salad	8***	7
Deep fat fried	3**	19

* Introduced method

** Answered by only 1-2 villagers.

15.4.2 Growing of Cowpeas

The effect of the Introduction on the growing of cowpeas by villagers in the six villages were measured firstly by interviewing villagers one week before and two weeks after the Introduction, on the period and area of growing, and secondly by interviewing the village head men who had been growing cowpea during the last two months.

It was found that the Introduction had an effect on the number of villagers growing cowpeas. Table 95 shows the average percentage of villagers growing cowpea in each village. Results show that a large percentage of villagers (62%) grew cowpeas during the period of 0-6 months after the Introduction comparing with 14% before the Introduction and the area of growing also increased (Table 95).

Table 95: Growing of Cowpea Before and After the Introduction in the Six Villages
(Average Percentage of Households in Six Villages)

	Before Introduction	After Introduction
A. <u>Period of Growing</u>		
0-6 months	14+10	62+15
7-12 months	4+4	2+4
13-18 months	6+1	5+1
19-20 months	17+5	0
Over 2 years	12+0	3+0
B. <u>Area of Growing</u>		
Less than 1/4 rai	8+5	28+21
1/4 rai	14+7	26+12
1/2 rai	6+4	12+12
3/4 rai	4+0	5+2
1 rai	10+8	15+10
Over 1 rai	10+0	0

(1 hectare = 6.25 rais)

At the beginning of the Introduction and during the Introduction, some of the villagers had stated their intention to grow cowpeas for their own consumption in the coming season (June/July 1981). Cowpea seeds were given to the villagers to grow at the beginning of the Introduction. Some of them had grown cowpeas during the months of June and July 1981. They had already harvested and some were eaten by themselves. Some seeds were also kept for growing in the coming

season. Unfortunately villagers in Ban Koksri had not had good production due to high insect damage and could not be prevented in time. And furthermore Ban Nong Pai received low rainfall, land was very dry and few of the villagers could grow cowpeas. Table 96 shows the number of households growing cowpeas in the six villages, before and after the Introduction. Before the Introduction 7 households in the six villages had been growing red cowpea with the growing area of 2.75 rais (0.44 ha.); after the Introduction, a significant number of villagers had grown the red cowpea, the total of 244 households in six villages.

Table 96: Growing of Red Cowpea Before the Introduction and After the Introduction in the Six Villages and of the Local Cowpea in the Control Villages

	Before Introduction		After Introduction				
	No. House- hold	Area (rai)	No. House- hold	Area (rai)	Seed Given (kg)	Seed Used (kg)	Quantity Used per household (kg)
<u>Introduced Villages</u>							
Ban Koksri	3	1.5	25	9	11.2	7.9	0.32
Ban Huey Tuey	-	-	36	16	14.4	13.4	0.37
Ban Pasan	3	1.0	33	27	21.7	21.7	0.66
Ban Nong Pai	-	-	49	16	13.7	13.3	0.27
Ban Maung*	1	.25	56	23	18.6	18.6	0.33
Ban Wang Yawl	-	-	45	16	15.0	13.7	0.33
TOTAL	7	2.75	244	107	94.6	88.6	-
<u>Present Growing</u>							
			No. Household		Area (rai)		
<u>Control Villages</u>							
Ban Jode**			9		8.75		
Ban Had**			10		2.5		
TOTAL			29		11.25		

* The household grows cowpea in own land, the other villagers work for Cropping System in the experimental farm in Ban Maung.

** Growing only local cowpea.
(1 hectare = 6.25 rais)

In the control villages, Ban Jode and Ban Had had grown the local cowpea, the quantity of cowpea seeds used for had grown the local cowpeas on 19 households and 11.25 rais (1.8 ha.). On average each household used about 300 g. of seeds for growing except those in Ban Pasan (in Model II) which had used double this amount.

15.4.3 Eating of Cowpeas

At the beginning of the Introduction and the end of the Introduction villagers were interviewed for their liking of cowpeas, their opinion on eating cowpeas everyday and on how they had eaten cowpeas. Villagers in the six villages and the control villages were also interviewed at the end of the Introduction on how often they had cooked cowpeas, and whether they had grown cowpea sprouts and the kinds of dishes they had cooked most often.

It was found that 80% of the group discussion leaders, in Ban Koksri, 9% in Ban Huey Tuey, 70% in Ban Maung, 22% in Ban Wang Yawl and the two contact persons in Ban Pasan and one contact person in Ban Nong Pai indicated that they liked to eat cowpeas, when they were interviewed at the beginning of introduction. On average 41% of villagers indicated that they liked to eat cowpeas. At the end of the Introduction 98% of the villagers indicated that they liked to eat cowpeas. The average in the control villages, Ban Had and Ban Jode was 14% of villagers who liked to eat cowpeas.

When the villagers were interviewed for their opinion of eating cowpeas everyday, it was found that before the Introduction an average 57% of villagers in the six villages indicated that they could eat cowpeas every day. After the Introduction an average of 85% of villagers indicated they could eat cowpea every day. The main reason for not eating cowpeas everyday at the beginning of the Introduction was that "they would be boring" (average of 27% mentioned) but when interviewed after the Introduction only 11% mentioned this. 57% of the villagers in the control villages indicated that they would eat cowpeas every day and about half of them (25%) said that they would be bored eating cowpeas everyday.

After the end of the Introduction the villagers in the six villages and the control villages were asked whether they would intend to grow cowpeas for eating and whether they would have any problem in growing cowpeas for their own consumption. From the interviews it was

found that 97% of the villagers in the six villages intended to grow cowpeas for eating and the problems in growing cowpea was mainly due to insects and other pests. 72% of villagers in the control villages also indicated their intentions to grow cowpea for eating and they would face the same problem of insects and pests.

Table 97: Frequency of Cooking Cowpea and Sprouting Cowpea by Villagers in the Six Villages and the Control Village
(Total times per week multiply by % people)

	Introduction Model							
	I		II		III		Control	
	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung Wang	Ban Yawl	Ban Had	Ban Jade
Cooking cowpea	221 (260)	229	416 (387)	358	188 (161)	133	130 (168)	206
Sprouting cowpea	152 (182)	212	227 (216)	205	117 (134)	151	0 (8)	16

Table 97 shows the results of cooking cowpeas and sprouting cowpeas. Villagers were classified according to model of the Introduction namely Model I, II, III and control. The parenthesis shows the average value for the model. It was found that villagers in Model II cooked cowpea dishes and grew cowpea sprouts more often than other villagers. Comparing Model I and II, it was indicated that villagers in Model I cooked cowpea dishes and made cowpea sprouts more often than Model III. In the control villages cowpea dishes were cooked quite frequently but they rarely made cowpea sprouts.

The lists of the dishes which cooked more frequently are given in Table 98. It was found that the villagers indicated all of the 11 cowpea dishes which had been introduced and the other cowpea dishes. The cowpea dishes indicated by a larger number of villagers were: fried cowpea sprouts, cowpea curry, steamed glutinous rice stuffed with cowpeas, cowpea sprout curry, cowpea and sago pudding and steamed sago stuffed with cowpeas. And the other dish the villages cooked most often was cowpeas in syrup. The villagers in control villages cooked cowpeas in syrup more often than other dishes.

Table 98: Cowpea Dishes Indicated as Cooked More Often by a Group of Villagers After the Introduction
(% households interviewed)

	Introduced Villages	Control Village
<u>Introduced Dishes</u>		
Fried cowpea sprouts	36+16	
Cowpea sprout curry	21+14	
Steamed sago stuffed with cowpeas	20+9	
Seasoning mashed cowpea	6+2	
Pumpkin and cowpeas spiced soup	10+9	
Cowpeas and fermented fish hot sauce	5+1	
Steamed glutinous rice stuffed with cowpeas	24+15	6+1
Steamed cowpeas and bamboo shoot	7+5	
Cowpea curry	28	
Cowpeas and pumpkin hot soup	13	
Cowpea and sago pudding	21+13	10
<u>Other Dishes</u>		
Cowpeas in syrup	16+10	61+23
Cowpea salad	8+6	11+1
Cowpeas stuffed in glutinous rice dough	3	6+1
Boiled cowpea seeds	3+0	
Cowpea sprouts, eaten raw	3+0	
Fried young pod with pork		5

The villagers in the six villages and the control villages were also asked if all members of their families ate cowpeas. It was found from the results of interviews that 98% of the villagers in six villages indicated all of their family ate cowpea and 70% of villagers in control villages indicated all the members in the family ate cowpeas.

15.4.4 Opinions of Cowpeas

Two quality factors of cowpeas were determined, the eating quality and nutritional quality. The eating quality was determined by asking the villagers to rank 7 kinds of foods according to their preferences. This was to determine how the villager's opinion placed cowpeas in comparing them with common protein food, meat, fish, eggs, milk and other two common legumes: (mungbean and soybean). The nutritional quality was determined by interviewing the villagers on their opinion

of cowpeas and its nutritional value.

The results of the ranking preference are given in Table 99. Before the Introduction cowpeas had been ranked 5th and 6th of the 7 kinds of food by the villagers, the group discussion leaders and the contact persons: while after the Introduction it had been ranked 4th of the 7 kinds of food by the villagers in the six villages. The villagers in the control villages also ranked cowpeas in the fourth place. Meat, fish and egg are always the villager's favourite food. The villagers placed cowpeas after these kinds of food and before milk.

Table 99: Preference Ranking of 7 Kinds of Food by the Villagers Before and After the Introduction
(Total Rank of the Villages Interviewed in Six Villages and Control Villages)

	Before Introduction		After Introduction	Control Village
	Group Discussion Leader and Contact Person	Villagers	Villagers	Villagers
Meat	1 (9)	1 (7)	1 (6)	1 (2)
Fish	3 (13)	2 (11)	3 (18)	2 (5)
Egg	3 (12)	3 (19)	2 (15)	2 (5)
Milk	5 (28)	4 (25)	5 (29)	6 (12)
Soybean	7 (30)	7 (37)	6 (38)	7 (13)
Mungbean	4 (27)	6 (36)	7 (39)	5 (11)
Cowpea	6 (29)	5 (33)	4 (22)	4 (8)

Figures in parenthesis are the total rank numbers.

Introduction had little effect on the general knowledge of the villagers on cowpeas as a good food but it had greater effect on increasing the knowledge of villagers on the nutritional properties of the cowpea. It was found that prior to the Introduction 78% of the group discussion leaders and contact persons, 80% of the villagers indicated that cowpeas were a good food and after the Introduction all of the villagers interviewed indicated cowpeas as good food. 96% villagers in the control villages also indicated the same. Before the Introduction only 55% of the answers of the nutritional properties of cowpeas were correct but after the Introduction they were all correct.

15.5 THE COSTING OF THE THREE INTRODUCTION MODELS

Table 100 shows the total cost of the three introduction models. Model I cost 10036 bahts and was the highest cost, Model II cost 8,668 and was the lowest cost. Model III cost 8,713 bahts.

Table 100: Comparison of the Cost of the Three Introduction Models at Different Stages of Introduction
(Cost in Bahts per one village)

	Model I	Model II	Model III
<u>Before Introduction</u>			
Contact Village	660	440	660
<u>Awareness Stage</u>			
Training at KKU and gift given to group discussion leader, contact person and sub group	2,350	890	2,350
<u>Interest Stage</u>			
Running food party and giving cowpea seeds	3,069	3,057	3,069
<u>Evaluation Stage</u>			
Running cooking demonstration	1,921	1,921	-
Running video cooking demonstration	-	-	1,490
<u>Trial Stage</u>			
Running cooking competition (Gift and cowpea seeds given)	1,952	2,228	-
Cooking at home	-	-	933
<u>After Introduction</u>			
Cowpea seeds given	84	132	211
TOTAL COST	10,036	8,668	8,713

Cost of the different introduction methods per householder is shown in table 101. Group Discussion method cost higher than Person Contact but transmitted message quicker. Cost of Food Party was considered high compared with the cost of the other introduction methods, however Food Party was very useful and effective as it combined the actual tasting of food with the visual nutrition education. Video cooking Demonstration was cheaper than live Cooking Demonstration as it could be shown to a larger number of audience. Cooking Competition of Best Dish was the most expensive. Cooking at Home was the cheapest but less effective method. Cooking competition for best cook was cheaper than cooking competition for best dish and more effective. It should be recommended for future application.

Table 101: Cost of Different Introduction Methods per Householder*

	<u>Bahts</u>
<u>Awareness Stage</u>	
Group discussion-decision	24
Person contact	10
<u>Interest Stage</u>	
Food party	39
<u>Evaluation Stage</u>	
Cooking demonstration	16
Video cooking demonstration	7
<u>Trial Stage</u>	
Competition for best dish	46
Competition for best cook	41
Cooking at home	8

*Calculated from the average number of villagers in six villages attending the introduction at different periods.

15.6 CONCLUSION

From the evaluation, it could be concluded that the Introduction caused many effects and changes to the villagers in the six villages. Firstly a significant number of villagers cooked the cowpea dishes at home. Secondly, some villagers cooked cowpea dishes many number of times, and continued cooking until two months after the end of introduction. Thirdly a significant number of villagers had grown cowpeas for their own consumption. Fourthly the villagers had learned more methods of cooking cowpeas and they could be able to modify them to their own choice in the future. Fifthly the villagers had come to like cowpeas, they placed cowpeas in their preferences after meat, fish and eggs. Finally the villagers had learnt about the nutritional significance of cowpeas.

The methods of introduction showed a significant difference in the number of villagers who cooked the cowpea dishes and the number of times they cooked the cowpea dishes. It was found that Introduction Model II (Person contact -Food Party -Cooking Demonstration -Cooking Competition for Best Cook) was more effective than Introduction Model I (Group Discussion -Food Party -Cooking Demonstration -Competition for Best Dish) and Introduction Model III (Group Discussion -Food Party -Video Cooking Demonstration -Cooking at Home). Introduction Model I was more effective than Introduction Model III.

16. THE FINAL ANALYSIS OF THE INTRODUCTION OF THE COWPEA DISHES

This study has found useful methods for the Introduction of the new nutritional foods to the Northeastern villagers in Thailand. It was found that the Introduction should be planned in steps, following the stages in the adoption process. The introduction methods developed from the marketing system of introducing new foods proved useful for the Introduction of the new nutritional diets to this area of low nutritional status. To create more permanent adoption of the new nutritional diets, nutrition education should be introduced at the same time.

Different methods were used for the Introduction in following the four stages of the adoption process. In the awareness stage, "group discussion" and "person contact" methods were used. It was found that both methods were very useful to create awareness. The results showed that the group discussion method had diffused the information faster. The group discussion leaders could be used in the initial spread of the information and form a group activity in which the group leaders themselves could act as a leader or co-ordinator. The results also showed the importance of using persons such as village headman, his assistant and the teacher to make the village "aware" of the information. Such persons would be more useful in the person contact method, to give more strength to the information and have more influence on the villagers. In all introductions, it is necessary to have their co-operation and enthusiasm for the project.

In the interest stage, only one method was used - the food party. Food party was shown to be a most successful method in gathering a large number of villagers and a useful method for giving information especially in nutrition education, photographs can be displayed. Food party could be also useful in gathering villagers for a video cooking demonstration.

In the evaluation stage, two methods were used, a cooking demonstration and a video cooking demonstration. Both methods were found very useful. Cooking demonstration gave an increased effect to the cooking competition in gaining large numbers of villagers who had cooked the cowpea dishes at home. Cooking demonstrations would be useful for demonstration of the special techniques in cooking. Video was shown to be a suitable method for showing the cooking demonstration

in the Northeast villages, where there will always be a large number of villagers watching the cooking demonstration. The video cooking demonstration can demonstrate the cooking method to a large audience in which there are not only the housewives but also the group of men who are the heads of the families and the children who are in the vulnerable group.

In the trial stage, three methods were used: the cooking competition for best dish, the cooking competition for best cook and the cooking at home. Results showed that the cooking competition for best cook, in which the villagers competed with each other on the frequency of cooking, had a greater effect as a larger number of villagers cooked the cowpea dishes and cooked more often. This method perhaps is very useful to persuade the villagers to cook the new nutritional diet at home more often so that they could readily adopt the habit of cooking the diet. Experience from the study also showed that the cooking competition for best cook is useful, not only to gain a number of villagers cooking for the competition, but because the villagers paid more attention to the cooking demonstration as they had to cook the competitive dishes similar to the demonstrated dishes. Perhaps this method is useful when it is necessary for the villagers to use the right amount of ingredients and a certain method of cooking for the introduced diet. Cooking at home was found less persuasive and less encouraging for the villagers to try cooking the menu. When video cooking demonstration was used in combination with the cooking at home method, there was a lesser impact and strength. It required more of an effort of the group discussion leaders in seeing that villagers in their groups had cooked at home. When the group discussion leaders were strong as in Ban Maung, the method could be useful but if the group discussion leaders were weak like in bahtsan Wang Yawl, this method is not useful for food introduction. Perhaps the most useful method would be to use a video cooking demonstration with a cooking competition.

The study has found that all of the villagers in the six villages had highly accepted the new cowpea dishes and the 7-Day menu. After the end of the Introduction they had increased their preference for cowpeas. This demonstrated that the new cowpea dishes and the 7-Day menu, and the way planned for them to be used, had the right characteristics of relative advantage, compatibility, triability and observability perceived by the villagers in this innovation. It is

also shown that the method by which the innovation was introduced was also appropriate and effective. This means that all of the three introduction models were suitable.

Some variable factors should be noted in this study - the factors which limited the effectiveness of the Introduction and the factors which had influenced the Introduction. During the Introduction, the availability of the cowpea seeds had limited the number of villagers who would like to cook more of the cowpea dishes. Cowpea seeds were not available in villages for villagers to cook after the Introduction, this would explain the decrease in number of households and quantity of cowpeas used for cooking when they were evaluated two months after the Introduction. The period of the Introduction was in the middle of the raining season and the villagers were very busy with the field work. Some villagers could not attend every introduction activity. The working time in the villages was also limited, as most of the villagers were only available after the evening meal. Introduction had to be rushed through in an hour to fit in with the villagers' life style. As the Introduction had to be evaluated, there were many interviews and this interfered with the Introduction. Some of the villagers were reluctant to receive the cowpea seeds as they did not want to answer the questions. The other factors which could not be controlled and which were observed to exhibit an effect on the Introduction were: the nature of the villagers in the village (whether they are active or less active, co-operative or less co-operative), the organisation in the village itself, the leadership in the village and the availability of the raw materials in the village, the capacity of the villagers in that village to produce the raw material of the introduced diet.

For the Introduction of the new diet to the Northeastern region the method used for the Introduction has to depend on the nature of the villagers and the time taken for each introduction method would have to be considered from village to village. Some villages could be taken through many stages at the same time, some villages might need more time for training the group discussion leader or teaching the nutrition. Generally in the awareness stage, the group discussion and person contact were useful, in the interest stage, the food party was very effective. In the evaluation stage, video cooking demonstration with the cooking practice session at the end would be very useful and in the trial stage the cooking competition for best cook would be very effective. But in the village where the villagers are divided into

many groups and which has a group conflict, cooking competition should not be encouraged.

There still are some answers needed, firstly to find a suitable introduction method for the uncooperative villages whose leader is not very strong and the vulnerable groups are in the status of nutritional need. Also there is some need in the villages where the Introduction was effective and the villagers were willing and ready to accept another innovation; these villagers still need to be kept in touch by teaching them a more advanced cooking technique or a simple processing or storage technology.

CONCLUSION

THE CRITICAL APPRAISAL OF THE SYSTEM

The aim of this study was to develop a system for the design of a nutritionally balanced diet and to find a method of introducing this diet to villagers in Northeastern Thailand. Particular emphasis was placed on improving the protein content of the diet by supplementing with a known but seldom used protein food. The system developed consisted of three stages:

Study of the present foods and food dishes eaten, the eating pattern and the methods of cooking.

Design of protein maximised dishes and a 7-Day menu using linear programming and mixed integer programming.

Introduction of the protein maximised dishes and the 7-Day menu by training village leaders to inform the villagers, holding an introduction food party, using a video cooking demonstration and a cooking session to teach villagers and finally using competitions to encourage the villagers to cook the dishes and follow the menu.

The "recall" survey using village school teachers as interviewers was found satisfactory for determining eating patterns. The type of household sample selected for interview truly represented the whole village population and a total of 100 households in ten villages was also found adequate for obtaining the required information. The survey found that the general eating pattern of the villagers in the ten villages was similar to those of villagers in other areas in Northeastern Thailand reported in past surveys and it confirmed that the diet of the villagers in Northeastern Thailand was mainly glutinous rice and vegetables. It gave extensive information, on the food dishes and recipes and the methods of preparing and eating meals, which could be used as the basis for menu planning. The nutritionally balanced 7-Day menu based on the information obtained from this survey in Khon Kaen Province should be relevant to other areas in Northeastern

Thailand.

The method used for the design of the protein maximised dishes was: study traditional recipes, protein maximize recipe using linear programming and test acceptability of protein maximised dishes by use of consumer panels. Linear programming was found very useful in this study for the formulation of the large number of protein maximised cowpea dishes and common food dishes because it systematically handled the development of the formulations and at the same time calculated a large number of nutrients in the recipes. There has been little use of the computer in recipe development by other workers, most recipe development has been done by a trial and error method in the laboratory. Certainly, this study has proved that linear programming is a fast and successful method, when there is a constant control of the acceptability of the recipe during the computer design.

The design of the 7-Day menu using mixed integer programming as an extension of linear programming was found satisfactory but there were difficulties in using this method. The basic method developed of firstly selecting foods and food dishes by linear programming and then planning the dishes in a suitable daily meal pattern using mixed integer programming was successfully used for the diet planning of villagers but there is a need to study the actual computer programming method further before it can be generally adopted. The present research developed a computer programme to obtain a "near optimum" solution but further study is needed to find a method of obtaining the optimum solution. It took a long time to run the mixed integer programming in selection of the daily menu for the whole week and a faster method needs to be developed.

In the introduction of the 7-Day menu to the villagers, the four stage structure of the "adoption process" proved a powerful method of gaining the interest and acceptance of the villagers. This slower introduction method taking 21 weeks led to a more permanent use of the food dishes and the new food raw material in the daily eating pattern of the villagers. Nutrition education was also necessary in the introduction of the 7-Day menu so that the villagers could see that there was a need for them to change. It was found that in the village setting in Northeastern Thailand, the key people in the villages are very important for introduction of new concepts. Also with the rapid communication development in the modern world, the use of new techniques such as video e.g. a video cooking demonstration, is also

needed in the villages. This attracts a large number of villagers. The scope of using video for the introduction of new foods needs further development.

Therefore, this study has developed a system to introduced a supplementary food to villagers in Northeastern Thailand for self-improvement of nutritional status based on an adequate daily consumption of nutrients from foods which can be grown and cooked in the villages by the villagers themselves without any outside help. This research system can be used in communities of low nutritional and economic status and can also be applied to the introduction of any new food crop for supplementing the local food. The design and introduction of any new menu or any new food can follow the basic outline as shown in Figure 22. However, the system does require further study as outlined below.

This system proved to be a reasonably fast method of introducing new acceptable foods to the villagers. The present study took 3 years from the start of the survey to the final stage of the introduction; in the future the system would take a minimum of 2 years if it was necessary to have a whole year's study of the eating pattern and about 1.5 years if only a short survey was necessary. The main advantage was that both the dishes and the menu were similar to the present diet of the villagers and therefore gained quick acceptance. However, the study showed that several steps of introduction were still needed to teach villagers how to cook the dishes. The timing in the system could be studied to see how the time could be reduced further.

Although this study did design a nutritionally balanced diet using the raw materials in the village and the supplementary food, it was not possible to overcome all the problems of the villagers' diet. For example, because there were few fatty foods available, it was difficult to obtain energy except by eating a large quantity of the glutinous rice. To change this it would be necessary either to introduce another supplementary food or to find a method of increasing some food locally available which would increase the fat in the diet.

Considering only food highly acceptable to the Northeast Thai villagers may have caused some foods to be ignored which could have overcome some of the problems of the present diet. It might be advisable to study such foods for their nutritional suitability and if they provided a better balance to the diet, reformulate them in new dishes so that they become more acceptable.

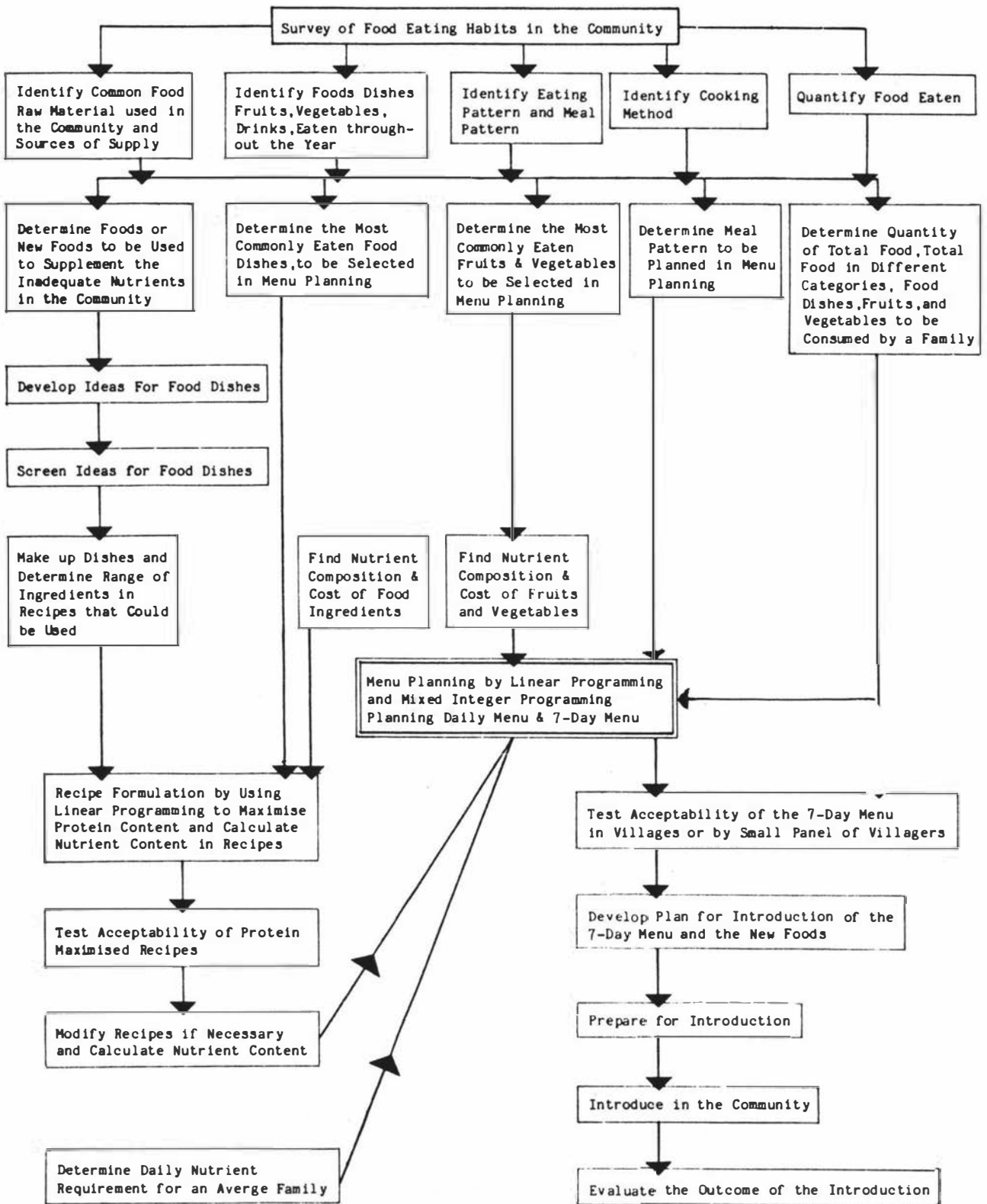


Figure 22: Basic Outline for Development of System for Self-Improvement of Nutrition Status in Community

The linear programming method uses cost as the objective, but this is unreal in the village situation where little food is bought but it is grown or collected. Therefore the important controlling factor in food intake is "availability". If food is available, then it is eaten; if not available, then it is not eaten. This was clearly shown in the survey during the three seasons. This study concentrated on producing a food which could be stored and therefore should be available for most of the year. However, to achieve this, the villagers must be taught to grow and store cowpeas. In this study, when the cowpeas had been eaten, the amount of cowpeas consumed decreased rapidly because there were none available. The villagers then had to wait until the next growing season. So it can be seen that introducing a new crop such as cowpeas will take several years before a regular growing and storing pattern develops. Instead of using a supplementary food, another method to improve nutrition would be to quantitatively study the availability of the different foods throughout the year and try to plan menus to take advantage of the foods available. This would mean the design of a series of menus which would be introduced throughout the year. It might be useful to encourage the growing of different supplementary foods throughout the year. The use of the linear programming/mixed integer programming system would allow a comparison of these alternative methods of improving the nutritional status.

This study shows the need for a multidisciplinary approach to the introduction of the foods to the villages. The agronomist, the food technologist, and the nutritionist must work together in developing suitable crops and foods, and must combine with the home economist and the social worker in introducing the foods. However, the most important part is the cooperation of the villagers in the introduction; if the influential villagers do not take an active part there is little hope of success. There is a real need for further study in the method of obtaining this multidisciplinary cooperation.

INTRODUCTION OF THE SYSTEM IN NORTHEASTERN THAILAND

In the present situation in Thailand, there are two appropriate approaches by which the system can be introduced on a regional scale.

(a) By using the services of the existing government personnel who have been working in the villages: the agricultural extension worker, the home economist and the health worker. The agricultural extension worker could be responsible for the cowpea growing, the home economist for the nutrition education and the cooking demonstration and the health worker also for the nutrition education. But these three people must go to the villages together and help each other in conducting the introduction of the whole system.

(b) By using the already trained villagers to teach villagers in similar villages under the organisation of the three government personnel.

There are two problems which need to be considered before the system could be launched on the regional scale. The first problem is the large quantities of cowpea seed required for the large scale introduction. This needs an organisation of seed production and seed stocking and it would take time to stock a large enough quantity. Perhaps the setting up of a "seed bank" in the village might be an advantage. Farmers could borrow seed for home consumption or growing, then could return the seeds when they have their own. The second problem is how to deal with some villages that may not cooperate during the introduction. This type of village may be nutritionally in need and a method of encouraging cooperation is needed. This problem needs to be studied in the future.

Although the 7-Day menu and the cowpeas were successfully introduced in villages a further introduction is needed to reinforce the value of the 7-Day menu and the cowpeas. Research on increasing the utilisation of cowpeas should be going on in the village, as there is a need to make cowpeas a permanent part of the diet for the villagers. It would be most appropriate if cowpeas in the form of cowpea flour were encouraged for use in the villages and in the towns as the next step of introduction. Cowpea flour would have more extensive uses in food dishes and in snack foods. Snack foods could be developed for village food vendors and small scale food processors in town. Therefore farmers could continue and increase the production of

cowpeas for their own use and for sale to those food vendors and food processors. Small milling units could be set up in the villages. Housewives could bring their own cowpeas to be milled. New cooking methods for the household could be introduced and villagers could modify their own cooking. Snack food recipes using cowpea flour for food vendors could also be introduced. This would increase the utilisation of cowpeas in villages in addition to the cowpea seed used in the 7-Day menu. This would lead to more varieties of foods eaten resulting in improvement of the nutritional status.

In conclusion this study was successful in planning a highly acceptable 7-Day menu and in encouraging cowpea growing, cooking and eating in the villages where the 7-Day menu and cowpeas were introduced.

BIBLIOGRAPHY

- Alfin-Slater, R.B. 1974. Fats, Essential Fatty Acids and Ascorbic Acid. *Journal of the American Dietetic Association* 64 (2) 168-170.
- Anderson, A.M. 1975. A Quantitative Model for the Design of Nutritious and Acceptable Foods. Thesis, Ph.D. Massey University, Palmerston North, New Zealand.
- Armstrong, R.D. and Sinha, P. 1974. Application of Quasi-Integer Programming to the Solution of Menu Planning Problems with Variable Portion Size. *Management Science* 21(4): 474-482.
- Ascroft, J. 1976. The Role of Mass Communication in Nutrition Improvement Program. *PAG Bulletin* 6 (1) 2-8.
- Balintfy, J.L. (1964) Menu Planning by Computer. *Communications of the Association for Computing Machinery* 7(4) 255-259.
- Balintfy, J.L. 1967. Computerised Dietary Information System Vol.1 Data Organisation and Collection Procedures. School of Business Administration, New Orleans, Louisiana, Research Paper 14, 70pp.
- Balintfy, J.L. (1969) System/360 Computer Assisted Menu Planning, Contributed Program Library No. 360D - 15.2.013 IBM Corporation PID, Hawthorne N.Y. 286p.
- Balintfy, J.L. 1975, A Mathematical Programming System for Food Management Applications, *Interfaces* 6(1), pt2:13
- Balintfy, J.L. 1976, Applications of Mathematical Programming to Optimise Human Diets. In *Symposite Mathematica Vol.19: Mathematical Programming and Its Applications, Proceeds of a Symposium, April 4-9, 1974. Institute Nazionale Di Alta Mathematica, Academic Press, London, p313-339.*
- Balintfy, J.L. 1979a. The Cost of Decent Subsistence. *Management Science* 25(10) 980-989.
- Balintfy, J.L. 1979b. The Utilisation of Computers in Menu Planning. In *Livingston, G.E. and Chang, C.M., Food Service Systems - Analysis, Design and Implementation. p155-175. Academic Press New York, London.*
- Balintfy, J.L. and Blackburn, C., 1969. Generalised Multiple Choice Programming with Truncated Black Enumeration. *Operation Research* 17 Supplement 2., p B222.
- Balintfy, J.L., Duffy, W.J. and Sinha, 1974. Modeling Food Preferences Over Time *Operation Research* 22(4) 711-727.
- Balintfy, J.L., Neter, J. and Wasserman, W. 1970. An Experimental Comparison Between Fixed Weight and Linear Programming Food Price Indices. *Journal of the American Statistical Association* 65 (329) 49-60.
- Baqchi, K. 1980. Nutrition education through health-care systems (WHO). In *Sinclair, H.M. and Howat, G.R. World Nutrition and Nutrition Education, p.173. Oxford University Press. UNESCO, Paris.*
- Baust, R.T., 1967. Computer Assisted Menu Planning, *Data Processing Magazine* 9, (12) 22-24.
- Beaton, G.H. and Swiss, L.D. 1974. Evaluation of the Nutritional Quality of Food Supplies: Prediction of "Desirable" or "Safe" *Nutrition* 27 485-504.
- Berq, A. 1973. *The Nutrition Factor: Its Role in National Development. The Brookings Institution. N.Y. Chapter 6.*
- Blair, T.L.V. 1969. Planning the introduction of low-cost protein-enriched cereal foods in Africa and the developing countries. In *Milner, M. Protein-Enriched Cereal Foods for World Needs. p.316-319. American Association of Cereal Chemistry Inc., St. Paul, Minn.*

- Branch, W.J., Southgate, D.A.T. and James, W.P.T., 1975. Binding of Calcium by Dietary Fibre: Its Relationship to Unsubstituted Uronic Acids. The Proceedings of the Nutrition Society 34 120A.
- Britt, S.H. 1978. Psychological Principles of Marketing and Consumer Behaviour. Lexington, Mass. 532p.
- Brown, J.E. 1979. Mothercraft Centers Project. L.I.F.E. Newsletter Digest: Nutrition Education 1975-1978. L.I.F.E. January 1979. p 9-11.
- Burk, M.C. and Pao, E.M. 1976. Methodology for Large-Scale Surveys of Household and Individual Diets. Home Economic Research Report No. 40. Agricultural Research Service, United States Department of Agriculture. 88p.
- Burroughs Corporation, 1975. Burroughs B7700/B6700 System Tempo. Mathematical Programming System User's Manual, Detroit, Michigan.
- Carmel, J. 1976, The Prediction of Diets of High Energy and Protein Value by Linear Programming. Ecology of Food and Nutrition 5 (3) 161-177.
- Chittaporn, Patchree, 1977. A Quantitative model for the Design of a Processed Infant Food Product for Thailand. Thesis, Ph.D. Massey University, Palmerston North, New Zealand.
- Colle, R.D. and Fernandez de Eolle, S. 1978. The Communication Factor in Health and Nutrition Programmes: A Case Study from Guatemala. *Cajanus* 11 (3) 151-190.
- Collins, D.E. 1977. Paulo Freire: His Life, Works and Thought. Paulist Press. N.Y. 93p.
- Cordaro, J.B. and Call, D. 1975. Nutritional Protection of Vulnerable Groups, Through Protein-Rich Mixtures. A Critical Review. Proc. 9th Int. Congr. Nutrition, Mexico 1972. 4 190-198. (Karger, Basel).
- Crane, E. 1965. Marketing Communication. John Wiley & Sons Inc. N.Y. p11.
- Cropping System Project. 1978. Annual Report KCU-FORD Cropping System Project 1978. Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.
- Crouch, B.R. and Chamala, S. 1981. Extension Education and Rural Development. Vol. 1. John Wiley & Sons Chichester/N.Y./Brisbane/Toronto p103.
- Cummings, J.H., Hill, M.J., Jenkins, D.J.A., Peason, J.R. and Wiggin, H.S., 1976. Changes in Fecal Composition and Colonic Function Due to Cereal Fibre. The American Journal of Clinical Nutrition 29 1468.
- Cummings, W.A.W. 1979. Launching a Successful Product on the Consumer Market. Journal of the American Oil Chemists's Society. 56 400-403.
- Dadd, P.C. and Starr, P.D. 1976. Characteristic of the Community. In McLaren, D. Nutrition in the Community. p11-23. John Wiley & Sons, London.
- Davey, P.L.H. and McNaughton, J.W. 1969. Nutrition Education in Developing Countries. Nutrition Newsletter 7 (3) 34-36.
- Davidson, S., Passmore, R., Brock, J.F. and Truswell, A.S., 1975 Human Nutrition and Dietetics., Churchill Livingstone, Edinburgh, London, p89.
- De Muelenaere, H.J.H. 1969. Development, production, and marketing of high-protein foods. In Milner, M. Protein-Enriched Cereal Foods for World Needs. American Association of Cereal Chemistry Inc., St. Paul. Minn.

- Department of Agricultural Economics, Ministry of Agriculture 1978. Statistics of Agricultural Production Year 1975/1976. Kingdom of Thailand.
- Devadas, R.P. and Chandrasekhar, V. 1970. Nutrition Education of Illiterate People. *Journal of Nutrition Education* 3 13-16.
- Dhannamitta, S. and Valyasevi, A. 1977. Vitamin A Deficiency Disease. In Varavith, V. *Nutrition Deficiency Diseases* 61-63p. Faculty of Medical Science. Mahidol University (In Thai.).
- Dhannamitta, S.; Valyasevi, A. and Tanphaichitr, V. 1977. Beri-Beri. In Varavith, V. *Nutrition Deficiency Diseases* p.34. Faculty of Medical Science, Mahidol University (In Thai).
- Dhannamitta, S.; Virojailee, S. and Valyasevi, A. 1981. Implementation of A Conceptual Scheme for Improving the Nutritional Status of the Rural Poor in Thailand. *Food and Nutrition Bulletin* 3 (3) 11-15.
- Division of Nutrition, Ministry of Health, 1970. The Composition of Thai Food Stuffs. Bangkok (in Thai).
- Division of Nutrition, Ministry of Health, 1973. Recommended Dietary Allowances for Thailand. Bangkok (in Thai).
- Division of Nutrition, Ministry of Public Health. 1975. Dietary Survey in Nakorn Rachasima Province in 1975 (personal communication).
- Dutra de Oliveira, J.E., Pileggi Vinha, Veratteloisa and Moura Duarte, F.A. 1980. Reaching Preschool Children Through a Community Food Program. *Ecology of Food and Nutrition* 9 223-228.
- Dwyer, J. 1976. Nutrition Education at the Village Level. *Food and Nutrition (FAO)* 2 (2) 2-7.
- Eastwood, M.A. 1974. Dietary Fibre in Human Nutrition. *Journal of the Science of Food and Agriculture* 25 1523.
- Eastwood, M.A., Kirkpatrick, J.R., Mitchell, W.D., Bone, A. and Hamilton, T. 1973. Effects of Dietary Supplements of Wheat Bran and Cellulose on Faeces and Bowel Function. *The British Journal of Nutrition* 4 392.
- Eckstein, E.F. 1967. Menu Planning by Computer: The Random Approach. *Journal of the American Dietetic Association* 51 529-535.
- Eckstein, E.F. 1973. Menu Planning. AVI, Westport, Connecticut, Chapter 1,3.
- Edwardson, W., 1974. The Design of Nutritional Food Products for a Developing Country. Thesis, Ph.D., Massey University, Palmerston North, New Zealand.
- Edwardson, W., Anderson, A.M., Chittaporn, P., Ngarmsak, T., and Earle, M.D. 1980., Linear Programming in Food Formulation Paper Present in A Symposium - Food Product and Process Development in Pacific Countries., November 10-13, 1980, Auckland, New Zealand.
- Engel, J.F., Kollat, D.T. and Blackwell, R.D. 1968. Consumer Behaviour. Holt, Rinehart and Winston, Inc. N.Y. Part III-V.
- Finley, J.M., Smith, A.N., Mitchel, W.D. Anderson, A.J.B., and Eastwood, M.A. 1974. Effects of Unprocessed Bran on Colon Function in Normal Subjects and in Diverticular Disease. *Lancet* 1 146.
- Food and Agriculture Organisation, 1957. FAO Committee on Protein Requirements (Report) FAO, Nutritional Studies, No.16. Rome
- Food and Agriculture Organisation, 1970. Amino Acid Content of Foods and Biological Data on Proteins. FAO Nutrition Studies No.24, Rome.
- Food and Agriculture Organisation. 1970. Assessment of Protein Nutritional Status. A Committee Report. *The American Journal of Clinical Nutrition* 6 807-819.

- Food and Agriculture Organisation, 1972. Food Composition Table for Use in East Asia. FAO, Rome.
- Food and Agriculture Organisation, 1980. Dietary Fats and Oils in Human Nutrition, Report of Pan Expert Consultation. FAO Food and Nutrition Series No. 20, Rome, pp 102.
- Food and Agriculture Organisation/World Health Organisation 1962. Calcium Requirements, FAO Nutrition Meeting Report Series, No. 30, Rome.
- Food and Agriculture Organisation/World Health Organisation 1965. Joint FAO/WHO Expert Group on Protein Requirements, Report. FAO Nutrition Meetings, Report Series NO. 37; WHO Tech. Rep. Series No. 301.
- Food and Agriculture Organisation/World Health Organisation 1967. Requirement of Vitamin A, Thiamine, Riboflavin and Niacin. WHO Technical Report Series No. 362, FAO, Rome.
- Food and Agriculture Organisation/World Health Organisation 1970. Requirements of Ascorbic Acid, Vitamin D, Vitamin B12, Folate and Iron. Report of a Joint FAO/WHO Expert Committee, WHO Technical Report Series No. 452, WHO Geneva, 75p.
- Food and Agriculture Organisation/World Health Organisation 1973. Report of a Joint FAO/WHO Committee, Energy and Protein Requirements, WHO Technical Report Series No. 522, Geneva.
- Food and Agriculture Organisation/World Health Organisation, 1975. Energy and Protein Requirements: Recommendations by a Joint FAO/WHO Informal Gathering of Experts. Food and Nutrition (FAO) 1(2) 11-19.
- Food and Nutrition Board, National Research Council, 1974. Recommended Dietary Allowances, 8th ed., National Academy of Science, Washington, D.C.,
- Food Planning and Nutrition Board of Thailand. 1977. Document and Information on the National Planning the Development of Food and Nutrition (1977-1981) 197p (In Thai).
- Forman, M.J. and Hornstein, I. 1976. AID Program for the introduction of new protein technology. In Altshul, A.M. New Protein Foods. p 239-258. Academic Press, N.Y.
- Gift, H.H., Washbon, M.B. and Harrison, G.G. 1972. Nutrition, Behaviour, and Change. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. Chapter 8-9.
- Gongora, J. and Shaw, D.J. 1977. World Food Programme Assistance for Supplementary Feeding Programmes: Review and recommendations. Food and Nutrition (FAO) 3 (2) 15-20.
- Gopaldas, T. 1978. Supplementary Feeding Programmes. The Case for programme information and nutrition education support. Food and Nutrition (FAO) 4 (1-2) 15-19.
- Greaves, J.P. 1979. Nutrition Delivery System. The Indian Journal of Nutrition and Dietetics 16 75-82.
- Gue, R.L. 1969, A Reformulation of the Menu Planning Problem. American Institute of Industrial Engineers Transaction 12. 146-149.
- Gue, R.L. and Liggett, J.C., 1966. Mathematical Programming Models for Hospital Menu Planning. The Journal of Industrial Engineering 17 395-400.
- Guthrie, H.A. 1978. The Role of Nutrition Education in Dietary Improvement. Food Technology 32 (9) 89-90.
- Habicht, J. and Butz, W.P. 1979. Measurement of health and nutrition effects. In Klein, RE et al. Evaluating the Impact of Nutrition and Health Programmes, p.133. Plenum Press, N.Y. and London.

- Halstead, S.B. and Valyasevi, A. 1967. Studies of Bladder Stone Disease in Thailand. I. Introduction and Discription of Area Studies. *American Journal of Clinical Nutrition* 20 (12) 1312-1319.
- Halstead, S.B.; Valyasevi, A. and Umpaivit, Prabhasri. 1967. Studies of Bladder Stone Disease in Thailand. V. Dietary Habits and Disease Prevalences. *American Journal of Clinical Nutrition* 20 1352-1361.
- Harper, J.M., Jansen, G.R., Shigetomi, C.T., and Frey, A.L., 1976. Menu Planning in the Nutrition Program for the Elderly. *Journal of the American Dietetic Association* 68 529-534.
- Hayhurst, R. 1973. Control and self control in testing marketing. In Wills, G., Haqhurst, R. and Midgley, D. *Creating and Marketing New Products*. p325. Crosby Lockwood Staples. London.
- Hein, F.G., Rabibhadana, A. and Pinthong, C. 1980. How to work with Farmers: A Manual for Field Workers. 52p (In press).
- Hennigan, K.M., Flay, B.R. and Haaq, R.A. 1979. Clarification of concepts and terms commonly used in evaluation research. In Klein, R.E., et al. *Evaluating the Impact of Nutrition and Health Programs*, P. 387. Plenum Press, N.Y. and London.
- Hixson, S. 1975. Consumer Education - Los Angeles Style. *Journal of the American Dietetic Association* 66 167-168.
- Hocevar, T., 1959. Review of Vlado Franković, Alenka Rismal, and Vidojka Kozak Upliu dohodkov in cen no raven potrovne prebivalstva v slovceniji (The Influence of Incomes and Prices upon the Level of Consumption in Slovenia). Economic Institute of Slovenia, Ljubljana, 1958 in *American Economic Review*, 49 417-418.
- Holt, K. 1977. Product Innovation. *Newness-Butterworths*. London. p.150-153.
- Hookham, E. 1980. Opening speeches address to the Conference. In Sinclair, H.M. and Howat, G.R. *World Nutrition and Nutrition Education* p.xvi. Oxford University. UNESCO, Paris.
- Icaza, S.J. 1976. The Incaparina Project. *PAG Bulletin* 6 (1) 35-37.
- Inoue, G., Fujita, Y. and Niyama, Y., 1973. Studies of Protein Requirement of Young Men Fed Egg Protein and Rice Protein with Excess and Maintenance Energy Intakes. *The Journal of Nutrition*, 103,. 1673.
- Interdepartmental Committee on Nutrition for National Defense. 1962. *The Kindom of Thailand: Nutrition Survey*. October-December, 1960. Bethesda, Md; National Institute of Health.
- Ismail-Beigi, F., Reinhold, J.G., Faraji, B. and Abadi, P. 1977. Effects of Cellulose Added to Diets of Low and High Fibre Content Upon the Matabolism of Calcium, Magnesium, Zinc and Phosphorus by Man. *The Journal of Nutrition* 107 510.
- Jelliffe, D.B. 1966. *The Assessment of the Nutritional Status of the Community WHO Monograph Series, No.53*.
- Kansra, A.C., Srinivasn, N. and Copaldas, T., 1974. Least-Cost Multi-Mix Supplements: Development of Formulae to Fill Dietary Deficits of Preschool Children. *The Indian Journal of Nutrition and Dietetics* 11 276-283.
- Klein, R.E., Read, M.S., Riecken, H.W. et al. 1979. *Evaluating the Impact of Nutrition and Health Programs*. Plenum Press, N.Y. and London. 462 p.
- Kleyngeld, H.P. 1974. *Adoption of New Food Products*. Telburg University Press. The Netherlands. 133p.

- Kumazawa, A; Ono, M.; Takahashi, H.; Vchijima, Y.; and Hirano, T. 1974. Investigations on Nutritional Anemia of the Farmes in North-Eastern Part of Thailand. Part 1, Dietary Survey. Division of Nutrition, Department of Public Health Promotion, Ministry of Public Health, Thailand and Nagoya Women's University, Japan, 235-263p.
- Latham, M.C. 1972. Planning and Evaluation of Applied Nutrition Programmes. FAO Nutritional Studies. No.26. FAO, Rome. 125p.
- Leveille, G.A. 1970. Adipose Tissue Metabolism Influence of Periodicity of Eating and Diet Composition Federation Proceeding 29 1294-1301.
- Lewin, K. 1958. Group decision and social change. In Maccoby, E.E.; New Comb, T.M. and Hartley, E.L. Reading in Social Psychology p 197-211. Henry Holt and Company, N.Y.
- McAllister, J. 1981. Rural innovators: A struggle for power. In Grouch, B.R. and Chamala, S. Extension Education and Rural Development. Vol.1 p135. John Wiley and Sons. Chichester/N.Y./Brisbane/Toronto.
- McConnell, A.A., Eastwood, M.A. and Mitchell, W.D., 1974. Physical Characteristics of Vegetable Foodstuffs that Could Influence Bowel Function. Journal of the Science of Food and Agriculture 25 1457-1464.
- McKenzie, J.C. and Mumford, P. 1965. The Evaluation of Nutrition Education Programmes: A Review of the Present Situation. World Review of Nutrition and Dietetics 5 21-29.
- McNaughton, J. 1978. Applied Nutrition Programmes - the Past as a Guide for the Future. Food and Nutrition (FAO) I (3) 17-23.
- McNaughton, J. 1980. A review of the activities of the FAO in nutrition education and training 1949-1977. In Sinclair H.M. and Howart, G.R. World Nutrition and Nutrition Education, p. 156. Oxford University Press. UNESCO, Paris.
- Manoff, R.K. 1974. The Effective Use of Mass Media in Nutrition Education. PAG Bulletin 4 (1) 12-17.
- Markin, R.J. 1969. The Psychology of Consumer Behaviour. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. Chapter 1.
- Mauron, J. 1975. Protein Enriched Foods: Facts and Illusions. Proc. 9th Int. Congr. Nutrition. Mexico 1972. 3 231-245. (Karger, Basel).
- Maxwell, S. 1978. Food Aid for Supplementary Feeding Programmes. An Analysis. Food Policy 3 (4) 289-298.
- Midley, D.F. 1977. Innovation and New Product Marketing. Croom Helm. London. 296p.
- Moskowitz, H.R. and Klarman, L., 1977. Food Compatibilities and Menu Planning, Canadian Institute of Food Technology Journal 10 (4) 257-264.
- Nondasuta, A. 1977. Endemic gorter in Varavith, V. Nutrition deficiency Diseases p.215-216. Faculty of Medical Science, Mahidol University (In Thai).
- Oliver, M. 1967. Pilot study in Alabama, Part IV In Program Aides work with the Needy. Journal of the American Dietetic Association 50 483-485.
- Orr, E. 1972. The Use of Protein-Rich Foods for the Relief of Malnutrition in Developing Countries: An Analysis of Experience. Tropical Products Institute, London. 71p.
- Orr, E. 1977. The Contribution of New Food Mixtures to the Relief of Malnutrition - A Second Look. Food and Nutrition (FAO) 3 (2) 2-10.

- Ozelci, A., Ramos, R., and Leveille, G.A. 1977. Influence of Diet Composition on Nitrogen Balance and Body Composition in Meal-Eating and Nibbling Rats. *Journal of Nutrition* 107 1768-1774.
- PAG. 1973. Mass Communication in Nutrition Education. PAG statement No.27. *PAG Bulletin* 4 (1) 2-5.
- PAG. 1976. A Pilot Study on the Feasibility of Using Mass Media for Imparting Nutrition Education in Maharashtra, India. *PAG Bulletin* 4 (1) 37-41.
- Painter, N.S., Almeida, A.Z., and Colbourne, K.W. 1972. Unprocessed Bran in Treatment of Diverticular Disease of the Colon. *The British Journal of Nutrition* 2 137-146.
- Park, M. 1980. Nutrition Education in the Republic of Korea. In. Sinclair, H.M. and Howat, G.R. *World Nutrition and Nutrition Education*. p.186. Oxford University Press. UNESCO, Paris.
- Parlato, R. 1974. Advertising and Mass Communications: A Model for Rural Nutrition Information Programs. *PAG Bulletin* 4 (1) 17-18.
- Patrick, G.F. and Simoes, M.H.R., 1971. Least-Cost Diet in Cristalina, Goias, Brazil. *Archivos Latino Americanos De Nutricion* 21 371-380.
- Peryam, D.R., 1959. Discussion: Linear Programming Models for the Determination of Palatable Human Diets. *Journal of Farm Economics* 41 302-305.
- Pike, R.L. and Brown, M.L. 1975. *Nutrition: An Integrated Approach*. John Wiley & Sons. Inc. New York and London. Chapter 26.
- Pinto, G.F., 1971. Optimization of Protein-rich Mixtures. *Archivos Latino Americanos De Nutricion* 21 169-183.
- Raw, I. 1980. The need-identification process: the question of education relevance. In Sinclair, H.M. and Howat, G.R. *World Nutrition and Nutrition Education*, p.85. Oxford University Press. UNESCO, Paris.
- Riecken, H.W. 1979. Practice and problems of evaluation. In Klein, R.E., et al. *Evaluating the Impact of Nutrition and Health Programs*, p. 363. Plenum Press, N.Y. and London.
- Ritchie, J.A.S. 1967. *Learning Better Nutrition*. FAO. Nutritional Studies No.20. FAO. Rome. Chapter 5.
- Rogers E.M. 1962. *Diffusion of Innovations*. The Free Press, N.Y. 367p.
- Rogers, E.M. and Shoemaker, F.F. 1971. *Communication and Innovations* Free Press. N.Y. p.100-133.
- Rolling, N.G., Ascroft, J. and Chege, F.W. 1981. The diffusion of innovations and the issue of equity in rural development. In. Crouch, B.R. and Chamala, S. *Extension Education and Rural Development*. Vol. 1, p.225. John Wiley & Sons. Chichester/ New York/Brisban/Toronto.
- Ronchi, F. and Gongora Y., Lopez, J. 1976. Evaluation of Supplementary Feeding Programmes Assisted by the World Food Programme. *Food and Nutrition (FAO)* 2 (4). 19-25.
- Schaik, T.F.S.M. van, 1974. Are Advice or Rules Requires on the Amount and Type of Fat in the Diet of the Netherlands Population? *Voeding* 35 (3, supplement) 19-105 In *Nutrition Abstracts and Reviews* 45 (4) No.2362 1975.
- Schofield, S. 1979. *Development and the Problems of Village Nutrition*. Croom Helm, London. Chapter 2-4.

- Scrimshaw, N.S. 1977. Through a Glass Darkly: Discerning the Practical Implication of Human Dietary Protein-Energy Interrelationship. *Nutrition Reviews* 35 (129) 321-337.
- Second European Nutrition Conference 1977. Round Table on Comparison of Dietary Recommendations in Different European Countries, Munich September 14-17, 1976. *Nutrition and Metabolism* 21 (4) 210-279.
- Shelton, M. 1976. The Physical and Socio-Economic Environment for Pasture and Beef Production in Northeast, P5. In Annual Report Pasture Improvement Project 1976. Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.
- Sevenhuysen, G.P. 1978. Informal Nutrition Education. *Food and Nutrition (FAO)* 4 (1-2) 25-26.
- Skinner, R.N. 1972. Launching New Products in Competitive Markets. Cassell/Associated Business Programmes. London 184p.
- Sim, L.S. and Smiciklas-Wright, H. 1978. An Ecological Systems Perspective: Its Application to Nutrition Policy, Program Design and Evaluation. *Ecology of Food and Nutrition* 7 173-179.
- Sinclair, H.M. and Howat, G.R. 1980. World Nutrition and Nutrition Education. Oxford University Press. UNESCO, Paris. Section IV. p222.
- Sinha, P., 1978. Concepts of Preference Maximisation in Computer Assisted Menu Planning. *Journal of Food Processing and Preservation* 2 75-89.
- Smith V.E., 1959. Linear Programming Models for the Determination of Palatable Human Diets. *Journal of Farm Economics* 41(2) 272-283.
- Smith, V.E., 1963. Electronic Computation of Human Diets, East Lansing Bureau of Business and Economic Research, Graduate School of Business Administration, Michigan State University.
- Smith, V.E. 1974. A Diet Model with Protein Quality Variable. *Management Science* 20 971-980.
- Smith P.E., 1961. The Diet Problem Revised: A Linear Programming Model for Convex Economists. *Journal of Farm Economics* 43 706-712.
- Smitherman, A. 1976. Arizona Food Fair. *Journal of the American Dietetic Association* 68 553-554.
- Southgate, D.A.T. 1973. Fibre and Other Unavailable Carbohydrate and Their Effects on the Energy Value of the Diet. *The Proceedings of the Nutrition Society* 32 131.
- Southgate, D.A.T., 1977. The Definition and Analysis of Dietary Fibre. *Nutrition Reviews* 35 (2), 31.
- Southgate, D.A.T., Branch, W.J., Hill, M.J., Draser, B.S., Waltus, R.L., Davies, P.S. and Baird, D.M., 1976. Metabolic Response to Dietary Supplement of Bran. *Metabolism* 25 (10) 1129-1135.
- Southgate, D.A.T. and Durmin, J.V.G.A. 1970. Caloric Conversion Factors. An experimental Reassessment of the Factors Used in the Calculation of the Energy Value of the Diet. *The British Journal of Nutrition* 24 517.
- Spiller, G.A., Chernoff, M.C., Shipley, E.A., Beigler, M.A., and Briggs, G.M., 1977. Can Fecal Weight be Used to Establish a Recommended Intake of Dietary Fibre (Planlix)? *The American Journal of Clinical Nutrition* 30 659.
- Spiller, G.A., Shipley, E.A. and Blake, J.A., 1978. Recent Progress in Dietary Fibre (Phantix) in Human Nutrition. *CRC Critical Reviews in Food Science and Nutrition* 10 (1) 31-90.

- Spindler, E.B., Jacobson, M.E. and Russell, C.B. 1969. Action Programs to Improve Nutrition. *Journal of Home Economics* 61 (8) 635-639.
- Stevens, C. 1978. Food Aid and Nutrition - the Case of Botswana. *Food Policy* 3 (1) 18-28.
- Stigler, G.J., 1945. The Cost of Subsistence. *Journal of Farm Economics* 27 303-314.
- Taguchi, H.; Hara, K; Hasei, T.; Hatta, R.; Mori, H.; Sanada,, H.; Iwasaki, I. and Kiraki, K. 1972. Investigations on Nutritional Anemia of the Farmers in North-Eastern Part of Thailand. Part 2 - Medical survey. Division of Nutrition, Department of Public Health Promotion, Ministry of Public Health, Thailand and Nagoya Women's University, Japan. 265-303p.
- Tanphaichitr, V.; and Sirivayd, S. 1977. Iron-Deficiency Anemia Nutrition Aspect in Varavith, V. *Nutrition Deficiency Diseases* p.187. Faculty of Medical Science, Mahidol University (In Thai).
- Thurnham, D.I.; Migasena,P.; Niyomsri, Y. and Supawan, V. 1972. Riboflavin Supplementation in a Resettlement Village in Northeast Thailand. *The British Journal of Nutrition* 28 91-97.
- Trimmer-Smith, B. and Tepley, L.J. 1980. UNICEF Co-operation in education efforts to improve nutrition. In Sinclair, H.M. and Howat, G.R. *World Nutrition and Nutrition Education*, p.167. Oxford University Press, UNESCO, Paris.
- Trowell, H., 1976. Definition of Dietary Fibre and Hypotheses that is a Protective Factor in Certain Diseases. *The American Journal of Clinical Nutrition* 29 417.
- Ullrich, H.D. and Briggs, G.M. 1976. Education to combat malnutrition. In McLaren, D.S. *Nutrition in the Community*. p.243-258. John Wiley and Sons. London.
- Unklesbay, N and Unklesbay, K., 1978. An Automated System for Planning Menus for the Elderley in Title VII Nutrition Programmes. *Food Technology* 32 80-83.
- Valyasevi, A. 1964. Protein-calorie Malnutrition in Thailand in Interdepartmental Committe on Nutrition for National Defense Tran. Second Far East Symp. Nutr.
- Valyasevi, A. 1980. Public Health Program to Promote Nutrition in Rural Areas - Thailand Experience, in Santos, W; Lopes, N; Barbosa, J; Chavas, D and Valente, J. *Nutrition and Food Science* Plenum Press, New York.
- Valyasevi, A. and Dhannamitta, S. 1974. Studies of Bladder stone Diseases in Thailand, XVII Effect of Exogeneous Sources on Oxalate on Crystalluria. *American Journal of Clinical Nutrition* 27 877-822.
- Valyasevi, A. and Dhannamitta, S. 1977. Idiopathic Uninary Bladder Stone Disease in Varavith, V. *Nutrition Deficiency Diseases* p.162. Faculty of Medical Science, Mahidol University (In Thai).
- Valyasevi, A.; Halstead, S.B.; Puntuwatana, Suntaree and Tankakul, Channaan. 1967. Studies of Bladder Stone Disease in Thailand in Dietary Habits, Nutritional Intake, and Infant Feeding Practices Among Residents of Hypo and Hyper endermic area. *American Journal of Clinical Nutrition* 20 1340-1351.
- Vimokesanth, S.L.; Milker, D.M.; Nakornchai, S.; Rungruangsak, K. and Dhannamitta, S. 1975. Effects of Betal Nut. and Fermented Fish on the Thiamine of Northesatern Thais. *American Journal of Clinical Nutrition* 28. 1458-1463.

- Vorasoot, N. and Wongpichet, K. 1981. Soybean Agronomy II Date of Planting Trial for Soybean. p.92. In Patanothai, A. KRU-IDRC Semi-Arid Cropping Project. Summary Report 1975. Faculty of Agriculture. Khon Kaen University, Khon Kaen, Thailand.
- Watts, R. 1970. Reaching the Consumer: the Elements of Product Public Relations. Business Books Limited. London. 169p.
- Webster, F.E. 1971. Marketing Communication-Modern Promotional Strategy. The Ronold Press. N.Y. p.35-50.
- Weisberg, S.M. 1976. Food Products Intended to Improve Nutrition in the Developing World. Advance in Food Research 22 187-203.
- White, R. 1973. Consumer Product Development. Longman. London. Chapter 7.
- Whitehead, F.E. 1973. Nutrition Education Research. World Review of Nutrition and Dietetics 17 91-149.
- Wolf, R. 1980. The role of evaluation in nutrition education. In. Sinclair, H.M. and Howat, G.R. World Nutrition and Nutrition Education, p.109. Oxford University Press. UNESCO, Paris.
- World Health Organisation. 1963. Expert Committee on Medical Assessment of Nutrition Status WHO Technical Report Series No. 258.

APPENDICES

APPENDIX 1: INFORMATION ON VILLAGES

Name of Village	Village Facilities	Closest Market Place and Distance	Road Condition to Village
<u>Multiple Cropping Villages</u>			
Ban Jode	1 school, 1 rice mill, 1 food stall, no food vendor.	Khon Kaen 47 km	Gravelled road moderate conditon.
Ban Koksri	1 school 4 rice mills, 3 food stalls, no food vendor.	Khon Kaen 10 km	Track entering village poor condition in rainy season.
Ban Maung	1 school 6 rice mills 3 food stalls, 5 food vendors.	Khon Kaen 14 km	Gravelled road, poor condition in rainy seasons
Ban Had	1 school 5 rice mills 6 food stalls, 1 food vendor.	Khon Kaen 32 km	Fair condition.
Ban Pasan	1 school 3 rice mills 4 food stalls, 1 food vendor.	Khon Kaen 34 km	Good condition by main road.
<u>The Other Villages</u>			
Ban Wang Yawl	1 school 4 rice mills 5 food stalls 2 food vendors.	Chumpae 40 km	Poor condition.
Ban Huey Sai	1 school no rice mills 2 food stalls 1 food vendor	Nam Pong 28 km	Good condition.
Ban Na Dee	1 school 2 rice mills 6 food stalls 2 food vendors	Chumpae 20 km	Poor condition.
Ban Nong Pai	1 school 2 rice mills 1 food stall 2 food vendors	Pol 5 km	Good condition.
Ban Huey Tuey	1 school 2 rice mills 3 food stalls 1 food vendor.	Kranuan 20 km	Poor condition.

APPENDIX 2: THE DESCRIPTION OF NORTHEASTERN COOKING

- "Larb" "Larb" is a meat dish made from raw or cooked minced meat and seasoned with "Larb" ingredients: ground roasted rice powder, chopped mint and spring onion, lemon juice, fish sauce and chilli powder. Larb is usually eaten with various sorts of vegetables. Larb can be made from beef, pork, fish, chicken, duck, shrimp, bird and other animals. Ingredients used in larb is usually dependable on type of meat used.
- "Somtam" "Somtam" is a vegetable dish made from raw papaya or fresh stringbean or fresh cowpea pod or cucumber. Papaya and cucumber are shredded into fine strips. Bean pods are chopped and coarsely mashed and then mixed with ground garlic and chilli and flavoured with salt or fish sauce or fermented fish sauce and lemon. Tomato, tamarin extracted and native olive are some times added.
- "Soop" "Soop" is a cooked and mashed vegetable dish. Vegetables commonly used are stringbean and cowpea pod, egg plants, and mushroom. Immature jackfruit and bamboo shoot are also popular for cooking "soop" dishes. Ingredients used for "soop" are varied. For bamboo shoot soup, bamboo shoot is firstly boiled and grated and cooked in the mixture of ground galangal, garlic, chilli and juice of yanang leaf extracted. Lemon grass and sweet basil are added and flavoured with fermented fish sauce. Ground roasted rice powder is sometimes added. For the other kinds of vegetable "soop", the vegetables are cooked and mashed and mixed with finely ground mixture of shallot, garlic, chilli and flavoured with fermented fish sauce. Mint leaf and chopped spring onion are often added.
- "Moke" Food is wrapped in banana leaf and cooked on charcoal or steamed. Meat such as fish, small toad, frog and bamboo shoot are often used for "Moke". Meat are mixed with ground garlic and chilli, lemon grass, sweet basil and fermented fish sauce, these are roasted or steamed. Juice of yanang leaf extracted is added if bamboo shoot is used.
- "Roasted" "Roasted" dish is a dish of meat cooked on charcoal.
- "Goy" "Goy" is similar to "Larb" only the meat is uncooked and coarser in texture, fish is preferred.
- "Kuir" Usually a mixture of meat and vegetable cooked on pot or fried pan with small quantity of water.

Appendix 2 (continued)

- "Pla" A beef, shrimp or shellfish dish, similar to "Larb" but meat is used in pieces instead of minced as in "Larb". Fresh lemon grass is often added.
- "Toum" "Toum" is a soup dish. Meat is cooked in a large quantity of water with lemon grass and leach lime leaf. Fresh or roasted shallot, garlic and chilli are added. Flavour with salt, fish sauce, lemon or tamarin pulp.
- "Kang" "Kang" is one kind of soup. Vegetables and leaves of native tree are added to meat and fish. Ground garlic and chilli are also added and flavoured with fermented fish sauce.
- "Aom" "Aom" is a spicy soup. Meat, fish and vegetables are cooked in a small quantity of water. A mixture of ground roasted or ground fresh galangal, lemon grass, chilli, shallot and garlic are added to the soup. Seasoning with fermented fish sauce and leaves of fresh sweet basil.
- "Hot Sour Soup" "Hot sour soup" is a "Kang" fish with vegetable. A portion of cooked fish is ground with chilli, garlic, shallot and shrimp paste. Tamarin pulp is added for the sour taste.
- "Pone" "Pone" is a sauce made from any of ground cooked fish, shrimp, small toad, frog, snail or shellfish with ground fresh or ground roasted chilli, shallot and garlic. Fermented fish sauce or fish sauce and lemon are added for salty and sour taste.
- "Namprig" "Namprig" is a typical Thai sauce. It is made of a mixture of ground garlic, chilli, shrimp paste, lemon juice, fish sauce and sugar. Ground dried shrimp or ground roasted fish can be added. "Namprig" fermented fish in the Northeastern style, fermented fish is used instead of shrimp paste. Chilli, garlic and shallot are roasted, ground and added to the sauce.
- "Jeaw" "Jeaw" is a chilli sauce. A popular "jeaw" is made from chopped whole fermented fish with mixture of ground fresh or ground roasted chilli, garlic and shallot.

APPENDIX 3: MINOR FOOD DISHES EATEN BY 100 HOUSEHOLDS IN TWO DAYS
IN ALL SEASONS

In parenthesis are number of households eating food in rainy - cool - hot season.

Breakfast	Lunch	Dinner
<u>Dry Main Dishes</u>		
Canned fish (1-0-1)	Steamed fish (0-1-1)	Canned fish (1-1-0)
"Goy" shrimp (0-0-1)	Fermented fish (0-1-1)	"Goy" shrimp (0-0-1)
"Larb" shrimp (0-1-0)	Canned fish (0-1-1)	"Larb" shrimp (0-1-0)
Steamed chicken (1-0-0)	"Goy" fish (0-1-0)	Steamed chicken (0-1-0)
Chicken rice (0-0-1)	"Goy" shrimp (0-1-1)	"Kuir" egg (0-0-1)
"Larb" duck (0-1-0)	"Larb" shrimp (0-1-0)	Boiled egg (1-1-0)
Fried chicken visceral (0-0-1)	"Larb" duck (0-0-1)	"Larb" pork (1-0-0)
"Kuir" egg (0-0-1)	Boiled egg (0-0-1)	Fried pork sausages (1-0-0)
Fried pork (0-1-1)	Fried egg (1-0-1)	Fermented beef sausages (1-1-0)
"Roasted" pork (1-0-1)	Fried pork (0-1-0)	Fermented beef (0-1-0)
"Larb" pork (1-0-0)	"Roasted" pork (0-1-0)	Fried pork rib bone (0-0-1)
"Fried" pork sausages (0-0-1)	"Larb" pork (0-0-1)	Fried meat ball (0-1-1)
Fermented beef (0-0-1)	Fried pork sausage (1-0-1)	"Pla" beef (0-0-1)
Fried meat ball (0-1-1)	Fermented beef sausages (0-1-0)	Fried frog (1-0-0)
"Pla" beef (0-0-1)	Fried hot beef (0-0-1)	"Roasted" frog (1-0-1)
"Mog" small toad (0-1-0)	Fried pork (1-0-1)	"Moke" small toad (0-1-1)
"Kuir" frog (0-0-1)	"Goy" frog (0-0-1)	"Kuir" frog (0-0-1)
"Larb" frog (0-1-0)	"Roasted" rat (1-0-0)	"Larb" bird (0-0-1)
"Roasted" rat (0-1-0)	"Larb" bird (0-0-1)	Fried rice noodle (0-0-1)
"Larb" bird (0-1-1)	Fried dried fish (1-0-0)	"Somtam" legume (0-1-0)
"Mog" lizard (0-0-1)	"Roasted" dried squid (1-1-0)	"Somtam" cucumber (0-1-1)
"Roasted" dried fish (1-0-0)	Fried rice noodle (0-1-1)	"Soop" jackfruit (0-0-1)
"Soop" mushroom (1-0-0)	"Roasted" pork sausages (0-1-0)	"Goy" beef (0-0-1)
Fried bean sprout (1-0-0)	"Soop" jackfruit (0-1-1)	"Moke" bamboo shoot (0-1-1)
Fried spong gourd (1-0-0)	"Moke" tadpole (0-0-1)	"Moke" tadpole (0-0-1)
Fried beef (1-0-1)	"Soop" egg plant (1-0-1)	"Kuir" skink (0-0-1)
"Roasted" dried squid (0-1-0)	Fried meat ball with bean sprout (0-1-0)	"Roasted" bull frog (0-0-1)

Fried rice noodle (0-1-1)	"Somtam" lemon (0-1-0)	"Larb" chicken (0-0-1)
Fried sausage with cucumber (0-1-0)	Fried cucumber with pork (0-1-0)	Fried rat (0-0-1)
"Somtam" legume (0-1-0)	"Moke" bullfrog (0-0-1)	"Mog" rat (0-0-1)
"Roasted" pork sausage (0-1-0)	"Kuir" ground June beetle (0-0-1)	Fried pork with egg plant (0-0-1)
Fried kale with pork (0-1-0)	Fried string bean (0-0-1)	
"Somtam" cucumber (0-1-1)	Fried hot chicken (0-0-1)	
"Soop" jackfruit (0-0-1)		
"Goy" beef (0-0-1)		
"Moke" bamboo shoot (0-0-1)		
"Soop" gajaew flowers (0-0-1)		
"Moke" tadpole (0-0-1)		
"Roasted" bull frog (0-0-1)		
"Kuir" shrimp (0-0-1)		

Liquid Main Dish

"Kang" snail (1-2-1)	"Toum" chicken (1-1-2)	"Kang" mushroom (1-0-1)
"Kang" beef (1-3-1)	"Kang" mushroom (1-0-1)	"Toum" beef (1-0-1)
"Kang" fish sour soup (1-0-1)	"Kang" chicken (0-1-1)	"Toum" visceral (0-1-1)
"Toum" chicken (0-1-1)	"Kang" snail (0-1-0)	"Kang" small toad (0-1-0)
"Aom" beef (2-1-1)	"Aom" beef (0-1-1)	"Kang" snail (0-1-1)
"Toum" frog (1-0-1)	"Toum" frog (1-0-0)	"Kang" fish sour soup (1-0-0)
"Aom" frog (0-0-1)	"Aom" frog (1-0-1)	"Toum" chicken (1-0-1)
"Aom" small toad (0-1-1)	"Aom" small toad (0-1-0)	"Aom" beef (0-1-1)
"Kang" acasia flower (0-1-1)	"Kang" Euphobiaceae (0-1-1)	"Toum" frog (1-1-0)
"Kang" Euphobiaceae (0-0-1)	Rice noodle curry (0-1-1)	"Aom" frog (1-0-1)
Rice noodle curry (0-1-0)	Chinese noodle soup (1-0-0)	"Aom" small toad (0-1-1)
"Aom" fish (0-1-0)	"Aom" fish (0-1-0)	"Kang" acasia flower (0-1-1)
"Kang" chicken sour soup (1-0-0)	"Toum" duck (0-0-1)	"Kang" Euphobiaceae (0-1-1)
Pork soup (1-0-1)	"Toum" snail (1-0-1)	Rice noodle curry (0-1-0)
"Toum" visceral (pork) (0-0-1)	"Kang" crab (1-0-0)	Chinese noodle soup (1-0-0)
"Toum" duck (0-1-0)	"Aom" crab (0-1-0)	"Aom" fish (0-1-0)
Egg in soy sauce soup (0-1-0)	"Kang" pumpkin (0-1-0)	"Aom" chicken (0-1-0)
"Kang" frog (1-0-0)	Bamboo shoot soup (1-0-0)	Pork soup (0-1-0)
"Toum" small toad (1-0-0)	Silver noodle soup (0-0-1)	"Aom" crap (0-1-0)
"Aom" crab (0-1-0)	"Kang" tadpole (0-0-1)	Egg in soy sauce soup (0-1-0)

Bamboo shoot soup (1-0-0)	"Toum" bull frog (0-0-1)	"Kang" frog (1-0-0)
Silver noodle soup (0-0-1)	Beef in panang curry (0-0-1)	"Toum" small toad (1-0-0)
Spong Gourd soup (1-0-0)	Meat ball soup (0-0-1)	"Toum" shellfish (0-0-1)
"Aom" egg plant (1-0-0)	Eel curry (0-0-1)	"Aom" shellfish (0-1-0)
"Kang" tadpole (0-0-1)		"Kang" Pumpkin (1-0-0)
"Toum" bull frog (0-0-1)		Bamboo shoot soup (1-0-0)
"Toum" pork leg (0-0-1)		"Kang" tadpole (0-0-1)
		"Kang" palm shoot (0-0-1)
		"Aom" chilli (0-0-1)
		"Aom" bird (0-0-1)
		"Kang" rat (0-0-1)
		Meat ball soup (0-1-0)

Sauces

"Pone" frog (2-1-0)	"Pone" frog (2-1-1)	"Pone" shrimp (0-0-1)
"Pone" crab (2-1-0)	Chilli in fermented Fish sauce (0-1-0)	"Jaew" fresh chilli (1-0-0)
"Namprig" fried chilli (3-0-0)		
"Pone" small toad (0-1-1)	"Pone" small toad (1-0-0)	"Namprig" Mangda (0-0-1)
"Jeaw" fresh chilli (1-0-0)		
"Jeaw" dried chilli (2-0-0)	"Namprig" fried chilli (1-0-0)	
"Namprig" Mangda (Insect) (0-0-1)	"Jeaw" fresh chilli (1-0-0)	

Vegetable Eaten with Sauce

Water Mimosa stem (0-1-0)	Young Gadone Leaf (0-1-1)	Immature Melon (1-0-0)
Immature melon (1-2-1)	Immature melon (0-1-0)	Cabbage (0-1-1)
Acasia insuavis leaf (0-0-3)	Cabbage (1-0-1)	Ball leaf (0-0-2)
Ball leaf (1-1-2)	Ball leaf (0-0-1)	Pumpkin shoot (4-0-0)
Bitter gourd shoot (4-0-0)	Pumpkin shoot (1-0-0)	Bitter gourd shoot (1-0-0)
Piper sarmetosum (1-0-0)	Bitter gourd shoot (1-0-0)	Piper sarmetosum (1-0-1)
Pickled spring onion (0-3-0)	Piper Sarmetosum (1-0-0)	Pickled spring onion (0-2-0)
Cauliflower (0-2-0)	Pickled spring onion (0-1-0)	Cauliflower (0-3-0)
Spong Gourd (0-1-0)	Cauliflower (0-1-0)	Spong gourd (1-0-0)
Horse radish pod (0-0-1)	Spong gourd (1-1-0)	Young grater galangal shoot (0-0-1)
Lettuce (0-1-1)	Horse raddish pod (0-1-0)	
Squash shoot (0-0-1)	Pak Gajaew (0-1-0)	Plantain (0-1-0)
Plantain (0-0-1)	Young grater galangal shoot (0-0-1)	Young Teaw Tree Leaf (0-0-1)

Pak Pha Long (0-0-2)		Chinese Kake (0-1-0)
Young Teaw Tree leaf (0-0-2)	Tomato (0-0-1)	Pak Nong (1-0-1)
Pak Nong (0-0-1)	Algae (0-0-1)	Young cassava leaf (0-0-1)
Mint (0-0-1)	Chinese kale (0-1-0)	Water hyacinth (0-0-1)
Young cassava leaf (0-0-1)	Young cassava leaf (0-1-0)	Bean sprout (0-1-0)
Piperaceie (0-0-1)	Water hyacinth (0-0-1)	Pak Kan Kom (0-1-0)
Pak Kea (0-0-1)	Bastard mustard (0-0-2)	Pak young pae (0-1-0)
Water hyacinth (0-0-1)	Bean sprout (0-2-0)	Balsam pear (0-1-0)
Bastard mustard (0-0-1)	Garlic stem (0-1-0)	Fragrant Flower garlic mustard (0-0-1)
Garlic stem (0-1-0)	Pak kan kom (0-1-0)	
Indian penny wort (0-1-0)	Pak yong pae (0-1-0)	Euphobiaceae (0-0-1)
Amaranth bayan (0-0-3)		Duck weed (0-0-1)
		Amaranth Bayam (0-0-1)

Desserts and Snacks

Sweet corn pudding (2-0-0)	Biscuit (2-1-1)	Egg cake (2-1-0)
Shrimp puff (1-0-0)	Fried sweet batter (Kanom dok boa) (1-0-0)	Sago pudding (4-0-0)
Boiled sweet corn (0-3-0)		Boiled sweet corn (0-3-0)
Steamed glutinous rice stuffed with banana (0-0-1)	Black bean boil in syrup (0-0-2)	Banana in coconut milk (0-0-2)
Biscuit (0-0-1)	Banana in coconut milk (0-0-4)	Chinese cake (0-2-0)
Groundnut brittle (0-0-2)		Deep fried sweet batter (kanom dok jog)(0-1-0)
Banana in coconut milk (0-0-2)	Mungbean boiled in syrup (0-0-1)	Steamed glutinous gel (kanon chun)(0-1-0)
mungbean sweet paste (0-0-2)	Pumpkin in coconut milk (2-0-2)	Sweet potato in coconut milk (0-1-0)
Mungbean wrapped in glutinous rice dough (0-0-4)	Assorted pudding (Lommit) (1-0-0)	
Fried banana (0-0-1)	Fried crust stuffed with Bean paste (Kanom kai Houg) (1-0-0)	
Mungbean boiled in syrup (0-0-1)	Ice cream (1-1-2)	
Red bean boiled in syrup (0-0-1)	Steamed stuffed rice dough (0-1-0)	
Mungbean pudding (Toa soup) (0-0-1)	Boiled sweet potato in syrup (0-1-0)	
Steamed glutinous rice with Mango (0-0-1)	Chocolate (0-1-0)	
	Sugar glazed banana (0-0-1)	
	Banana sweet paste (0-0-1)	
	Palm jelly pudding (0-0-1)	

Fruits

Musk melon (3-0-0)	Pomelo (0-1-0)	Jujube (0-1-0)
Pomelo (1-0-0)	Jujube (0-3-0)	Tamarind (0-2-0)
Sapodilla (1-0-0)	Tamarind (0-2-0)	Rambi (0-0-1)
Jujube (2-1-0)	Rambi (0-0-4)	Rambutan (0-0-3)
Tamarind (0-1-0)	Jackfruit (0-0-1)	Jackfruit (0-0-1)
Rambi (0-0-4)	Pomegranate (2-0-0)	Orange (1-0-0)
Pineapple (0-0-1)	Starapple (0-1-0)	
Rambutan (0-0-1)	Orange (0-1-1)	
Jackfruit (0-0-1)		
Grape (1-0-0)		

APPENDIX 4: SUMMARY OF DEVELOPMENT WORK IN DIET PLANNING

YEAR	ORIGINAL DESIGNER & REFERENCE	DEVELOPMENT & PLANNING	OBJECTIVE FUNCTION, CONSTRAINTS & SELECTION CRITERIA	MATHEMATICAL PROGRAMMING & COMPUTER USED
1945	Stigler, G. J (Smith, 1959 & Baust, 1967)	Diet selection for moderate man 1 year. Six foods selected: wheat, flour, evaporated milk, cabbage, spinach dried mungbean.	Minimum cost 9 nutrients: cal prot, 2 minerals, 5 vitamins, 77 foods listed.	Linear programming with simplex method.
1949	Beckman, M. (Smith, 1963)	Diet selection for 45 year old man 4 foods selected lard, frozen orange juice, beef liver, soybean meal.	Minimum cost 9 nutrients: cal, prot, 2 minerals, 5 vitamins.	Linear programming.
1950	Brown, J.A.C. (Smith, 1963)	4 types of diets planned similar to actual diet of British working classes.	Fullfil nutritional requirements: cal, fat, calcium, thiamine and Vitamin A.	Descriptive models.
1958	Vajda, S. (Eckstein, 1973)	Diet model for British population, 8 foods selected: wheatmeal bread, cheese, roasted chicken, steamed fresh haddock, dried prune, walnut, bread & margarine.	Minimum cost 3 nutrients: prot, fat and CHO.	Linear programming.

1958	Frankovic, V. Rismal, A. Kozak, V. (Hocevae, 1959)	One day diet planning of Slovenia family.	Minimum cost satisfied qual- itative and quantitative physiological requirement.	Linear progra- mming.
1959	Smith, V.C. (Smith, 1959 & 1963)	Diet planning by computer, 3 models: <u>The Midget Model</u> : 4 foods selected. <u>The Small Model</u> : 10 foods selected with cooking aid <u>The Large Model</u> : 57 foods selected with cooking aid.	Minium cost 12 nutrients: cal prot, fat, CHO 3 minerals, 5 vitamins, 73,83 and 572 food lists with mini- mum limit quantity of common food and maximum quantity of cheap food and including cooking aid, eg. baking powder.	Linear program- ming. Simplex method.
1961	Smith, P.E. (Smith, 1961)	Diet selection 4 foods selected haddock, lett- uce, cooked turnip top and wheat germ.	Minimized calories.	Linear program- ming.
1964	Balintfy, J.L. (Balintfy, 1964)	Menu planning by computer. Non selective menu planning for a cycle of one day or one meal for a ent- ire menu cycle.	Minimum cost 9 nutrients: cal prot, 2 mineral and 5 vitamins. Selection of one menu item of accepted recipes from each of menu components in a menu struct- ure. Each menu item was in fixed portion size.	Zero-one inte- ger programming algorithm used Fortran program for IBM 1410 30 sec. comput- ation time for a daily menu.

- | | | | | |
|------|--|---|---|--|
| 1966 | Glue, R.L.
Liggett, J.C.

(Glue and
Liggett, 1966) | Menu planning by computer, selective menu planning, daily menu for a cycle of 14 days - Multistage menu planning. | Minimum cost 9 nutrients: cal prot, 2 minerals, 5 vitamins. A choice of menu items selection probability was included in the model. | A stochastic zero-one programming for IBM 709 40 sec. computation time for a daily menu. |
| 1966 | Brown, R.M.

(Eckstein,
1973) | Automated menu planning for individual non selective lunch and dinner menus | Factors included in model were texture, flavour, colour, shape and method of preparation. | Random selection-technique. |
| 1967 | Eckstein, E.F.

(Eckstein,
1967 & 1973) | Menu planning by random approach planning selective dinner. | Selection criteria including cost, colour, texture shape, calorie, variety and acceptability. | Random approach computer programming 99 dinners in 1 1/2 min. |
| 1969 | Eckstein, E.F.
(Eckstein, 1973) | Menu planning by random approach refinement of 1967 model planning breakfast and lunch menu for 21 days. | 9 nutrients: cal, prot, fat, CHO, 2 minerals, five vitamins. | Random approach computer programme. |
| 1969 | Balintfy J.L.
Blackburn C.R.
(Balintfy 1975;
Balintfy and
Blackburn, 1969) | Menu planning by computer to non selective menu refinement of Multiple choice programming in Multi-stage menu planning. | Same as Balintfy (1964). A set of structural constraints added to become multiple choice constraints. | Zero-one integer programming using technique of truncated block pivoting. |

- | | | | | |
|------|--|---|--|---|
| 1969 | Balintfy, J.L.

(Balintfy, 1975) | System/360 Computer Assisted Menu Planning (CAMP) - a computerized food services information processing and menu planning programme package. | Minimum cost 10-20 nutrient constraints, 600-800 variables, 10-24 menu course per day. | Zero one integer programming solving by an additional block pivoting algorithm on IBM computer S/360 CAMP system. |
| 1969 | Glue, R.L.

(Glue, 1969) | Reformulation of menu planning. | Addition to Glue & Liggett (1966) model constraints of colour, texture, variety, and other sensory attributes. | Chance constrained zero-one programming problem. |
| 1970 | Langier, J.D.

(Eckstein, 1973) | Developing solution for use in Guatemala and less developed countries. Selection of common and acceptable foods to be added to improve nutritional status. | Minimum cost | Linear programming. |
| 1970 | Balintfy, J.L.

(Balintfy, 1976) | Menu planning by computer-single stage menu planning of non selective menu planning length of menu cycle and only the frequency of the menu items and not their sequence in the meals is planned. | Minimum cost. Frequency of menu items serving in upper bound constraints. 800 variables. 100 constraints. | Linear programming with bounded variables. |

- | | | | | |
|------|--|--|---|--|
| 1970 | Balintfy, J.L.
Neter, J.
Wasserman, W.

(Balintfy et al, 1970) | Linear programming food price index based on the single stage menu planning and permits possibility of routine substitution in response to price change. | Minimized cost 5 nutrients: cal prot, iron, thiamine and niacin. 385 menu items serving frequency constraints planning for 31 day period. | Linear programming with bounded variables. |
| 1971 | Pinto, G.F.

(Pinto, 1971) | Optimization of protein rich food mixtures. | Minimum cost adequate crude protein value & best amino acid pattern. | Linear programming. |
| 1971 | Patrick, G.F.
Simoes MHR

(Patrick & Simoes, 1971) | Diet selection for weekly food consumption of Cristalina family in Brazil. | Minimum cost. nutritionally adequate. | Linear programming. |
| 1974 | Armstrong, D.R.
Sinha, P.

(Armstrong & Sinha, 1974) | Menu planning by computer non-selective menu planning with variable portion size. | Minimum cost 10 nutrients: cal, prot, fat, 2 minerals, 5 vitamins. variation of portion size within specific limits. | Quasi-integer multiple-choice programming. run on CDC 3600 |
| 1974 | Edwardson W.

(Edwardson, 1974 & Edwardson et al 1980) | Raw material selection for nutritional food product formulation to supply 26 nutrients daily requirement at lowest cost for the Philippines average man. | Minimum cost 26 nutrients: cal prot, fat, fibre, 3 minerals, 9 vitamins, 10 amino acids. Quantitative constraints on nutrients relationship and amino acid pattern 170 lists of food raw materials for selection. | Linear programming on IBM LPS/1130 |

- | | | | | |
|------|--|--|--|---|
| 1974 | Balintfy, J.L.
Duffy, W.J.
Sinha, P.

(Balintfy,
et al. 1974) | Modeling food preferences over time: the measurement of preference for a menu item and the time history of its previous consumption. | Maximized the total preference over a given time schedule. the estimation of preference time function obtained from questionnaires interviewing. | Finding the mathematical representation of preference time function is feasible. |
| 1974 | Sinha, P.

(Balintfy,
1976, 1979 and
Sinha, 1978) | Preference Maximising Models for Menu Planning and a phototype menu planning by computer. | Preference maximisation with cost, nutrient- s, menu structure, and service frequency constraints of a single stage, non-selective menu planning. | Non-linear programming and integer programming problem. |
| 1974 | Kansra, A.C.
Srinivasan, N.
Copaldas, T

(Kansra et al.
1974) | Formulation of multimix supplement for preschool children in India. | Minimum cost calorie constraints. Four food raw materials. | Linear programming. |
| 1974 | Smith, V.E.

(Smith, 1974) | Diet selection for 27 geographic areas in Nigeria. Protein quality was considered. | Minimum cost 9 nutrients: cal, prot, two minerals, 5 vitamins, 6 amino acids. Adding a non-linear constraint of protein variable to the model. 462 activities, 541 rows. | Linear programming using Control Data Corporation OPTIMA routine and CDC 3600 computer with computation time of 17 minutes. |

- | | | | | |
|------|--|--|---|---|
| 1975 | Anderson, A.M.
(Anderson, 1975
Edwardson et al.
1980) | Raw material selection for nutritional food product formulation for Thai man aged 20-29 years. | Minimum cost 26 nutrients. As Edwardson(1974) with the addition of acceptability function obtained from information analysed by multidimensional scaling. 151 food raw materials for selection. | Linear programming and goal programming to minimise deviation of the nutrients. |
| 1976 | Balintfy, J.L.
(Balintfy, 1976) | Multistage menu planning with chance constraints. | Minimum cost nutrients constraints to be considered as random variables. | Zero one integer programming and solved with either separate or joint chance constraints with a block pivoting algorithm. |
| 1976 | Harper, J.M.
Jansen, G.R.
Shigetomi, C.T.
Freg, A.L.

(Harper et al.
1976) | Planning weekly menu for the elderly. | 10 nutrients: cal, prot, 3 minerals, 5 vitamins. Calculation of nutritional value using AOA menu monitor method from 1100 raw materials. | A Nutrient Standard Menu (NSM) planning method. |
| 1976 | Carmel, J.
(Carmel, 1976) | Formulation of baby food of mixture of banana, milk powder and oil. | Minimum cost 3 food raw materials with limiting range of quantity. Adaption of equation to express NDp Cal%. | Linear programming on IBM 370. |

- | | | | | |
|------|---|---|--|--|
| 1977 | Chittaporn, P.
(Chittaporn, 1977) | Selection of raw materials for baby food formulations for Thailand. | Minimum cost 43 nutrients: cal, prot, fat, fibre, sugar, linoleic acid, CHO, 11 minerals, 14 vitamins, 11 amino acids with the nutritional loss during processing, colour and sweetness constraints. | Linear programming on IBM 1130. |
| 1977 | Moskowitz, H.R.
Klarman, L.
(Moskowitz and Klarman, 1977) | 3 step approach evaluating compatibilities for menu planning. | | Computer programmes for multidimensional scale, regression and cluster analysis. |
| 1978 | Unklesbay, N.
Unklesbay, K.
(Unklesbay and Unklesbay, 1978) | Menu planning for elderly in USA by automated menu planning system. | 17 nutrients: cal, prot, 6 minerals, 9 vitamins. 608 menu items. | Heuristic algorithm. |
| 1979 | Balintfy, J.L.
(Balintfy, 1972) | Menu planning with the Cost of Decent Subsistence (CDS)- planning a menu at minimum budget level where a nutritionally adequate diet is still not an unpleasant experience. | Maximised budget and optimised food purchases in income maintenance programme (where prices change). | Quadratic programming algorithm. |

No later development in diet planning had been found.

APPENDIX 5: INFORMATION ON RED COWPEA 6-1US

Comparison of Protein Content and Production Yield of Red Cowpea and the Common Legume Eaten in the Northeastern, Thailand

Legumes	Variety	Protein Content (a) g/100g	Production Yield (b) kg/ha	Protein Yield kg/ha
Red cowpea	6-1US	27.9	1102	307
cowpea	local	26.9	1023	275
Mungbean	M-7-A	24.8	469	116
Mungbean	MG-50-10A	27.1	(469)(d)	127
Black mungbean	local	25.6	156	40
Black bean	local	28.1	(469)(d)	132
Rice bean	local	23.7	-	-
Peanut	Thainan No.9	23.6	1563	369
Soybean	local	37.9(c)	406	154

(a) moisture free basis

(b) data from cropping system project (private communication)

(c) data taken from USDA Agriculture Handbook, No.s, revised, 1963

(d) estimate.

Comparison of Red Cowpea and Local Cowpea for Production Yield,
Nutrition Yield, Nutritional Value, Seed Characteristic and Cooking
Quality

	Red Cowpea	Local Cowpea
<u>Production</u>		
Production yield kg/ha	1102	1023
<u>Nutritional Value</u>		
Energy, kcal/100g	321	312
Protein, %	24.6	23.7
Fat, %	1.13	1.16
Crude fibre, %	3.9	7.2
Ash, %	4.4	3.7
Trypsin inhibitor, % tryptic inhibit/mg dry basis	11.6	17.3
<u>Seed Characteristics</u>		
Seed size, mm	7.8x5.4x4.6	9.2x6.4x4.3
Weight/100 seeds, g	12.16	15.43
No. of seed/100g	508	396
% seed coat	10.7	10.8
<u>Cooking Quality</u>		
Cooking time, min (50% seed split)	29	64
% Solid in cooking broth, g	1.11	15.75

APPENDIX 6: DEVELOPMENTS OF COWPEA DISHES

6.A Screening of Cowpea DishesTable 6.1: Evaluation of 56 Main, Snack and Dessert Dishes Made from Cowpeas

Evaluation of 50 Main, Snack and Dessert Dishes Made From Cowpea

<u>Name of Dish</u>	<u>Protein/ Serving g</u>	<u>Protein Consumption per week, g</u>	<u>Cost</u>	<u>Method of Cooking</u>	<u>Raw Material Availability</u>	<u>Possibility of Dish Improvement</u>	<u>Suitability for Villagers</u>
MAIN DISH							
1. Cowpea sprout curry (Kang Ped Toa Ngok)	10.4	10.4	Moderate	Moderate	Moderate	Possible	Suitable
2. Cowpea curry (Kang Pa Toa Pum)	11.2	11.2	Moderate	Moderate	Easy	Possible	Very Suitable
3. Fried pork and cowpea ball (Tod Mun Toa)	6.1	6.1	Moderate	Moderate	Easy	Possible	Suitable
4. Cowpea and fermented fish hot sauce (Namprig Plara Toa)	4.1	57.7	Cheap	Easy	Easy	Possible	Very Suitable
5. Fried cowpea sprout (Pad Toa Ngok)	9.7	19.4	Cheap	Easy	Easy	Possible	Suitable
6. Seasoned minced beef and cowpeas (Larb-Nou)	13.7	41.1	Moderate	Easy	Easy	Possible	Very suitable
7. Steamed cowpeas and bamboo shoot (Mog Nor Mai Toa)	4.5	9.0	Cheap	Easy	Easy	Possible	Very suitable
8. Steamed fish, cowpeas and bamboo shoot (Mog Nor Mai Pla)	6.9	20.7	Cheap	Easy	Easy	Possible	Very suitable
9. Seasoned mashed cowpeas (Sooop Toa)	3.8	11.4	Cheap	Easy	Easy	Possible	Very suitable
10. Cowpeas and fish hot sauce (Pone Pla)	6.2	12.4	Cheap	Easy	Easy	Possible	Very suitable
11. Cowpea hot soup (Aom Toa Pum)	7.3	14.6	Cheap	Moderate	Easy	Possible	Very suitable
12. Fried cowpeas and noodle (Pad Finao)	33.0	33.0	Cheap	Moderate	Moderate	Possible	Moderate
13. Fried rice noodle and cowpeas (Pad Thai)	30.6	30.6	Cheap	Moderate	Moderate	Possible	Moderate
14. Bamboo shoot and cowpeas spice soup (Kang Normaí Yanang)	5.5	5.5	Cheap	Moderate	Easy	Possible	Very suitable
15. Soybean curd and cowpea sprout soup (Kang jhud Toa Ngok)	6.0	6.0	Cheap	Easy	Moderate	Not Possible	Moderate
16. Noodle and cowpea curry (Kheaw te:aw kagk)	19.2	19.2	Moderate	Difficult	Moderate	Possible	Not suitable
17. Fried rice with fermented pork sausage and cowpeas (Kao Pad sai krok)	33.3	33.3	Cheap	Moderate	Easy	Possible	Not suitable
18. Vermicelli in cowpea curry (Kanom Jeen Namprig)	12.6	12.6	Moderate	Difficult	Moderate	Possible	Suitable
19. Salty bamboo shoot and cowpea soup (Kang Palo)	6.1	6.1	Cheap	Moderate	Easy	Possible	Moderate
20. Cowpeas and shrimp hot sauce (Namprig Pao)	4.6	4.6	Expensive	Difficult	Moderate	Possible	Moderate
21. Fried cowpeas with ginger and pork (Pad Khing Toa Kub Moo)	7.6	7.6	Cheap	Moderate	Easy	Possible	Moderate
22. Fried cowpeas and ginger (Pad Toa Kub Khing)	6.0	6.0	Cheap	Moderate	Easy	Possible	Moderate
23. Cowpeas and pork sausage (Sai Krog Moo)	7.5	7.5	Expensive	Difficult	Moderate	Possible	Suitable
24. Steamed cowpea curry (Hoa-Mog Toa)	10.3	10.3	Moderate	Difficult	Moderate	Possible	Suitable
25. Fried bamboo shoot and cowpeas							

Table 6.1 (Continued)

<u>Name of Dish</u>	<u>Protein/ Serving g</u>	<u>Protein Consumption per week, g</u>	<u>Cost</u>	<u>Method of Cooking</u>	<u>Raw Material Availability</u>	<u>Possibility of Dish Improvement</u>	<u>Suitability For Villagers</u>
<u>SNACK AND DESSERT</u>							
1. Fried cowpea paste (Kai Nog Kata)	4.1	28.7	Cheap	Easy	Easy	Possible	Very suitable
2. Steamed glutinous rice stuffed with cowpeas (Kao Tom Pad)	2.0	6.0	Cheap	Easy	Easy	Possible	Very suitable
3. Fried banana coated with cowpea batter (Kloay Tod)	1.7	11.9	Cheap	Easy	Easy	Possible	Very suitable
4. Fried cowpea crust (Krob Kem)	4.1	12.3	Moderate	Moderate	Moderate	Possible	Very suitable
5. Cowpea paste coated with egg yolk (Med Kanoon)	2.9	8.7	Moderate	Moderate	Easy	Possible	Very suitable
6. Steamed sago stuffed with cowpeas (Sago Sai Toa)	2.7	10.8	Cheap	Moderate	Easy	Possible	Very suitable
7. Cowpeas and sago pudding (Sago Toa Gang Boid)	3.6	10.8	Cheap	Easy	Easy	Possible	Very suitable
8. Cowpea pudding (Toa Soun)	4.1	16.4	Cheap	Easy	Easy	Possible	Very suitable
9. Cowpeas wrapped in glutinous rice dough (Toa Pab)	6.9	19.8	Moderate	Moderate	Easy	Possible	Very suitable
10. Cowpea sweet paste (Toa Pum Guan)	3.1	3.1	Cheap	Moderate	Easy	Possible	Very suitable
11. Fried cowpeas (Toa Pum Tod)	4.5	4.5	Cheap	Easy	Easy	Possible	Suitable
12. Wrapped and fried cowpea snack (Fried Pour-Pial)	4.3	4.3	Moderate	Moderate	Difficult	Possible	Moderate
13. Steamed cowpea custard (Sunkaya Toa)	3.5	3.5	Moderate	Moderate	Moderate	Not possible	Very suitable
14. Stuffed cowpea dumpling (Boe Loi Toa)	4.1	8.2	Cheap	Moderate	Moderate	Possible	Suitable
15. Cream puff stuffed with cowpeas (Cream puff)	2.5	2.5	Expensive	Difficult	Difficult	Possible	Not suitable
16. Fried chinese ball (Salapao Sai Toa)	4.6	13.8	Expensive	Moderate	Moderate	Possible	Suitable
17. Baked cowpea custard (Khanom Moa Kang)	3.4	3.4	Moderate	Difficult	Moderate	Possible	Suitable
18. Fried cowpeas stuffed in wheat dough (Pan-Sib)	7.2	7.2	Moderate	Difficult	Difficult	Possible	Suitable
19. Cowpea pie (Pie Toa)	2.5	2.5	Expensive	Difficult	Difficult	Possible	Not suitable
20. Cowpea doughnut (Doughnut Toa)	6.2	12.4	Expensive	Moderate	Moderate	Possible	Suitable
21. Cowpeas stuffed noodle (Kao Taew Lord)	6.2	12.4	Moderate	Moderate	Moderate	Possible	Not suitable
22. Boiled sweet glutinous rice and cowpeas (Khao Niag Piag)	2.9	8.7	Cheap	Easy	Easy	Possible	Not suitable
23. Fried cowpeas and pork sandwich (Khanom Pung Na Moo)	10.4	20.8	Expensive	Moderate	Difficult	Possible	Not suitable
24. Roasted cowpeas stuffed in glutinous rice (Kao Niag Ping)	1.4	4.2	Cheap	Moderate	Easy	Possible	Very suitable
25. Steamed cowpeas stuffed in glutinous rice dough (Khanom Tein)	1.7	5.1	Cheap	Moderate	Easy	Possible	Very suitable

6.B Formulation of Cowpea Dish Recipes

An acceptable range of ingredients used in 25 cowpea recipes was prepared to input in the linear programming selection for the protein maximised recipe in two limits: lower limit quantity and upper limit quantity as are shown in Table 6.2. These lower and upper limit quantities of ingredients used in each recipe are listed below. The quantity of each ingredients was in g/g of total ingredients in each recipe. The full name of ingredients are given at the end of the list.

Table 6.2: Lower Limit and Upper Limit of Ingredients Used in Recipe Formulation to Maximise Protein Content by Linear Programming

INGREDIENTS	QUANTITY LIMIT		INGREDIENTS	QUANTITY LIMIT	
	lower	Upper		Lower	Upper
<u>COWPEA MAIN DISHES</u>					
<u>Cowpea and Fermented Fish Hot Sauce</u>			<u>Cowpea and Fish Hot Sauce</u>		
COWPEAFL	0.139	0.209	COWPEAFL	0.096	0.144
FISHFERN	0.334	0.500	MACKEREL	0.288	0.432
SHALLOT	0.111	0.167	CHILLID	0.019	0.029
GARLIC	0.083	0.125	SHALLOT	0.160	0.240
GALANGAL	0.022	0.034	GARLIC	0.045	0.067
TAMARIND	0.055	0.083	FISHFERM	0.096	0.144
CHILLID	0.055	0.083	ONIONSPR	0.096	0.144
<u>Cowpea and Pumpkin Hot Soup</u>			<u>Cowpea Curry</u>		
COWPEASD	0.096	0.144	COWPEAPD	0.176	0.264
CARP	0.147	0.221	COWPEASD	0.124	0.186
PUMPKIN	0.368	0.552	CHICKEN	0.264	0.396
GALANGAL	0.008	0.012	LEECHLF	0.006	0.008
LEMONGSS	0.014	0.022	BASILHLY	0.006	0.008
SHALLOT	0.022	0.034	FISHSAU	0.035	0.053
GARLIC	0.008	0.012	SUGARCO	0.026	0.040
PEPPERGT	0.021	0.031	VEGOIL	0.035	0.053
FISHFERM	0.037	0.055	PEPPERGT	0.035	0.053
BASILSWT	0.014	0.022	GALANGAL	0.009	0.013
FISHSAU	0.044	0.066	LEMONGSS	0.018	0.026
ONIONSPR	0.022	0.034	GARLIC	0.026	0.040
			PEPPERBD	0.021	0.031
			SHRPASTE	0.018	0.026
<u>Cowpea Sprout Curry</u>			<u>Fried Cowpea Sprout Ball</u>		
COWPEASDDP	0.166	0.259	COWPEASP	0.700	0.800
BEEF	0.080	0.120	SOYCURD	0.100	0.200
COCOMILK	0.440	0.665	GARLIC	0.005	0.208
SUGARCO	0.011	0.017	VEGOIL	0.050	0.150
FISHSAU	0.022	0.034	FISHSAU	0.025	0.075
PEPPERGT	0.011	0.017	ONIONSPR	0.030	0.075
LEECHLF	0.003	0.005			
BASILHLY	0.006	0.008			
GALANGAL	0.006	0.008			
LEMONGSS	0.008	0.012			
SHALLOT	0.011	0.017			

CHILLID	0.008	0.012
GARLIC	0.011	0.017
SHRPASTE	0.006	0.008

Fried Pork and Cowpea Ball

COWPEASD	0.200	0.300
PORK	0.200	0.300
CORIAN	0.014	0.020
GARLIC	0.027	0.040
FISHSAU	0.054	0.080
SUGARWHT	0.008	0.012
WHEATFL	0.027	0.040
EGGHEN	0.143	0.212
VEGOIL	0.122	0.180

Pumpkin and Cowpea Spice Soup

COWPEASD	0.085	0.127
COWPEAFL	0.011	0.017
LEMONGSS	0.007	0.011
SHALLOT	0.014	0.022
GARLIC	0.004	0.006
PEPPERGT	0.014	0.022
FISHFERM	0.021	0.031
YANANG	0.526	0.790
BASILSWT	0.007	0.011
PUMPKIN	0.110	0.164

Seasoned Grated Bamboo Shoot and Cowpeas

COWPEASD	0.076	0.114
BAMBOSTB	0.250	0.378
FISHFERM	0.033	0.067
SUGARCO	0.000	0.016
GALANGAL	0.008	0.033
LEMONGSS	0.022	0.062
SHALLOT	0.025	0.108
GARLIC	0.004	0.035
PEPPERGT	0.004	0.035
BASILSWT	0.017	0.050
YANANG	0.100	0.400
SESAME	0.029	0.039

Seasoned Mashed Cowpea

COWPEASD	0.035	0.051
COWPEAPD	0.512	0.768
COWPEAFL	0.038	0.058
CHILLID	0.010	0.015
SHALLOT	0.064	0.096
MINT	0.013	0.019
ONIONSPR	0.038	0.058
CORIAN	0.013	0.019
FISHFERM	0.051	0.077
GARLIC	0.018	0.027

Seasoned Minced Beef and Cowpea

COWPEAFL	0.70	0.085
COWPEASD	0.039	0.046
BEEF	0.567	0.680
LIMEJUC	0.024	0.042
SUGARWHT	0.000	0.006
GALANGAL	0.006	0.024
CHILLID	0.003	0.012
FISHSAU	0.005	0.048
SHALLOT	0.035	0.070
CORIAN	0.005	0.024
MINT	0.006	0.018
LEECHLF	0.000	0.009
ONIONSPR	0.018	0.036

Seasoned Minced Fish and Cowpea

COWPEAFL	0.070	0.085
COWPEASD	0.039	0.046
CATFISH	0.567	0.680
LIMEJUC	0.024	0.042
SUGARWHT	0.000	0.006
GALANGAL	0.006	0.024
CHILLID	0.003	0.012
FISHSAU	0.005	0.048
SHALLOT	0.035	0.070
CORIAN	0.005	0.024
MINT	0.006	0.018
LEECHLF	0.000	0.009
ONIONSPR	0.018	0.036

Steamed Cowpea and Bamboo Shoot

COWPEASD	0.076	0.114
BAMBOSTB	0.250	0.378
FISHFERM	0.033	0.067
SUGARCO	0.000	0.016
GALANGAL	0.008	0.033
LEMONGSS	0.022	0.062
SHALLOT	0.025	0.108
GARLIC	0.004	0.035
PEPPERGT	0.004	0.035
BASILSWT	0.017	0.050

Steamed Fish, Cowpea and Bamboo Shoot

COWPEASD	0.074	0.089
BAMBOSTB	K0.210	0.250
PERCH	0.100	0.120
GALANGAL	0.008	0.033
LEMONGSS	0.022	0.062
SHALLOT	0.025	0.108
GARLIC	0.004	0.035
PEPPERGT	0.004	0.035
FISHFERM	0.033	0.067
BASILSWT	0.017	0.050

YANANG	0.100	0.400	YANANG	0.100	0.400
--------	-------	-------	--------	-------	-------

COWPEA SNACKS AND DESSERTSCowpea and Sago Pudding

COWPEASD	0.194	0.237
SUGARCO	0.048	0.059
SUGARWHT	0.077	0.095
COCOMILK	0.483	0.591
SAGO	0.097	0.118

Cowpea Pudding

COWPEASD	0.180	0.220
CORNFL	0.072	0.088
SUGARWHT	0.288	0.352
COCOMILK	0.360	0.440

Cowpeas Wrapped in Glutinous Rice

COWPEASD	0.167	0.250
COCONUT	0.133	0.200
RICEGLUFL	0.200	0.300
SUGARWHT	0.200	0.300
SESAME	0.100	0.150

Fried Cowpea

COWPEASD	0.515	0.773
TAPIOCA	0.086	0.129
GARLIC	0.003	0.005
CORIAN	0.003	0.005
SUGARWHT	0.010	0.016
EGGHYOLK	0.027	0.041
VEGOIL	0.154	0.180

Fried Cowpea Paste

COWPEASD	0.222	0.250
TAPIOCA	0.214	0.267
SUGARWHT	0.128	0.156
VEGOIL	0.320	0.350
EGGHYOLK	0.032	0.040

Steamed Sago Stuffed with Cowpea

COWPEASD	0.124	0.185
SHALLOT	0.266	0.400
FISHSAU	0.016	0.024
SUGARCO	0.043	0.064
SAGO	0.320	0.479
GARLIC	0.011	0.016
VEGOIL	0.021	0.032

Cowpea Paste Coated with Egg Yolk

COWPEASD	0.117	0.234
COCONUT	0.117	0.234
SUGARWHT	0.476	0.582
EGGHYOLK	0.106	0.129

Cowpea Sweet Paste

COWPEASD	0.110	0.134
SUGARWHT	0.250	0.306
COCOMILK	0.482	0.589
COCONUT	0.058	0.070

Fried Banana Coated with Cowpea Batter

COCONUT	0.165	0.240
RICEFL	0.028	0.040
COWPEAFL	0.110	0.160
CORNST	0.028	0.040
SESAME	0.028	0.040
SUGARWHT	0.011	0.016
SUGARCO	0.011	0.016
BANANA	0.440	0.640

Fried Cowpea Crust

COWPEAFL	0.153	0.187
WHEATFL	0.153	0.187
RICEFL	0.025	0.031
TAPIOCA	0.025	0.031
EGGHEN	0.051	0.063
COCOMILK	0.252	0.308
SUGARCO	0.103	0.125
SUGARWHT	0.103	0.125
FISHSAU	0.031	0.037

Steamed Glutinous Rice Stuffed with Cowpea

COWPEASD	0.099	0.148
RICEFLU	0.198	0.297
COCOTMILK	0.198	0.297
SUGARWHT	0.040	0.060
BANANA	0.265	0.397

FULL NAME OF INGREDIENTS

BAMBOSTB	= Bamboo shoot, boiled
BASILHLY	= Basil, holy
BASILSWT	= Basil, sweet
CHILLID	= Chilli, dried
COCOMILK	= Coconut milk
COCONUT	= Coconut meat
CORIAN	= Coriander leaf
COWPEAFL	= Cowpea flour
COWPEAPD	= Cowpea pods
COWPEASS	= Cowpea seeds
CORNFL	= Corn flour
CORNST	= Corn starch
EGGHEN	= Egg, hen
EGGYOLK	= Egg yolk, hen
FISHFERN	= Fermented fish
FISHSAU	= Fish sauce
LEECHLF	= Leech lime leaf
LEMONGSS	= Lemon grass
LIMEJUC	= Lime juice
MINT	= Mint leaf
ONIONSPR	= Onion spring
PEPPERBD	= Pepperbird
PEPPERGT	= Pepper, goat
RICEFL	= Rice flour
RICEGLU	= Glutinous rice
RICEGLUR	= Glutinous rice, roasted and ground
SHRPASTE	= Shrimp paste
SUGARCO	= Sugar, coconut
SUGARWHT	= Sugar, white
TAMARIND	= Tamarind pulp
TAPIOCA	= Tapioca flour
VEGOIL	= Vegetable oil
WHEATFL	= Wheat flour
YANANG	= "Yanang extract

APPENDIX 7: RAW MATERIALS USED IN LINEAR PROGRAMMING AND MIXED
INTEGER PROGRAMMING

There are three listings of food raw materials, food dishes, vegetables and fruits used in the linear programming and mixed integer programming problems.

7.A Food Raw Materials Used in the Recipe Development of Cowpea
Dishes and the Commonly Eaten Dishes

Meats, Fish, Frogs and Poultryes

Beef	Beef tripe	Chicken	Frog
Beef heart	Buffalo heart	Carp	Mackerel
Beef liver	Buffalo liver	Catfish	Perch
Beef lung	Buffalo lung	Egg (hen)	Pork
Beef small intestine	Buffalo small intestine	Egg yolk (hen)	Small toad
Beef spleen	Buffalo spleen	Fermented fish (whole fish)	

Cereals and Legumes

Cowpea flour	Cowpea sprout	Rice flour	Soybean curd
Cowpea young pod	Corn flour	Sago	Tapioca flour
Cowpea seed	Glutinous rice	Sesame	Wheat flour

Cooking Ingredients

Coconut milk	Lime juice	Sugar, coconut	Yanang extract
Fermented fish sauce	Shrimp paste	Tamarind paste	
Fish sauce	Sugar, white	Vegetable oil	

Vegetables

Acacia	Galangal	Papaya, raw	Shallot
Bamboo shoot, boiled	Garlic	Pepper, bird	Spring onion
Bamboo shoot, fermented	Gourd, wax	Pepper, goat	Tamarind leaf
Basil, holy	Leech lime leaf	Plantain	Tomato
Basil, sweet	Lemon grass	Pumpkin	
Chilli, dried	Mint	Pumpkin shoot	
Coriander leaf	Mushroom	Radish, chinese	

7.B Food Dishes, Fruits and Vegetables Used in Menu Planning by Linear Programming

Commonly Eaten Food Dishes

<u>Dry Main Dishes</u>	<u>Liquid Main Dishes</u>	<u>Sauces</u>
Fermented fish, whole	*Aom beef (beef curry)	Chilli in fermented fish sauce
Fried fish (fried mackerel)	*Kang bamboo shoot (bamboo shoot hot soup)	Chilli in fish sauce
Larb Beef (Seasoned minced beef)		
*Larb fish		*Kang beef
(seasoned minced fish)	*Namprig fish (beef hot soup)	(fish hot sauce)
Roasted beef	*Kang Chicken (chicken hot soup)	*Namprig shrimp paste (shrimp paste hot sauce)
Roasted chicken	*Kang fish (fish hot soup)	*Namprig whole fermented fish (whole fermented fish hot paste)
Roasted fish (roasted perch)	*Kang mushroom (Mushroom hot soup)	*Namprig fermented fish (fermented fish hot sauce)
*Roasted fish in banana leaf	*Kang hot soup (vegetable hot soup)	
*Roasted frog in banana leaf	*Toum beef (beef soup)	
Roasted small toad	*Toum beef visceral (beef visceral soup)	
*Somtam papaya (raw papaya salad)	*Toum buffalo visceral (buffalo visceral soup)	
*Soop bamboo shoot (seasoned grated bamboo shoot)	*Toum chicken (chicken soup)	
Steamed fish (steamed carp)	*Toum fish (fish soup)	

Commonly Eaten Vegetables

Acacia	Chinese cabbage	Gourd, snake	Spinach
Amaranth bayam	Corkwood, flower	Gourd, spong	Water con- volvulus
Bamboo shoot,	Corkwood, leaf	Lead tree leaf	Water fern
Bean, sprout			
Bean, long yard	Cowpea, young pod	Lettuce	Water mimosa
Bean, wing	Cucumber	Malabar night shade	
Bitter gourd shoot	Egg plant	Neem	
Cabbage	Gourd, bottle	Pumpkin shoot	
Cauliflower	Gourd, ivy	Spring onion	

Commonly Eaten Fruits

Banana	Guava	Papaya
Custard apple	Mushmelon	Water melon

Cowpea DishesMain Dishes

- *Cowpea and fermented fish hot sauce (Namprig plara toa)
- Cowpeas and fish hot sauce (pone pla)
- *Cowpeas and pumpkin hot soup (aom toa pum)
- *Cowpea curry (kang pa toa pum)
- *Cowpea sprout curry (Kang ped toa pum)
- *Fried Cowpea Sprout (Pad Toa Ngok)
- *Fried pork and cowpea ball (Tod mon toa)
- *Pumpkin and cowpeas spice soup (Kang fungton toa)
- (Pad Toa Ngok)
- (soop toa)
- *Seasoned minced beef and cowpeas (larb nou)
- *Seasoned minced fish and cowpeas (larb pla)
- *Steamed cowpeas and bamboo shoot (mog normai toa)
- *Steamed fish, cowpeas and bamboo shoot (mag normai pla)

Snacks and Desserts

- *Cowpea and sago pudding (sago toa gang boid)
- Cowpea boiled in syrup (Toa tomnam tal)
- *Cowpea paste coated with egg yolk (med kanoon)
- *Cowpea pudding (tao soum)
- *cowpea sweet paste (toa pum guan)
- *Cowpeas wrapped in glutinous rice dough (Toa Pab)
- *Fried banana coated with cowpea batter (Kloay tod)
- (krob kem)
- *Fried cowpea paste (kai nag kata)
- *Steamed glutinous rice stuffed (with cowpea (kao tom pod)
- *Steamed sago stuffed with cowpea (kao tom pod)

* Recipe formulated by linear programming for protein maximum content.

7.C Food Dishes, Fruits and Vegetables Used in Menu Planning By Mixed Integer Programming

Commonly Eaten Food DishesDry Main Dishes

- Fermented fish, whole
- Fried beef
- Fried fish (fried mackerel)
- *Larb beef (seasoned minced beef)
- *Larb fish (seasoned minced fish)
- Roasted beef
- Roasted chicken

Liquid Main Dishes

- *Kang chicken (chicken hot soup)
- *Kang fish (fish hot soup)
- *Kang bamboo shoot (bamboo shoot hot soup)
- *Kang bamboo shoot (bamboo shoot hot soup)
- *Kang mushroom (mushroom hot soup)
- *Toum beef (fish soup)
- *Toum fish (beef soup)

Sauces

- Chilli in fermented fish sauce
- Chilli in fish sauce
- *Namprig fish (fish hot sauce)
- *Namprig shrimp paste (shrimp paste hot sauce)
- *Namprig whole fermented fish (whole fermented fish hot paste)
- *Namprig fermented fish (fermented fish hot sauce)

Roasted fish
 *Roasted fish in banana leaf
 *Roasted frog in banana leaf
 *Roasted small toad
 *Somtam papaya
 (raw papaya salad)
 *Soop bamboo shoot
 (seasoned grated bamboo shoot)
 Steamed fish
 (steamed carp)

Commonly Eaten Vegetables

Bamboo shoot, boil	Cucumber	Leaf mustard	Water fern
Chinese cabbage	Egg plant	Neem	
Corkwood leaf	Gourd, ivy	Spring onion	
Coriander leaf	Lead tree leaf	Water convolvulus	

Commonly Eaten Fruits

Banana	Guava	Mango
Custard apple	Water melon	

Cowpea Dishes

Main Dishes

*Cowpea and fermented fish hot sauce (Namprig plara toa)
 Cowpea and fish hot sauce (pone pla)
 *Cowpeas and pumpkin hot soup (acm toa pum)
 *Cowpea curry (kang pa toa pum)
 *Fried cowpea sprout (Pad Toa Ngok)
 *Cowpea sprout curry (Kang ped toa pum)
 *Fried pork and cowpea ball (tod mon toa)
 *Pumpkin and cowpeas spice soup (Kang fungtong toa)
 *Seasoned grated bamboo shoot and cowpeas (soop nor mai)
 *Seasoned mashed cowpeas (soop toa)
 *Seasoned minced beef and cowpeas (larb nou)
 *Seasoned minced fish and cowpeas (larb pla)
 *Steamed cowpeas and bamboo shoot (mog normal toa)
 *Steamed fish, cowpeas and bamboo shoot (mog normal pla)
 * Recipes formulated by linear programming for protein maximum content

Snacks and Desserts

*Cowpea and sago pudding (sago toa gang boid)
 Cowpea boiled in syrup (Toa tomnam tal)
 *Cowpea paste coated with egg yolk (med kanoon)
 *Cowpea pudding (tao soun)
 *cowpea sweet paste (toa pum guan)
 *Cowpea wrapped in glutinous rice dough (toa pab)
 *Fried banana coated with cowpea batter (Kloay tod)
 *Fried cowpea (toa pum tad)
 *Fried cowpea crust (krob kem)
 *Fried cowpea paste (kai nag kata)
 *Steamed glutinous rice stuffed with cowpea (kao tom pod)
 *Steamed sago stuffed with cowpea (sago sai toa)

APPENDIX 8: THE 26 NUTRIENT CONTENT, COST AND RECIPE OF COWPEA
DISHES AND COMMONLY EATEN DISHES

Data on the 26 nutrient compositions, cost and quantity of food ingredients selected for recipes of the protein maximised 25 cowpea dishes, protein maximised 22 commonly eaten dishes and 9 commonly eaten are presented as follows:

- A. Data of the 25 cowpea dishes obtained from protein maximisation linear programming, used in menu planning by linear programming, presented in Table 8.1, and Table 8.2.
- B. Data of the final recipe of the 25 protein maximised cowpea dishes obtained after the cowpea dishes were given to taste panels for acceptability test and recipes were re-adjusted, the nutrient content and cost were recalculated, used in menu planning by mixed integer programming, presented in Table 8.3 and Table 8.4.
- C. Data of the 22 commonly eaten dishes obtained from protein maximisation linear programming, used in menu planning by linear programming and mixed integer programming, presented in Table 8.5.
- D. Data of the 9 commonly eaten dishes in which recipes were made of only one or two ingredients and were not required formulation, used in menu planning by linear programming and mixed integer programming, presented in Table 8.6.
- E. Data of 5 cowpea dishes and 2 commonly eaten dishes cooked by frying in oil 150 C, 10 min. and by deep frying 190 C, 5 min., presented in Table 8.7.

TABLE 8.1 The 26 Nutrient Content, Cost and Recipe of Protein Maximised Cowpea Main Dishes (per 100g raw ingredients)

Nutrient	Cowpea & Fermented Fish Hot Sauce	Cowpeas & Fish Hot Sauce	Cowpea & Pumpkin Hot Soup	Cowpea Curry	Cowpea Sprout Curry	Fried Cowpea Sprout	Fried Pork & Cowpea Ball						
Energy (Kcal)	128	92	42	79	201	131	314						
Protein (g)	8.49	9.13	3.57	5.00	5.86	5.27	10.91						
Fat (g)	2.9	1.7	0.7	2.1	17.1	6.7	0.9						
Dietary Fibre (g)	2.3	1.9	1.7	2.2	1.3	2.4	5.9						
Calcium (mg)	36	25	22	22	43	102	43						
Phosphorus (mg)	87	120	49	70	186	286	174						
Iron (mg)	2.6	1.4	0.9	1.1	3.5	6.3	2.9						
Vitamin A (IU)	612	310	463	353	477	147	363						
Thiamine (mg)	0.15	0.13	0.05	0.08	0.09	0.13	0.36						
Riboflavin (mg)	0.12	0.10	0.04	0.06	0.11	0.11	0.16						
Niacine (mg)	0.9	2.4	0.6	1.6	1.5	1.8	1.8						
Vitamin C (mg)	5	5	4	4	7	9	2						
Vitamin B6 (mg)	0.22	0.20	0.08	0.10	0.10	0.05	0.27						
Vitamin B12 (µg)	2.1	1.1	0.4	0.0	0.4	0.4	2.0						
Pantothenic Acid (mg)	0.29	0.27	0.13	0.27	0.10	0.04	0.8						
Folic Acid (µg)	82.2	61.5	31.7	35.1	5.6	8.0	127.2						
Isoleucine (mg)	561	518	229	356	295	331	941						
Leucine (mg)	826	774	333	454	517	485	1113						
Lysine (mg)	811	830	377	476	539	708	1077						
Methionine (mg)	225	237	102	141	133	149	320						
Cystine (mg)	83	99	40	75	103	48	138						
Phenylalanine (mg)	473	417	191	238	334	364	650						
Tyrosine (mg)	324	296	139	170	280	338	433						
Threonine (mg)	432	420	197	233	335	397	644						
Tryptophane (mg)	132	127	53	81	117	179	176						
Valine (mg)	598	558	246	313	417	464	908						
Cost (Bahts)	0.95	1.54	0.71	0.64	1.13	0.55	1.39						
<u>Recipe/g</u>													
COWPEAFL	14.7	COWPEAFL	9.7	COWPEASD	5.8	COWPEASD	7.3	COWPEASP	25.0	COWPEASP	70.0	COWPEASD	26.1
FISHFERM	32.7	MACKEREL	29.2	CARP	8.9	COWPEAPD	6.9	BEEF	12.0	SOYCURD	14.0	PORK	26.1
SHALLOT	7.8	CHILLID	1.3	PUMPKIN	14.8	PEPPER	0.1	COCOMILK	50.3	GARLIC	0.5	CORIAN	1.2
GARLIC	5.8	SHALLOT	10.8	GALANGAL	0.5	CHICKEN	15.6	SUGARCO	1.1	FISHSAU	7.5	GARLIC	2.3
TAMARIND	3.9	GARLIC	3.0	LEMONGSS	0.6	LEECHLF	0.2	FISHSAU	3.4	VEGOIL	5.0	FISHSAU	4.7
GALANGAL	1.5	FISHFERM	7.0	SHALLOT	1.4	BASILHLY	0.2	PEPPERGT	1.7	ONIONSPR	3.0	SUGARWHT	0.7
CHILLID	3.9	ONIONSPR	6.5	GARLIC	0.5	FISHSAU	1.4	LEECHLF	0.3			WHEATFL	2.3
WATER	29.1	WATER	32.4	PEPPERGT	1.3	VEGOIL	1.4	BASILHLY	0.6			EGGHEN	12.9
LEECHLIPL	0.5			FISHFERM	2.2	PEPPERGT	1.4	GALANGAL	0.6			VEGOIL	10.6
				BASILSWT	0.9	GALANGAL	0.4	LEMONGSS	0.8			WATER	11.6
				FISHSAU	2.7	LEMONGSS	0.7	SHALLOT	1.1			CORIANRT	1.1
				ONIONSPR	1.3	GARLIC	1.0	CHILLID	1.2				
				WATER	59.3	PEPPERBD	0.8	GARLIC	1.1				
				SALT	0.2	SHRPASTE	1.0	SHRPASTE	0.8				
						WATER	59.7	LEECHLIPL	0.3				
						VEGOIL	0.9	CORIANRT	0.1				
						SUGARCO	1.0	PEPPER	0.1				
								SALT	0.5				

TABLE 8.1 (continue).

Nutrient	Pumpkin & Cowpea Spice Soup	Seasoned Grated Bamboo Shoot & Cowpeas	Seasoned Mashed Cowpeas	Seasoned Minced Beef & Cowpeas	Seasoned Minced Fish & Cowpeas	Steamed Cowpeas & Bamboo Shoot	Steamed Fish, Cowpeas & Bamboo Shoot						
Energy (Kcal)	67	86	77	230	116	71	74						
Protein (g)	3.68	4.18	4.88	14.01	14.68	3.72	5.18						
Fat (g)	0.7	2.8	1.1	14.6	1.7	1.0	1.7						
Dietary Fibre (g)	4.3	4.9	4.1	2.3	2.3	4.4	3.8						
Calcium (mg)	27	66	55	31	48	41	47						
Phosphorus (mg)	106	88	88	144	135	69	83						
Iron (mg)	1.7	2.0	2.1	2.8	1.4	1.7	2.6						
Vitamin A (IU)	1079	913	815	398	538	935	1158						
Thiamine (mg)	0.11	0.12	0.17	0.13	0.16	0.10	0.09						
Riboflavin (mg)	0.07	0.09	0.12	0.28	0.08	0.08	0.11						
Niacine (mg)	1.5	0.9	1.1	3.6	2.1	0.8	1.2						
Vitamin C (mg)	6	7	19	6	6	7	7						
Vitamin B6 (mg)	0.10	0.25	0.19	0.36	0.20	0.21	0.20						
Vitamin B12 (µg)	0.20	0.4	0.5	1.2	2.5	0.4	0.5						
Pantothenic Acid (mg)	0.23	0.34	0.29	0.50	0.50	0.25	0.23						
Folic Acid (µg)	68.1	56.7	72.6	69.3	74.8	56.7	47.8						
Isoleucine (mg)	303	310	311	800	811	277	329						
Leucine (mg)	402	434	443	1325	1287	379	470						
Lysine (mg)	334	357	396	1361	1386	335	481						
Methionine (mg)	76	102	93	320	507	78	127						
Cystine (mg)	37	61	144	163	175	54	70						
Phenylalanine (mg)	247	274	269	710	633	235	279						
Tyrosine (mg)	141	179	207	514	512	154	209						
Threonine (mg)	201	227	245	695	713	194	255						
Tryptophane (mg)	78	94	112	184	181	85	99						
Valine (mg)	313	332	339	890	1046	292	377						
Cost (Bahts)	0.28	0.79	0.67	2.38	4.47	0.63	1.06						
Recipe/g													
COWPEASD	12.7	COWPEASD	10.3	COWPEASD	4.8	COWPEAFL	8.1	COWPEAFL	8.1	COWPEASD	10.3	COWPEASD	8.3
COWPEAFL	1.7	BAMBOSTB	34.1	COWPEAPD	60.1	COWPEASD	4.4	COWPEASD	4.4	BAMBOSTB	34.0	PERCH	11.2
LEMONGSS	0.7	FISHFERM	6.0	COWPEAFL	5.4	BEEF	64.8	CATFISH	64.8	FISHFERM	6.0	BAMBOSTB	23.4
SHALLOT	2.2	GALANGAL	3.0	CHILLID	1.4	LIMJUE	2.3	LIMEJUC	2.3	SUGARCO	1.4	GALANGAL	3.1
GARLIC	0.6	LEMONGSS	2.0	SHALLOT	6.0	GALANGAL	0.6	GALANGAL	0.6	GALANGAL	3.0	LEMONGSS	2.1
PEPPERGT	2.2	SHALLOT	9.7	MINT	1.2	CHILLID	1.1	CHILLID	1.1	LEMONGSS	2.0	SHALLOT	10.1
FISHFERM	3.1	GARLIC	3.2	ONIONSPR	3.6	FISHSAU	4.6	FISHSAU	4.6	SHALLOT	9.7	GARLIC	3.3
YANANG	59.3	PEPPERGT	3.2	CORIAN	1.2	SHALLOT	3.7	SHALLOT	3.7	GARLIC	3.2	PEPPERGT	3.3
BASILSWT	1.1	BASILSWT	4.5	FISHFERM	7.2	SHALLOT	2.3	CORIAN	2.3	PEPPERGT	3.2	FISHFERM	6.3
PUMPKIN	16.4	SESAME	3.5	GARLIC	2.5	MINT	1.7	MINT	1.7	BASILSWT	4.5	BASILSWT	4.7
SALT	0.5	YANANG	10.7	WATER	5.0	ONIONSPR	1.7	ONIONSPR	1.7	YANANG	12.8	YANANG	20.9
		WATER	9.9	SALT	1.3	WATER	4.8	WATER	4.8	WATER	9.9	WATER	6.5
						SALT	0.4	SALT	0.3				

TABLE 8.2 The 26 Nutrient Content, Cost and Recipe of Protein Maximised Cowpea Snacks and Desserts (per 100g raw ingredients)

Nutrient	Cowpea & Sago Pudding	Cowpea Paste Coated With Egg Yolk	Cowpea Pudding	Cowpea Sweet Paste	Cowpeas Wrapped in Glutinous Rice Dough	Fried Banana Coated With Cowpea Dough Batter	Fried Cowpea	Fried Cowpea Crust
Energy (kcal)	165	336	142	293	267	174	250	274
Protein (g)	3.76	6.97	2.91	4.91	6.08	3.72	8.7	6.78
Fat (g)	8.7	8.5	5.6	17.5	2.82	6.6	1.0	7.5
Dietary Fibre (g)	2.9	7.3	2.2	3.7	7.12	4.5	9.7	2.2
Calcium (mg)	23	50	14	23	103	44	51	38
Phosphorus (mg)	100	169	74	132	170	98	175	137
Iron (mg)	1.7	2.8	1.0	1.8	2.82	2.0	3.0	3.0
Vitamin A (IU)	10	523	2	2	4	185	76	146
Thiamine (mg)	0.10	0.18	0.46	0.11	0.20	0.12	0.26	0.16
Riboflavin (mg)	0.04	0.12	0.03	0.04	0.06	0.12	0.10	0.08
Niacine (mg)	0.5	0.6	0.4	0.6	1.32	0.81	1.0	1.0
Vitamin C (mg)	0	1	0	1	1.0	5	1	0
Vitamin B6 (mg)	0.06	0.15	0.07	0.08	0.29	0.21	0.19	0.17
Vitamin B12 (µg)	0	0.8	0	0	0	0	0.1	0.3
Pantothenic Acid (mg)	0.20	0.88	0.16	0.21	0.73	0.40	0.62	0.55
Folic Acid (µg)	60.2	106.6	46.4	61.8	81	62.7	194	91.3
Isoleucine (mg)	285	548	232	338	468	290	803	485
Leucine (mg)	404	753	344	509	685	282	1030	692
Lysine (mg)	288	597	228	344	428	399	1319	516
Methionine (mg)	68	140	58	88	153	81	1595	143
Cystine (mg)	55	77	41	89	68	39	69	104
Phenylalanine (mg)	254	438	205	326	416	252	624	433
Tyrosine (mg)	142	262	112	192	226	135	319	256
Threonine (mg)	199	372	161	257	333	199	488	350
Tryptophane (mg)	70	127	54	90	125	86	172	117
Valine (mg)	327	574	261	414	519	315	824	544
Cost (Bahts)	0.43	0.81	0.39	0.82	0.95	0.62	0.52	0.75
<u>Recipe/g</u>	COWPEASD 13.2 SUGARCO 2.7 SUGARWHT 4.3 COCOMILK 30.1 SAGO 5.4 WATER 44.4	COWPEASD 15.9 COCONUT 10.9 SUGARWHT 32.3 EGGHYOLK 8.8 WATER 32.0 SALT 0.1	COWPEASD 10.2 CORNFL 4.1 SUGARWHT 13.3 COCOMILK 18.7 WATER 53.7	COWPEASD 9.2 SUGARWHT 17.2 COCOMILK 38.4 COCONUT 4.0 WATER 31.0 SALT 0.1	COWPEASD 17.6 COCONUT 9.4 RICEGLUF 18.8 SUGARWHT 14.1 SESAME 10.6 WATER 29.6	COWPEAFL 11.4 COCONUT 17.0 RICEFL 2.8 CORNST 2.0 SESAME 2.8 SUGARWHT 0.8 SUGARCO 0.8 BANANA 33.3 WATER 28.6 SALT 0.4	COWPEASD 43.9 TAPIOCA 5.2 GARLIC 0.2 SUGARWHT 0.6 EGGHYOLK 1.6 VEGOIL 9.4 WATER 39.0 SUGARWHT 9.0 FISHSAU 3.2 WATER 12.3 SALT 0.4 BAKEPOWDER 0.4 PEPPER 0.2 CORIANRT 0.1	COWPEAFL 16.3 WHEATFL 16.3 RICEFL 2.7 TAPIOCA 2.2 EGGHEN 5.5 COCOMILK 23.0 SUGARCO 9.0 SUGARWHT 9.0 WATER 3.2 WATER 12.3 SALT 0.4 BAKEPOWDER 0.4 PEPPER 0.2 CORIANRT 0.1

TABLE 8.2 (continue)

Nutrient	Fried Cowpea Paste	Steamed Glutin- ous Rice Stuffed With Cowpeas	Steamed Sago Stuffed With Cowpeas
Energy (kcal)	411	234	156
Protein (g)	4.43	5.46	3.18
Fat (g)	29.4	6.9	1.9
Dietary Fibre (g)	4.4	3.93	3.1
Calcium (mg)	27	24	36
Phosphorus (mg)	92	119	97
Iron (mg)	1.5	1.64	1.8
Vitamin A (IU)	132	129	31
Thiamine (mg)	0.13	0.14	0.04
Riboflavin (mg)	0.06	0.10	0.04
Niacine (mg)	0.5	1.16	0.7
Vitamin C (mg)	0	3	2
Vitamin B6 (mg)	0.09	0.30	0.12
Vitamin B12 (µg)	0.2	0	0.1
Pantothenic Acid (mg)	0.48	0.64	0.31
Folic Acid (µg)	93.1	65.8	78.6
Isoleucine (mg)	386	345	240
Leucine (mg)	504	551	308
Lysine (mg)	397	346	276
Methionine (mg)	85	84	57
Cystine (mg)	38	80	29
Phenylalanine (mg)	301	313	193
Tyrosine (mg)	161	168	105
Threonine (mg)	241	246	159
Tryptophane (mg)	85	124	55
Valine (mg)	397	410	250
Cost (Bahts)	1.08	0.59	0.94
<u>Recipe/g</u>	COWPEASD 20.0	COWPEASD 13.1	COWPEASD 12.5
	TAPIOCA 21.0	RICEGLU 26.3	SHALLOT 26.4
	SUGARWHT 10.2	COCOMILK 22.1	FISHSAU 1.6
	VEGOIL 25.6	SUGARWHT 3.5	SUGARCO 2.9
	EGGHYOLK 3.6	BANANA 23.5	SAGO 21.6
	WATER 19.7	WATER 11.0	GARLIC 1.1
	SALT 0.2	SALT 0.5	VEGOIL 1.4
			WATER 32.4
			SALT 0.2

TABLE 8.3 The 26 Nutrient Content, Cost and Recipe of the Final Recipe of Protein Maximised Cowpea Main Dishes (per 100g raw ingredients)

Nutrient	Cowpea & Fermented Fish Hot Sauce	Cowpea & Fish Hot Sauce	Cowpea & Pumpkin Hot Soup	Cowpea Curry	Cowpea Sprout Curry	Fried Cowpea Sprout	Fried Pork & Cowpea Ball
Energy (kcal)	128	92	42	79	198	131	261
Protein (g)	8.5	9.1	3.6	5.0	5.3	5.3	9.06
Fat (g)	2.9	1.7	0.7	2.1	17.1	6.7	0.7
Dietary Fibre (g)	2.3	1.9	1.7	2.2	1.2	2.4	4.9
Calcium (mg)	36	25	22	22	42	102	36
Phosphorus (mg)	87	120	49	70	184	286	145
Iron (mg)	2.6	1.4	0.9	1.1	3.4	6.3	2.4
Vitamin A (IU)	612	310	463	353	453	147	301
Thiamine (mg)	0.15	0.13	0.05	0.08	0.09	0.13	0.30
Riboflavin (mg)	0.12	0.10	0.04	0.06	0.10	0.11	0.13
Niacine (mg)	0.9	2.4	0.6	1.6	1.4	1.8	1.5
Vitamin C (mg)	5	5	4	4	6	9	2
Vitamin B6 (mg)	0.22	0.20	0.08	0.10	0.09	0.05	0.22
Vitamin B12 (µg)	2.10	1.1	0.4	0	0.4	0.4	1.7
Pantothenic Acid (mg)	0.29	0.27	0.13	0.27	0.09	0.04	0.66
Folic Acid (µg)	82.2	61.5	31.7	35.1	5.3	8.0	105.6
Isoleucine (mg)	561	518	229	356	267	331	782
Leucine (mg)	826	774	333	454	469	485	924
Lysine (mg)	811	830	377	476	483	708	895
Methionine (mg)	225	237	102	141	120	149	266
Cystine (mg)	83	99	40	75	99	48	115
Phenylalanine (mg)	473	417	191	238	311	364	540
Tyrosine (mg)	324	296	139	170	261	338	360
Threonine (mg)	432	420	197	233	311	397	535
Tryptophane (mg)	132	127	53	81	111	179	146
Valine (mg)	598	558	246	313	389	464	754
Cost (Bahts)	0.95	1.54	0.71	0.64	1.02	0.55	1.15
<u>Recipe/g</u>	FISHFERM 32.7 SHALLOT 7.8 GARLIC 5.8 COWPEAFL 14.7 TAMARIND 3.9 GALANGAL 1.5 CHILLID 3.9 WATER 29.1 LEECLIPL 0.5	MACKEREL 29.2 CHILLID 1.3 COWPEAFL 9.7 SHALLOT 10.8 GARLIC 3.0 FISHFERM 7.0 ONIONSPR 6.5 WATER 32.4 SALT 0.3	COWPEASD 5.8 CARP 8.9 PUMPKIN 14.8 GALANGAL 0.5 LEMONGSS 0.6 SHALLOT 1.4 GARLIC 0.5 PEPPERGT 1.3 FISHFERM 2.2 BASILSWT 0.9 FISHSAU 2.7 ONIONSPR 1.3 WATER 59.3 SALT 0.2	COWPEASD 7.3 COWPEAPD 6.9 PEPPER 0.1 CHICKEN 15.6 LEECHLF 0.2 BASILHLY 0.2 FISHSAU 1.4 SUGARCO 1.0 VEGOIL 1.4 PEPPERGT 1.4 GALANGAL 0.4 LEMONGSS 0.7 GARLIC 1.0 PEPPERBD 0.8 SHRPASTE 1.0 WATER 59.7 SALT 0.9	COWPEASP 24.8 BEEF 11.9 COCOMILK 49.8 SUGARCO 1.1 FISHSAU 3.4 PEPPERGT 1.7 LEECHLF 0.3 BASILHLY 0.6 GALANGAL 0.6 LEMONGSS 0.8 SHALLOT 1.1 CHILLID 1.2 GARLIC 1.1 SHRPASTE 0.8 LEECLIPL 0.3 CORIANRT 0.1 PEPPER 0.1 SALT 0.5	COWPEASP 70.0 SOYCURD 14.0 GARLIC 0.5 FISHSAU 7.5 VEGOIL 5.0 ONIONSPR 3.0	COWPEASD 21.7 PORK 21.7 CORIAN 1.0 GARLIC 1.9 FISHSAU 3.9 SUGARWHT 0.6 WHEATFL 1.9 EGGHEN 10.7 VEGOIL 8.8 WATER 26.4 CORIANRT 0.9 SALT 0.5

TABLE 8.3 (continue)

Nutrient	Pumpkin & Cowpea Spice Soup	Seasoned Grated Bamboo Shoot & Cowpeas	Seasoned Mashed Cowpeas	Seasoned Minced Beef & Cowpeas	Seasoned Minced Fish & Cowpeas	Steamed Cowpeas & Bamboo Shoot	Steamed Fish, Cowpeas & Bamboo Shoot						
Energy (kcal)	62	71	77	230	105	58	71						
Protein (g)	3.4	3.5	4.9	14.0	13.3	3.3	5.1						
Fat (g)	0.7	2.3	1.1	14.6	1.5	0.9	1.7						
Dietary Fibre (g)	4.1	4.1	4.1	2.2	2.1	4.0	3.8						
Calcium (mg)	25	55	55	24	43	34	45						
Phosphorus (mg)	87	73	88	143	122	66	85						
Iron (mg)	1.4	2	2.1	2.7	1.3	1.4	1.7						
Vitamin A (IU)	853	756	815	299	486	881	1226						
Thiamine (mg)	0.10	0.10	0.17	0.13	0.15	0.09	0.09						
Riboflavin (mg)	0.06	0.08	0.12	0.23	0.07	0.07	0.10						
Niacine (mg)	1.1	0.8	1.1	3.6	1.9	0.8	1.3						
Vitamin C (mg)	5	6	19	5	5	6	7						
Vitamin B6 (mg)	0.09	0.21	0.19	0.36	0.18	0.17	0.19						
Vitamin B12 (µg)	0.2	0.3	0.5	1.2	2.3	0.4	0.5						
Pantothenic Acid (mg)	0.21	0.28	0.29	0.49	0.45	0.21	0.21						
Folic Acid (µg)	61.6	47.0	72.6	68.7	67.6	47.8	42.4						
Isoleucine (mg)	273	257	311	797	733	251	328						
Leucine (mg)	361	360	443	1320	1163	342	467						
Lysine (mg)	300	296	396	1356	1252	302	467						
Methionine (mg)	69	85	93	319	458	71	125						
Cystine (mg)	33	51	144	162	159	46	67						
Phenylalanine (mg)	222	227	269	706	572	211	276						
Tyrosine (mg)	125	148	207	506	463	138	207						
Threonine (mg)	180	188	245	692	645	174	253						
Tryptophane (mg)	68	78	112	182	164	71	99						
Valine (mg)	282	275	339	886	945	265	376						
Cost (Bahts)	0.24	0.65	0.67	2.39	4.04	0.41	0.84						
<u>Recipe/g</u>													
COWPEASD	11.5	COWPEASD	8.5	COWPEASD	4.8	COWPEAFL	8.1	COWPEAFL	7.3	COWPEASD	9.4	COWPEASD	8.3
COWPEAFL	1.5	BAMBOSTB	28.3	COWPEAPD	60.1	COWPEASD	4.4	COWPEASD	4.0	BAMBOOSTB	31.3	PERCH	11.2
LEMONGSS	0.6	FISHFERM	5.0	COWPEAFL	5.4	BEEF	64.8	CATFISH	58.5	FISHFERM	5.5	BAMBOSTB	23.4
SHALLOT	2.0			CHILLID	1.4	LIMEJUE	4.0	LIMEJUE	2.1	GALANGAL	0.6	GALANGAL	3.1
GARLIC	0.5	GALANGAL	2.5	SHALLOT	6.0	GALANGAL	0.6	GALANGAL	0.5	LEMONGSS	1.8	LEMONGSS	2.1
PEPPERGT	2.0	LEMONGSS	1.7	MINT	1.2	CHILLID	1.1	CHILLID	1.0	SHALLOT	3.2	SHALLOT	2.4
FISHFERM	2.8	SHALLOT	8.0	ONIONSPR	3.6	FISHSAU	4.6	FISHSAU	4.2	GARLIC	2.5	GARLIC	3.3
YANANG	39.6	GARLIC	2.7	CORIAN	1.2	SHALLOT	3.7	SHALLOT	3.3	PEPPERGT	2.5	PEPPERGT	3.3
BASILSWT	1.0	PEPPERGT	2.7	FISHFERM	7.2	CORIAN	0.9	CORIAN	2.1	BASILSWT	4.1	FISHFERM	6.3
PUMPKIN	14.8	BASILSWT	3.7	GARLIC	2.5	MINT	1.0	MINT	1.5	YANANG	20.8	BASILSWT	4.7
SALT	0.5	SESAME	2.9	WATER	5.0	ONIONSPR	1.7			WATER	18.2	YANANG	23.7
WATER	23.1	YANANG	8.9	SALT	1.3	WATER	4.8	ONIONSPR	1.5			WATER	6.5
		WATER	24.7			SALT	0.4	WATER	13.6				
		SALT	0.5					SALT	0.3				

TABLE 8.4 The 26 Nutrient Content, Cost and Recipe of Final Recipe of Protein Maximised Cowpea Snacks and Desserts (per 100g raw ingredients)

Nutrient	Cowpea & Sago Pudding		Cowpea Paste Coated With Egg Yolk		Cowpea Pudding		Cowpea Sweet Paste		Cowpeas Wrapped in Glutinous Rice Dough		Fried Banana Coated with Cowpea Batter		Fried Cowpea		Fried Cowpea Crust	
Energy (kcal)	150		325		129		258		267		277		250		328	
Protein (g)	3.4		6.7		4.1		4.3		6.01		3.45		8.7		6.13	
Fat (g)	7.9		8.2		4.6		15.4		2.82		20.5		1.0		16.7	
Dietary Fibre (g)	2.6		7.1		2.9		3.3		7.12		4.18		9.7		2.0	
Calcium (mg)	21		48		17		20		103		41		51		34	
Phosphorus (mg)	91		163		76		116		170		91		175		124	
Iron (mg)	1.5		2.7		1.1		1.6		2.8		1.84		3.0		2.7	
Vitamin A (IU)	9		506		2		2		4		172		76		132	
Thiamine (mg)	0.09		0.17		0.09		0.10		0.20		0.11		0.26		0.14	
Riboflavin (mg)	0.04		0.12		0.03		0.04		0.06		0.11		0.10		0.07	
Niacine (mg)	0.5		0.6		0.4		0.5		1.32		0.75		1.0		1.0	
Vitamin C (mg)	0		1		0		1		1.0		5		1		0	
Vitamin B6 (mg)	0.05		0.15		0.07		0.07		0.29		0.20		0.19		0.15	
Vitamin B12 (µg)	0		0.8		0		0		0		0		0.1		0.3	
Pantothenic Acid (mg)	0.18		0.85		0.19		0.18		0.73		0.37		0.62		0.50	
Folic Acid (µg)	54.6		103.1		58.3		54.4		81		58.3		194		82.5	
Isoleucine (mg)	258		530		270		297		468		269		803		437	
Leucine (mg)	366		728		379		448		685		262		1030		631	
Lysine (mg)	261		577		267		303		428		371		1319		467	
Methionine (mg)	62		135		63		77		153		75		1595		129	
Cystine (mg)	50		75		40		78		68		36		69		94	
Phenylalanine (mg)	230		424		217		287		416		234		624		392	
Tyrosine (mg)	129		253		122		169		226		125		319		232	
Threonine (mg)	180		360		179		226		333		185		488		317	
Tryptophane (mg)	64		123		61		79		125		80		172		106	
Valine (mg)	297		555		296		364		519		293		824		492	
Cost (Bahts)	0.39		0.78		0.32		0.72		0.95		0.96		0.52		0.94	
<u>Recipe/g</u>	COWPEASD	12.0	COWPEASD	15.4	COWPEASD	13.0	COWPEASD	12.7	COWPEASD	17.6	COWPEAFL	10.6	COWPEASD	43.9	COWPEAFL	14.7
	SUGARCO	2.5	COCONUT	10.5	CORNFL	2.5	SUGARWHT	13.2	COCONUT	9.4	COCONUT	15.8	TAPIOCA	5.2	WHEATFL	14.7
	SUGARWHT	3.9	SUGARWHT	31.2	SUGARWHT	10.9	COCOMILK	33.8	RICEGLUF	18.8	RICEFL	2.0	GARLIC	0.2	RICEFL	2.4
	COCOMILK	27.3	EGGHYOLK	8.5	COCOMILK	15.3	COCONUT	3.5	SUGARWHT	14.1	CORNST	1.9	SUGARWHT	0.6	TAPIOCA	2.0
	SAGO	4.9	WATER	34.2	WATER	58.3	WATER	36.8	SESAME	10.6	SESAME	2.0	EGGHYOLK	1.6	EGGHEN	4.9
	WATER	49.3	SALT	0.1			SALT	0.1	WATER	29.6	SUGARWHT	0.7	VEGOIL	9.4	COCOMILK	20.8
	SALT	0.1									SUGARCO	0.7	WATER	39.0	SUGARCO	8.1
											BANANA	30.9			FISHSAU	2.9
											WATER	21.9			WATER	11.1
											SALT	0.4			SALT	0.4
											VEGOIL	13.0			BAKEPOWDER	0.4
															PEPPER	0.2
															CORIANRT	0.1
															VEGOIL	9.4

TABLE 8.4 (continue)

Nutrient	Fried Cowpea Paste	Steamed Glutinous Rice Stuffed With Cowpeas	Steamed Sago Stuffed With Cowpeas
Energy (kcal)	441	154	192
Protein (g)	4.75	3.6	4.8
Fat (g)	31.5	4.6	2.9
Dietary Fibre (g)	4.7	2.6	3.7
Calcium (mg)	29	16	39
Phosphorus (mg)	99	79	114
Iron (mg)	1.6	1.09	2.1
Vitamin A (IU)	142	85	39
Thiamine (mg)	0.14	0.09	0.11
Riboflavin (mg)	0.06	0.07	0.04
Niacine (mg)	0.5	0.77	0.5
Vitamin C (mg)	0	2	1
Vitamin B6 (mg)	0.10	0.20	0.09
Vitamin B12 (µg)	0.2	0	0.1
Pantothenic Acid (mg)	0.51	0.42	0.21
Folic Acid (µg)	99.8	43.6	81.3
Isoleucine (mg)	414	229	304
Leucine (mg)	504	365	388
Lysine (mg)	426	229	339
Methionine (mg)	91	56	70
Cystine (mg)	41	52	28
Phenylalanine (mg)	323	207	237
Tyrosine (mg)	173	111	125
Threonine (mg)	258	163	199
Tryptophane (mg)	91	82	65
Valine (mg)	426	272	317
Cost (Bahts)	67	0.39	0.46
<u>Recipe/g</u>			
	COWPEASD 21.4	COWPEASD 8.7	COWPEASD 16.4
	TAPIOCA 22.5	RICEGLU 17.4	SHALLOT 3.4
	SUGARWHT 10.9	COCOMILK 14.6	FISHSAU 2.1
	VEGOIL 10.7	SUGARWHT 2.3	SUGARCO 3.1
	EGGHYOLK 3.4	BANANA 15.6	SAGO 28.3
	WATER 30.8	WATER 41.1	GARLIC 1.4
	SALT 0.2	SALT 0.3	VEGOIL 2.4
			WATER 42.5
			SALT 0.3

TABLE 8.5 The 26 Nutrient Composition, Cost, Acceptability Score and Recipe of 22 Protein Maximised Commonly Eaten Dishes

Nutrient	Raw Papaya Salad	Roasted Fish in Banana Loaf	Roasted Frog in Banana Loaf	Seasoned Grated Bamboo Shoot	Seasoned Minced Beef	Seasoned Minced Fish	Bamboo Shoot Hot Soup	Beef Curry								
Energy (kcal)	45	92	67	34	178	73	31	113								
Protein (g)	2.7	10.5	11.4	2.1	14.6	10.8	2.1	7.0								
Fat (g)	0.9	4.4	1.0	0.9	11.5	1.7	0.7	8.2								
Dietary Fibre (g)	1.7	0.4	0.9	3.3	0.3	0.4	2.1	1.3								
Calcium (mg)	36	67	27	27	19	26	21	30								
Phosphorus (mg)	27	98	125	32	156	72	33	58								
Iron (mg)	0.9	1.4	1.5	0.9	3.8	0.6	1.0	1.5								
Vitamin A (IU)	227	970	218	947	10912	326	2021	826								
Thiamine (mg)	0.04	0.03	0.05	0.04	0.14	0.07	0.05	0.04								
Riboflavin (mg)	0.06	0.13	0.12	0.07	0.62	0.04	0.08	0.18								
Niacine (mg)	0.8	2.1	1.6	0.6	6.0	1.5	1.7	1.9								
Vitamin C (mg)	35	2	5	10	9	4	8.0	13								
Vitamin B6 (mg)	0.11	0.16	0.14	0.21	0.44	0.13	0.22	0.23								
Vitamin B12 (µg)	1.0	1.0	2.1	0.5	14.9	2.4	0.50	0.9								
Pantothenic Acid (mg)	0.20	0.14	0.32	0.18	2.33	0.30	0.27	0.22								
Folic Acid (µg)	7.8	3.7	5.3	11.0	66.5	11.3	16.1	13.7								
Isoleucine (mg)	110	507	586	111	789	514	104	346								
Leucine (mg)	167	777	907	155	1325	880	187	621								
Lysine (mg)	331	1055	1207	215	1366	1032	218	681								
Methionine (mg)	76	311	385	50	413	403	50	169								
Cystine (mg)	29	128	105	53	186	136	37	89								
Phenylalanine (mg)	98	413	458	100	724	405	99	327								
Tyrosine (mg)	95	402	654	97	529	376	87	264								
Threonine (mg)	159	479	518	107	668	510	115	337								
Tryptophane (mg)	28	125	121	34	184	117	60	93								
Valine (mg)	140	693	586	128	887	707	161	400								
Cost (Bahts)	0.62	2.53	3.57	0.46	2.73	3.59	0.43	1.42								
Acceptability Score	5.2	5.3	5.6	5.3	5.5	5.8	5.6	4.9								
Recipe/g	PAPAYAIM	68.6	PERCH	56.4	FROG	62.5	BAMBOSTB	66.6	BEEF	44.8	CATFISH	52.9	BAMBOSTB	25.9	BEEF	35.1
	PEPPERBD	4.0	CHILLID	0.7	CHILLID	0.7	YANANG	10.5	BFHEART	7.9	GALANGAL	0.7	YANANG	5.4	GALANGAL	0.3
	GARLIC	2.0	GALANGAL	0.6	GALANGAL	0.7	BASILSWT	1.8	BFLIVER	24.5	CHILLID	0.3	FISHFERM	4.7	SHALLOT	4.0
	FISHSAU	8.4	SHALLOT	1.2	SHALLOT	2.7	PEPPERGT	5.4	BFTRIPE	9.8	ONIONSPR	2.8	BASILSWT	0.9	FISHSAU	2.5
	LIMEJUE	5.7	GARLIC	2.6	GARLIC	0.5	SHALLOT	3.3	GALANGAL	0.6	RICEGLUR	2.0	ACACIA	6.7	ONIONSPR	9.3
	TOMATO	3.7	ONIONSPR	1.2	PLANTAIN	15.7	ONIONSPR	2.9	ONIONSPR	1.8	LIMEJUE	2.8	PUMSHOOT	6.7	GARLIC	1.3
	FISHFERM	7.6	BASILSWT	2.3	BASILSWT	0.5	CORIAN	1.3	RICEGLUR	1.2	FISHFERM	5.7	PEPPERGT	2.7	CHILLID	0.5
			FISHFERM	4.3	FISHFERM	9.0	FISHFERM	4.9	CORIAN	0.5	RICEGLU	0.5	RICEGLU	1.4	LEMONGSS	2.0
			FISHSAU	3.1	FISHSAU	5.4	FISHSAU	3.3	MINT	0.6	MINT	0.9	FISHSAU	3.4	BITGRDSH	5.0
			LEMONGSS	0.5	LEMONGSS	2.2			FISHSAU	4.8	FISHSAU	4.2	MUSHROOM	6.7	BASILSWT	1.5
			WATER	26.5					LIMEJUE	2.4	WATER	27.2	LEMONGSS	0.6	FISHFERM	3.4
									CHILLID	0.3			WATER	34.9	WATER	34.8
									WATER	1.0						

TABLE 8.5 (continue)

Nutrient	Beef Soup	Beef Hot Soup	Beef Visceral Soup	Buffalo Visceral Soup	Chicken Hot Soup	Chicken Soup	Fish Hot Soup
Energy (kcal)	96	127	33	33	82	76	53
Protein (g)	5.9	8.0	48	5.0	7.6	72	7.7
Fat (g)	7.6	9.3	1.2	1.0	4.7	45	1.8
Dietary Fibre (g)	0.2	1.0	1.0	0.1	1.0	0.3	0.3
Calcium (mg)	5.0	30	18	20	13	8	25
Phosphorus (mg)	46	64	44	41	83	74	72
Iron (mg)	0.9	1.6	1.4	1.1	0.9	0.7	0.8
Vitamin A (IU)	99	440	846	951	264	251	108
Thiamine (mg)	0.02	0.04	0.04	0.03	0.03	0.03	0.02
Riboflavin (mg)	0.13	0.18	0.09	0.15	0.07	0.06	0.04
Niacine (mg)	1.6	2.1	1.2	1.2	3.0	3.0	1.1
Vitamin C (mg)	1.0	6.0	3.0	4	1.0	2	2
Vitamin B6 (mg)	0.40	0.22	0.05	0.04	0.14	0.09	0.09
Vitamin B12 (µg)	0.5	1.1	2.5	1.6	0.3	0.2	1.0
Pantothenic Acid (mg)	0.17	0.24	0.42	0.42	0.41	0.37	0.20
Folic Acid (µg)	3.3	11.4	6.4	7.7	5.0	2.4	11
Isoleucine (mg)	288	393	265	245	491	472	401
Leucine (mg)	527	702	390	398	623	595	663
Lysine (mg)	560	778	452	439	744	703	791
Methionine (mg)	137	193	145	135	250	241	252
Cystine (mg)	74	97	62	75	111	108	81
Phenylalanine (mg)	270	357	207	206	284	266	351
Tyrosine (mg)	213	293	158	159	300	223	305
Threonine (mg)	275	380	228	232	324	301	384
Tryptophane (mg)	70	92	66	70	97	96	88
Valine (mg)	329	442	276	296	385	361	443
Cost (Bahts)	1.14	1.58	1.17	1.10	1.24	1.09	2.29
Acceptability Score	5.1	5.6	5.3	5.6	5.4	5.7	5.0
<u>Recipe/g</u>	BEEF 34.3	BEEF 40.0	BFLIVER 1.7	BULIVER 1.7	CHICKEN 35.7	CHICKEN 35.7	CARP
	GALANGAL 1.2	BASILSWT 0.9	BFHEART 6.3	BUHEART 6.3	BAMBOSTF 18.4	GALANGAL 2.1	CHILLID
	LIMEJUE 0.6	ONIONSPR 2.3	BFTRIPE 19.4	BUTRIPE 19.4	SHALLOT 3.0	PEPPERBD 0.4	SHALLOT
	FISHSAU 0.9	CABCHIN 10.0	BFLUNG 9.5	BULUNG 9.5	GARLIC 0.6	TAMARIND 0.5	GARLIC
	ONIONSPR 1.2	CHILLID 0.7	BFSMINT 1.0	BUSMINT 1.0	PEPPERGT 0.5	ONIONSPR 1.7	GALANGAL
	CORIAN 0.3	GALANGAL 0.3	BFSPLEEN 2.0	BUSPLEEN 2.0	BASILSWT 0.6	CORIAN 0.2	FISHSAU
	CHILLID 0.1	SHALLOT 3.0	LIMEJUE 0.4	LIMEJUE 0.4	FISHSAU 2.5	FISHSAU 1.6	FISHFERN
	LEMONGSS 1.2	GARLIC 1.0	FISHSAU 2.2	FISHSAU 2.2	LEMONGSS 0.3	LEMONGSS 0.7	BASILSWT
	LEECHLIF 0.2	FISHSAU 3.4	CHILLID 0.2	CHILLID 0.2	WATER 38.4	LEECHLF 0.1	GOURDWAX
	WATER 60.0	FISHFER: 4.6	ONIONSPR 0.1	ONIONSPR 0.3		WATER 57.0	LEMONGSS
		LEMONGSS 0.2	CORIAN 0.1	CORIAN 0.9			WATER
		WATER 33.6	GALANGAL 2.0	GALANGAL 0.9			
			LEMONGSS 1.0	LEMONGSS 0.9			
			LEECHLF 0.1	LEECHLF 0.1			
			WATER 54.1	WATER 54.1			

TABLE 8.5 (continue)

Nutrient	Fish Soup	Mushroom Hot Soup	Vegetable Hot Soup	Fermented Fish Hot Sauce	Fish Hot Sauce	Shrimp Paste Hot Sauce	Whole Fermented Fish Hot Sauce	
Energy (kcal)	47	25	33	120	87	92	122	
Protein (g)	6.6	1.6	4.3	7.0	12.7	7.8	7.2	
Fat (g)	1.3	0.7	0.9	3.3	2.1	1.0	3.5	
Dietary Fibre (g)	0.9	1.4	0.2	9.1	0.1	2.1	2.5	
Calcium (mg)	25	12	18	61	24	264	37	
Phosphorus (mg)	66	37	46	82	74	142	49	
Iron (mg)	0.8	1.1	0.5	3.3	0.8	4.8	2.3	
Vitamin A (IU)	459	207	82	6655	118	465	1624	
Thiamine (mg)	0.02	0.06	0.01	0.23	0.02	0.07	0.11	
Riboflavin (mg)	0.04	0.18	0.02	0.36	0.04	0.13	0.15	
Niacine (mg)	1.1	4.7	0.7	1.8	1.1	1.8	1.0	
Vitamin C (mg)	3	2.0	5.0	58	1	20	15	
Vitamin B6 (mg)	0.09	0.28	0.06	0.24	0.09	0.14	0.25	
Vitamin B12 (ug)	0.7	0.40	0.4	1.9	1.0	3.7	2.6	
Pantothenic Acid (mg)	0.8	1.05	0.06	0.20	0.07	0.20	0.16	
Folic Acid (ug)	10.9	16.5	8.1	18.4	10.5	4.1	18.6	
Isoleucine (mg)	343	62	222	383	434	365	346	
Leucine (mg)	559	96	366	539	719	585	596	
Lysine (mg)	713	173	449	620	840	865	666	
Methionine (mg)	215	34	141	199	271	206	207	
Cystine (mg)	68	15	44	101	82	160	89	
Phenylalanine (mg)	302	53	196	383	380	383	331	
Tyrosine (mg)	263	55	169	324	326	301	282	
Threonine (mg)	349	89	217	381	407	335	334	
Tryptophane (mg)	83	22	49	77	93	257	108	
Valine (mg)	362	77	247	361	475	410	386	
Cost (Bahts)	2.01	1.09	1.4	0.85	2.4	2.02	1.68	
Acceptability Score	5.2	6.1	5.3	5.0	5.1	5.3	5.7	
Recipe/g	35.5 CARP	31.2 MUSHROOM	49.1 CARP	21.4 FISHFERM	30.0 CARP	59.1 SHRPASTE	50.3 FISHFERM	40.5
	0.2 TAMALEAF	3.1 CHILLID	0.5 CHILLID	0.4 SHALLOT	10.0 FISHFERM	10.7 PEPPERBD	13.4 CHILLID	12.1
	1.1 GALANGAL	2.0 SHALLOT	1.0 SHALLOT	0.8 PEPPERGT	60.0 CHILLID	2.2 GARLIC	2.8 GALANGAL	4.0
	0.2 SHALLOT	0.8 FISHSAU	4.4 GARLIC	0.3	GARLIC	2.8 LIMEJUE	13.4 SHALLOT	19.2
	0.3 GARLIC	0.8 FISHFERM	2.2 SHRPASTE	0.2	WATER	25.2 SUGARCO	6.7 GARLIC	8.1
	1.1 FISHSAU	4.7 BASILSWT	1.7 TAMARIND	0.8		FISHSAU	13.4 TAMARIND	12.1
	5.5 ONIONSPR	2.0 ONIONSPR	0.1 SUGARCO	0.3			LEMONGSS	4.0
	0.2 BASILSWT	0.7 LEMONGSS	1.1 FISHSAU	1.5				
	10.2 PEPPERGT	1.2 WATER	39.8 RADDISHC	10.0				
	0.4 LEMONGSS	0.8	WATER	64.3				
	45.3 WATER	52.7						

TABLE 8.6 The 26 Nutrient Composition, Cost and Recipe of Commonly Eaten Dishes (per 100g raw ingredients)

Nutrient	Fermented Fish, Whole	Fried Fish	Roasted Beef	Roasted Chicken	Roasted Fish	Roasted Small Toad	Steamed Fish	Chilli in Fermented Fish Sauce	Chilli in Fish Sauce
Energy (kcal)	152	193	273	200	137	68	113	147	71
Protein (g)	14.8	17.5	16.7	19.6	16.7	14.8	18.1	13.3	8.9
Fat (g)	8.0	12.9	22.1	12.6	7.1	0.3	3.8	7.1	0.3
Dietary Fibre (g)	0	0	0	0	0	0	0	2.1	2.1
Calcium (mg)	22	11	8	14	98	23	55	31	44
Phosphorus (mg)	20	200	130	200	160	176	182	33	47
Iron (mg)	3.4	0.6	2.3	1.5	1.6	1.3	1.3	3.4	2.9
Vitamin A (IU)	183	45	67	408	1117	0	128	1665	1796
Thiamine (mg)	0.02	0.14	0.06	0.08	0.02	0.06	0.03	0.07	0.06
Riboflavin (mg)	0.16	0.13	0.36	0.16	0.27	0.14	0.07	0.21	0.14
Niacine (mg)	0.8	5.9	4.5	8.0	3.2	1.9	2.5	1.0	4.1
Vitamin C (mg)	0	2	0	0	0	3	0	13	13
Vitamin B6 (mg)	0.19	0.25	0.42	0.22	0.20	0.12	0.18	0.20	0.20
Vitamin B12 (µg)	6.4	2.1	1.4	0.4	1.0	2.0	1.4	5.5	5.0
Pantothenic Acid (mg)	0.15	0.27	0.47	1.00	0.20	0.37	0.14	0.16	0.16
Folic Acid (µg)	6.3	1.7	6.9	3.00	0.5	3.0	25	7.6	7.6
Isoleucine (mg)	783	806	825	1293	806	781	953	688	335
Leucine (mg)	1297	1296	1513	1626	1227	1197	1579	1162	440
Lysine (mg)	1518	1589	1568	1859	1624	1518	1847	1318	1734
Methionine (mg)	490	489	385	653	490	507	596	426	339
Cystine (mg)	147	202	206	288	204	132	179	138	93
Phenylalanine (mg)	685	634	770	717	647	597	834	614	229
Tyrosine (mg)	588	518	605	595	630	918	715	522	343
Threonine (mg)	734	749	770	787	727	629	894	647	798
Tryptophane (mg)	164	212	190	246	187	154	205	152	53
Valine (mg)	857	892	935	972	1115	749	1043	759	518
Cost (Bahts)	1.00	3.16	3.20	2.9	4.08	1.50	5.80	1.41	1.13
RECIPE/g	FISHFERM: 100.0	MACKERAL VEGOIL 90.0	BEEF 100.0	CHICKEN 100.0	PERCH 100.0	SMALLTOAD 100.0	CARP 96.1	CHILLID 13.7	CHILLID 13.7
							SALT 3.9	FISHFERM 86.3	FISHSAU 86.3

TABLE 8.7 The 26 Nutrient Composition and Cost of Cowpea Dishes and Commonly Eaten Dishes, Cooking by Frying in Oil 150°C - 10 min. and by Deep Frying 190°C, 5 min. (per 100g ingredients)

Nutrient	COWPEA DISHES				COMMONLY EATEN DISHES		
	Fried Banana Coated With Cowpea Batter	Fried Cowpea	Fried Cowpea Crust	Fried Cowpea Paste	Fried Pork & Cowpea Ball	Fried Beef	Fried Beef
	190°C, 5 min	190°C, 5 min	190°C, 5 min	190°C, 5 min	150°C, 10 min	150°C, 10 min	150°C, 10 min
Energy (kcal)	277	250	328	441	261	303	193
Protein (g)	3.5	8.7	6.1	4.8	9.1	15.0	17.5
Fat (g)	20.5	1.0	16.7	31.5	0.7	29.9	12.9
Dietary Fibre (g)	4.2	9.7	2.0	4.7	4.9	0	0
Calcium (mg)	41	51	34	29	36	7	11
Phosphorus (mg)	91	175	124	99	145	117	200
Iron (mg)	1.84	3.0	2.7	1.6	2.4	2.1	0.6
Vitamin A (mg)	107	47	82	89	264	53	40
Thiamine (mg)	0	0	0	0	0.07	0.01	0.03
Riboflavin (mg)	0.09	0.08	0.05	0.05	0.11	0.27	0.11
Niacine (mg)	0	0	0	0	1.3	3.6	5.1
Vitamin C (mg)	0	0	0	0	1	0	1
Vitamin B6 (mg)	0.13	0.12	0.1	0.06	0.19	0.33	0.22
Vitamin B12 (µg)	0	0.1	0.0	0	1.0	0.8	1.3
Pantothenic Acid (mg)	0.21	0.35	0.28	0.29	0.56	0.36	0.23
Folic Acid (µg)	0	0	0	0	3.8	0.2	0.1
Isoleucine (mg)	139	413	225	213	662	629	683
Leucine (mg)	163	642	393	314	862	1270	1209
Lysine (mg)	226	806	284	259	810	130	1438
Methionine (mg)	28	589	48	34	229	299	421
Cystine (mg)	0	0	0	0	47	76	82
Phenylalanine (mg)	225	598	376	310	531	681	623
Tyrosine (mg)	72	184	134	100	336	509	484
Threonine (mg)	170	449	292	237	524	679	734
Tryptophane (mg)	71	152	94	80	139	163	202
Valine (mg)	278	783	467	405	733	819	867
Cost (Bahts)	0.96	0.52	0.94	0.67	1.15	3.04	3.16

APPENDIX 9: THE NUTRIENT REQUIREMENTS FOR DAILY MENU

Energy Requirements

FAO/WHO (1973) recommendation for energy requirement was used as a basis for calculation of the required energy level for each member of the family. This recommendation was preferred to the Thai recommendation, as it was intended to encourage "catch-up growth", i.e. it would be more sensible to calculate the target energy requirements for children on a desirable rather than actual weight. Body weight of men and women in the two age groups in the "average" family were 54 and 47 kg respectively. "Active" activity was designed for men and women aged 20-39, as men and women aged 20-29 are young farmers and spend long hours and strenuous work in the fields. "Moderate activity" was taken for the men and women aged 40-49 and allowance was made for a decrease of 5% for the effect of ageing (FAO/WHO 1973). The total energy requirements designed for a family of 7 persons was 15,581 kcal per day and energy requirements for individual members of family is shown in Table 9.1. The unit of energy in the "kilocalorie" (kcal) was preferred to the International System of units of energy which is expressed in the "joule" (J) as most of the available data on the Thai food composition has experienced the energy content of foodstuffs in the "kilocalorie".

Table 9.1: Energy Daily Requirements for a Family of 7 Persons

		<u>Body Weight</u>	<u>Energy Requirements</u>
		kg	kcal
Child	1-3	10	1360
Boy	10-12	25	2600
Girl	10-12	25	2350
Man	20-39	54	2916
Woman	20-39	47	2209
Man	40-49	54	2360
Woman	40-49	47	<u>1786</u>
TOTAL			15581

Protein Requirement

The Thai recommendation for protein requirement (Division of Nutrition, 1973) and FAO/WHO (1973) safe levels of protein intake were compared as shown in Table 9.2. The Thai recommendation is based on a protein requirement per kg body weight. The FAO/WHO (1973) safe levels of protein intake are given in terms of the reference proteins, egg and milk. It was proposed that 0.57g of egg protein per kg body weight would be sufficient to meet the needs of nearly all (97.5%) of normal adults with generous calorie intakes. These safe levels are significantly lower than previously recommended allowances (FAO 1957, 1965) and also are inadequate for long term maintenance of the healthy, young adult man when energy intake is wholly adequate or even excessive (Schimshaw, 1977). Inoue et al. (1973) found that when energy intake was sufficient, the protein requirement for young Japanese men to maintain apparent nitrogen balance was 0.65g egg protein and when energy intake was in excess only 0.42g/kg of egg protein was required.

Table 9.2: Comparison of Protein Requirement from Thai Recommendation and FAO/WHO (1973) Recommendation

			<u>THAI</u>	<u>FAO/WHO (1973)</u>		
			g/kg	g	g/kg	g
		Body Weight kg				
Child	1-3	10	1.7	17	1.19	16
Boy	10-12	25	1.28	32	0.81	30
Girl	10-12	25	1.28	32	0.76	29
Man	20-39	54	1	54	0.57	30.78
Woman	20-39	47	1	47	0.52	24.44
Man	40-49	54	1	54	0.57	30.78
Woman	40-49	47	1	47	0.52	24.44
TOTAL REQUIREMENT					283	185.44

The FAO/WHO (1975) suggested that the estimation of dietary protein would be as follows:

$$\text{Safe level of egg and milk} \times \frac{100}{\text{Amino acid score}} \times \frac{100}{\text{Digestibility}}$$

In the Northeastern diet, which consists largely of cereals and vegetables, if amino acid score was estimated to be 80% and digestibility of such a diet as 85% the dietary protein required for a family of 7 persons would be only 273 g protein. This figure was still lower than the Thai recommendation. Therefore the Thai recommendation of 283g was used as a basis for designing protein requirement for a Northeastern family. It was decided that the protein requirement should be in the form of digestible protein and the minimum requirement should also be set at 283g. These would allow for adequate protein intake for a family.

Amino Acid Pattern

In 1971, FAO/WHO Committee recommended a new amino acid reference pattern (FAO/WHO 1973) in which the quality of a protein may be estimated from the amino acid composition as compared with the reference pattern of amino acid (Table 9.3). FAO/WHO (1975) reported experience with the new amino acid reference pattern had shown that protein scores calculated as recommended by the 1971 Committee were consistently higher than were those based upon either the whole egg pattern proposed by the 1963 committee (FAO/WHO, 1965) or the reference pattern suggested in 1957 (FAO, 1957). Such new evidence as was available indicated that the new pattern was satisfactory. Thus the FAO/WHO (1973) recommendation was used in the linear programming model and minimum requirement of amino acid score was set at 80.

Table 9.3: Reference Pattern of Amino Acid (FAO/WHO, 1973)

Amino Acid	Suggested Level mg/g of Protein
Isoleucine	40
Leucine	70
Lysine	55
Methionine + cystine	35
Phenylalanine + tyrosine	60
Threonine	40
Tryptophane	10
Valine	50
TOTAL	360

Protein-Energy Ratio

Energy intake affects protein utilization and metabolism in two ways. First, there is a general interrelationship between level of energy intake and nitrogen balance, so that some reduction in energy intake below requirement results in a low body protein in the adult or a reduction in growth rate of the young. In addition, a severe reduction in energy intake impairs the utilization of protein added to the diet. When energy intakes are deficient, part of the dietary protein is used to provide energy (FAO/WHO, 1973). In planning a diet for the Northeastern villagers where most of the population had been reported to have protein-energy malnutrition, protein-energy ratio - the proportion of energy supplied by total protein needed to be considered together.

FAO/WHO (1973) had made no recommendation concerning safe or desirable protein-energy ratio in a diet, as there was no evidence to indicate whether protein and energy requirements correlated. There are a variety of ways in which the protein-energy ratio has been calculated. The predictions of safe ratios by Beaton and Swiss (1974) could be used as a basis for designing a minimum limit on the protein-energy ratio for the Northeastern diet. They published predictions of a "safe" ratio based upon the energy and protein requirements estimates published in the FAO/WHO (1973) report and taking into account variability of requirements for protein and for energy and the estimated correlation between them. For diets having a protein utilization value of approximately 70% relative to that of egg and milk, they predicted that the needs of all but 2.5% of individuals the energy supplied by protein would be 8-12% of the dietary energy.

Based on their predictions of "safe" ratios, the average "safe" protein-energy ratio would range from 7.96 to 11.29% as shown in Table 9.4. They reported a coefficient of variation of protein as percent of total calories for North America 15%. No data was found relevant to developing countries, but a staple cereal diet with protein rich foods consumed in varying quantities could yield a high coefficient. If a coefficient of variation of approximately 20% was estimated for the Northeastern population the safe protein-energy ratio of 9.69% would be needed. Thus the minimum limit of protein/calorie ratio of 10% was set for the nutrient requirements in the linear programming.

Table 9.4: Prediction of "Safe" Protein-Energy Ratio Based on Beaton and Swiss (1974)

Protein with Utilization 70% that of Milk or Egg Protein to Cover all but 2.5% of Individual				
Family Composition	Coefficients of Variation of Dietary Protein Concentration			
	10	15	20	25
Children 1-3	7.50	8.16	9.14	10.94
Boy 10-12	7.56	8.21	9.20	10.69
Girl 10-12	7.56	8.21	9.20	10.69
Man 20-39	8.27	8.97	10.07	11.69
Woman 20-39	8.27	8.97	10.07	11.69
Man 40-49	8.27	8.97	10.07	11.69
Woman 40-49	8.27	8.97	10.07	11.69
AVERAGE	7.96	8.64	9.69	11.29

Fat requirement

FAO (1980) suggested a level of dietary fat for the developing countries of 15 to 20% of energy was adequate for essential fatty acids. Although many physically active individuals appear to tolerate diets containing more than 40% of the dietary energy as fat with no apparent health problems, it is recommended that the upper limit for dietary fat be 30-35% of energy. The recommendation of dietary fat for United States population was 35% of total energy (Alfin-Stater, 1975), for the Netherlands was 30-40% of total energy, 10-12% as linoleic acid, (Schaik, 1975), for Sweden 25-35% of total calorie and for Germany, 30-33% of total calorie (Second European Nutrition Conference, 1977). Davidson and Passmore (1975) recommended that at least 20% of total energy should be obtained from fat. Based on these data, it was designed that the minimum level of fat in the menu be 20% of total energy and the maximum level should be 35% of total energy.

Dietary fibre requirement

In recent years there has been a renewed interest in "dietary fibre" and its relation to human health. It is apparent that populations where diets are relatively "fibre deficient", have shown higher incidence of diseases such as colon cancer, diverticular disease of the colon, diabetic and certain forms of coronary artery diseases etc., than the population consuming "fibre rich diets". There are large numbers of investigations on plant fibre in both clinical and nutritional areas and results concluded that higher (but not excess) dietary fibre intake could help in the prevention of these diseases. It was also recognised that the crude designations of "fibre" or "indigestible CHO" depends on the types of foods consumed. The data applicable to a population consuming particular plant fibrous material may not apply to populations consuming other kinds of plant fibrous material. (Trowell, 1976; Southgate, 1977, and Spiller et al, 1978). There seemed to be evidence that there is a relationship of excess dietary fibre intake with mineral balance (calcium, magnesium, zinc and phosphorus) in the diet (Ismail-Beigi et al, 1977).

There was no agreement on the recommendations for minimum requirement or maximum limit of dietary fibre in the diet, but there are many individual investigations which would suggest the optimum intake of dietary fibre. Painter et al (1972) found that by adding 12-14 g of bran to the patient's diet, they could restore 62 patients out of 70 who suffered from diverticular disease. Various studies also added wheat bran in the quantity of 16-20 g (Eastwood et al, 1973, 1974; Finlay et al, 1974). Spiller et al (1977 and 1978) suggested the dietary intake equal to or greater than the faecal weight of 140-150 g per day. McConnell et al (1974) found the influence of water capacity of vegetable dietary fibre on bowel function; they reported the water holding capacity of bran, mango, carrot and apple as 447, 312, 208 and 177 g per 100 g material, and found cereal fibre is better in increasing faecal excretion than the other fibre. It was Southgate (1973) and Southgate et al (1976) who converted the fibre intake reported in the past into dietary fibre. It was found that the dietary intake of British adults was equivalent to 10.5 g dietary fibre and of children, 6-7 g dietary fibre; 2 g cereal fibre was equivalent to 6 g dietary fibre and 20 g wheat bran was equivalent to 5.34g dietary fibre. With this conversion, the minimum level of dietary fibre in an adult and a children could be derived. The minimum level should be the level of dietary fibre in an ordinary British diet plus 2 g cereal fibre or 20 g wheat bran - this resulted in approximately 17 g dietary fibre for an adult, 12 g for children and 6 g for small children. These figures agreed with the figures that Cummings et al (1976) and Southgate and Durmin (1970) planned for control of the diet in their experiments in which the dietary fibre levels were 17 and 16.16g respectively.

The maximum dietary limit was based on the result found by Branch et al (1975). They used the diet containing large quantities of fruit and vegetables of Southgate and Durmin (1970) which contained 41.89 g dietary fibre and found that such diet bound approximately 360 mg dietary calcium per day. The level of 42 g of dietary fibre per day was then used for maximum limit of dietary requirement for an adult. Based on the minimum limit and maximum limit of dietary fibre decided for an adult requirement per day of 17 and 42 g, a factor of 2.5 was used to design the maximum limit for children and small children as shown in Table 9.5. The total minimum requirement and maximum limit of dietary fibre for a family of 7 persons was 98 and 243 g respectively.

Table 9.5: The Design of a Dietary Fibre Requirement for a Family Of 7 Persons

	Minimum Requirement	Maximum Requirement
	g per person per day	
Child 1-3	6	15
Boy 10-12	12	30
Girl 10-12	12	30
Man 20-39	17	42
Woman 20-39	17	42
Man 40-49	17	42
Woman 40-49	17	42
Total	<u>98</u>	<u>243</u>

Mineral requirements

Three recommendations for the calcium requirement were considered: Thai recommendation (Division of Nutrition, 1973), FAO (1962) and RDA 1974 (Food and Nutrition Board, 1974). Thai and FAO (1962) are similar; 400-500 mg was recommended for an adult. RDA 1974 recommended a calcium requirement higher than Thai and FAO (1962). For an American citizen who consumes a high protein diet, the level of 800 mg was recommended; since high protein intake tends to increase dietary calcium requirement. This recommended level was too high for the Northeastern Thai whose diet was low in milk and animal protein. The Thai recommendation was used and the calcium requirements for each member of the family are shown in Table 20. The total family requirement of 3400 mg per day was used for the minimum requirement. There was no recommendation for the maximum limit, a level of 1500 mg calcium per capita for all ages as designed by Anderson (1975) was used for maximum limit, i.e. a total of 10,500 mg per day. This maximum limit for calcium was needed as excess calcium excretion could cause bladder stone disease.

The requirements for phosphorus were the same as the calcium requirement and are shown in Table 9.6. Maximum limit of phosphorus was not set in the linear programming. RDA 1974 (Food and Nutrition Board, 1974) recommended calcium/ phosphorus ratio of one to one for adults and adolescents. This ratio was used as a constraint in the linear programming model.

Table 9.6: Minimum Requirement for Calcium and Phosphorus Use in Menu Planning

	Calcium Requirement	Phosphorus Requirement
	mg per day	
Child 1-3	400	400
Boy 10-12	600	600
Girl 10-12	600	600
Man 20-39	500	500
Woman 20-39	400	400
Man 40-49	500	500
Woman 40-49	<u>400</u>	<u>400</u>
Total	<u>3400</u>	<u>3400</u>

FAO/WHO (1970) recommended certain daily intakes of iron. In 1972 the WHO group of experts on nutritional anemias reconsidered these figures but did not alter the recommendation as there was insufficient evidence to justify the change. The FAO/WHO (1970) recommendation based the recommended intake of iron on estimates of physiological losses of iron from the body and of increments in body iron during growth. The recommended intakes were also derived from the estimates of daily amounts of iron that should be absorbed from 3 types of diet: high, medium and low content of animal foods. Based on FAO/WHO (1970) recommendation of iron requirement, the iron requirement for each member of family was derived as shown in Table 9.7 and this figure was compared with the Thai 1973 recommendation. The Thai recommendation was lower. The higher level was preferred as iron deficiency anemia is one of the important nutritional problems in the Northeast. The calculated iron requirement based on FAO/WHO (1970) was then used for a minimum limit in the menu planning. There was no maximum limit required.

Table 9.7: Comparison of Iron Requirement Based on FAO/WHO (1970) and Thai Recommendation

	FAO/WHO (1970)		Thai Recommendation
	Absorbed Iron* required (mg)	Recommended** Intake (mg)	Intake
Boy 10-12	1.0	10	4
Girl 10-12	1.0	10	8
Man 20-29	.756	7.56	6
Woman 20-29	2.658	26.58	16
Man 40-49	.756	7.56	6
Woman 40-49	2.658	<u>26.58</u>	<u>16</u>
Total		<u>98.28</u>	<u>64</u>

* Absorbed iron from diet contain less than 10% of calories from foods of animal origin.

** Assumed upper limit of iron absorption by normal individual of 10%.

Vitamin A requirement

Vitamin A deficiency is one of the seven important nutritional problems in Thailand especially in the Northeast. But excessive intake of vitamin A is toxic to both children and adults. RDA 1974 (Food and Nutrition Board, 1974) reviewed various studies and concluded that 500-600 mg of retinol (1666-2000 IU) or twice as much -carotene, is minimum requirement for adults to maintain an adequate blood concentration and to prevent all deficiency symptoms. Since animal studies have shown that little storage of Vitamin A occurs at intakes minimal for growth, a recommended daily allowance in excess of the requirement is considered desirable. RDA (1974) recommended 1000 retinol equivalent or 5000 IU for an adult man and because of the smaller body size of women, the recommendation for adult women was 800 retinol equivalent (4000 IU). The FAO/WHO (1967) estimation of vitamin A requirements had been made "per adult man or woman" or per kilogram of body weight. The recommendations of vitamin A intake for adult man and woman are 750 mg retinol or 12/mg per kg body weight. The Thai recommendation was based on the FAO/WHO (1967) recommendation but

transferred into IU units. The Thai recommendation was preferred, as the average Thai food composition for vitamin A has been reported in IU units. The minimum vitamin A requirements for each member of a family are shown in Table 9.8 and the total minimum requirement set in linear programming was 14650 IU.

Table 9.8: Minimum Vitamin A Requirement

	I U
Child 1-3	850
Boy 10-12	1900
Girl 10-12	1900
Man 20-31	2500
Woman 20-31	2500
Man 40-49	2500
Woman 40-49	<u>2500</u>
Total	<u>14650</u>

Water-soluble vitamins requirement

Vitamin C requirement for family of 7 persons derived from Thai recommendation 1970 (Division of Nutrition, 1970), FAO/WHO (1970) recommendation and RDA 1974 recommendation (Food and Nutrition Board, 1974) were compared (Table 9.9). The requirement derived from RDA 1974 was higher than Thai and FAO/WHO (1970) recommendation and perhaps the most suitable. Evidence has been presented and confirmed that a daily intake of 10 mg of Vitamin C is sufficient to alleviate and cure the clinical signs of scurvy in human subjects. This amount however, may not be satisfactory for the maintenance of optimal health over long periods of time. It has been indicated that an intake of 30 mg/day is sufficient to replenish the quantity of Vitamin C metabolised daily. An intake of 45 mg/day will maintain an adequate body pool of 1500 mg (FAO/WHO, 1970). Therefore a minimum limit was set for a family of 300 mg/day. A maximum limit was not necessary to be set for the Vitamin C requirement.

Table 9.9: Comparison of Vitamin C Requirement Derived from Thai FAO, and RDA Recommendations

	Thai 1970	FAO 1970	RDA 1970
	mg/day		
Child 1-5	20	20	40
Boy 10-12	20	20	40
Girl 10-12	20	20	40
Man 20-39	30	30	45
Woman 20-39	30	30	45
Man 40-49	30	30	45
Woman 40-49	<u>30</u>	<u>30</u>	<u>45</u>
Total	<u>180</u>	<u>180</u>	<u>300</u>

FAO/WHO (1967) recommendation was used for the minimum requirement for thiamine, riboflavin and niacin. Thiamine, riboflavin and niacin intakes are expressed in terms of calorie intake and are 0.4 mg, 0.55

mg and 6.6 mg respectively per 1000 kcal. Total minimum intake for a family therefore was determined by total energy intake of the family. The minimum limit for the daily intake set for thiamine, riboflavin and niacin in the linear programming model were 6.23 mg, 8.57 mg and 102.83 mg respectively.

The requirement for vitamin B6 intake is increased with high protein diet and with age. RDA 1974 recommended allowance for adults has been set at 2 mg/day (Food and Nutrition Board, 1974). There was no recommendation from other sources so the RDA 1974 recommendation was used. The vitamin B6 requirement for each member of the family is shown in Table 9.10 with the total minimum limit of 11.4 mg/day.

FAO/WHO (1970) has recommended vitamin B12 intake for infants 0-12 months of 0.3 mg, children 1-3 years, 0.9 mg, children 4-9 years, 1.5 mg, adolescents and adults aged 10 years and over 2.0 mg, pregnant women 3.0 mg and lactating women 2.5 mg. Although the WHO group of experts on nutritional anemia (WHO, 1972) thought that these amounts were greater than the minimum requirements for health, there was no adequate new information to justify any change in the recommendation. The vitamin B12 requirement for each member of a family are shown in Table 9.10. The minimum limit of 12.9 mg was set.

FAO/WHO (1970) recommended daily intake of folic acid as in the form of "free" folate. Later (1972) had revised the recommendation and presented it as "total folate". FAO/WHO (1970) and WHO (1972) the total minimum requirement of folic acid for a family of 7 persons was 1100 mg free folate or 2200 mg total folate/day. The individual member requirements are shown in Table 9.10.

There was no recommendation for the requirement of pantothenic acid except for the suggestion of Food and Nutrition Board (1974) for a daily intake of 5-10 mg for all adults; the upper limit is suggested for pregnant and lactating women. Anderson (1975) has estimated the minimum requirement for pantothenic acid for a Thai and his estimation was used for calculating the minimum requirement for a family of 7 persons as shown in Table 9.10. The total minimum requirement of pantothenic acid was 47 mg/day.

Table 9.10: Vitamin B6, Vitamin B12, Folic Acid and Pantothenic Acid Requirement

	Vit.B6	Vit.B12	Free Folate	Total Folate	Pantothenic Acid
	mg/day	mg/day	mg/day	mg/day	mg/day
Child 1-3	0.6	0.9	100	200	3
Boy 10-12	1.4	2.0	100	200	6
Girl 10-12	1.4	2.0	100	200	6
Man 20-39	2.0	2.0	200	400	8
Woman 20-39	2.0	2.0	200	400	8
Man 40-49	2.0	2.0	200	400	8
Woman 40-49	<u>2.0</u>	<u>2.0</u>	<u>200</u>	<u>400</u>	<u>8</u>
Total	<u>11.4</u>	<u>12.9</u>	<u>1100</u>	<u>2200</u>	<u>47</u>

Reference: See reference section.

APPENDIX 10: SURVEY OF FREQUENCY OF EATING WEEKLY FOODS AND
"PREFERENCE" MEAL PATTERN FOR MENU PLANNING

The survey of frequency of eating of 70 commonly eaten food dishes, fruits and vegetables and on preference of food chosen for different meals were conducted in two villages, Ban Koksri and Ban Maung. Twenty eight villagers were asked to choose food for breakfast, lunch and dinner and to indicate how frequently they would have consumed in a week each of the 70 foods listed to them. Results obtained were used for determining the "preference" meal pattern and for planning food for menu selection.

Frequency of Eating of Food Dishes, Fruits and Vegetables

(no. of days per week)

Dry Main Dish	Commonly Eaten Food Dishes	
	liquid Main Dishes	Sauces
Fermented fish, whole	2 Kang chicken	3 Chilli in fermented fish sauce
Fried beef	2 Kang fish	4 fish sauce
Fried fish	3 Kang bamboo shoot	3 Chilli in fish sauce
Larb beef	2 Kang mushroom	3 Namprig fish
Larb fish	2 toum beef	2 Namprig shrimp
Roasted beef	4 Toum fish	4 paste
Roasted chicken	4 Fruits	Namprig whole fermented fish
Roasted fish	4 Banana	5
Roasted fish in banana leaf	2 Custard apple	6 Namprig fermented fish
Roasted frog in banana leaf	Guava	3
Roasted small toad	2 Water melon	3
Somtam papaya	Mango	6
Soop bamboo shoot		
Steamed fish		
<u>Vegetables</u>		
Bamboo shoot	3 Cucumber	5 Leaf mustard
Chinese cabbage	5 Egg plant	4 Neem
Corkwood leaf	2 Gourd, ivy	3 Spring onion
Coriander leaf	3 Lead tree leaf	5 Water convolvulus
		4
<u>Cowpea Dishes</u>		
<u>Main Dishes</u>		<u>Snacks and Desserts</u>
Cowpea and fermented fish hot sauce	5	Cowpea and sago pudding
Cowpea and fish hot sauce	3	Cowpea boiled in syrup
Cowpea and pumpkin hot soup	2	Cowpea paste coated with egg yolk
Cowpea curry	2	Cowpea pudding
Cowpea sprout curry	2	Cowpea sweet paste
Fried pork and cowpea ball	3	Cowpea wrapped in glutinous rice dough
Pumpkin and cowpeas spice soup	3	Fried banana coated with cowpea batter
Seasoned grated bamboo shoot and cowpeas	3	Fried cowpea
Seasoned mashed cowpea	2	Fried cowpea crust
Seasoned minced beef and cowpea	3	Fried cowpea paste
Seasoned minced fish and cowpea	2	Steamed glutinous rice stuffed with cowpeas
Steamed cowpeas and bamboo shoot	2	Steamed sago stuffed with cowpea
Steamed fish, cowpeas and bamboo shoot	2	

Preference of Food Chosen for Breakfast, Lunch and Dinner

BREAKFAST		LUNCH		DINNER	
<u>Kind of Food</u>	<u>No. of Families Choosing</u>	<u>Kind of Food</u>	<u>No. of Families Choosing</u>	<u>Kind of Food</u>	<u>No. of Families Choosing</u>
<u>DRY MAIN DISHES</u>					
LARB BEEF	4	SOMTAM PAPA YA	21	LARB BEEF	6
LARB FISH	3	ROASTED CHICKEN	8	FRIED FISH	5
FRIED FISH	3	ROASTED BEEF	3	STEAMED FISH	3
FERMENTED FISH	2	STEAMED FISH	3	SOOP BAMBOO SHOOT	2
ROASTED BEEF	2	ROASTED FISH	2	ROASTED FISH	2
ROASTED CHICKEN	2	FERMENTED FISH	2	ROASTED CHICKEN	2
ROASTED FROG IN BANANA LEAF	1	ROASTED FROG IN BANANA LEAF	1	SOMTAM PAPA YA	2
ROASTED FISH IN BANANA LEAF	1	LARB FISH	1	LARB BEEF	1
SOMTAM PAPA YA	1	FRIED FISH	1	ROASTED BEEF	1
TOTAL	<u>19</u>		<u>42</u>		<u>24</u>
<u>LIQUID MAIN DISHES</u>					
KANG FISH	8	KANG MUSHROOM	2	KANG CHICKEN	5
TOUM FISH	5	TOOM FISH	2	KANG BAMBOOSHOOT	5
TOUM CHICKEN	4	TOUM CHICKEN	2	KANG BEEF	4
KANG HOT SOUP	3	KANG HOT SOUP	2	KANG FISH	4
KANG BEEF	2	KANG CHICKEN	2	KANG MUSHROOM	4
KANG CHICKEN	2	KANG BEEF	1	AOM BEEF	3
TOUM BEEF	2	TOUM BEEF	1	TOUM FISH	2
KANG BAMBOOSHOOT	2	KANG BAMBOOSHOOT	1	TOUM BEEF	2
AOM BEEF	1	AOM BEEF	1	TOUM VISCERAL BEEF	2
TOUM VISCERAL BEEF	1	TOUM VISCERAL BEEF	1	KANG HOT SOUP	2
TOTAL	<u>30</u>	KANG FISH	<u>16</u>		<u>33</u>
<u>SAUCES</u>					
NAMPRIG WHOLE FERMENTED FISH	7	NAMPRIG FERMENTED FISH	3	NAMPRIG WHOLE FERMENTED FISH	9
NAMPRIG FISH	5	NAMPRIG FISH	3	NAMPRIG FERMENTED	4
CHILLI IN FISH SAUCE	4	NAMPRIG WHOLE FER.FISH	2	NAMPRIG SHRIMP PASTE	2
NAMPRIG SHRIMP PASTE	2	NAMPRIG SHRIMP PASTE	2	NAMPRIG FERMENTED FISH	1
NAMPRIG FERMENTED FISH	1			FISH SAUCE	1
TOTAL	<u>19</u>		<u>10</u>		<u>17</u>
<u>VEGETABLES</u>					
CHINESE CABBAGE	5	LEAD TREE YOUNG LEAF	9	CHINESE CABBAGE	6
YARD LONG BEAN	5	WATER CONVOLVULUS	7	CABBAGE	5
EGG PLANT	4	CHINESE CABBAGE	4	ACACIA	4
CUCUMBER	4	WING BEAN	4	WATER CONVOLVULUS	2
WATER CONVOLVULUS	3	EGG PLANT	3	CUCUMBER	2
LEAD TREE YOUNG LEAF	2	BAMBOOSHOOT BOIL	2	NEEM	2
BAMBOOSHOOT BOIL	2	SPRING ONION	2	CAULIFLOWER	2
				CORKWOOD FLOWER	2

WATER FERN	2	NEEM	2	MUNG BEANSPROUT	2
PUMPKIN SHOOT	2	WATER FERN	2	YARD LONG BEAN	2
IVY GOURD	1	LETTUCE	2	WING BEAN	2
NEEM	1	CAULIFLOWER	2	PUMPKIN SHOOT	2
CABBAGE	1	YARD LONG BEAN	2	EGG PLANT	1
AMARANTH BAYAM	1	PUMPKIN SHOOT	2	BAMBOOSHOOT BOIL	1
ACACIA	1	GOURD SPONG	2	IVY GOURD	1
CAULIFLOWER	1	WATER MIMOSA	2	SPRING ONION	1
MUNG BEAN SPROUT	1	IVY GOURD	1	WATER FERN	1
WING BEAN	1	CABBAGE	1	CORKWOOD YOUNG	
COWPEA YOUNG POD	1	MALABAR NIGHTSHADE	1	YOUNG LEAF	1
WATER MIMOSA	1	CORKWOOD FLOWER	1	LETTUCE	1
		COWPEA YOUNG POD	1	GOURD SNAKE	1
				COWPEA YOUNG POD	1
				WATER MIMOSA	1
TOTAL	<u>39</u>		<u>52</u>		<u>43</u>

FRUIT

BANANA	9	WATERMELON	9	BANANA	9
WATERMELON	8	CUSTARD APPLE	4	WATERMELON	7
CUSTARD APPLE	4	MUSK MELON	4	MUSK MELON	3
PAPAYA	3	BANANA	4	CUSTARD APPLE	1
GUAVA	2	GUA VA	1		
		PAPAYA	1		
TOTAL	<u>26</u>		<u>23</u>		<u>23</u>

APPENDIX 11: COMPUTER INPUTS AND SOLUTION

11.A Nutrient Requirement Interrelationship Input in Linear and Mixed Integer Programming Models for Menu Planning

<u>Nutrient Relationship</u>	<u>Interrelationship Expression</u>
Protein energy ratio, 10%	$PROT - 0.10 CAL = PROCAL \geq 0$
Fat, 20% energy	$9.0 FAT - 0.2 CAL = LOFAT \geq 0$
35% energy	$9.0 FAT - 0.35 CAL = HIFAT \geq 0$
CA:P, $\frac{P}{Ca} = 1$	$1.0 P - 1.0 CAL = PCON = 0$
, $\frac{P}{Ca} = 0.8$	$1.0 P - 0.8 CAL = PCONLO \geq 0$
, $\frac{P}{Ca} = 2.5$	$1.0 P - 2.5 CA = PCONHI \leq 0$
Thiamine, 0.4 mg/1000 cal	$1.0 THAI - 0.0004 CAL = LOTHAI \geq 0$
Riboflavin, 0.55 mg/1000 cal	$1.0 RIBO - 0.00055 CAL = LORIBO \geq 0$
Niacine, 6.6 mg/1000 cal	$1.0 NIA - 0.0066 CAL = LONIA \geq 0$
Isoleucine, 32 mg/g protein	$1.0 ISO - 32.0 PROT = CISO \geq 0$
Leucine, 56 mg/g protein	$1.0 LEU - 56.0 PROT = CLEO \geq 0$
Lysine, 44 mg/g protein	$1.0 LYS - 44.0 PROT = CLYS \geq 0$
Methionine 28 mg/g protein	$1.0 METHCYS - 28.0 PROT = CMETHCYS \geq 0$
+ cystine	
Phenylalanine 48mg/g protein	$1.0 PHETYR - 48.0 PROT = CPHETYR \geq 0$
+ tyrosine	
Threonine, 32 mg/g protein	$1.0 THREO - 8.0 PROT = CTHREO \geq 0$
Tryptophane, 8 mg/g protein	$1.0 TRYP - 8.0 PROT = CTRYP \geq 0$
Valine, 40 mg/g protein	$1.0 VAL - 40.0 PROT = CVAL \geq 0$

Example 1: Protein-Energy Ratio:

where $\frac{\text{Prot-Energy}}{\text{Energy}} \geq 10\%$

and requirement of protein $\geq 283g$ requirement of energy ≥ 15580 kcal

therefore $PROT = \sum a_{ij} k_j \geq 283$

and for the protein-calorie ratio:

$$\frac{4PROT}{CAL} \geq 0.10$$

$$4PROT > 0.10 CAL$$

$$4PROT - 0.10 CAL \geq 0$$

Define and $4PROT - 0.10 CAL = PROT/CAL \geq 0$
 $PROT/CAL = PROCAL$

PROT	PROCAL	4.0
CAL	PROCAL	-0.1

Thus PROT and CAL were in ROWS and COLUMNS, TEMPO would not automatically transpose ROW-PROT, COLUMN-PROT and this had to be defined in the COLUMN section at the data input. Two cards were required:

PROT	PROT	-0.1
CAL	CAL	-1.0

In the situation of protein requirement:

$$\begin{array}{c} \text{PROT} = \sum a_{ij} k_j - \text{PROT} = 0 \\ \uparrow \qquad \qquad \qquad \uparrow \\ \text{ROW} \qquad \qquad \qquad \text{COLUMN} \end{array}$$

PROT in the ROW no longer has a constraint of ≥ 283 but in fact should be zero. It was PROT in the COLUMNS which should be ≥ 283 . Cards then were prepared for input as:

```

ROWS
  E CAL
  E PROT
  G PROCAL
COLUMNS
  CAL          CAL          -1.0
  CAL          PROCAL       -0.1
  PRO          PRO          -1.0
  PRO          PROCAL       4.0
BOUNDS
  LO BNDST    CAL          15580.0
  LO BNDST    PROT         283.0

```

Example 2: Amino Acid Requirement - Isoleucine

It was required that 1 g protein should contain not less than 32 mg isoleucine.

```

thus:          ISO  ≥  32  PROT
define         CISO  =  ISO > 32 PROT
              CISO  =  ISO - 32 prot ≥ 0

```

cards required

```

  ISO          CISO          1.0
  PROT         CISO         -66.0

```

and cards need to change ROW to COLUMNS

```

  ISO          ISO          -1.0

```

cards input arranged as:

```

ROWS
  E ISO
  G CISO
COLUMNS
  PRO          CISO         -66.0
  ISO          CISO          1.0
  ISO          ISO          -1.0

```

In TEMPO, cards in COLUMNS section of the same name had to group together e.g. cards beginning with PROT in Example 1 and PROT in example 2 had to be grouped together in the COLUMNS input section.

11.B Limit Quantity of Food Dishes, Fruits and Vegetables Input in Menu Planning by Linear and Mixed Integer Programming

Only upper limit quantity of food dishes, fruits and vegetables were used in menu planning by linear programming (Table 11.1) and both lower limit and upper limit quantity of food dishes, fruits and vegetables were used in menu planning by mixed integer programming (Table 11.2).

TABLE 11.2 Lower and Upper Limits Quantity of Food Dishes, Fruit and Vegetables Used in Menu Planning by Mixed Integer Programming
(Quantity of 5 times and 7 times quantity consumed by adult man, quantity in g)

Commonly Eaten Food Dishes						Cowpea Dishes													
<u>Dry Main Dishes</u>		L.L.	U.L.	<u>Liquid Main Dishes</u>		L.L.	U.L.	<u>Vegetables</u>		L.L.	U.L.	<u>Main Dishes</u>		L.L.	U.L.	<u>Snacks & Desserts</u>		L.L.	U.L.
Fermented fish, whole	55	80	Bamboo shoot hot soup	1150	1610	Bamboo shoot, boil	400	560	Chinese cabbage	225	315	Cowpea & fermented fish hot sauce	55	80	Cowpeas & sago pudding	650	910		
Fried beef	250	350	Beef soup	1250	1750	Corkwood leaf	150	210	Coriander leaf	75	105	Cowpea & fish hot sauce	275	385	Cowpea boiled in syrup	650	910		
Fried fish	350	490	Chicken hot soup	1150	1610	Cucumber	750	1050	Egg plant	300	420	Cowpeas & pumpkin hot soup	700	980	Cowpea paste coated with egg yolk	300	420		
Papaya salad	725	1015	Fish hot soup	1250	1750	Gourd, ivy	150	210	Leadtree leaf	100	140	Cowpea curry	500	700	Cowpea pudding	750	1050		
Roasted beef	250	350	Fish soup	1150	1610	Leaf mustard	250	350	Neem	150	210	Cowpea sprout curry	725	1015	Cowpea sweet paste	500	700		
Roasted chicken	400	560	Mushroom hot soup	1150	1610	Spring onion	125	175	Water convolvulus	250	350	Fried pork & cowpea ball	275	385	Cowpeas wrapped in glutinous rice dough	600	840		
Roasted fish	350	490			Waterfern	50	70					Pumpkin & cowpeas spice soup	600	840	Fried banana coated with cowpea batter	375	525		
Roasted fish in banana leaf	575	805										Seasoned grated bamboo shoot & cowpeas	575	805	Fried cowpeas	200	280		
Roasted frog in banana leaf	225	315										Seasoned mashed cowpea	400	560	Fried cowpea crust	300	420		
Roasted small toad	225	315										Seasoned minced beef & cowpeas	425	595	Fried cowpea paste	375	525		
Seasoned grated bamboo shoot	575	805										Seasoned minced fish & cowpeas	325	455	Steamed glutinous rice stuffed with cowpeas	300	420		
Seasoned minced beef	425	595										Steamed cowpeas & bamboo shoot	350	490	Steamed sago stuffed with cowpeas	250	350		
Seasoned minced fish	325	455																	
Steamed fish	350	490																	
<u>Sauces</u>		L.L.	U.L.	<u>Fruits</u>		L.L.	U.L.												
Chilli in fermented fish sauce	30	40	Banana	500	700														
Chilli in fish sauce	40	55	Custard apple	250	350														
Fermented fish hot sauce	125	175	Guava	500	700														
Fish hot sauce	275	385	Watermelon	750	1050														
Shrimpaste hot sauce	100	140	Mango	250	350														
Whole fermented fish hot sauce	55	80																	

L.L. - Lower Limit, U.L. - Upper Limit

11.C Running of Mixed Integer Programming

Schemes for menu structure planning a first day menu in "survey" and "preference" meal pattern are shown in Table 11.3. The revised input data for planning 7 days menus are shown in Table 11.4

The parameter used in running the mixed integer programming are described as follows:

ZALPHA	All integer solutions within ZALPHA of the linear programming optimum are output.
ZJUST	Mixed integer programming terminates after finding ZJUST integer solutions.
ZBIOBJ	For a minimisation problem, nodes with projected objective greater than ABIOBJ are dropped. If a sub-optimal integer solution to the integer program is already known, ZBIOBJ can be set to that value. Use of ZBIOBJ reduces run times.
ZFREQ1	Demand ADOFQ1 is set at iteration intervals ZFREQ1. A mixed integer iteration consists of a branching and an optimization step.
ZDOFQ1	A demand exists. Interrupt frequency defined in ZFREQ1 is reached then return.

Table 11.3: Schemes for Menu Structure for Planning a First Day Menu in "Survey" and "Preference" Meal Patterns

Food Item	Number Available	Number Required		Menu Structure Planning For	
		"Survey"	"Preference"	"Survey"	"Preference"
Dry main dishes	22	2	3	BDRMDTOT=20	BDRMDTOT=19
Liquid main dishes	10	2	3	BKANGTOT= 8	BKANGTOT= 7
Sauces	8	2	2	BSAUTOT = 6	BSAUTOT = 6
Vegetables	13	3	5	BVEGETOT=10	BVEGETOT= 8
Fruits	5	1	2	BFRUITOT= 4	BFRUITOT= 3
Desserts	12	1	1	BDESTOT =11	BDESTOT =11

Table 11.4: Revised Input Data for Planning Menus for 7 Days by Mixed Integer Programming

	Days1-2	Day 3	Day 4	Day 5	Day 6	Day 7
<u>Number of Food Items</u>	69	66	64	60	57	54
<u>Number of Food Items Removed</u>						
Dried main dishes	-	2	2	3	4	4
Liquid main dishes	-	1	2	2	4	4
Sauces	-	-	-	1	1	2
Vegetables	-	-	1	2	2	3
Fruits	-	-	-	-	-	1
Desserts	-	-	-	1	1	1
<u>Menu Structure</u>						
Dried main dishes-BDRYMDTOT	20	18	18	17	16	16
Liquid main dishes-BKANGTOT	8	7	6	6	4	4
Sauces-BSAUCTOT	6	6	6	5	5	4
Vegetables-BVEGETOT	10	10	9	8	8	7
Fruits-BFRUITOT	4	4	4	4	4	3
Desserts-BDESTOT	11	11	11	10	10	10
<u>Upper Quantity Limit (x100g)</u>						
Dried main dishes-DRYMDTOT	18.2	18.2	18.2	18.2	18.2	18.2
Liquid main dishes-KANGTOT	35.0	35.0	35.0	35.0	33.6	33.6
Sauces-SAUCETOT	7.7	7.7	7.7	7.7	7.7	7.7
Vegetables-VEGETOT	20.3	20.3	20.3	20.3	20.3	20.3
Fruits-FRUITOT	10.5	10.5	10.5	10.5	10.5	10.5
Desserts-DESTOT	10.5	10.5	10.5	10.5	10.5	10.5

Food Item Removed

- Day 3 Whole fermented fish, fried cowpea sprout and cowpea sprout curry.
- Day 4 Those of Day 3 and mushroom hot soup, and boiled neem.
- Day 5 Those of Days 3,4 and seasoned mashed cowpea, chilli in fish sauce, water convolvulus and steamed sago stuffed with cowpea.
- Day 6 Those of Days 3,4,5 and fried beef, toum beef, and pumpkin and cowpea spiced soup.
- Day 7 Those of Days 3,4,5,6 and chilli in fermented sauce, boiled corkwood leaves and banana.

11.D Solution of Menu Planning by Mixed Integer Programming

The solution of nutrient content of the 7-Day menu is shown in Table 11.5. The solution of trial runs of mixed integer programming for Day 1 menu planning on "preference" pattern are shown in Table 11.6 and Table 11.7 and for Day 1-5 menu planning on "Survey" pattern are shown in Table 11.8 and Table 11.9. Six solutions of the "preference" pattern were obtained from trial runs as follows:

- A. Running with no upper bound of food items:
 - A.1 One step running with $ZALPHA = 20$, $ZJUST = 7$
 - A.2 One step running with $ZALPHA = 20$, $ZJUST = 14$
 - A.3 One step running with $ZALPHA = 20$, $ZJUST = 35$
 - A.4 Two steps running with $ZALPHA = 20$, $ZJUST = 7$
and $ZBIOBJ = 75.63579$, $ZJUST = 2$
- B. Running with upper bound on food items:
 - B.1 One step running with $ZALPHA = 20$, $ZJUST = 5$
 - B.2 Two steps running with $ZALPHA = 20$, $ZJUST = 5$
 $ZBIOBJ = 76.07793$, $ZJUST = 5$

The solution of Day 1-5 menus of the survey pattern were obtained from trial runs as follows:

- A. One or several runs for each menu until final optimal solution was obtained.
- B. One step running for each menu with modifier
 $ZALPHA = 20$, $ZJUST = 7$.

TABLE 11.5 Solution of Menu Planning by
Mixed Integer Programming: Nutrient Content

NUTRIENT	7 DAY MENUS					
	Day 1-2	Day 3	Day 4	Day 5	Day 6	Day 7
Energy (kcal)	18713	18138	18317	18636	19880	18177
Protein (g)	467.8	498.5	508.8	496.8	596.0	569.8
Fat (g)	374.3	362.8	366.3	372.7	397.6	363.5
Dietary fibre (g)	230.0	233.9	242.0	214.8	235.6	225.0
Calcium (mg)	4298	3400	3400	3400	3512	3437
Phosphorus (mg)	10746	8142	8443	7759	8781	8593
Iron (mg)	227.3	158.0	129.4	243.8	201.8	112.9
Vitamin A (IU)	54600	54600	54600	54600	54600	54600
Thiamine (mg)	7.49	7.26	7.33	7.45	7.95	7.27
Riboflavin (mg)	10.36	10.01	10.07	10.25	10.93	9.99
Niacine (mg)	149.42	159.28	121.54	123.37	131.21	133.62
Vitamin C (mg)	515	463	905	364	510	854
Vitamin B6 (mg)	32.09	33.72	34.73	38.03	35.44	31.73
Vitamin B12 (µg)	43.36	26.23	20.35	17.20	28.31	29.95
Pantothenic acid (mg)	70.09	73.62	65.83	67.41	68.71	66.81
Folic acid (µg)	1788.9	2515.4	2931.3	1808.4	2566.7	2009.6
Isoleucine (mg)	22106	23200	23479	23461	28904	27619
Leucine (mg)	43042	45810	45808	46341	53537	52257
Lysine (mg)	32480	21935	24256	26246	38609	39049
Methionine (mg)	9124	8576	8149	8306	10446	10917
Cyst (mg)	7111	6583	7180	6931	8369	8068
Phenylalanine (mg)	22780	23054	22310	22691	26506	25192
Tyrosine (mg)	15969	14718	14478	14596	17200	18131
Threonine (mg)	21080	20889	19810	20137	23563	22832
Tryptophane (mg)	11571	10526	10036	9973	11182	10145
Valine (mg)	29725	29901	29021	29724	34480	32187
Protein-energy ratio (%)	10.0	11.0	11.1	10.7	11.5	12.5
Energy from fat (%)	18	18	18	18	18	18
Phosphorus/calcium ratio	2.49	2.39	2.48	2.28	2.50	2.50
Thiamine/energy (mg/1000 kcal)	.0004	.0004	.0004	.0004	.0004	.0004
Riboflavin/energy (mg/1000 kcal)	.00055	.00055	.00055	.00055	.00055	.00055
Niacin/energy (mg/1000 kcal)	.0080	.0088	.0066	.0066	.0066	.0074

TABLE 11.6

Solution of Trial Run of Mixed Integer Programming for Day 1 Menu Planning on "Preference" Pattern: The Menu and Cost

	A.1	A.2/A.3	A.4	B.1	B.2
	g	g	g	g	g
<u>Rice</u>					
RICEGLUS	5100	RICEGLUS 5100	RICEGLUS 5100	RICEGLUS 5100	RICEGLUS 5100
<u>Dry Main Dishes</u>					
FISHFERM	202	FISHFERM 150	FISHFERM 174	FISHFERM 55	FISHFERM 160
FRIEDBF	250	FRIEDBF 250	FRIEDBF 250	ROASTSM 225	FRIEDBF 292
CPADNGOK	500	CPADNGOK 500	CPADNGOK 500	FRIEDBF 288	CPADNGOK 500
<u>Liquid Main Dishes</u>					
KANGMR	1150	KANGMR 1150	KANGMR 1150	KANGMR 1150	KANGMR 1150
CKANGPED	953	CKANGPED 944	CKANGPED 954	CKANGPED 1091	CKANGPED 857
CAOMTOA	700	CAOMTOA 700	CAOMTOA 700	CKANGPA 500	CKANGPA 500
<u>Sauces</u>					
FERMSAU	30	FERMSAU 30	CHIFHSAU 40	FERMSAU 30	FERMSAU 64
CNPPLARA	55	CNPPLARA 55	FERMSAU 30	CNPPLARA 55	CNPPLARA 55
<u>Vegetables</u>					
CABCHIN	225	CABCHIN 225	CABCHIN 225	CABCHIN 225	LEADTREE 100
WATERCON	250	WATERCON 250	WATERCON 250	WATERCON 250	BAMBOSTB 400
CUCUMBER	750	ONIONSPR 125	EGGPLANT 300	CUCUMBER 750	ONIONSPR 125
CORIAN	75	CORIAN 75	CORIAN 75	BNEEM 183	CORIAN 75
BNEEM	248	BNEEM 268	BNEEM 270	BCORKLF 150	BNEEM 357
<u>Fruits</u>					
BANANA	500	CUSAPPLE 250	CUSAPPLE 250	BANANA 590	BANANA 655
GUAVA	500	BANANA 500	BANANA 500	GUAVA 500	WTMELON 750
<u>Desserts</u>					
CSAGOSAI	250	CSAGOSAI 250	CSAGOSAI 250	CSAGOSAI 250	CSAGOSAI 250
TOTAL WEIGHT	11738	10852	11018	11392	11390
COST (BAHTS)	74.09	74.09	74.71	76.08	74.51

RICEGLUS = Steamed glutinous rice
 FISHFERM = Fermented fish (whole)
 FRIEDBF = Fried beef
 CPADNGOK = Fried cowpea sprout
 KANGMR = Mushroom hot soup
 CKANGPED = Cowpea sprout curry
 CAOMTOA = Cowpea and pumpkin hot soup
 FERMSAU = Chilli in fermented fish sauce

CNPPLARA = Cowpea and fermented fish hot sauce
 CABCHIN = Chinese cabbage
 WATERCON = Water convolvulus
 CORIAN = Coriander leaf
 BNEEM = Neem, boiled
 CSAGOSAI = Steamed sago stuffed with cowpea
 ONIONSPR = spring onion

CUSAPPLE = Custard apple
 CHIFHSAU = Chilli in fish sauce
 ROASTSM = Roasted small toad
 CKANGPA = Cowpea curry
 BCORKLF = Corkwood leaf, boiled
 LEADTREE = Leadtree leaf
 BAMBOSTB = Bamboo shoot, boiled
 WTMELON = Water melon

TABLE 11.7

Solution of Trial Runs of Mixed Integer Programming to DAY 1 Menu Planning
on "Preference" Pattern: Nutrient Content

<u>Nutrient</u>	<u>A.1</u>	<u>A.2/A.3</u>	<u>A.4</u>	<u>8.1</u>	<u>8.2</u>
Energy (kcal)	18859	18622	18638	18763	18940
Protein (g)	471.5	465.5	465.9	473.5	473.5
Fat (g)	377.2	372.4	375.8	375.3	378.8
Dietary Fibre (g)	238.5	233.9	231.4	224.5	243
Calcium (mg)	4036	3961	3984	3719	3956
Phosphorus (mg)	10089	9904	9960	9299	9681
Iron (mg)	191.1	189.1	190.5	201.2	191.3
Vitamin A (IU)	52537	54023	52966	54600	53432
Thiamine (mg)	7.61	7.48	7.59	7.52	7.58
Riboflavin (mg)	10.41	10.26	10.33	10.32	10.42
Niacine (mg)	156.00	150.95	153.68	157.96	158.47
Vitamin C (mg)	1291	638	624	1203	434
Vitamin B6 (mg)	33.11	32.87	32.99	33.80	35.37
Vitamin B12 (µg)	31.20	29.73	30.27	22.35	27.55
Pantothenic acid (mg)	74.18	72.03	72.45	75.51	75.54
Folic acid (µg)	2026.4	2071.7	2014.8	1941.3	1730.5
Isoleucine (mg)	21973	21603	21598	21915	23005
Leucine (mg)	43075	42537	42496	42665	43878
Lysine (mg)	28023	27512	27919	26247	28246
Methionine (mg)	8571	8405	8445	8516	8793
Cystine (mg)	6807	6792	6779	6947	7238
Phenylalanine (mg)	22230	21960	21944	21316	22789
Tyrosine (mg)	15129	14896	14997	15110	15360
Threonine (mg)	20209	19957	20187	19317	20597
Tryptophane (mg)	10826	10910	10884	10265	11175
Valine (mg)	29050	28552	18647	28101	29520
Protein energy ratio (%)	10	10	10	10	10
Energy from Fat (%)	18	18	18	18	18
Phosphorus/Calcium Ratio	2.49	2.50	2.49	2.5	2.44
Thiamine/Calorie (mg/1000 kcal)	.0004	.0004	.0004	.0004	.0004
Riboflavin/Calorie (mg/1000 kcal)	.00055	.00055	.00055	.00055	.00055
Niacin/Calorie (mg/1000 kcal)	.0083	.0081	.0082	.0084	.0084

TABLE 11.8 Solution of Trial Runs of Mixed Integer Programming for Day1-5 Menu Planning on "Survey" Pattern: The Menu and Cost

	A. ONE OR SEVERAL RUNS FOR EACH MENU UNTIL FINAL OPTIMAL SOLUTION OBTAINED								B. ONE STEP RUNNING FOR EACH MENU WITH MODIFIER ZALPHA=20: ZJUST=7							
	DAY 1-2		DAY 3		DAY 4		DAY 5		DAY 1-2		DAY 3		DAY 4		DAY 5	
	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	
<u>Rice</u>	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100	RICEGLUS	5100
<u>Dry Main Dishes</u>	FISHFERM	392	FRIEDBF	640	FRIEDBF	605	ROASTBF	250	FISHFERM	361	FRIEDBF	860	FRIEDBF	604	ROASTBF	684
	CPADNGOK	1080	CSOOPTOA	1009	CSOOPTOA	832	FRIEDBF	460	CPADNGOK	1455	CSOOPTOA	726	CSOOPTOA	1009	CMOGMAI	350
<u>Liquid Main Dishes</u>	KANGMR	1150	TOUMBF	1250	TOUMBF	1250	KANGMR	1150	KANGMR	1150	KANGMR	1249	TOUMBF	1316	TOUMBF	1250
	CKANGPED	1121	CKANGFUG	800	CKANGFUG	600	CKANGFUG	731	CKANGPED	1050	CKANGPA	500	CKANGFUG	600	CKANGFUG	600
<u>Sauces</u>	CHIFHSAU	40	CHIFHSAU	40	CHIFHSAU	40	FERMSAU	80	CHIFHSAU	40	CHIFHSAU	96	CHIFHSAU	40	FERMSAU	30
	FERMSAU	30	NPSHRIMP	100	FERMSAU	30	CNPPLARA	55	FERMSAU	30	NPFERFH	138	CNPPLARA	55	CNPPLARA	55
<u>Vegetables</u>	WATERCON	284	WATERCON	310	CABCHIN	927	CABCHIN	240	LEADTREE	100	CABCHIN	225	CABCHIN	889	CABCHIN	320
	CORIAN	75	EGGPLANT	300	WATERCON	409	EGGPLANT	698	CORIAN	75	BNEEM	298	WATERCON	308	EGGPLANT	576
	BNEEM	364	BNEEM	295	EGGPLANT	340	BCORKLF	459	BNEEM	419	WATERFER	63	CORIAN	75	BCORKLF	419
<u>Fruits</u>	BANANA	500	BANANA	500	BANANA	500	BANANA	592	BANANA	668	GUAVA	500	BANANA	620	BANANA	938
<u>Desserts</u>	CSAGOSAI	250	CSAGOSAI	256	CSAGOSAI	250	CKLOYTOD	375	CSAGOSAI	250	BSAGOSAI	250	CSAGOSAI	250	CSAGOBD	685
TOTAL WEIGHT		10386		10594		10883		10190		10698		10005		10866		11007
COST (BAHTS)		64.11		75.07		77.17		75.01		65.75		79.27		77.87		77.63

KEY:

RICEGLUS = Steamed glutinous rice	BNEEM = Neem, boiled	CNPPLARA = Cowpea and fermented fish hot sauce
FISHFERM = Fermented fish (whole)	CSAGOSAI = Steamed sago stuffed with cowpea	BCORKLF = Cork wood leaf, boiled
CPADNGOK = Fried cowpea sprout	FRIEDBF = Fried beef	CKLOYTOD = Fried banana coated with cowpea batter
KANGMR = Mushroom hot soup	CSOOPTOA = Seasoned mashed cowpea	LEADTREE = Lead tree leaf
CKANGPED = Cowpea sprout curry	TOUMBF = Beef soup	CKANGPA = Cowpea curry
CHIFHSAU = Chilli in fish sauce	CKANGFUG = Pumpkin and cowpea spice soup	NPFERFH = Fermented fish hot sauce
FERMSAU = Chilli in fermented fish sauce	NPSHRIMP = Shrimp paste hot sauce	WATERFER = Water fern
WATERCON = Water convolvulus	CABCHIN = Chinese cabbage	CMOGMAI = Steamed cowpea and bamboo shoot
CORIAN = Coriander leaf	ROASTBF = Roasted beef	CSAGOBD = Cowpea and sago pudding

Table 11.9 Solution of Trial Runs of Mixed Integer Programming for DAY 1-5 Menu Planning on "Survey" Pattern:Nutrient Content

Nutrient	A. ONE OR SEVERAL RUNS FOR EACH MENU UNTIL FINAL OPTIMAL SOLUTION OBTAINED				B. ONE STEP RUNNING FOR EACH MENU WITH MODIFIER ZALPHA=20; ZJUST=7			
	DAY1-2	DAY 3	DAY 4	DAY 5	DAY1-2	DAY 3	DAY 4	DAY 5
Energy (kcal)	18776	18686	18317	18002	19324	17951	18578	19119
Protein (g)	469.4	525.7	508.9	450.0	483.1	489.9	517.7	520.8
Fat (g)	375.5	373.7	366.3	360.0	386.5	359.0	371.5	382.4
Dietary fibre (g)	225.8	242.0	242.0	219.7	243.0	243.0	242.4	221.2
Calcium (mg)	4436	3400	3400	3400	5038	3400	3416	3400
Phosphorus (mg)	11090	8500	8443	7558	11923	7870	8541	8188
Iron (mg)	234.4	154.0	129.4	242.0	256.9	152.6	128.7	235.3
Vitamin A (IU)	54600	54600	4600	54600	54600	54600	54600	54600
Thiamine (mg)	7.62	7.47	7.32	7.20	8.16	7.18	7.43	7.64
Riboflavin (mg)	10.33	10.29	10.07	9.90	10.62	9.87	10.21	10.51
Niacine (mg)	15.33	124.36	121.54	151.77	160.23	170.05	122.61	126.19
Vitamin C (mg)	529	568	905	300	425	1065	915	362
Vitamin B6 (mg)	32.02	36.00	34.73	34.82	33.85	33.64	35.41	37.96
Vitamin B12 (mg)	42.38	23.95	20.35	18.76	41.61	23.15	21.06	21.32
Pantothenic Acid (mg)	70.09	65.52	65.83	74.91	70.78	75.16	66.20	67.05
Folic acid (ug)	1702.6	2679.8	2931.3	1740.4	1472.9	2067.7	2928.8	2117.9
Isoleucine (mg)	22350	24981	23479	20741	24036	22600	24109	25675
Leucine (mg)	43370	48659	45808	41012	45307	44461	46796	49187
Lysine (mg)	33073	26587	24256	21760	35443	21557	25210	33860
Methionine (mg)	9196	9020	8149	7184	9735	8544	8356	9031
Cystein (mg)	7102	7882	7180	6031	7350	6973	7501	7748
Phenylalanine (mg)	23089	24592	22310	20403	24576	22056	22910	24191
Tyrosine (mg)	16275	15779	14475	12614	17587	14447	14846	15548
Threonine (mg)	21392	21736	19810	18148	22734	20258	20350	21357
Tryptophane (mg)	11766	11290	10036	9285	12478	10019	10323	10411
Valine (mg)	30127	31551	29021	27063	31919	28704	29738	31614
Protein calorie ratio (%)	10	11.25	11.11	10	10	10.9	11.1	10.9
Fat/calories (%)	18	18	18	18	18	18	18	18
Phosphorus/calcium ratio	2.50	2.50	2.48	2.22	2.36	2.31	2.5	2.4
Thiamine/calorie (mg/100 kcal)	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004
Riboflavin/calorie (mg/100 kcal)	.00055	.00055	.00055	.00055	.00055	.00055	.00055	.00055
Niacin/Calorie (mg/1000 kcal)	.0080	.0067	.0066	.0084	.0083	.0095	.0066	.00666

APPENDIX 12: INTRODUCTION METHOD IDEAS FROM BRAINSTORMING

AWARENESS STAGE1. Radio

The Introduction information on the developed menu, of how it will solve their nutrition problems or of how it will be beneficial to them, could be broadcast from the local broadcasting station on programmes such as "the daily news programme for the local". This programme is the popular programme and is on air about three times a day: morning, midday and in the evening. It is recommended that the advantage of this technique should be to use the short message, frequently repeated in the midst of, and between the highly popular entertainment programme with a large audience.

2. Group Discussion

Discussion- decision method has been used to stimulate people to try new foods. It is the first step in certain situations to get people to recognise their own nutritional problems and to provide the stimulation needed to seek solutions to such problems.

With this method a group of people could be formed, e.g. from school teachers, home economics teachers, health educator, village head man and other people of achievement in the village. It requires a leader who is competent in the discussion leading to decision concerning the menu.

3. Posters

Poster carrying a message and showing menu for the whole week either in word or in picture could be put at different places in the village, e.g. in health centre, in school, in meeting place or at the power pole at the entrance of the village. The villagers will see and learn and become aware of the information given.

4. Person Contact Home

This method is normally used by the villager. Message spreads throughout the village by a communicator. The communicator will go around the village and can reach each home. He would be a person whom the villagers know well, could be a person living in the village or the outside person.

5. Person Contact Food Shop

Similar to (4) the communicator could deliver the message to only the food shop in the village. The food shop could be the small village grocery or the noodle shop or the coffee shop. This could be the place for message distribution as the owner of the shop can spread the news to the customer.

6. Cassette Tape

Cassette tape is another possibility for providing information at the village. The cassette tape system would be ideal to be used rather than the broadcasting system as the message can be specifically

directed to the village chosen. It also can be repeated many times while the radio fails to do so. A key person could bring the cassette with the auxiliary speaker to increase the volume to the village meeting place or to the food shop. Cassette tape with information about the menu together with the entertaining programme could be lent to the housewife to be heard at home.

7. Shop Display

A display like information on nutrition problem, nutrition education, a cowpea seed and some of the cowpea dishes and the 7-day menus at the food shop could attract the awareness of the villagers.

8. Food for Monk

Each day the villagers offer food to the monks. They usually offer the best food they have. On Budha day which is every 7 days most of the villagers will go to offer food to the monks in the temple and listen to the religious prayer given by the monks. To attract awareness from the villagers, dishes in menu could be offered to the monk at this time with the information.

9. Teaching Health to School Children

Teaching the teacher and school children at each school in the village about the basic nutrition, the need for food, the good health and the balanced meal - the menu. Show them a picture of the menu. When the children come home they will tell their parents about the menu.

INTEREST STAGE

1. Television

Television is a good device for including the visual effect but it is usually restricted to only the villages that the electricity has reached.

2. Films, Filmstrips and Slides

This could be substituted for the Television and the village that the electricity has not reached as it could be shown by the mobile audiovisual unit. It is also cheaper than using T.V. time.

3. Group Discussion - Decision Method

Discussion - decision method has been used to stimulate people to try new foods, to get people to recognise their own nutritional problems and to provide the stimulation needed to seek solutions to such problems.

4. Picture of Menu and Dish

Colour photographs of dishes or a combination of dishes into a menu for one day may interest the villagers.

5. Food Party

Dishes as in menu is prepared and the villagers are invited to join. The villagers can see and taste. This should be best to have at the village head man's house and at the evening meal. Women should be encouraged to come and join the party as normally the women are too shy to join in.

6. Competition for Question

Once the concepts were taught to the villagers. Competition in answering the questions in relation to the concept taught could be held with all age groups. The competition to answer the question will create learning of the information. The villagers should be allowed to prepare themselves before the competition starts, so they can acquire more information. All participants as well as the witnesses should be rewarded. This method will help develop leadership.

7. Competition for Song

Competition with words written and song composed about the story of the 7-day menus will help the villager to learn more about the menu. They can remember the food in each day menu by remembering the song.

8. Famous People Talk

To have famous people talk to the villagers in the village will help in gathering the large group of audience. Once they hear and learn about the menu they will go on talking about the famous person and what he/she said.

9. Food in Hospital

7 day menus will be provided to the patient. The patient and the relative who have come to visit at the hospital will see and taste the menu. If they are well and recover they will think that the menu is good food and part of making them well. If they were told to cook the menus for themselves and their family they will tend to do so.

EVALUATION STAGE

1. Printed Material

A printed material or a pamphlet with pictures showing the dishes in menu will help the literate villagers to evaluate the innovations.

2. Cooking Demonstration

The potential adopter especially the illiterate group could be helped to make evaluations through cooking demonstrations. Demonstrations offer an opportunity to explain in concrete terms the idea, aim to transfer and also provide opportunity for the villager to see, and sometimes take part. Therefore demonstrations give an opportunity for the villagers to see, hear and do.

3. Video Demonstration

Demonstrations of cooking on video tape could save some trouble in carrying food raw materials to the village. Once it is prepared it can be used for other villagers. The message given to the audience in each village is the same. But the villagers can only see and hear and cannot take part in the cooking, even cannot be able to taste the dishes.

4. Food Vendor Demonstration

Cooking demonstration of the cowpea dishes in the menu will be demonstrated to the food vendor only. Also it is hoped that the food vendor will spread the news to the villagers, the food vendor could be used as an early adopter.

5. Famous People Demonstration

The cooking demonstration is the same as in (2) but it is hoped that the cooking demonstration by the famous people will attract more attention from the villagers and they may think that the menu is the famous food and good thing to follow.

TRIAL STAGE

1. Cooking at Home

Certain active villagers should try out the menu preparation at home under the supervision of the "aide" or the project staff, using their own available equipment. Friends and neighbours may be called in to observe this trial and perhaps, use the person being observed as a reference when later they try the menu themselves, thereby multiplying the different effect.

2. Competition for Best Dish

Setting up a cooking competition between the housewives, or the cooks in the same villages and compete on the cooking of the same kind of dish for the "best dish". Menu and recipe should be handed out beforehand for the competitor to try at home. A friendly atmosphere should be maintained - the more people take part in competition the better for the diffusion effect. Judge can be a group of people in the village or an outside person. At the end of the competition, the competitors will receive rewards as well as the audience.

3. Competition Between Villages Based on the Number of Households

Cooking Dish

The target number of households cooking dishes in each village could be set. The village that made this number first will receive the prize. By comparing a record of each village at a certain interval period, the highest record will win the first prize. This will encourage the increasing number of households cooking dishes.

4. Competition for Best Cook

Competitions for the best cook between villages can also create increased cooking of the dishes. This could be organised so that each village will choose the best cook and send him/her to compete with other villages. The competition place could be set up in the provincial building or at the district office to attract a larger audience.

5. Teaching Children at School

Teaching school children to cook the dishes at school could have a multiple effect, the children persuade their parents at home to cook the dishes.

6. Mens' Meeting

Normally the village men hunt and find food for their family. The dish and recipe of food cooked by housewives will depend on what food ingredients the men found. And also whenever there is a feast occasion in the village, like the wedding ceremony, the cooks are men. To encourage men at group meetings to trial cooking may be another means to increase the number of adoptors.

7. Cooking in KKV Demonstration Village

There are 10 families of farmers living in the KKV demonstration farm. This group of people come from different places in the Northeast region. By teaching the group of people, when they go back to their own village, they will cook this menu at their home and will set an example for the others to follow.

APPENDIX 13: EVALUATION OF INTRODUCTION METHOD IDEAS

13.A CRITERIA AFFECTING THE EFFECTIVENESS OF THE "METHOD OF INTRODUCTION"

There are various variable criteria that need to be considered in selecting a method of introducing the menu for the villagers. These are presented in their chronological order of their importance:

- (1) The compatibility of the "method" to the activities of the villagers. This could improve the effectiveness of the information given. The villagers are more likely to be exposed to an information and "method" that is compatible with their beliefs and fit into the village activity system, than to information and "method" that is incompatible with such beliefs and activities.
- (2) The "method" that provides information to reach the target rapidly and efficiently disperses information.
- (3) Complexity of the information and method of introduction. A more complex method will not gain as high a level of attention as a simple one. The information and method of introduction should suit the education level of the villagers.
- (4) The "method" should at best be able to evaluate awareness of an idea.
- (5) The "method" should be easy to evaluate. The "method" should cover a large percentage of the villagers and gain a large number of villagers with a positive attitude or positive response. Even better would be to gain a large number of villagers willing to make a commitment and try the menu.
- (6) The "method" and information should give a reassurance of the idea, giving the villagers a feeling of certainty and confidence in the menu.
- (7) Arousing the desire to try the menu or encouraging the villagers to have a desire to test the menu which they should think is "good tasting". Give them the belief of enjoyment and desire for something "good".
- (8) Reward of the information. Reward on the basis that the villagers will perceive it is beneficial in their own interest.
- (9) Method that leads itself to an interaction effect, which is the process through which individuals who have adopted an innovation, influence those who have not yet adopted.
- (10) Arousing the introduction of a favourable setting for the villagers who are willing to taste the food in the menu.
- (11) The "method" that overcomes the hesitations and shyness of the villagers to participate in this introduction.
- (12) The "method" that should give an exactness of the information transfer.
- (13) Credibility of the information and source of information that are highly credible, are likely to motivate and persuade more of the villagers.
- (14) The villagers will learn and remember information that has a great effective value to them much more than they will learn and remember information to which they are emotionally neutral.
- (15) The villagers tend to be more easily motivated and persuaded by a communicator they perceive as being similar to themselves, than by a communicator who seems dissimilar.

- (16) The more trustworthy and expert the communicator is perceived to be by the villagers or the higher prestige communicator has, the more likely he will be able to motivate and persuade the villagers to agree with this information.
- (17) Certain personality characteristics and physical aspects of this communicator may interact with more objective characteristics to either increase or decrease the change of the villagers being motivated and persuaded by the information. This may arouse anti-sentiment.
- (18) The "method" should overcome negative attitudes towards trying a new menu due to unfamiliarity of this information. Information that is familiar to the villagers and has high interest value for them is more effective.
- (19) The "method" should give the villagers an opportunity to take part, involve and provide criteria for making the decision.
- (20) The "method" that gives a non-directive motivation allows the villagers to feel that the ideas expressed by the communicator are his own. This attempts to eliminate ego-defense mechanisms that can destroy the effectiveness of the communication.
- (21) If the information is pictorially presented, it is better remembered than if the villagers read the verbal counterpart.
- (22) The more the "method" is repeated the more the villagers take in the information. Repetition with a slight variation in the information or distributed information, are more effective in causing the villagers to learn the message than no repetition of the information. Over a period of time the villagers' retention of this information will decrease.
- (23) The "method" should give ease of clarity of interpretation. The information should be avoided which would lend itself into multiple interpretation by the villagers.
- (24) The greater the consistency, the more it fits into a pattern of village life, the greater the chance that the entire information will be perceived by the villagers, as the communicator desired.
- (25) "Method" that gives intensity of the information (strength and emphasis) will be more likely attended by the villagers.
- (26) The "method" that gives information which consists of several elements or important points, will increase the villagers' effectiveness of learning when they are shown it repeatedly. With an increased display villagers will attend to more cues and they will learn the information more completely.
- (27) The villagers are more likely to learn information that reinforces their existing beliefs and attitudes than those which dispute their beliefs and attitudes.
- (28) Competitions of the "method" with the village surroundings. The "method" should stand out conflictingly with the surroundings in order to gain more awareness.
- (29) The "method" should have less conflict with the existing programme in the village.
- (30) If the "method" is too forceful the villagers will give a negative reaction.

13.B CRITERIA SCALING1. The number of villagers reached total scoring 20

It is a quantitative criterion - how many people or how many households are reached one or more times (reach means exposing, hearing, seeing, involve or participate either directly from the media or from "word of mouth").

- Very Good - The opportunity that the media reaches 60-80 percent of the population in the village.
Good - reach 40-59 percent.
Average - reach 30-39 percent.
Poor - reach 10-29 percent.
Very Poor - reach 0-9 percent.

NOTE: From survey data of 10 villages in 1978, 17 percent of the population are children aged 0-5 years old. Therefore you can say that about 80 percent of the population in the village are the aim for this campaign, 3 percent are illiterate, 2 percent are people who can read but not write.

2. Cost of using particular media total score 15

It is also a quantitative criterion.

- Very good - estimate that it should be less than 500 bahts per 1000 people reached.
Good - 1000 bahts per 1000 people reached.
Average - 3000 bahts per 1000 people reached.
Poor - 5000 bahts per 1000 people reached.
Very Poor - 10000 bahts per 1000 people reached.

NOTE: In 10 villages average about 180 households/village about 1000 villagers/ village.

3. Comptability of the media and the message delivery by the media to the village system total score 15

It is a qualitative criterion. Defined as the degree the media and the message is compatible to the beliefs and attitudes of the villagers, compatible to the village activities (convenient fit to village life), compatible to the background and knowledge of the village and to the village life style.

- Very good - Defined as the degree that the media and message were presented in the pleasant way and fitted very well into the village life style. The views of the message are also in agreement with the beliefs and attitudes of the villagers. The messages are very simple and in the villagers' own language. The media and message are very compatible to the village activities.
Good - Defined as the degree that the media and message are compatible to the village activities. They are presented in the simple and easy way that the villagers can understand easily and their opinion can support the view of the media.

- Average - Defined as the degree that the message or media were moderately compatible to the villager every day life activities. And the villagers can support the view of the message.
- Poor - Defined as the degree that the message or media is not quite agreeable with the villager's belief and attitudes. The messages were presented in the unpleasant and slightly complicated way. The villagers are aware of the message, but they may not clearly understand the message.
- Very Poor - Defined as the degree that the message or media disagree with the belief and attitudes of the villagers. They were presented in the forceful way or in the very complicated way so that, the villagers may not agree with the message or may not understand the message.

4. Attract Attention

total score 15

It is a quantitative criterion. Define as an opportunity of the media or message to attract the villager's individual sense in order to attend to the message.

- Very Good - The media and message that attract and hold attention to most of the villagers (- 80 percent of the population) or increasing the attention of the audience to the maximum number of population. Cause the villagers to be aware and arouse interest in the message. Usually, the media or message is the high entertainment value type or large illustration, showing action; colourful, which will give a better performance and ability to get whole attention than other media as message.
- Good - The media and message that attract good attention of the villager (- 60 percent of the population who has been exposed to the message). It should cause the villager to become aware and become interested in the message.
- Average - The media and message that attract moderate attention of the villagers. About 50 percent of the population who has been exposed to the message should be aware and interested in the message.
- Poor - The media and message that attracts less attention of the villagers. About 30 percent of the population who has been exposed to the message became aware and interested in the message.
- Very Poor - The media and message that attract the attention of few villagers who has been exposed to the message.

5. Reassuring

total score 15

It is a qualitative criterion, the degree of media and message give a feeling of certainty, confidence, trustworthy and reassurance to the villagers. The media and message should be in a persuasive way that the villagers will gain the impression of something beneficial to them.

- Very good - The degree that media and message give all of the villagers that have been exposed to the message a feeling of absolutely certainty.
- Good - The degree that media and message give all of the villagers who have been exposed to the message a feeling of certainty.
- Average - The degree that media and message give almost all of the villagers who have been exposed to the message some feeling of reassurance and certainty, by giving about 50 percent of the villagers who have been exposed to the message a feeling of absolutely certainty.
- Poor - The degree of media and message that give some reassuring to the villagers who have been exposed to the message or give a few villagers who have been exposed to the message a feeling of certainty.
- Very Poor - The degree of media and message that give a poor reassurance to the villagers who have been exposed to the message.

6. Participating

total scoring 10

It is a qualitative criterion. The degree that media and message give the villagers an opportunity to take active participation in the programme, e.g. get the villagers to repeat (recall) the message, to contest, to taste, to examine and arousing the desire to try.

- Very good - The media and message that get all the villagers who were exposed to the message a chance to involve or participate in the programme or to get most of the villagers who were exposed to the message involved in watching the cooking of the food, so that they can hear, see, taste and touch.
- Good - The media and message that get all of the villagers who were exposed to the message a chance to discuss see and taste the food.
- Average - The media and message that gets all of the villagers who were exposed to the message a chance to recall or repeat the message.
- Poor - The media and message that get a few villagers who were exposed to the message a chance to participate e.g. in seeing, recalling a cooking or taste of the food.
- Very Poor - The media and message that gives the villagers no chance to participate or little chance to participate.

7. Strength of Information

total scoring 10

It is a qualitative criterion. The degree which media and message give a strength of information or "impact" of information to attract attention to hold that attention to arouse interest and to develop interest and arouse a desire to try the menu. The information that gives a good strength should be short and meaningful; should be accurate and easy to comprehend and convincing. The important point of the message should be emphasised and repeated. Such information will make the villagers remember longer.

- Very good - The degree that the media give a strength of information in such a way that attracts attention from all the villagers to whom the media has been exposed and arouse in them a desire to cook the menu.
- Good - The degree that the media gives a strength of information that attracts attention to a large number of the villagers to whom the media has been exposed. All of them are interested in the menu and some have a desire to cook the menu.
- Average - The degree that the media give a strength of information that gains the awareness from a moderate number of villagers to whom the media has been exposed to. They can remember the message for some time and and some are interested in the message.
- Poor - The degree that the media gives a strength of information, gains an awareness from some of the villagers and only a few villagers can remember the message.
- Very Poor - The degree that the media gives a strength of information that most of the villagers, to whom the media has been exposed to, cannot remember the message.

APPENDIX 14: DESCRIPTION OF INTRODUCTION METHODS

Radio

Radio can deliver exact messages at a faster rate and can reach further into the community even to the remote areas. The message to create awareness of the malnutrition problems which exist and to inform about the menu developed by the project would be broadcast through local broadcasting station.

The adaptation of the reach-and-frequency technique of advertising should be used. That is the message should be short enough to hold attention, interesting enough to bear frequent repetition and frequently repeated in the midst of and between the highly popular entertainment programs with large audiences, and also comprehensive enough to get the idea across (and to eventually effect desired changes in knowledge, attitudes and hopefully practice). The message in the first week could be like "eating cowpea menus will make your family healthy, strong and happy", this short message should be on air for 3 continuous days and all the time, about 2 hours interval.

The message in the second week should be:

- (1) What is nutritious food;
- (2) Why protein is very important part of health diet;
- (3) How they should eat;
- (4) How the menu will be beneficial to them;
- (5) Interviewing or discussions with the villagers by the popular radio personnel of how his/her family eat, and suggest her to try the menu. During this week the series of programmes should be built up one day and then another day.

The first stage evaluation of the effectiveness of radio broadcasting the information is required on:

- (1) How many radio sets are in the village;
- (2) What percentage of the villagers make up the audience of the media;
- (3) What are their views and listening habits, i.e. what programmes do they like, when do they listen?

The final evaluation will be the interviewing for:

- (1) Number of villagers who have listened to our programme, and how often they hear the programme, and at what time;
- (2) Number of villagers who understand the programme;
- (3) The retention of message;
- (4) The change of attitude, rating scale could be used for this measurement;
- (5) Number of villagers who have heard of our message through other channel.

Television

Like radio, TV delivers exact messages and has a faster capability. But TV has more advantages than radio in that the audience can see and listen at the same time.

As the TV air-time is expensive the message could be sent as:

- (i) a brief message for a minute or 30 seconds and have a spot picture of the "menu". On this the message should be repeated frequently like an ordinary commercial advertising.
- AND
- (ii) A short documentary film about 15-20 minutes starting: the pretty girl laying out food in the first day menu on the table, then the family of persons come and take the food, firstly for

breakfast, then lunch, then dinner.

This film should enable the illiterate villagers to understand it the first time they saw it and it should motivate the villagers to improve their diet. The film should be shown at the evening meal. If possible it should have the programme on at the same time everyday for the whole week.

(iii) Show the recipe book. People who are interested can get this book from KKU.

The information is required on:

- (1) how many TV sets are in the village;
- (2) what are the audiences;
- (3) what are the popular programmes.

Evaluation on:

- (1) attitude of the villagers;
- (2) number of villagers who have heard through this channel;
- (3) the increasing awareness;
- (4) number of villagers/households watching the TV and how many times they have seen it;
- (5) how they understand and how they can retain information.

Film/Filmstrip/Slide

Showing film or slides in the village is a useful method to collect large groups of people in the village. Films have continuing appeal if they are in colour and in the language of their region. Making films is highly technical and usually an expensive business. Filmstrip and slide is easier to make. A short story of showing time about 15-20 minutes could be made into film or filmstrip and slides. This story may start with the problem of malnutrition and show the children who are malnourished. Show them the cowpeas, how to grow and prepare for cooking and also show them the other raw materials that can easily be obtained in the village for the cooking of the "menu", show them how to prepare and cook the food. A sound track of local language can be made to explain the film, filmstrip or slide. The film or filmstrip or slide should be shown a few times in each village.

To evaluate:

- (1) Keep record of the number of audiences and number of repeated audience.
- (2) Interview the villager for their understanding of the film or filmstrip or slide.
- (3) The increasing awareness.
- (4) The ability of the villagers to repeat the story.
- (5) The attitude of the villagers.
- (6) The intention of the villager, either they will grow cowpea or cook the meal.
- (7) What is the limitation if they not intend to do.
- (8) Number of persons who have not seen the film/filmstrip or slide but heard from the neighbour.

Group Discussions

It is suggested that group discussions leading to decision may be one of the best ways to modify social behaviour. The use of groups as media for producing increased efficiency is being accepted in the business as well as in the social field.

A group of villagers of about 10 people is formed. The group should consist of people who are interested in food, eating or cooking or the health of people. It is preferable to have a local villager to

be the group leader, to create more belonging to the group.

To produce good discussion groups and successful meeting, it needs to be comfortable seating and discussion beforehand with the group leader of the objective of the meeting, how to conduct the meeting and how to help the members of the group, if necessary to achieve the aim. The project staff, if attending should become part of the group.

The following are the guidelines of the meeting:

- (1) An introduction by the leader, start the topic with the physical fitness. For healthy and strong body, need good food.
- (2) Relate the problem to everybody in the group or to the village condition. Do the group see any child being taught the effects of undernourishment.
- (3) Request group opinions on what needs to be done.
- (4) Relate the opinions back to the menu and introduce the menu to the group.
- (5) Ask the group who have eaten food like the menu (everybody will say they have).
- (6) Provide more information to the group, by showing pictures, slide or pamphlet.
- (7) Ask the volunteer from the group who want to try cooking "menu" at home.
- (8) During discussion should make periodic summary so that everyone is aware of the point of discussion.
- (9) Should control them on the subject.

In each village the group leader will be firstly, trained by the project staff and then secondly, each one will form a group discussion with another 10 villagers in their own village.

To evaluate:

- (1) Number of people who volunteer or said that they would be interested to try the menu at home.
- (2) After 2 weeks record the number of persons who actually did the cooking.
- (3) Number of villagers who have heard from the person attending the meeting.

Person to Person

Person to person or face to face communication method is highly successful. It has greater personal persuasiveness. It has greater effectiveness in the face of resistance and makes the later adopter aware. This method is most important at the evaluation and trial stage as it gains "trust" from the audience. The disadvantage of face to face communication is that it is time consuming and costly and that the size of the population group which it can reach is comparatively small. Another disadvantage is that it is not the most reliable system for delivery of information as the content and quality of the communication, can often vary from person to person and it is difficult to exercise control of the information transmitted. Therefore, it is necessary to train a person to disseminate information. The person delivers the message at every home - can cover more of the population of the village than other methods as the message will likely meet every member of the family rather than a single person. The person who delivers the message, can be the village headman or a popular person in the village whom the villagers trust his or her information.

The message could be like:

- (1) The University has developed a cheap menu. The menu is the same kind of food the villagers eat everyday already and they only need to know which one is eaten and in what quantity.

- (2) They said they will come to the village to show the villagers about this menu.

More than one person could deliver this message and this may create more awareness and create more mouth to mouth communication between the villagers. To evaluate the method:

- (1) As every household will learn the message, the record of the number of persons who have heard of the message has no meaning. Every household or a sample of households could be interviewed for the ability to repeat the message.
- (2) The interview of the villagers of:
 - (a) who would like more information of the message
 - (b) who would like to gain benefit (of being clever, strong and healthy)
 - (c) who would like to try the menu.

Poster

Posters have potential to illustrate and to inform, spread ideas and make them well known. Posters suitable for exhibition in public places in the village should contain single simple ideas and these should be conveyed through a picture.

There should be a series of posters. One day, one poster, another day, another poster. The poster on the first day maybe starting with the breakfast, leave a blank space and say guess what is coming next. Also, there should be a few words underneath the picture. The wording could be "eat more legume food", or "eat right food make you strong". Then with the sign of the project so people will know to whom the poster belongs.

The poster should be put in the most prominent place where most of the villagers can easily see it everyday, e.g. the entrance of the village. The poster should be pretested for the villagers' understanding.

To evaluate at the end of a certain period (a week):

- (1) number of villagers who have seen the poster,
- (2) the understanding of the poster,
- (3) number of persons who have heard from neighbour who went to see the poster,
- (4) number of persons who have heard but did not see the poster,
- (5) the attitude of the villagers.

Cassette

Cassette is another oral media to provide communication. The villagers can continue their work and listen at the same time. It is flexible and could be used consistently day in and day out, to achieve impact through repetition and reinforcement, which the radio could not give as flexibly. Only limitation is that it could not deliver the message to the villagers who work in the field. Cassette has to be played and listened to only within the village homestead distance with the loudspeaker.

It should be played three times a day, in the early morning before people go to work in the field, in the evening when everybody comes home and during daytime for the elderly villagers who stay at home.

It has been suggested that the content of the message should be (as Guatemala case, Colle and Fernandez de Colle, 1978).

- (1) "Dramatization - to provide some "safety credibility".
 - (2) Authority - to add "competence credibility" to the dramatization.
- A strong clear authoritative sounding voice was used to summarize

- the major points covered in the dramatization.
- (3) Reinforcement - In addition, to summarise, placed short announcement or reminder in several parts of the tape. Additional reinforcement was provided by including occasional interviews with medical or other specialists often known to the people in the village.
 - (4) Localization - Interview, not necessary related to health and nutrition, were included to lighten interest in the programme and to give listeners a feeling that the content was relevant to them and to their community.
 - (5) Entertainment - music.
 - (6) Question - ask question - give music - answer.
 - (7) Brief - a starter programme to permit someone who has a brief moment understand.
 - (8) Semi-sequential flow - arrange that people who have started listening anytime can pick up a message.
 - (9) Information - motivation - behaviour - same pattern was followed in going from programme to programme. Those who missed earlier programme still were exposed to this pattern.
 - (10) Repetition - the programme should be about 30 minutes and run for 3 weeks."

In our case the recipes and the menu could be told by this system. The villagers would remember them if they were listened to everyday.

To evaluate:

A sample of villagers could be interviewed for:

- (1) Did they hear the cassette and how many times,
- (2) How they liked the programme,
- (3) What is the best time to listen,
- (4) Is the message telling the truth,
- (5) Can they repeat the recipe/menu or the message,
- (6) Did they try the cooking,
- (7) Had they cooked some of the dishes before.

Shop Display

A poster or real food could be set to display at the village food grocery. This display will present the idea in a form that can be readily grasped and may interest villagers who come to buy food from the shop. As there are only 2-5 food grocery shops in each village, it is better to display at every shop in the village to achieve impact through repetition and expose to most of the audience as possible. This display should be on about 2 weeks.

To evaluate:

- (1) A sample of villagers could be interviewed for:
 - (a) did they see the display,
 - (b) what they learnt and how can they repeat the message,
 - (c) did they have tried.

OR

- (2) Record number of villagers who have come to each shop as usual or as the intention to see the display.

OR

- (3) Ask the shop buyer to interview the opinion and the attitude of the villagers who have seen the display.

Food for the Monk

For each day of the week food as the menu could be offered to the monk in the morning. The villagers could be invited to join in and

hand food to the monk too. Food could be cooked from the University or at some of the villagers' homes. The monk should be informed of what we try to do and achieve, and ask for their co-operation.

To evaluate:

- (1) During the first week or the week after that, all the food the villagers offer to the monk should be recorded. The villagers tend to imitate what they thought is the good thing to do.
- (2) Sample villagers and interviewing for the awareness of the food.

Food Party

Dishes as day one in menu should be prepared in large quantities enough for everybody in the village to try. The village headman and school teacher should be the first person to invite to taste the food, as an example for the villagers and approve the food. Villagers may be asked to bring some of the food, e.g. glutinous rice, vegetable and fruit to the party. This will make the villagers have the feeling of involvement and participation and give them the assurance that nothing is suspicious.

Food for day 2-7 could be repeated in similar way of an interval of 2-3 days.

To evaluate:

- (1) Number of villagers attending the first party,
- (2) Number of increasing attending of the villager,
- (3) How they like the food in each day,
- (4) Number of villagers who have cooked the food at home after attending the party for the first time, second ... seventh time,
- (5) Number of villagers who still cooked the food after 2-4 weeks of last party,
- (6) Number of villagers who could repeat the names of the dishes in the menu for each day.

Competition Question

The competition in answering the question could be organised in two ways.

- (1) Answering the question relate to the information in the cassette. The question could be asked beforehand so the villagers can prepare themselves for the questions asked during the competition. The questions should be asked the villagers of what they have learned and how they can repeat.
- (2) The questions that are asked in general not related to the information they have learned before, but to the information that is going to inform them and they want them to remember.

This competition is held in the village.

To evaluate:

- (1) number of villagers attending,
- (2) the performance of answering the question.

Competition for Song

Song may be competed on the basis of the meaningfulness of the idea, the list of dishes in the menu for 7 days and for the popularity of the song itself. Song competition could be held in the village or competition between villages. A group of the competitors are organised and were handed the list of menus. Popular people are invited to judge the competition, the songs that gain first, second, or third place maybe popularised by teaching the villagers to sing or publish in the

pamphlet or put in the cassette. To evaluate:

- (1) number in the competition,
- (2) number of villagers attending the competition,
- (3) number of villagers who can repeat the words of the song or can sing the song after 1-2 weeks of the competition,
- (4) number of villagers who have actually cooked the dish in the song.

Cooking Demonstration

Cooking demonstrations could be organised in the similar way to the village cooking. Only the cooking method should improve the hygiene and retention of nutrients. The ingredients should be set out for inspection and the cooking should be set out so that the audience should be able to help and pass around the ingredients of the food. The demonstrator should not have an assistant for this may give the impression that the operation is too complicated for the members of the audience to carry out by themselves at home. The audience could be also asked to help in certainly lengthy operations. The cooking utensils are in the villagers' style.

Cooking demonstrations could be held at the village public meeting place, school or at the home of village headman or school teacher. The home setting has the advantage of making the recommended practice seem feasible under everyday conditions. The demonstrator should be careful to select the house of a person who is popular and respected and whoever the villagers are likely to imitate.

The influence and key person in the community should be invited to the demonstration and this person is invited to taste the food first or to help in the cooking. Discussion could be also arranged during demonstrations. Recipe or pamphlet could be also handed out. Volunteers may be able to carry out the cooking in their own home.

The advantages of cooking demonstration is:

- (1) It narrows the gap between people's understanding and their attitude toward new information. People always understand but simply do not accept.
- (2) The audience, while the attention is held, become totally involved in the subjects. As a result of this the message is more likely to be retained and a favourable opinion created. Something both seen and heard make a deeper impression.
- (3) In the case of the audience helping in the cooking and tasting the food, then it appeals to all five senses - sight, hearing, touch, smell and taste. People can then decide for themselves whether they will adopt the practice.

To gain the successful result, it is important to rehearse the procedure beforehand to decide on the main points to be emphasized at each step. Cooking demonstrations should be conducted for a few times in the village to ensure the assurance and a favourable attitude to the menu.

To evaluate:

- (1) Number of audience attending the cooking demonstration,
- (2) the increasing number of audiences at later cooking demonstrations,
- (3) number of villagers volunteering to cook at home,
- (4) number of villagers who have actually cooked at home approximately a fortnight after the demonstrations,
- (5) number of villagers who can repeat or remember the recipe.

Video Demonstration

Video demonstration has advantages over live demonstrations, the

information distributed to different villages is exactly the same. Raw material is saved and there is the convenience for the project being carried out demonstrations in the village in different seasons. At the end of the video demonstration, the villager could be allowed to ask the questions but they cannot have the sample to taste. Popular people can also be invited to demonstrate.

To evaluate:

- (1) number of villagers attending the demonstration,
- (2) how they understand and how well can they repeat the cooking step,
- (3) number of people who showed enthusiasm and want to cook at home,
- (4) number of people who actually cook at home.

Famous People Demonstration

The demonstration is carried out the same way as the cooking demonstration.

Cooking at Home

When the volunteer household or a person who want to try the cooking were found, the project staff will help the villagers to cook in their own homes. List of ingredients and cooking utensils can firstly be worked out. The villagers should cook themselves under the supervision of the project staff. If the villagers are very keen to try out the other menu, then the project staff will help them in the same way. Some of the ingredients may be provided for them.

To evaluate:

- (1) number of volunteers,
- (2) number of villagers cooking the menu after their first trial of cooking and how often they have cooked the menu,
- (3) their attitudes and the problems they encounter during cooking the menu.

Cooking Competition

Competitions serve as a method of emphasizing the principle taught and as a means of evaluation. The basic ingredients were provided and the competitor may bring their own spice or other ingredients they like. The competition should be held a few times in the village to overcome the hesitation of the villagers to join in. At the later competition, more people will like to be involved when they have seen the first one and the reward. Once this method is more familiar to the villager, the competition between the villagers can be organised.

Competition between villagers has an advantage that the villagers in each village will group together and gain more involvement in practising cooking, then get more people involved.

To evaluate:

- (1) the performance of the competition,
- (2) number of the competitors,
- (3) number of audience,
- (4) number of villagers cooking the best dish,
- (5) number of villagers who can remember the recipe or the competition theme,
- (6) what the villagers learn from this competition.

APENDIX 15: PROCEDURE OF GROUP DISCUSSION AND PROGRAMMING

Morning

Lead the group discussion with "what would you like to eat if you have money?" The answer may be fish, beef, pork, duck, chicken, some fruits, vegetables and desserts. Then we ask "do you know why we like to eat these foods?" Then say, "because our body needs them. These foods (list the protein foods) are the protein foods. Our body needs them for body- building and repair. When a child is born his body and his brain, go on growing, if we want a child to grow fast and healthy and clever, we have to give him plenty of protein food. When a child becomes an adult he stops growing, that is, he stops getting taller and only gets heavier if he gets very fat. Adult does not need protein for growing but needs it to repair his body as the different part of his body are wearing out all the time. So we need protein to make new cells and repair the body".

People who need protein - ask them "who needs protein and why do they need them?"

- Healthy adults need protein to repair their body.
- Pregnant women need protein to repair and for building the baby who is growing inside them.
- Nursing mothers need protein to repair and also to make milk to feed their growing child.
- Children need protein to repair and for growing.
- Sick adults need extra protein to repair the harm caused by their families.
- Sick children need extra protein for repair as well as proteins for growing.

The protein foods are beef, pork, chicken, duck, egg, milk, fish and legumes. These foods except legume are expensive food. Legume is a very cheap protein and is as good as other proteins, it can be used for body- building and repair. In our region we can grow cowpea. Cowpea is a good protein food and can be cooked into many delicious dishes, e.g. larb, kang, snack and dessert.

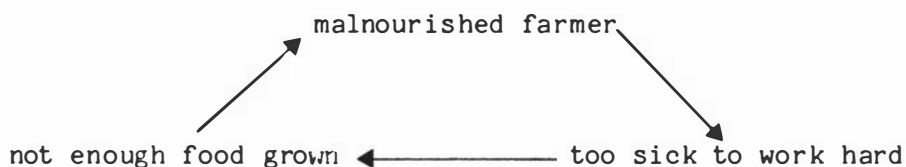
Do you know why we like to eat (energy food) we eat because our body needs energy and warmth. Our body needs energy food for moving and working. If we run fast and do heavy work we use up more energy so we need plenty of energy for heavy work. Rice, sugar, fat are energy foods. Do you know why we eat (fruit and vegetables)? We eat (fruit and vegetables) because our body needs protection from diseases. Fruits and vegetables give us vitamins and minerals. Fruit like banana and custard apple have plenty of vitamins. Green and yellow vegetables like water convolvulus, neem, coriander, corkwood leaves, spring onion and pumpkin have also plenty of vitamins and minerals. Of course we should drink clean and safe water. Water is also a nutrient. It is very important that the family should eat these food groups everyday, then discuss with them about food that they grow in their garden or raise at home. Then tell them that is good (they will probably say that they grew this vegetable and fruit, we named some raised pig and chicken). Now we can say, you have grown your own rice, which is the energy food, fruit and vegetables from your garden that is the protective food that you eat everyday. How about the protein food - we need to eat them everyday too. Can we eat one of these, beef, pork, chicken, fish everyday? It will be too expensive to eat one of these everyday. How about if we raised our own protein food, it will be also expensive to start is not it? Raising a cow will

take time and impossible to eat everyday. Pig also takes time and have to buy foodstuffs and piglets. Chicken also needs small chick and foodstuffs. Fish need a pond and a small fry. Then you see growing legume is the cheapest and quickest (2 months to mature). You only need a legume seed which we will give you cowpea seeds. You do not need to buy a foodstuff. It is already in your soil. Then this way we can eat protein food very cheap everyday. We eat other proteins from legume and supplement to the others protein which is expensive. Who like to have cowpea? Discuss with them the problem of not eating cowpea.

Then tell them of how to grow cowpea, and take them to see the cowpea growing in the field, the growing procedure will be told to them by the Agronomy staff. Visit the field.

Morning Break

Show slides and pictures of protein malnutrition children and vitamin deficiency children and adults. Ask them have they seen anyone like this before and do they know the cause of it and then tell them - because these people have not eaten enough good food (body-building or protein food, the energy food and the protective food). Show them again the photographs or slide of the happy and healthy family (of the villagers) and tell them that this family has been eating good food. Then turn back to the photographs or slide of the malnutrition. Tell them that the child will not grow up healthy and the child will not be clever and unable to do well at school. If mothers have a child who is not clever and not doing well at school, he will not be able to earn so much money when he is grown up and will not be able to keep them and look after them. Also as the sick and unfit adult, they may be a little sick so that they feel tired and do not work hard.



How can we help these children and adults. Should we give them to eat more cowpea, green and yellow vegetable and fruit and enough rice? Ask them - do you yourself and your family eat these foods? What do you eat? Keep telling them that what they eat is good. Discuss the problem if they do not eat cowpea. The answer maybe: not available, do not know how to cook, don't like the taste, never eat them before. Try to get the group discussing among themselves.

"Now you have seen how to grow cowpea and we will give you the seed for growing them yourselves. Then we will teach you and show you how to prepare and cook various delicious dishes from cowpea. Then you will be able to give to your family a balanced meal. If the members of your family are going to stay healthy and be able to work hard, and if the children are going to grow, they will need enough of each kind of nutrient. A meal that contains the right amount of body building protein, energy giving carbohydrates or fat, protective foods is said to be a balanced meal. That is that you eat legume (cowpea) as protein food with other small amounts of fish or beef dish, with rice, and yellow and green vegetables and fruit and some dessert everyday your family will stay healthy and strong.

There is a menu of a very good food that the family should eat in one day. We have calculated this menu if your family of 7 persons eat

each food in about these quantities (show figure), then it will be enough for your family's body requirement for a day. A family of a smaller number of people should eat a lesser amount. Show them the picture and tell them the first day menu by calling out the name of the food. You can choose to eat any dish in any meal as you like. Then show them the picture or name of the other day menu. "You can see that they are your very own food and some of you may already eat some of these dishes everyday". Ask the group who have eaten food like in the menu before (everybody will say they did). "You see you have already eaten this food. But you did not eat it in a combination in one day or did not use cowpea in some of the dishes. You already eat good food but if you eat as in this menu it will be very good for your family. Your family will be more healthy and your children will be brighter and more clever".

Then come back to the first day menu and discuss with them in more detail about "how the other housewife like yourself or the housewife in the happy family in the picture can obtain these foods, do they know how to cook, do they like to cook these dishes and do their family like to eat this menu. What will be the problem concerning obtaining ingredients, cooking and taste of food"?. Ask the group to help in solving the problem. Then tell them about the recipe of a dish like mushroom hot soup, how to make cowpea sprout and how to prepare fried cowpea sprout and cowpea sprout curry from cowpea sprout, and how to make steamed soya stuffing with cowpea. Then ask the group by a show of hands who will be willing to try menu for their family within the next weeks. Then tell them that we will come and visit and see how they are doing. Demonstrating to the group how to prepare cowpea sprout and cowpea dishes and other dishes in the Day 1 menu.

Lunch

Lunch will be provided for those at the University and the foods are the first day menu (whole day menu). The group are invited to choose whatever they like.

Afternoon

Ask the group opinion about the food, how they like it and are there any objections? Then the group are told that we want them to go back and tell their people in a group of 10 (which they will choose and tell us the names later on) of what they learn here and form a group discussion.

We instruct them that:

- (1) Ask the group what would they like to eat if they have money and tell the villagers what is the good food for protein which is needed for body building and repair. What is good food for supply energy and what is the good food for body protection.
- (2) Discuss with the villagers about food that they grow at home. Tell the villagers that it is more economical to grow cowpea for protein than raising the other livestock. Discuss with them the problem of growing cowpea and ask to help in answering. Tell the group what he/she has seen about cowpea growing and how to grow the cowpea show them the seeds.
- (3) Tell the villagers about the pictures/slides of the malnutrition people and the healthy family. Ask them do they think that there are malnourished people in the village and what can they do to help to solve the problem.
- (4) Tell the villagers that to make their family grow and be healthy

that everyday they should eat a balanced meal. That is eat legume with some other meal for the protein food, eat enough rice, eat fruit, green and yellow vegetables everyday.

- (5) Tell the villagers about the menu and the name of dish that the home processed legume project at Khon Kaen University has developed as a very good food. Ask the villagers have they eaten the food everyday before.
- (6) Discuss with the villagers how they think the happy family or the housewife like themselves will have any problem of getting food, cooking and eating the food as in menu. Ask the group to help answer the question.
- (7) Tell the villagers that he/she have tasted the menu and the menu tasted very good and have seen how the cowpea dishes are prepared and cooked.
- (8) Ask the villagers, by a show of hands, who would like to try cooking the menu sometime next week. (Note the number and name of person).
- (9) Tell the villagers that the university has planned the weekly menu for them, but will show them the first day menu first. In about 10 days time (on the day), at (place) there will be a food party in the village. Everybody was invited to join. To help the university with enough preparation of food. Anyone wishing to come should fill in the form and put in the box provided at
- (10) Ask the villagers to pass the information to the others about the food party and firstly the form and the form will be available to everybody to fill out.

APPENDIX 16: EVALUATION OF THE 7-DAY MENU, THE COWPEA DISHES
AND COWPEAS IN VILLAGES

16.A Acceptability of 7-Day Menu

Table 16.1: The Acceptability of 7 Day Menus

	Ban Koksri	Ban Huey	Ban Tuey	Ban Pasan	Ban Nong	Ban Pai	Ban Maung	Ban WangYawl	Total Mean Score
Mean Score on 1 to 7 scale									
Day 1-2 menu									
(a)*	6.0	6.1	6.5	5.5	6.3	5.9			6.1(48)**
(b)	6.3	6.3	6.2	6.2	5.4	6.3			6.1(111)
(c)	6.1	6.4	6.2	6.4	5.4	6.0			6.1(64)
Day 3 menu	5.9	6.3	6.3	6.6	6.0	6.0			6.2(102)
Day 4 menu	6.1	6.4	6.4	6.4	5.9	6.2			6.2(102)
Day 5 menu	6.1	6.1	6.3	6.6	5.9	6.3			6.2(102)
Day 6 menu	6.0	5.9	6.6	6.4	6.2	6.2			6.2(92)
Day 7 menu	5.9	5.9	6.3	6.4	6.2	5.9			6.1(92)

* (a) Trained people, (b) Villagers who ate at food party;
(c) Villagers who cooked at home.

**Figures in parenthesis were the total number of people interviewed.

16.B Choice of Dishes in 7-Day Menu Eaten in Each Meal Throughout the Day

Table 16.2 Choice of Dishes in Days 1-2 Menu
(% of Village Interviewed)

		Trained People at Khon Kaen (48 people)	Villagers at Food Party (111 People)	Villagers who Cooked at Home (64 People)
Whole fermented Fish (1)	B	41	45	39
	L	48	50	47
	D	23	48	44
Fried cowpea Sprouts (2)	B	36	53	60
	L	42	64	59
	D	33	56	58
Mushroom hot Soup (3)	B	79	74	64
	L	40	64	48
	D	53	65	64
Cowpea Sprout Curry (4)	B	59	77	62
	L	46	49	39
	D	48	53	60
Chilli in Fish sauce (5)	B	40	44	44
	L	38	39	52
	D	53	30	29
Chilli in Fermented Fish Sauce (6)	B	31	43	41
	L	41	41	36
	D	41	41	42
Water convolvulus (7)	B	61	61	62
	L	41	42	49
	D	52	39	41
Spring onions (8)	B	20	39	49
	L	43	41	45
	D	47	46	48
Neem (9)	B	20	39	49
	L	44	44	47
	D	39	45	40
Banana (10)	B	36	42	26
	L	39	48	45
	D	44	67	57
Steamed sago Stuffed with cowpeas (11)	B	22	36	24
	L	43	44	31
	D	49	67	55

Keys: B = breakfast; L = lunch; D = dinner

Table 16.3: Choice of Dishes for Breakfast, Lunch, Dinner
(% of Villagers Interviewed)

Dish, Name	Days 1-2			Day 3			Day 4			Day 5			Day 6			Day 7		
	Menu			Menu			Menu			Menu			Menu			Menu		
	B	L	D	B	L	D	B	L	D	B	L	D	B	L	D	B	L	D
1. Whole fermented fish roasted	39	47	44															
2. <u>Fried Cowpea Sprouts</u>	60	59	58															
3. Mushroom hot curry	64	48	64	72	49	50												
4. <u>Cowpea Sprout Curry</u>	62	39	60															
5. Chilli in fish sauce	44	52	29	51	36	49	47	42	42									
6. Chilli in fermented fish sauce	41	36	42				37	44	37	42	38	45	55	36	32			
7. Water convolvulus, raw	62	49	41	58	44	38	26	47	48									
8. Spring onion, raw	49	45	48															
9. Neem blanched	49	47	40	28	47	45												
10. Banana	26	45	57				36	45	44	31	49	57	32	34	59			
11. <u>Steamed sago stuffed with cowpeas</u>	24	31	55	29	40	52	26	39	68									
12. Fried beef				75	42	53	68	40	54	29	50	46						
13. <u>Seasoned mashed cowpeas</u>				55	45	46	57	45	47									
14. <u>Pumpkin and cowpeas spiced soup</u>				32	45	53	43	58	49	45	56	47						
15. <u>Cowpea and fermented fish hot sauce</u>				37	59	49				52	54	51	36	56	55	39	60	38
16. Coriander leaves, raw				27	47	49							24	46	37	17	42	47
17. Custard apple				24	47	45										43	40	68
18. Beef soup							63	50	50	60	55	67						
19. Chinese cabbage, raw							69	36	42	47	57	45	68	40	46	49	57	51
20. Egg plant, raw							34	45	48	45	52	39				63	44	41
21. Roasted beef										70	36	42	78	46	53	68	53	65
22. Cork wood young leaves										47	37	52	26	42	38			
23. <u>Steamed cowpeas and bamboo shoot</u>													56	49	52			
24. <u>Cowpea curry</u>													44	51	53	46	57	60
25. <u>Cowpeas and pumpkin hot soup</u>													48	48	57	49	60	51
26. <u>Cowpea sago pudding</u>													22	44	58			
27. Roasted small toad																62	31	32
28. Fermented fish hot sauce																56	43	58
29. <u>Steamed glutinous rice stuffed with cowpeas</u>										30	39	53				21	49	50

KEY: B = Breakfast, L = Lunch, D = Dinner.

Table 16.4: Overall Pattern of Menu Choice

	Breakfast	Lunch	Dinner
	% of People Interviewed		
Days 1-2 menu			
(a)*	41	42	44
(b)	50	48	51
(c)	43	45	49
Day 3 menu	44	46	48
Day 4 menu	46	45	48
Day 5 menu	45	48	48
Day 6 menu	44	46	49
Day 7 menu	47	49	51

* (a) Trained people; (b) villagers who ate at food pary;
(c) villagers cooked at home.

Table 16.5: Ranking of Cowpea Dishes Between the Other Dishes in the Menu

	1-2*	Menu-Day				
		3	4	5	6	7
Fried cowpea sprouts	(1)					
Cowpea sprout curry	(2)					
Steamed sago stuffed with cowpeas	(11)	(9)	(6)			
Seasoned mashed cowpeas		(3)	(3)			
Pumpkins and cowpea spiced soup		(7)	(3)	(4)		
Cowpeas and fermented fish hot sauce		(4)		(2)	(5)	(8)
Steamed glutinous rice stuffed with cowpeas					(11)	(10)
Steamed cowpeas and bamboo shoot					(2)	
Cowpea curry					(5)	(2)
Cowpea and pumpkin hot soup					(4)	(3)
Cowpea and sago pudding					(7)	

* Taken from Table 16.2, villagers who cooked at home.

16.C Cooking of Cowpea DishesTable 16.6: Villagers Cooking Cowpea Dishes After the Cooking Demonstration

(Number of times householder cooking)

	Ban Koksri	Ban Huey Tuey	Ban Pasan	Ban Nong Pai	Ban Maung	Ban Wang Yawl	Total (Rank)	Average (Rank)
<u>After first demonstration</u>								
Fried cowpea sprout	7(6)	4(10)	42(9)	23(8)	6(10)	8(5)	90(9)	8+2.1
Cowpea sprout curry*	11(5)	7(7)	10(11)	17(11)	3(11)	7(6)	55(11)	8.5+3.8
Steamed sago stuffed with cowpea*	5(7)	7(7)	36(10)	20(10)	13(8)	7(6)	88(10)	8+1.7
<u>After Second Demonstration</u>								
Seasoned mashed cowpea	2(9)	9(6)	98(3)	23(8)	16(7)	12(3)	160(6)	6+2.5
Pumpkin and cowpea spiced soup*	16(2)	40(1)	102(2)	29(6)	19(5)	12(3)	218(2)	3+1.9
Cowpea and fermented fish hot sauce	0(10)	19(3)	115(1)	45(5)	30(3)	14(2)	223(1)	4+3.2
Steamed glutinous rice stuffed with cowpea*	17(1)	31(2)	75(4)	27(7)	40(1)	16(1)	206(3)	2.6+2.4
<u>After Third Demonstration</u>								
Steamed cowpea and bamboo shoot	0(10)	0(11)	57(8)	73(1)	24(4)	0(9)	154(8)	7.1+3.9
Cowpea curry*	12(4)	15(4)	65(6)	65(2)	10(9)	0(9)	167(5)	5.6+2.9
Cowpea and pumpkin hot soup	3(8)	7(7)	66(5)	63(3)	17(6)	0(9)	156(7)	6.3+2.1
Cowpea and sago pudding*	14(3)	11(5)	60(7)	61(4)	35(2)	1(8)	182(4)	4.8+2.3
Total number	87	150	726	446	213	77		

*Dish in cooking competition for Ban Koksri and Ban Huey Tuey
Figure in parenthesis is the rank number of most frequent cooking.

16.D Knowledge of Cowpeas and Cowpea DishesTable 16.7: The Knowledge of Cowpeas, Percentage of Villagers in the Six Villages and the Control Villagers

	Before Introduction*	After Introduction*	Control Villages
Knowing cowpeas	60+26	99+3	80+14
Growing cowpeas	28+17	66+12	31+8
Eating cowpeas	44+29	98+3	61+16

*Significant different XXX (at 1% level)

Table 16.8: Kinds of Cowpea Dishes Indicated by Villagers in Six Villages in which they knew Cowpeas Could Be Cooked
(% of People Answer, Mean \pm SD)

	Before Introduction Group Discussion Leaders and Contact Persons	After Intro- duction Villagers	Control Villages
<u>The Introduced Cowpea Dishes</u>			
Fried cowpea sprouts	-	6 \pm 4	70 \pm 13
Cowpea sprout curry	-		48 \pm 18
Steamed sago stuffed with cowpeas	10	49 \pm 23	
Seasoned mashed cowpeas Pumpkins and cowpea spiced soup	10		19 \pm 9
Cowpea and fermented fish hot sauce	10	29 \pm 16	
Steamed glutinous rice stuffed with cowpeas	35 \pm 35	25 \pm 22	64 \pm 18
Steamed cowpeas with bamboo shoot	11		41 \pm 16
Cowpea curry		19 \pm 13	5 \pm 1
Cowpeas and pumpkin hot soup		27 \pm 15	
Cowpea and sago pudding		25 \pm 22	
		39 \pm 20	
<u>Other Cowpea Dishes</u>			
Cowpeas in syrup	34 \pm 5	50 \pm 23	25 \pm 17
Cowpeas stuffed in glutinous rice dough	11 \pm 1	30 \pm 14	11 \pm 9
Cowpea salad	20 \pm 14	23 \pm 14	4 \pm 1
Miscellaneous dishes	76 \pm 58	57 \pm 36	8 \pm 9
			85

16.E The Costing of Introducing the 7-Day Menu and the Cowpeas

1. Cost of Visiting

Transportation cost	1 return trip 100 km	= 100 Bahts
Staff overtime cost	1 visiting for 3 persons	= 120 Bahts
Model I required	9 visits	= 1980 Bahts
Model II required	8 visits	= 1760 Bahts
Model III required	9 visits	= 1980 Bahts

2. Cost of Training

Cost of bring villagers to KKU = 50 Bahts per person.
 Cost of recipes handout (menu booklet) = 12 Bahts per person
 Cost of day 1-2 cooking demonstration and sprouting cowpea demonstration:

Model I	= 200 Bahts
Model II	= 100 Bahts
Model III	= 200 Bahts
Cost of training material and miscellaneous	= 200 Bahts

10 people for Model I total cost	= 1020 Bahts
2 people for Model II total cost	= 424B
10 people for Model III total cost	= 1020 Bahts

3. Gifts Giving to the Group Discussion Leader, The Contact Person and the Sub Group

The project T-shirt to each of group discussion leader and contact person cost 30 Bahts each.
 Gift value of 200 Bahts for each of contact person.
 Shopping bag or cap for the sub group 10 Bahts each.

Gifts cost for Model I	= 1300 Bahts
Gifts cost for Model II	= 460 Bahts
Gifts cost for Model II	= 1300 Bahts

4. Cost of Food in the Food Party

Quantity of 20 times food for days 1-2 menu for a family.
 Cost of food for days 1-2 for the family = 65 Bahts
 Cost of the food in the party for each model = 1300 Bahts

5. Cost of Display in the Food Party

Display of days 1-2 menu, raw ingredient and cooked menu	= 130 Bahts
Total cost of preparing photographs for the display 7,000 Bahts, this could be used to display 20 villages therefore cost of photographs display per village	= 350 Bahts
Total cost of display in the food party for each model	= 480 Bahts

6. Cost of Entertaining and Set up the Party

Cost of renting movie film	= 200 Bahts
Electricity and instrument depreciation	= 300 Bahts
Prize giving to the food party	= 300 Bahts
(5 ice containers 40 Bahts each and 10 set of stationery 10 Bahts each)	
Total cost for each model	= 800 Bahts

7. Cost of Cowpea Seeds given during the Introduction and After the Introduction

The number of villagers whom cowpea seeds were given for cooking at home for Model I were taken from the average number of Ban Koksri and Ban Huey Tuey, for Model II from the average number of Ban Pasan and Ban Nong Pai and for Model III from the number of Ban Maung only. The cowpea seeds cost 8 Bahts per kg.

<u>Cowpea given per person</u>	<u>MODEL 1</u>		<u>MODEL II</u>		<u>MODEL III</u>	
	<u>No.</u>	<u>Cost (Baht)</u>	<u>No.</u>	<u>Cost (Baht)</u>	<u>No.</u>	<u>Cost (Baht)</u>
At training 380 g	10	30.40	2	6.08	10	30.46
At food party 190 g	32	48.64	24	36.48	32	48.64
At 1st cooking competition 380 g	13	39.52	28	85.12	17	51.68
At 2nd cooking demonstration Model I&III 520 g						
Model II 900 g	18	74.88	28	201.6	40	166.4
At 3rd cooking demonstration Model I&III 426 g						
Model II 1060 g	17	57.12	25	212.0	40	134.40
Two weeks after introduction 660 g	16	84.48	25	132.0	40	211.2
Total Cost		335		673		643

8. Cost of Running Cooking Demonstration

Two sets of food in the 7 day menus were used for the cooking demonstration.

Days 1-2	cost	65 Bahts per set	=	130
Day 3		78 Bahts	=	156
Day 4		78 Bahts	=	154
Day 5		77 Bahts	=	172
Day 6		86 Bahts	=	172
Day 7		89 Bahts	=	178
TOTAL			=	<u>946</u> Bahts

Cost of charcoal for each cooking cost 5 Bahts total for 3 cooking demonstrations = 15 Bahts. Miscellaneous cost for running cooking demonstration - e.g. electricity, batteries and gasoline for electrical generator, 100 baht for each demonstration, 3 cooking demonstrations = 300 Bahts
 Total of three cooking demonstration for each of Model I and Model II = 1261 Bahts.

9. Cost of Running Cooking Demonstration

Cost of the three programme video production, approximately 5200 baht, this could be used to show to 20 villages, therefore the cost of video production for each village = 260 baht.

Cost of video equipment depreciation, 100 Bahts for each demonstration total cost of the three demonstrations = 300 Bahts
 Cost of renting 2 video movies = 40 Bahts, three demonstrations = 120 Bahts
 Cost of electricity or gasoline for the electrical generator = 50 Bahts each, demonstration, three demonstrations = 150 Bahts

Total cost of running video cooking demonstration for Model III = 830 Bahts

10. Cost of Price Given in the Cooking Competition

Cooking Competition for Best Dish: Three set of prizes, 1st, 2nd and 3rd, and the T-shirt for everyone who enters the competition.

Cost for first prize	= 120 Bahts,	
second prize	= 80 Bahts,	
third prize	= 50 Bahts,	
cost per set	= 250 Bahts,	
Total cost 3 sets		= 750 Bahts
T-shirt for 9 persons for each competition,	cost for	
Three competitions		= 810 Bahts
Total cost for Model I		= 1560 Bahts

Cooking Competition for Best Cook: T-shirts were given to the person who had cooked a significant number in each cooking competition, 8 persons were given the T-shirts for each competition, total cost for three competition

	= 720 bahts
--	-------------

Ten prizes were given for the final record of cooking competition. The costs were:

First prize	= 200 Bahts
Second prize	= 150 Bahts
Third prize	= 100 Bahts
Fourth prize	= 80 Bahts
Fifth prize	= 60 Bahts
Sixth to tenth prizes	= 40 Bahts each
Total cost for Model II	= 1510 Bahts

11. Cost of the Ingredients for Cooking

In Model III cooking at home, sago were given to the villages after the first and third cooking demonstration, 1 bag cost 4 Bahts to each of 80 persons.

Total cost	= 360 Bahts
------------	-------------

12. The Total Cost of the Introduction in One Village

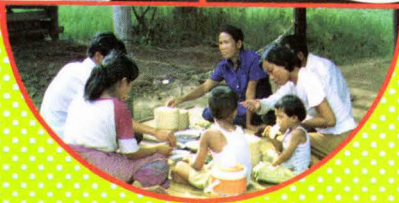
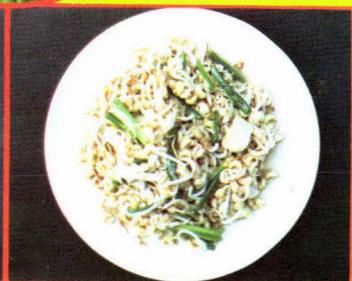
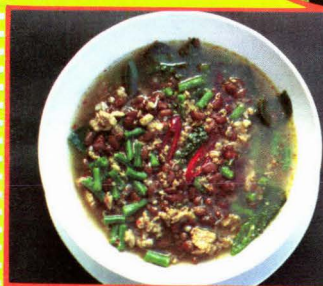
Model I (Group Discussion - Food Party - Cooking Demonstration - Competition for Best Dish)	= 10036 Bahts
--	---------------

Model II (Person Contact - Food Party - Cooking Demonstration - Competition For best Cook)	= 8668 Bahts
---	--------------

Model III (Group Discussion - Food Party - Video Cooking Demonstration - Cooking at Home)	= 8713 Bahts
--	--------------

ถั่วพุ่ม

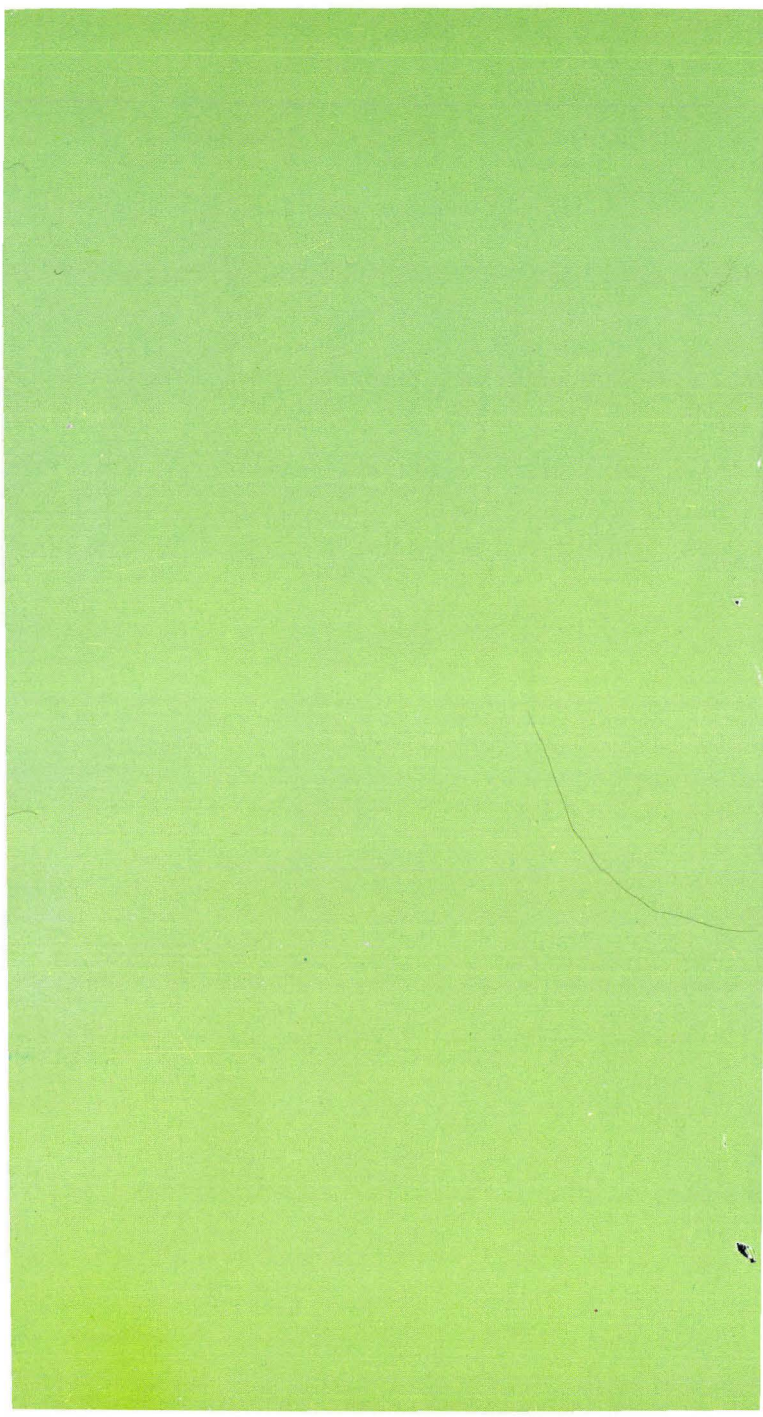
ในรายการอาหารประจำวัน



**โครงการวิจัยอาหารถั่ว
ภาควิชาผลิตภัณฑ์เกษตร
คณะเกษตรศาสตร์
มหาวิทยาลัยขอนแก่น**

ถั่วพุ่ม

โครงการวิจัยอาหารถั่ว
ภาควิชาผลิตภัณฑ์เกษตร
คณะเกษตรศาสตร์ มหาวิทยาลัยขอนแก่น
(HOME PROCESSED LEGUMES (THAILAND))



ถั่วพุ่ม

ในรายการอาหารประจำวัน

โครงการวิจัยอาหารถั่ว
ภาควิชาผลิตภัณฑ์เกษตร
คณะเกษตรศาสตร์
มหาวิทยาลัยขอนแก่น

(HOME PROCESSED LEGUMES (THAILAND))



★ วัตถุประสงค์ของโครงการ

เพื่อปรับปรุงคุณค่าทางอาหารของอาหารประจำวันชาวชนบทภาคตะวันออกเฉียงเหนือ โดยส่งเสริมการรับประทานอาหารถั่ว ซึ่งเป็นอาหารที่มีราคาถูก และมีปริมาณโปรตีนสูงมากขึ้น

★ วัตถุประสงค์ของเอกสารเล่มนี้

ทางโครงการอาหารถั่วได้ศึกษาค้นคว้าและพัฒนาสูตรอาหารถั่ว โดยใช้ถั่วพุ่มแดงเป็นวัตถุดิบที่สำคัญ เนื่องจากถั่วพุ่มแดงเป็นถั่วที่ให้ผลผลิตค่อนข้างสูง ปลูกง่าย ทนต่อสภาพความแห้งแล้ง และมีคุณค่าทางอาหารสูง

สูตรอาหารถั่วพุ่มที่ทางโครงการฯ ได้พัฒนาขึ้นนี้ ประกอบด้วยสูตรอาหารคาวและหวาน ได้ใช้ถั่วพุ่มแดงเป็นส่วนประกอบในปริมาณที่มากที่สุดที่อยู่ในเกณฑ์ยอมรับของผู้บริโภค เพื่อให้ได้ปริมาณโปรตีนสูงสุด

ทางโครงการฯ ได้นำเอาสูตรอาหารถั่วพุ่มที่คิดค้นขึ้นนี้มา สอดแทรกไว้ในรายการอาหารประจำวัน โดยได้คิดค้นรายการอาหาร ประจำวันขึ้น 7 วัน ซึ่งรายการอาหารประจำวันนี้จะประกอบไปด้วย อาหารพื้นบ้านที่นิยมรับประทานหรือรับประทานกันอยู่แล้วเป็น ประจำและอาหารถั่วพุ่ม รายการอาหารประจำวัน 7 วันนี้ เป็น รายการอาหารที่มีราคาถูก สามารถหาวัตถุดิบหรือส่วนประกอบ ได้ง่าย และมีคุณค่าทางอาหารครบถ้วนตามความต้องการของร่างกาย ในแต่ละวัน

ปริมาณอาหารที่รับประทานในรายการอาหารประจำวันทั้ง 7 วันนี้ ได้คำนวณไว้สำหรับครอบครัวที่มีสมาชิก 7 คน ซึ่งจะ ประกอบไปด้วย ผู้ใหญ่ 4 คน และเด็ก 3 คน มีอายุต่าง ๆ ดังนี้คือ เด็กหญิงหรือชายอายุ 1-3 ปี 1 คน, เด็กชายอายุ 10-12 ปี 1 คน, เด็กหญิงอายุ 10-12 ปี 1 คน, ผู้หญิงอายุ 20-30 ปี 1 คน, ผู้หญิง อายุ 40-49 ปี 1 คน, ผู้ชายอายุ 20-30 ปี 1 คน, ผู้ชายอายุ 40-49 ปี 1 คน

หากครอบครัวที่มีสมาชิก 7 คนนี้รับประทานอาหารประจำวัน แต่ละวันตามรายการและในปริมาณที่แนะนำนี้ครบถ้วน จะได้รับ สารอาหารคือ โปรตีน ไขมัน แคลอรี แร่ธาตุ และวิตามินต่าง ๆ ครบถ้วน และสมดุลย์ตามความต้องการของร่างกายในหนึ่งวันของ ทั้งครอบครัว สำหรับครอบครัวที่มีสมาชิกมากกว่าหรือน้อยกว่า จำนวนดังกล่าว ก็ให้รับประทานอาหารในปริมาณที่เพิ่มขึ้นหรือ ลดลงเป็นสัดส่วนกับปริมาณที่แนะนำ

ทางโครงการฯ จึงได้นำรายการอาหารประจำวัน 7 วัน ซึ่ง ประกอบด้วยอาหารพื้นบ้านและอาหารถั่วพุ่มนี้มาแนะนำและเผยแพร่ โดยหวังว่าจะเป็นส่วนหนึ่งของการช่วยแก้ปัญหาการเกิดโรค ขาดอาหารของประชากรในภาคตะวันออกเฉียงเหนือ และทาง โครงการฯ หวังเป็นอย่างยิ่งว่าจะมีผู้นำรายการอาหารทั้ง 7 วันนี้ ไปส่งเสริมเผยแพร่และทำอาหารรับประทานต่อไป



สารบัญ

รายการอาหารประจำวัน 7 วัน

วันที่ 1, 2	6
วันที่ 3, 4	7
วันที่ 5, 6	8
วันที่ 7	9

ตารางคุณค่าทางอาหาร

ของรายการอาหารประจำวัน 7 วัน _____ 10, 11

สูตรอาหาร ฯลฯ

รายการอาหารวันที่ 1, 2	12
รายการอาหารวันที่ 3	16
รายการอาหารวันที่ 4	20
รายการอาหารวันที่ 5	22
รายการอาหารวันที่ 6	25
รายการอาหารวันที่ 7	30

ภาคผนวก

วิธีเพาะถั่วงอก	31
วิธีทำถั่วม้วน	31



รายการอาหาร ประจำวัน 7 วัน



วันที่ 1

วันที่ 2



ข้าวเหนียวหนึ่ง
ปลาร้าทั้งตัว
ผัดถั่วงอกถั่วพุ่ม
แกงเห็ด
แกงเผ็ดถั่วงอกถั่วพุ่ม
พริกน้ำปลา
น้ำปลาร้าใส่พริก
ผักนึ่ง
ต้นหอม
สะเดาลวก
กล้วยน้ำว้า
สาकुใส่ถั่วพุ่ม

ข้าวเหนียวหนึ่ง
ปลาร้าทั้งตัว
ผัดถั่วงอกถั่วพุ่ม
แกงเห็ด
แกงเผ็ดถั่วงอกถั่วพุ่ม
พริกน้ำปลา
น้ำปลาร้าใส่พริก
ผักนึ่ง
ต้นหอม
สะเดาลวก
กล้วยน้ำว้า
สาकुใส่ถั่วพุ่ม

หมายเหตุ ปริมาณอาหารที่แสดงในรูปสำหรับครอบครัวที่มีสมาชิก 7 คน



รายการอาหาร ประจำวัน 7 วัน



วันที่ 3

วันที่ 4



ข้าวเหนียวหนึ่ง
เนื้อทอด
ซूपถั่วพุ่ม
แกงเห็ด
แกงฟักทองย่านางถั่วพุ่ม
พริกน้ำปลา
น้ำพริกปลาร้าถั่วพุ่ม
ผักบุ้ง
ผักชี
สะเดาลวก
น้อยหน้า
สาकुใส่ถั่วพุ่ม

ข้าวเหนียวหนึ่ง
เนื้อทอด
ซूपถั่วพุ่ม
ต้มเนื้อ
แกงฟักทองย่านางถั่วพุ่ม
พริกน้ำปลา
น้ำปลาร้าใส่พริก
ผักกาดขาว
ผักบุ้ง
มะเขือ
กล้วยน้ำว้า
สาकुใส่ถั่วพุ่ม



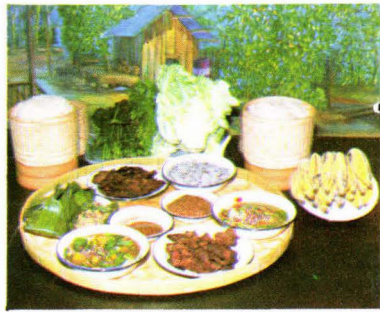


รายการอาหาร ประจำวัน 7 วัน



วันที่ 5

วันที่ 6



ข้าวเหนียวหนึ่ง
เนื้อย่าง
เนื้อทอด
ต้มเนื้อ
แกงผักทองย่านางถั่วพุ่ม
น้ำปลาร้าใส่พริก
น้ำพริกปลาร้าถั่วพุ่ม
ผักกาดขาว
มะเขือ
ยอดแคหลวง
กล้วยน้ำว้า
ข้าวต้มผัดถั่วพุ่ม

ข้าวเหนียวหนึ่ง
เนื้อย่าง
หมกหน่อไม้ถั่วพุ่ม
แกงป่าถั่วพุ่ม
แกงอ่อมถั่วพุ่ม
น้ำปลาร้าใส่พริก
น้ำพริกปลาร้าถั่วพุ่ม
ผักกาดขาว
ผักชี
ยอดแคหลวง
กล้วยน้ำว้า
สาकुถั่วพุ่มแกงบวด





รายการอาหาร ประจำวัน 7 วัน



วันที่ 7



ข้าวเหนียวหนึ่ง
เนื้อย่าง
เจียดย่าง
แกงป่าถั่วพุ่ม
แกงอ่อมถั่วพุ่ม
น้ำพริกปลาร้า

น้ำพริกปลาร้าถั่วพุ่ม
ผักกาดขาว
มะเขือ
ผักชี
น้อยหน่า
ข้าวต้มผัดถั่วพุ่ม



	วันที่ 1-2	วันที่ 3
สารอาหาร		
แคลอรี	18,714	18,139
(ก.ก.แคลอรี)		
โปรตีน*	468	499
(กรัม)		
ไขมัน	374	362
(กรัม)		
เยื่อใย**	230	234
(กรัม)		
แคลเซียม	4,298	3,400
(มิลลิกรัม)		
ฟอสฟอรัส	10,746	8,142
(มิลลิกรัม)		
ธาตุเหล็ก	228	158
(มิลลิกรัม)		
วิตามินเอ	54,600	54,600
(ยูนิตสากล)		
ไทอามิน	7.49	7.26
(มิลลิกรัม)		
ไรโบฟลาวิน	10.36	10.01
(มิลลิกรัม)		
ไนอาซิน	149	159
(มิลลิกรัม)		
วิตามินซี	155	463
(มิลลิกรัม)		
กรดโฟลิก	1,789	2,515
(ไมโครกรัม)		

วันที่ 4	วันที่ 5	วันที่ 6	วันที่ 7
18,317	18,636	19,880	18,177
509	497	569	570
366	373	397	363
242	215	236	225
3,400	3,400	3,512	3,437
8,443	7,759	8,781	8,592
129	244	202	113
54,600	54,600	54,600	54,600
7.32	7.45	7.95	7.27
10.07	10.25	10.93	9.99
122	123	131	134
904	364	510	854
2,931	1,808	2,567	2,010

** หมายถึง ไคเอทตารีไฟเบอร์ (Dietary Fibre)

สูตรอาหารและปริมาณแนะนำของ
รายการอาหารประจำวัน 7 วัน
สำหรับครอบครัวสมาชิก 7 คน

รายการอาหารวันที่ 1, 2

ข้าวเหนียวหนึ่ง

ใช้ข้าวสารเหนียว 3.5 กิโลกรัม, หรือข้าวเหนียวหนึ่งสุกแล้ว
5. กิโลกรัม

ปลาร้าทั้งตัว

ใช้ปลาร้า 2 ถ้วยของหวาน หรือปลาร้าตัวขนาด
กลาง 27 ตัว (4.2 ซีด
หรือ 420 กรัม)

วิธีทำ

นำปลาร้าห่อใบตอง แล้วปิ้งให้สุก



ผัดถั่วงอกถั่วงพุ่ม

เครื่องปรุง

ถั่วงอกถั่วงพุ่ม*	10	ถ้วยของหวาน หรือ 6.5 ซีด (650 กรัม)
เต้าหู้แข็ง	1½	แผ่น
กระเทียม	5	กลีบ
น้ำปลา	5	ช้อนตักกะสี
น้ำมันหมู. (หรือน้ำมันพืช)	5	ช้อนตักกะสี
ต้นหอม	6	ต้น

วิธีทำ

หั่นเต้าหู้เป็นชิ้นสี่เหลี่ยมพอประมาณ ต้มหอมหั่นเป็นชิ้น ๆ พักไว้
กระเทียมทุบสับแล้ว นำมาเจียวพอเหลือง ใส่เต้าหู้และถั่วงอกลง
ผัดปรุงรสด้วยน้ำปลา พอสุกใส่ต้นหอมผัดให้เข้ากัน ยกลง

แกงหืด

เครื่องปรุง

เห็ดฟาง	4	ถ้วยของหวาน หรือ 5.7 ชีด (570 กรัม)
พริกขี้หนูแห้ง	27	เม็ด
หอมแดง	2	หัว
น้ำปลา	5	ช้อนตักกะสี
น้ำปลาร้า	2	ช้อนตักกะสี
ใบแมงลัก	1	กำ
ต้นหอม	11	ต้น
ตะไคร้	1	ต้น
น้ำ	2½	ถ้วยของหวาน

วิธีทำ

โขลกเครื่องแกง มีพริกขี้หนูแห้ง หอมแดง ตะไคร้ ให้ละเอียด
พักไว้ ต้มน้ำให้เดือด ใส่เครื่องแกงลงไปและใส่เห็ดฟาง ปรุงรส
ด้วยน้ำปลาร้า น้ำปลา ใส่ต้นหอม ใบแมงลัก พอเดือดสักครู่ ยกลง

แกงเผ็ดถั่วงอกถั่วงู่ม

เครื่องปรุง

เนื้อวัว	1	ถ้วยของหวาน หรือ 1.4 ชีด (140 กรัม)
น้ำกะทิ	3½	ถ้วยของหวาน หรือใช้มะพร้าว ครึ่งกิโลกรัม
ถั่วงอกถั่วงู่ม*	3	ถ้วยของหวาน หรือ 2.3 ชีด (230 กรัม)
น้ำตาลมะพร้าว	½	ช้อนตักกะสี
น้ำปลา	3	ช้อนตักกะสี
พริกขี้พ้าเขียว-แดง	4	เม็ด



ใบมะกรูด	8	ใบ
ใบโหระพา	1/2	ถ้วยของหวาน
ข่า	4	แว่น
ตะไคร้	1/2	ต้น
หอมแดง	3	หัว
พริกชี้ฟ้าแห้งแกะเมล็ดแล้ว	21	เม็ด (หากไม่แกะเมล็ดใช้ 13 เม็ด)
กระเทียม	18	กลีบ
กะปิ	1/2	ช้อนตักกะสี
ผิวมะกรูด	1/2	ช้อนตักกะสี
รากผักชี	2	ราก
พริกไทยป่น		เล็กน้อย
เกลือ	1/2	ช้อนตักกะสี

วิธีทำ

คั้นกะทิ แยกหัวและหางไว้ต่างหาก โขลกเครื่องแกงให้ละเอียด นำหัวกะทิตั้งไฟ เคี่ยวให้แตกมัน ผัดเครื่องแกงให้หอม นำเนื้อลง ผัด ปรงรสด้วยน้ำปลา น้ำตาล ใส่หางกะทิ ต้มให้เนื้อเปื่อย จึงใส่ ถั่วงอกพร้อมใบมะกรูด ใบโหระพา พริกชี้ฟ้า ยกลง

พริกน้ำปลา

ใช้พริกป่น 1 ช้อนตักกะสี และน้ำปลา 3 ช้อนตักกะสี

น้ำปลาร้าใส่พริก

ใช้พริกป่น 1/2 ช้อนตักกะสี และน้ำปลาร้าที่ต้มสุกแล้ว 2 1/2 ช้อนตักกะสี

ผักจิ้ม

ผักบุ้ง	136	ต้น หรือ 3 ซีดครึ่ง (300 กรัม)
ต้นหอม	20	ต้น (4 มัดหรือ 125 กรัม)
สะเดาลวก	75	ยอด (5 มัดหรือ 370 กรัม)

กล้วยน้ำว้า

กล้วยน้ำว้า	9	ผล
-------------	---	----



สาकुใส่ถั่วพุ่ม

เครื่องปรุง

เมล็ดถั่วพุ่ม	4	ช้อนตักกะสี
หอมแดง	1	หัว
น้ำปลา	1/2	ช้อนตักกะสี
น้ำตาลมะพร้าว	เล็กน้อย	
สาकु	1	ถ้วยของหวาน หรือ 70 กรัม
กระเทียม	3	กลีบ
น้ำมันพืช	1	ช้อนตักกะสี
น้ำร้อน	1	ถ้วยของหวาน
เกลือ	เล็กน้อย	

วิธีทำ

ก่อนทำแช่ถั่ว 1 คืน ล้างเอาเปลือกออก แล้วนึ่งให้สุก โขลกหยาบ ๆ พักไว้ ทำตัวสาकुโดยล้างสาकुแล้วผึ่งให้แห้ง นวดด้วยน้ำร้อนให้เหนียว ปั้นเป็นก้อน ๆ แล้วพักไว้ ทำใส่สาकुโดยนำถั่วมาผัดและปรุงรสด้วย น้ำปลา น้ำตาล ใส่หอมแดง ที่สับเป็นชิ้นเล็ก ๆ ผัดพอสุก ทิ้งให้เย็นนำมาปั้นเป็นก้อน ๆ พักไว้ นำสาकुมาแผ่เป็นแผ่นบาง ๆ ใส่ใส่แล้วหุ้มให้มิด แล้วไปนึ่งให้สุกโรยด้วยกระเทียมเจียว จะได้สาकुประมาณ 35 ลูก

รายการอาหารวันที่ 3

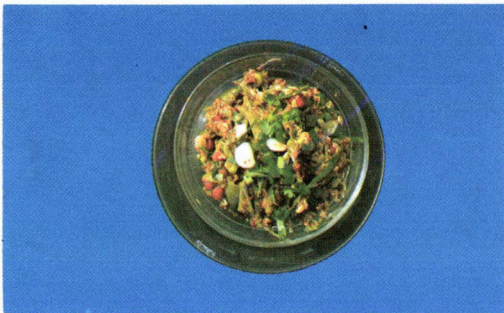
ข้าวเหนียวหนึ่ง

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

เนื้อทอด

ใช้เนื้อวัว 9 ชีด หรือ 900 กรัม

แล้วแล่นเนื้อเป็นชิ้นบางพอควร ปิ้งรสตามต้องการ นำไปทอดให้สุก



ซุปลั้วพุ่ม

เครื่องปรุง

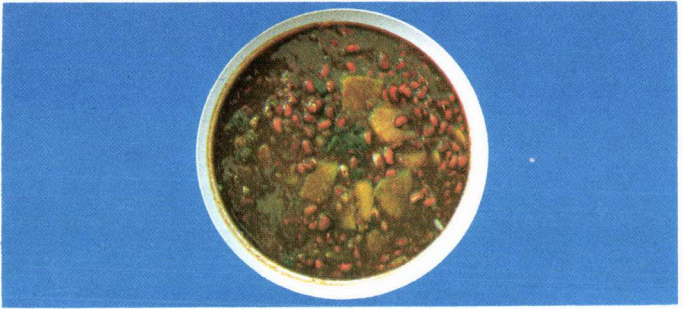
เมล็ดถั่วพุ่ม	1	ซ็อนสังกะสี
ถั่วพุ่มฝักอ่อน	15	ฝัก หรือถั่วฝักยาว 6 ฝัก (240 กรัม)
ถั่วพุ่มป่น**	2	ซ็อนสังกะสี
พริกขี้หนูแห้งป่น	2	ซ็อนสังกะสี
หอมแดง	4	หัว
สาระแหน่	4	ยอด
ต้นหอม	3	ต้น
ผักชี	1	ต้น
น้ำปลาร้าต้มสุก	2	ซ็อนสังกะสี
กระเทียม	15	กลีบ
น้ำ	1½	ซ็อนสังกะสี
เกลือ	½	ซ็อนสังกะสี

วิธีทำ

นำเมล็ดถั่วพุ่มที่แช่น้ำ 1 ถังแล้วมาต้มหรือึ่งให้สุก นำไปโขลกพอแตก พักไว้ ต้มถั่วพุ่มฝักอ่อนให้เปื่อยใส่เกลือขณะต้ม ถั่วถั่วพุ่มป่นให้เหลือ เผาหอม กระเทียมนำมาโขลกให้ละเอียดใส่ถั่วฝักอ่อนที่ต้มเปื่อยแล้ว โขลกพอแหลก ปรงรสด้วยน้ำปลาร้า พริกป่น ใส่เมล็ดถั่วพุ่ม ถั่วพุ่มป่น น้ำต้มถั่วที่เหลือ ใบสะระแหน่ ผักชีหั่นฝอย ตักใส่ภาชนะ

แกงเห็ด

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 1



แกงผักทองย่านางถั่วพุ่ม

เมล็ดถั่วพุ่ม	1/2	ถั่วของหวาน
ถั่วพุ่มป่น**	1	ซ็อนสังกะสี
ตะไคร้	1/2	ต้น
หอมแดง	2	หัว
กระเทียม	4	กลีบ
พริกชี้ฟ้าแดง	3	เม็ด
น้ำปลาร้า	1	ซ็อนสังกะสี
น้ำย่านาง	1 1/2	ถั่วของหวาน
ใบแมงลัก	1	ก้าน
ผักทอง	2	ชีก (90 กรัม)
เกลือ	1/2	ซ็อนสังกะสี
น้ำ	1/2	ถั่วของหวาน

วิธีทำ

แช่เมล็ดถั่ว 1 คืน แล้วต้มหรือนึ่งให้สุก พักไว้ คั้นใบย่านางแล้วกรอง (ใช้ใบย่านางประมาณ 20 ใบต่อน้ำ 1½ ถ้วยของหวาน) โขลกเครื่องแกงมีตะไคร้ หอมแดง พริก เกล็ด พักไว้ ต้มน้ำย่านางพอเดือดใส่เครื่องแกง ใส่เมล็ดถั่วพุ่ม พักทองที่หั่นเป็นชิ้น ถั่วพุ่มป่นคั่ว ปรงรสด้วยน้ำปลาร้า พอเดือดใส่ใบแมงลัก ยกลง

พริกน้ำปลา

ใช้พริกป่น	2	ช้อนตักกะสี
และน้ำปลา	6	ช้อนตักกะสี



น้ำพริกปลาร้า
ถั่วพุ่ม

เครื่องปรุง		
เนื้อปลาร้า	1	ถ้วยของหวาน
หอมแดง	3	หัว
กระเทียม	28	กลีบ
ถั่วพุ่มป่น**	½	ถ้วยของหวาน
เนื้อมะขามเปียก	1	ฝัก
ข่า	1	แฉ่ง
พริกขี้หนูแห้งป่น	2	ช้อนตักกะสี
ใบมะกรูด	4	ใบ
น้ำ	½	ถ้วยของหวาน

วิธีทำ

สับเนื้อปลาร้าพอละเอียด พักไว้ คั้นน้ำมะขามเปียก คั่วถั่วพุ่มป่นให้เหลือง คั่วหอม กระเทียม ข่า พริกป่น แล้วโขลกให้ละเอียด ใส่เนื้อปลาร้าสับ น้ำมะขาม ถั่วพุ่มป่น โขลกพอเข้ากันดี แล้วนำไปคั่วบนเตาให้สุกยกลงโรยด้วยใบมะกรูดหั่นฝอย

ผักจิ้ม

ผักบุ้ง	102	ต้น (6 มัดหรือ 250 กรัม)
ผักชี	25	ต้น (5 มัดหรือ 75 กรัม)
สะเดาลวก	76	ยอด (5 มัดหรือ 370 กรัม)

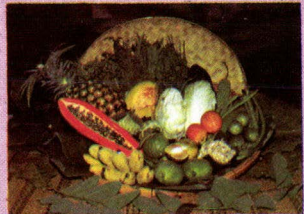
น้อยหน้า

น้อยหน้า	7	ผล
----------	---	----

สาकुใส่ถั่วพุ่ม

เครื่องปรุง		
เมล็ดถั่วพุ่ม	8	ช้อนตักกะสี
หอมแดง	2	หัว
น้ำปลา	1	ช้อนตักกะสี
น้ำตาลมะพร้าว	1/2	ช้อนตักกะสี
สาकु	1	ถ้วยของหวาน
กระเทียม	5	กลีบ
น้ำมันพืช	1 1/2	ช้อนตักกะสี
น้ำร้อน	1	ถ้วยของหวาน
เกลือ		เล็กน้อย

วิธีทำ เช่นเดียวกันกับรายการอาหารวันที่ 1



อาหาร 3 หมู่
ที่ร่างกาย
ต้องการ
ทุกวัน

รายการอาหารวันที่ 4

ข้าวเหนียวหนึ่ง

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

เนื้อทอด

ใช้เนื้อวัว 6 ซีดหรือ 600 กรัม

ซूपถั่วพุ่ม

เครื่องปรุง		
เมล็ดถั่วพุ่ม	2	ซ็อนสังกะสี
ถั่วพุ่มฝักอ่อน	30	ฝัก หรือถั่วฝักยาว 13 ฝัก (500 กรัม)
ถั่วพุ่มป่น**	4	ซ็อนสังกะสี
พริกขี้หนูแห้งป่น	2	ซ็อนสังกะสี
หอมแดง	9	หัว
สะระแหน่	9	ยอด
ต้นหอม	6	ต้น
ผักชี	3	ต้น
น้ำปลาร้าต้มสุก	4	ซ็อนสังกะสี
กระเทียม	30	กลีบ
น้ำ	1/2	ถ้วยของหวาน
เกลือ	1	ซ็อนสังกะสี

วิธีทำ เช่นเดียวกับรายการอาหารวันที่ 1

ต้มเนื้อ

เครื่องปรุง		
เนื้อวัว	2	ถ้วยของหวาน หรือ 4.3 ซีด (430 กรัม)

ข่า	9	แฉ่น
พริกชี้หนูแห้งป่น	เล็กน้อย	
ต้นหอม	14	ต้น
น้ำปลา	1	ช้อนตักกะสี
ผักชี	1	ต้น
น้ำมะนาว	1	ช้อนตักกะสี
ตะไคร้	2	ต้น
ใบมะกรูด	6	ใบ
น้ำ	4½	ถ้วยของหวาน

วิธีทำ

หั่นเนื้อเป็นชิ้น ๆ พักไว้ ต้มน้ำให้เดือดใส่ข่า ตะไคร้ ใบมะกรูด ใส่เนื้อ เคี่ยวให้เปื่อย ปรุงรสด้วยพริกชี้หนูแห้งป่น น้ำปลา น้ำมะนาว ต้นหอม ผักชี ยกลง

แกงผักทองย่านางถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 3

พริกน้ำปลา

ใช้ปริมาณเช่นเดียวกับรายการอาหารวันที่ 1

น้ำปลาร้าใส่พริก

ใช้ปริมาณเช่นเดียวกับรายการอาหารวันที่ 1

ผักจิ้ม

ผักกาดขาว	4	ต้น (930 กรัม)
ผักบุ้ง	170	ต้น (10 มัดหรือ 410 กรัม)
มะเขือ	17	ลูก (340 กรัม)

กล้วยน้ำว้า

กล้วยน้ำว้า	9	ผล
-------------	---	----

สาเกุ้ใส่ถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 1

รายการอาหารวันที่ 5

ข้าวเหนียวหนึ่ง

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

เนื้อย่าง

ใช้เนื้อวัว 2½ จีด (250 กรัม)
แล่เนื้อเป็นแผ่นบาง ๆ นำไปย่างให้สุก

เนื้อทอด

ใช้เนื้อวัว 4 จีด (400 กรัม)

ต้มเนื้อ

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 4

แกงฟักทองย่านางถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 3

น้ำปลาร้าใส่พริก

ใช้ปริมาณเช่นเดียวกับรายการอาหารวันที่ 1

น้ำพริกปลาร้าถั่วพุ่ม

เครื่องปรุง

เนื้อปลาร้า (สับละเอียด) 1 ช้อนสังกะสี หรือใช้ปลาร้า
ประมาณ 2 ตัว

หอมแดง 1 หัว

กระเทียม 4 กลีบ

ถั่วพุ่มป่น**	1	ช้อนตักกะสี
เนื้อมะขามเปียก	1	ฝัก
ข้า้	4	แวน
พริกขี้หนูป่น	1/2	ช้อนตักกะสี
น้ำ	1	ช้อนตักกะสี
ใบมะกรูด	1	ใบ

วิธีทำ เช่นเดียวกับรายการอาหารวันที่ 3

ผักจิ้ม

ผักกาดขาว	1 1/2	ต้น (260 กรัม)
มะเขือ	60	ลูก (1300 กรัม)
ยอดแคหลวง	49	ยอด (3 มัดหรือ 500 กรัม)

กล้วยน้ำว้า

กล้วยน้ำว้า	15	ลูก
-------------	----	-----



ข้าวต้มผัดถั่วพุ่ม

เครื่องปรุง		
ข้าวเหนียว	1/2	ถ้วยของหวาน
กะทิ	1/2	ถ้วยของหวาน
น้ำตาลทราย	1	ช้อนตักกะสี

เมล็ดถั่วพุ่ม
กล้วยน้ำว้า
น้ำ
เกลือ

2 ช้อนตักกะสี
1 ลูก
1/2 ถ้วยของหวาน
เล็กน้อย

วิธีทำ

แช่เมล็ดถั่วพุ่มไว้ 1 คืน แล้วต้มหรือนึ่งให้สุก พักไว้ คั้นน้ำกะทิ เอาแต่หัวกะทิ (ใช้มะพร้าว 1 ถ้วยของหวาน) ล้างข้าวเหนียวสง ขึ้นให้สะเด็ดน้ำ นำไปผัดกับกะทิจนแห้ง แล้วใส่เมล็ดถั่วพุ่ม แล้วนำไปแผ่ใส่ในใบตอง ใส่กล้วยน้ำว้าที่ผ่าซีก ห่อมัดให้แน่นนำไป นึ่งไฟแรงจนสุก



รายการอาหารวันที่ 6

ข้าวเหนียวนึ่ง

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

เนื้อย่าง

ใช้เนื้อวัว

1.05 กิโลกรัม (1 กิโลกรัมครึ่งขีด)



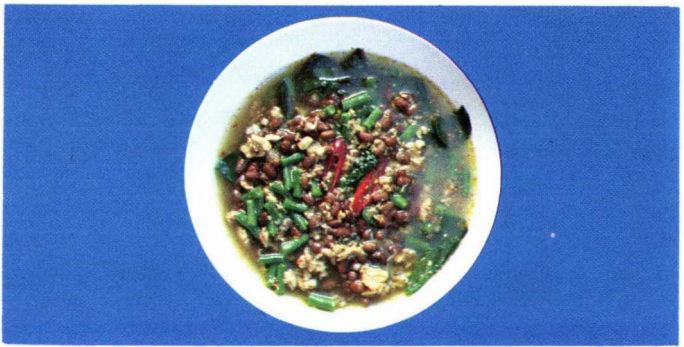
หมกหน่อไม้ถั่วพุ่ม

เครื่องปรุง		
หน่อไม้	3	หน่อ (240 กรัม)
เมล็ดถั่วพุ่ม	1/2	ถั่วของหวาน
น้ำปลาร้า	4	ซ็อนสังกะสี
ข่า	1/2	ซ็อนสังกะสี
ตะไคร้	2	ต้น
หอมแดง	4	หัว
กระเทียม	28	กลีบ
พริกขี้เผือก	1	เม็ด
ใบแมงลัก	9	ก้าน

น้ำย่านาง	1	ถ้วยของหวาน
น้ำ	1	ถ้วยของหวาน

วิธีทำ

แช่เมล็ดถั่วพุ่ม 1 คืน แล้วต้มหรือนึ่งให้สุก โขลกพอแตก พักไว้
คั้นน้ำย่านางกรองเอาแต่น้ำ (ใช้ใบย่านาง 10 ใบ น้ำ 1 ถ้วยของ
หวาน) ชูดหน่อไม้ที่ต้มแล้วให้เป็นเส้นเล็ก ๆ โขลกข่า ตะไคร้
หอม กระเทียม พริกหยาบ ๆ นำไปผสมกับน้ำย่านาง ใส่หน่อไม้
ใบแมงลัก ถั่วพุ่มต้ม คนให้เข้ากัน ปรงรสด้วยน้ำปลาร้า นำไปห่อ
ใส่ใบตอง นึ่งให้สุก



แกงป่าถั่วพุ่ม

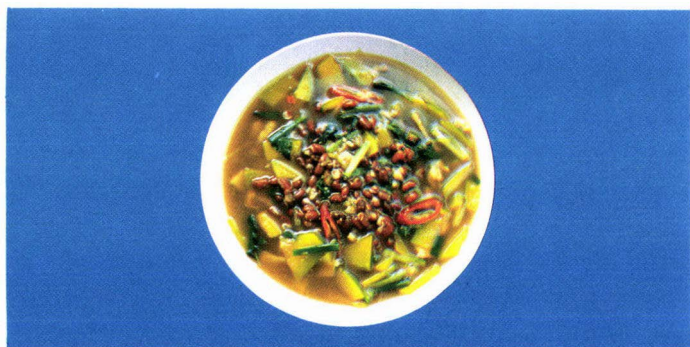
เครื่องปรุง

เนื้อไก่	1/2	ถ้วยของหวาน
เมล็ดถั่วพุ่ม	2	ช้อนตักกะสี (หรือประมาณ 80 กรัม)
ถั่วพุ่มฝักอ่อน	13	ฝัก
ใบมะกรูด	5	ใบ
ใบกระเพรา	18	ใบ
น้ำปลา	1	ช้อนตักกะสี
น้ำตาลมะพร้าว	เล็กน้อย	
น้ำมันพืช	1	ช้อนตักกะสี
พริกชี้ฟ้าเขียวหรือแดง	1	เม็ด
ข่า	1	แว่น

ตะไคร้	1/2	ซ็อนสังกะสี
กระเทียม	5	กลีบ
พริกชี้หนูสด	8	เม็ด
กะปิ	เล็กน้อย	
น้ำ	2	ถ้วยของหวาน
เกลือ	1/2	ซ็อนสังกะสี
พริกไทยป่น	เล็กน้อย	

วิธีทำ

แช่ถั่ว 1 คืน โขลกเครื่องแกงให้ละเอียด นำไปคั่วในน้ำมันให้เหลือง ใส่ไก่คั่วพอสุก เติมน้ำและใส่เมล็ดถั่วพุ่มต้มจนเปื่อย ปรุงรสด้วยน้ำตาล ใส่ถั่วพุ่มฝักอ่อนที่หั่นเป็นท่อน ๆ ใส่ใบมะกรูด ใบกระเพรา พริกชี้ฟ้าหั่น พอเดือด ยกลง



แกงอ่อมถั่วพุ่ม

เครื่องปรุง		
เมล็ดถั่วพุ่ม	3	ซ็อนสังกะสี
เนื้อปลาช่อน	1/2	ถ้วยของหวาน หรือใช้ปลาช่อน 1 ตัวเล็ก
ฟักทอง	1	ซีก หนักประมาณ 100 กรัม
ข่า	1	แวน
ตะไคร้	1	ต้น
หอมแดง	2	หัว
กระเทียม	3	กลีบ
พริกชี้ฟ้าสด	1	เม็ด

น้ำปลาร้า	2	ซอ่อนสังกะสี
ใบแมงลัก	1	ก้าน
น้ำปลา	2	ซอ่อนสังกะสี
ต้นหอม	2	ต้น
น้ำ	1/2	ถ้วยของหวาน
เกลือ		เล็กน้อย

วิธีทำ

แช่เมล็ดถั่วพุ่ม 1 คืน โขลกข่า ตะไคร้ หอมแดง กระเทียม พริก
ชี้ฟ้าสด เกลือให้ละเอียด แล้วนำไปคั่วพอหอมใส่ น้ำ พอดีใส่
ถั่วพุ่มต้มจนเปื่อย จึงใส่ฟักทองปิดฝาทิ้งให้เดือด พอฟักทองสุกใส่
ปลาซอ่อน ปรุงรสด้วยน้ำปลาร้า น้ำปลา เดือดแล้วใส่ใบแมงลัก
ต้นหอมหั่น ยกลง

น้ำปลาร้าใส่พริก

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

น้ำพริกปลาร้าถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 3

ผักจิ้ม

ผักกาดขาว	3	ต้น (515 กรัม)
ผักชี	25	ต้น (5 มัดหรือ 75 กรัม)
ยอดแคตวาก	32	ยอด (2 มัดหรือ 270 กรัม)

กล้วยน้ำว้า

กล้วยน้ำว้า	17	ลูก
-------------	----	-----



สาकुถั่วพุ่มแกงขวด

เครื่องปรุง

เมล็ดถั่วพุ่ม	1	ถ้วยของหวาน
น้ำตาลมะพร้าว	1	ช้อนตักกะสี
น้ำตาลทราย	2	ช้อนตักกะสี
น้ำกะทิ	1½	ถ้วยของหวาน (ใช้มะพร้าว 3 ชีด) (300 กรัม)
สาकुเมล็ดเล็ก	½	ถ้วยของหวาน
น้ำกวนสาकु	2½	ถ้วยของหวาน
เกลือ		เล็กน้อย

วิธีทำ

แช่เมล็ดถั่วพุ่มไว้ 1 คืน แล้วนึ่งหรือต้มให้สุก ล้างสาकु นำน้ำกวน
สาकुตั้งไฟให้เดือด ใส่สาकुลงกวนจนสุก พักไว้ คั้นกะทิให้หมดมัน
นำกะทิตั้งไฟใส่น้ำตาลมะพร้าว น้ำตาลทราย และเมล็ดถั่วพุ่ม
ใส่สาकु พอเดือด ยกลง

รายการอาหารวันที่ 7

ข้าวเหนียวหนึ่ง

ใช้ปริมาณเท่ากับรายการอาหารวันที่ 1

เนื้อย่าง

ใช้เนื้อวัว

1.2 กิโลกรัม (1 กิโลกรัมกับ 2 จีด)

เจียดย่าง

ใช้เจียดย่าง

7 ตัว

ล้างให้สะอาด นำไปย่างให้สุก

แกงป่าถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 6

แกงอ่อมถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 6

น้ำพริกปลาร้า

เครื่องปรุง

น้ำปลาร้า

7

ช้อนตวงกะสี

หอมแดง

6

หัว

พริกชี้ฟ้าสด

23

เม็ด

วิธีทำ

เผาหอมแดง พริกชี้ฟ้า นำไปโขลกพอแหลก ใส่น้ำปลาร้าที่ต้มสุกแล้ว รับประทานได้

น้ำพริกปลาร้าถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 5

ผักจิ้ม

ผักกาดขาว	4½	ต้น (1 กิโลกรัม)
มะเขือ	15	ลูก (300 กรัม)
ผักชี	45	ต้น (9 มัดหรือ 180 กรัม)

น้อยหน้า

น้อยหน้า	7	ผล
----------	---	----

ข้าวต้มผัดถั่วพุ่ม

ปริมาณเครื่องปรุงและวิธีทำเช่นเดียวกับรายการอาหารวันที่ 5

ภาคผนวก

* วิธีเพาะถั่วงอก

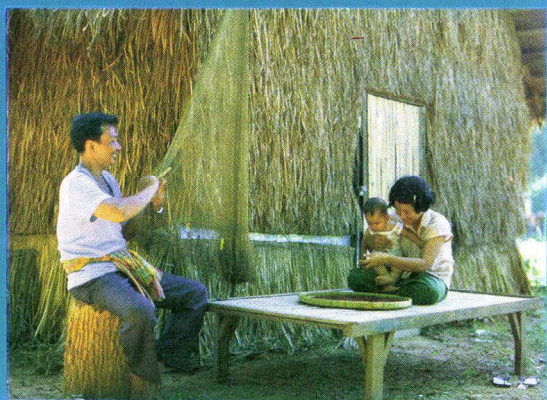
นำถั่วมาแช่น้ำทิ้งไว้ 1 คืน เตรียมป้อนก้นร้วที่จะใช้เพาะถั่วงอก โดยนำเอาใบตองมารองก้นป้อนสัก 3-4 ชั้น แล้วโรยแกลบเผาทับ ใบตองหนาประมาณ 1 นิ้ว นำถั่วที่แช่แล้วมาโรยบนแกลบเผาหนา ไม่เกิน 1 นิ้ว จากนั้นโรยแกลบเผาทับเมล็ดถั่วอีกทีให้หนาไม่เกิน 2 นิ้ว รดน้ำให้เปียกชุ่มวันละ 2-3 ครั้ง ทิ้งไว้ 2 คืน จะได้ถั่วงอก ก่อนจะนำมารับประทานล้างเอาแกลบเผาและเปลือกออกเสียก่อน ใช้เมล็ดถั่วพุ่มประมาณ 350 กรัม จะได้ถั่วงอกในปริมาณเพียงพอ สำหรับผัดถั่วงอกถั่วพุ่ม และแกงเผ็ดถั่วงอกถั่วพุ่มในรายการอาหารวันที่ 1

** วิธีทำถั่วพุ่มปั่น

นำเมล็ดถั่วพุ่มมาคั่วในกะทะบนไฟอ่อน ใช้เวลาประมาณ 5-10 นาทีจนถั่วสุก เมื่อเย็นแล้วนำมาโขลกหรือบดให้ละเอียด

หมายเหตุ เมล็ดถั่วพุ่มแดง 1 ถ้วยของหวาน เท่ากับเมล็ดถั่วหนัก 150 กรัม

ผลงานในเอกสารเล่มนี้ได้รับการสนับสนุนเงินวิจัยจาก IDRC
(International Development Research Centre) และรัฐบาล
ไทย และได้รับความร่วมมือจากมหาวิทยาลัยแมสซึ ประเทศนิวซีแลนด์



“กินอาหารถั่วพุ่มทุกวัน สุขสันต์แข็งแรง”