

AN ECONOMIC EVALUATION OF THE
THAI - NEW ZEALAND FEEDER ROAD
IN NORTHEAST THAILAND

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Abstract

Transport has been identified as an essential element in a comprehensive regional development programme and economic, social, and political benefits can result from the construction of a road in a developing region. This study investigates the economic impact of a road construction project in Northeast Thailand. The Thai-New Zealand feeder road, a 144 kilometre paved road, was completed in 1971 and links five major towns in two provinces while passing through a region of populated villages. Nearly all households in this region engage in agricultural production. The rice crop is the most important factor affecting the welfare of a household and the quantities of produce sold from other enterprises are small. Purchased inputs, aside from small quantities of fertilizer, are not commonly used.

This study has been undertaken only two years following completion of the road, although the first 36 kilometre section had been completed five years. The collection of data from households in villages adjacent to the road is described and the data obtained is discussed in relation to the characteristics and measurements of subsistence agriculture. Traffic usage of the road was measured in two surveys and a land classification survey was conducted to estimate the agricultural development that has taken place since road construction began.

A large part of the study is devoted to a description of the agricultural enterprises practised in the region, the problems preventing economic development, and the potential for further development following construction of the Thai-New Zealand feeder road. This data has been used to assess the impact of the road at the present time and the likely impact under various conditions which might eventuate in the future.

Methodology for a standard benefit-cost analysis has been used in the evaluation of the road. The three economic criteria, net present value, benefit-cost ratio, and project internal rate of return have been applied to the discounted cost and benefit flows. Together with those items that can not be quantified, these three criteria have been used to evaluate the profitability of the project.

Construction of the Thai-New Zealand feeder road should be regarded as the provision of one input essential for economic development in the region. Other inputs will be necessary before the full benefit of the road can be obtained. The road has already had a significant economic impact and if the potential from the application of improved technology and practices within existing agricultural enterprises can be realised, the road will have an even greater role in the economic development of the region.

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Table of Contents

	Page number
Chapter One: Introduction	1
1.1 The Role of Agriculture in Developing Countries	1
1.2 Outline of the Study	6
Chapter Two: Background Information for the Study	8
2.1 The Location and Setting	8
2.2 The Northeast Region	8
2.3 The Thai-New Zealand Feeder Road Project	13
2.4 Summary	14
Chapter Three: Transport and Economic Development	16
3.1 The Economic Evaluation of Transportation Projects	16
3.1.1 Feasibility studies and 'ex-poste' case studies	16
3.1.2 Analytical techniques for an 'ex-poste' case study	17
3.1.3 The limitations of an 'ex-poste' case study	18
3.2 The Economic, Social and Political Roles of Road Transport	20
3.3 The Role of Roads in Northeast Thailand	26
3.3.1 Transportation planning and progress in Northeast Thailand	26
3.3.2 Transportation studies completed in Northeast Thailand	28
3.4 The Economic Success of Transport Investment Projects	32
3.5 Summary	34
Chapter Four: Procedure and Method of Study	35
4.1 Agricultural Pilot Study	35
4.1.1 The purpose of the pilot study	35
4.1.2 Identification of the research worker	36
4.1.3 Materials used for the pilot survey	37
4.1.4 Village selection	39

4.1.5	Within village sample selection and interview technique	41
4.2	Farmer Case Studies	43
4.3	Land Classification Survey	46
4.4	Road Traffic Surveys	48
4.5	Summary	49
Chapter Five:	Agricultural Enterprises in the Region of the Thai-New Zealand Feeder Road	50
5.1	The Setting of a Typical Northeastern Village	50
5.1.1	Land areas	50
5.1.2	Housing	51
5.1.3	The family	52
5.1.4	Annual rainfall and work cycle	54
5.2	Rice Production	58
5.2.1	Soil preparation	60
5.2.2	Planting	60
5.2.3	Fertilizer usage	61
5.2.4	Treatment during the growing period	65
5.2.5	Harvesting and threshing	65
5.2.6	Area planted and production yields	66
5.2.7	Sales of rice	68
5.2.8	Financial analysis	71
5.3	Kenaf Production	73
5.3.1	The plant and growth requirements	73
5.3.2	Cultivation practices	74
5.3.3	Harvesting and retting	75
5.3.4	Area planted and production yields	77
5.3.5	Financial analysis	78
5.4	Vegetable Production	80
5.5	Fruit Production	82
5.6	Buffalo and Cattle Production	84
5.7	Pig Production	88
5.7.1	Financial analysis	89
5.8	Poultry and Duck Production	92
5.9	Fish Production	94

	Page number	
5.10	Silk Production	95
5.11	Marketing of Produce	97
5.11.1	The role of the Thai-New Zealand feeder road in produce marketing	99
5.12	Summary	101
Chapter Six:	The Study Area in Relation to Characteristics and Measurements of Subsistence Agricultural Production	103
6.1	Characteristics of the subsistence Farmer	103
6.2	Applying Measures of Subsistence to the Villagers Studied	106
6.3	Summary	115
Chapter Seven:	Economic Evaluation of the Thai-New Zealand Feeder Road	116
7.1	Introduction	116
7.2	Method of Evaluation	116
7.2.1	Project life	117
7.2.2	Residual value	119
7.2.3	Project costs	122
7.2.4	Project benefits	122
7.2.5	Discount rate	124
7.3	Project Cost Estimates and Assumptions	125
7.4	Project Benefit Estimates and Assumptions	128
7.4.1	Vehicle operating cost savings	128
7.4.2	Agricultural development estimates	135
7.4.3	Other tangible benefits	140
7.4.4	Intangible benefits	143
7.5	Economic Analysis	146
7.5.1	Net present value	147
7.5.2	Benefit cost ratio	148
7.5.3	Internal rate of return	149
7.6	Sensitivity Analysis	150
7.6.1	Effect of varying the maintenance expenditure level	151
7.6.2	Effect of varying the vehicle operating cost savings	151

	Page number	
7.6.3	Effect of varying the value of kenaf production	155
7.6.4	Effect of varying the residual value	157
7.6.5	Joint variation of factors affecting the economic worth of the Thai-New Zealand feeder road	157
7.7	Summary	163
Chapter Eight:	Potential Benefits From the Thai-New Zealand Feeder Road	164
8.1	Introduction	164
8.2	Estimates of Agricultural Productivity and Profitability	165
8.2.1	Livestock as a potential source of income	165
8.2.2	Vegetables and upland crops as a potential source of income	168
8.2.3	Fish culture as a potential source of income	170
8.2.4	Sericulture as a potential source of income	173
8.3	Problems Preventing Increased Agricultural Production and Strategies for Their Solution	175
8.4	Potential Agricultural Benefits	178
8.5	Summary	186
Chapter Nine:	Summary and Conclusions	187
<u>Appendices</u>		
Appendix One:	Glossary of Terms and Units of Measurement Used in the Study	196
Appendix Two:	A Description of the Villages Studied	197
Appendix Three:	Agricultural Information	205
Appendix Four:	Traffic Information	213
Appendix Five:	Valuation of Equipment	219
Appendix Six:	Survey Questionnaires	220
Bibliography		232

List of Figures

	Page number
Figure 3.1 Northeast Thailand 1970 Transport Network	25
4.1 Location Map of Villages Studied	40
5.1 Monthly Rainfall Pattern Recorded at the District Office, Ampher Borabue, Mahasarakham	55
5.2 Annual Cropping Cycle	57
5.3 Marketing Channels for the Sale of Unmilled Rice	97
7.1 Benefits from Generated Traffic, Class A	130
7.2 The Effect of Varying Uncertain Costs and Benefits on Project Net Present Value at a 12 Per Cent Discount Rate	160
7.3 The Effect of Varying Uncertain Costs and Benefits on Project Internal Rate of Return	161
A4.1 Traffic Survey Data Collection Form Prepared and Used by the Author	214

"If I could do only one thing in a region to spur agricultural development, I would build roads. If to this I could add a second, I would build more roads. And if to these I could add a third, I would build still more roads."

A.W. Ashby, quoted in Mosher, A.T. 1966;
"Getting Agriculture Moving".
Praeger, New York, page 119.

"Down With Cost-Benefit Ratio!!"

"It is heartening to note that somehow the experts have come around to accept the fact that the classic method used for the economic evaluation of road projects by aid-giving financial agencies based almost entirely on the cost-benefit ratio is "somewhat inadequate for planning rural roads."

"Whether it is the World Bank or the Asian Development Bank operations, the emphasis has always been on figures flowing out of the computer. The cost-benefit ratio is almost always the decisive factor. And the human factor seems all but insignificant in the minds of the experts."

.....

"We hope when the meeting of ECATE beginning tomorrow here is convened, those figure-conscious experts will wake up to the human needs and sentiments to strive to work towards things that are really meaningful to the people."

"After all, the world is for human beings -- and not computers."

Editorial in The Nation Bangkok, May 14, 1972.

"Agricultural growth is not the primary goal of rural people. Instead, for them as for all of us, the primary goal is the quality of life they can enjoy. Some aspects of that quality of life depend on level of family income, others are largely independent of it."

Mosher, A.T. 1969; "Creating a Progressive Rural Structure". Agricultural Development Council, N.Y., page 45.

Chapter OneINTRODUCTION1.1 The Role of Agriculture in Developing Countries

Examination of the structure of economically advanced countries such as West Germany, England, Denmark, Japan and the United States of America, shows that the agricultural sector of the economy in each has certain common characteristics. (Sitton, 1962) In these countries, the agricultural sector has contributed an increasing output of commodities to the economy in recent years. At the same time the proportion of total manpower resources devoted to agriculture has diminished as productivity per unit of input has increased. The predominant feature of the developing countries however, is the continued presence of a large agricultural sector in which the farming community is frequently preoccupied with subsistence production.

Thornton (1973) suggests that the functions of the agricultural sector in a country at any one time depend upon the relationship between the agricultural sector, the non-agricultural sector and the outside world. This relationship can be described in terms of the products supplied by one to the others; the demand which the people in one may have for both producer and consumer goods from one of the others; and the resources - land, labour, capital, technology and managerial or entrepreneurial talent - that may be transferable between them. Thornton has stressed the following six functions as being particularly important.

- (1) Supplying food to consumers in both the agricultural and non-agricultural sectors.
- (2) Supplying raw materials to the non-agricultural sector, as food for processing, and in the form of fibres, leather,

timber, charcoal, etc.

- (3) Transferring surplus labour to the non-agricultural sector.
- (4) Supplying capital funds, through taxes and savings, to the non-agricultural sector.
- (5) Providing exports (both food and raw materials) either directly or through processing in the non-agricultural sector, to the outside world.
- (6) Acting as a market for non-agricultural products, both for direct consumption and for investment from the non-agricultural sector.

The resources available, the state of international relationships and the stage of economic development are all factors influencing the importance of the agricultural sector in a country or region at any specified time. Low fertility, water scarcity, inaccessibility and low levels of knowledge or skills among the people will operate against an apparent abundance of natural resources in terms of a large land area and a high land/man ratio. The state of international relationships will affect trade policies and overseas investment programmes. The following observations have been noted by various economists writing of the relationship between the agricultural sector and the stage of development.¹

Kuznets (1966), using both time series data and cross-sectional data showed that successively higher levels of per capita income over a period of time, are associated with an agricultural sector declining in terms of its contribution to the national product and the percentage of the national labour force employed. The changing emphasis to non-agricultural production is likely to be linked with increased opportunity for investment in manufacturing and services outside the agricultural sector.

¹ For further study the reader is referred to books by Higgins (1968), Myint (1965), Southworth and Johnston (1967), and an essay by Thornton (1973), all listed in the bibliography.

Rising per capita incomes are accompanied by changes in the pattern of food and raw material consumption. The quantity of agricultural produce consumed tends to increase and there is a strong preference for quality. As economic development proceeds the internal market for the agricultural producers changes. However, if there is a high proportion of consumers in the agricultural sector, their consumption patterns and preferences will determine production activities in both the agricultural and non-agricultural sectors until substantial progress in economic development is achieved.

Considerable controversy has existed among economists as to the role of industrialisation in economic development and the quantity of surplus labour that exists within the subsistence agricultural sector. It is now recognised that concentrating on industrialisation will not necessarily bring about economic development and a government must have policies and plans for all sectors of the community. Industrial development should accompany agricultural development but because of the nature of the labour supply and its location in the rural areas, priority should be given to expanding those industries handling or processing agricultural produce.

Myint (1965) emphasised the distinction between surplus labour hours and surplus men. The seasonal nature of agricultural production in some countries means that the entire labour force may be engaged for long hours at times during the year. At other times the workload is spread over all those capable of working. If production in the subsistence sector is to be maintained when part of the work force is diverted to alternative employment, there must be incentives for those remaining who must work longer hours.

More recently the rate of population growth and the problems of feeding and employing the rapidly increasing numbers has become a major issue in the developing countries. The problems of employing the larger population are most evident in the cities where people from the rural areas are lured by the

prospect of high wages. Some economists such as Hirschman (1958) and Clark (1967) have argued that population growth is a stimulus to economic development. They suggest that in seeking to resist a decline in living standards, a community will increase in ability to control its environment and organise itself for development.

Thornton (1973) has summarised the current viewpoint of economists as to the importance of agriculture in economic development.

- (a) There is a general disenchantment with the notion that concentration on industrialisation is an easy way to bring about economic development.
- (b) Plans and policies must be built for both the agricultural and non-agricultural sectors at the same time.
- (c) There is a need to find solutions to employment, diet and income problems chiefly in the agricultural sector itself.

Given that an agricultural base is the foundation for economic development, how is the agriculture in a developing country to be improved? Mosher (1966) has identified five essential requirements for growth in agricultural productivity. These are summarised as follows:

- (1) A constantly changing technology: This is usually the result of formal research leading to the development of farm inputs including new fertilisers, insecticides and weedicides, and equipment to improve techniques of cultivation and husbandry.
- (2) Production incentives to the farmer: The farmer must be sure that the improved technology will benefit him. Usually a substantial net increase in income will be required before a farmer will adopt new techniques.
- (3) Local availability of supplies and equipment: The farmer must have access to the supplies and equipment

needed to put the new technology into practice. They must be of good quality, available when needed and at a price profitable to use.

- (4) Markets for farm products: Farmers must be able to sell their products. This requires a marketing system in which the farmer has confidence, to move the product from producer to consumer.
- (5) Transportation: Agriculture cannot be concentrated near its ultimate customers or near existing transport facilities. Rather it must be located in regions where the natural resources favouring agriculture can be found and transportation facilities of one kind or another must be provided to every farm.

Mosher has also observed that whether agriculture is subsistent or commercial, there are several additional activities or services that can accelerate the process of development. Education and training of all sections of the community is one of these. Farmers need to be educated in the benefits from modern agriculture, while government policy makers must know of the agricultural sector in order to plan effectively. Another is the provision of production credit to farmers, allowing the purchase of additional inputs that could increase agricultural output. A third accelerator is the various farmer organisations such as Co-operative movements, farmers clubs and community construction groups. These permit activities to be undertaken that an individual farmer may not be able to achieve through his own efforts.

The fourth recognised accelerator is the improvement or expansion of agricultural land. This means an improvement in the quality of the land already being farmed or expanding the area that is presently under cultivation. Land improvements can be brought about by terracing, levelling, drainage or irrigating existing areas. Expansion of the present land may require the removal of natural forest vegetation, extending irrigation to barren lands, or reclaiming waste lands.

The final accelerator suggested by Mosher, is the construction of a national plan for agricultural development. National planning should ensure that the five essentials for development are present in the best agricultural regions of the country. At the same time the planners should investigate and provide accelerators to development, initially in pilot or demonstration areas. The results can be evaluated and the process extended on a wider basis as resources permit.

Agricultural development is therefore a complex process. The essentials and the accelerators identified above have their effects by changing the facilities available and the conditions under which farmers operate. Throughout this study constant reference will be made to these factors in an effort to establish their combined importance in a developing region.

1.2 Outline of the Study

This study investigates the development, particularly agricultural development, taking place in a region where one of Mosher's five essential elements, transport, has recently been upgraded by a road construction project.

In December 1971 the Thai-New Zealand feeder road, a 144 kilometre sealed highway linking five major townships and numerous villages in two provinces of Northeast Thailand, was officially opened. Previously the only road communication for villagers in this region was via a dusty clay road which was impassable in some places during the wet season months. The people usually only travelled over short distances in carts hauled by cattle or buffalo. There were few motorised vehicles and the operators of vehicles using the route charged high rates for transporting both freight and passengers, to off-set heavy repair expenses.

While the introduction of an improved transportation facility to a region, such as that described above, will bring about improved social conditions, it may also induce economic

development in the region. The role of road transport in economic development is discussed in Chapter Three.

The economic benefits resulting from an improved facility in a developing region largely stem from the agricultural sector. This study is mainly concerned with the agricultural change and the benefits which accrue to farm families practising a subsistence agriculture. Chapter Four outlines the procedure and methodology used by the author in measuring the benefits resulting from the Thai-New Zealand feeder road.

Characteristics of the village population, particularly the agricultural practices, are discussed in Chapter Five. Information for this chapter has been derived from a survey of a number of villagers in the region of the road. Chapter Six reviews the information presented in the previous chapter in relation to measurements of subsistence economies used by both economists and sociologists.

In Chapter Seven an economic evaluation of the Thai-New Zealand feeder road has been undertaken. The expected net benefit of the road project has been calculated according to the standard measures used in project analysis: net present value, benefit-cost ratio and the internal rate of return. A project life of fifteen years was assumed and the data for the analysis was obtained from agricultural and road traffic surveys.

A number of technical missions have visited Northeast Thailand to make recommendations as to the way in which villagers in the region can move from a subsistence agriculture to a commercial agriculture. Chapter Eight discusses the agricultural potential for various enterprises in the villages near the Thai-New Zealand feeder road. The role of the road in an expanded economy is identified and the potential benefits have been calculated.

Finally Chapter Nine provides a summary and conclusions as to the value of the Thai-New Zealand feeder road as an investment to induce economic development in the region.

Chapter Two

BACKGROUND INFORMATION FOR THE STUDY

2.1 The Location and Setting

Thailand covers an area of about 518,000 square kilometres and the population in 1970 was estimated to be almost 35 million people. The rate of population growth is about 3.2 per cent per annum, and more than 50 per cent of the population is under 21 years of age. It is essentially an agricultural country, agriculture employing almost 80 per cent of the total working population, producing over 85 per cent of the country's exports and making up one-third of the national income. (D.T.E.C., 1970)

From an agricultural viewpoint the country consists of three main areas. The central plains area is the most prosperous. Much of the country's rice is grown here because of the low lying land and the good irrigation facilities. The second area is known as the upland area and takes in the large northeastern sector, northern Thailand and the southern peninsula. While there are heavy rains in the wet season, during the rest of the year this country suffers under drought conditions in the absence of natural catchment areas. The third area is the hill country of the north where most of the country's teak forests grow.

2.2 The Northeast Region

The Northeast has historically been the most remote area from Bangkok. It is an area of gently undulating land slightly larger than the South Island of New Zealand, supporting an estimated population of more than 12 million people.

In 1968, land utilisation in the Northeast was classified as follows, (Crump, 1972):

	<u>Million rai</u> ¹
Rice farming and agricultural crops	25.7
Forest and grazing	42.0
Swamps, rivers, etc.	0.4
Upland range grazing lands	37.9
Total land area	<u>106.0</u>

The soils in the Northeast are generally fine sandy loams of low natural fertility. In the valleys more fertile alluvial deposits can be found particularly near the Mekong River. Soils where rice is grown are usually of the Roi-et² series and are poorly drained with mottling occurring throughout the profile. Flooding in the wet season results in the formation of a strong surface gley. In the dry season these soils dry out to a great depth and are too dry for any cultivation unless supplementary irrigation is provided. The upland soils in the study area have been classified as being members of the Korat and Borabue² series. They are shallow soils on top of sandstone deposits, and deficiencies in nitrogen, phosphorus and potassium are recognised. During the rainy season they are easily erodible. The original vegetative cover was second growth forest, mainly Dipterocarp species of no commercial value. The natural productivity of the land is low and it is subjected to a periodic shifting cultivation of crops such as kenaf and maize. (Moorman, 1964) In some areas subterranean water with a high salt concentration has been discovered. This has led to the establishment of several family-unit salt production industries.

1 Rai - unit of land area used in Thailand; 1 rai is equivalent to 1600 square metres or 0.16 hectares.

NOTE: All Thai units and words used in this study are defined in footnotes on the first occasion they are used. A summary of all Thai units and words used is provided in Appendix I.

2 Roi-Et and Korat are two provinces in Northeast Thailand. Borabue is the name of a district in Mahasarakham province.

Modern agricultural inputs such as fertilizer, insecticides and mechanisation are not widely used. Much of the farming is of a subsistence nature. In addition to the crops they grow, the farmers eat fish and various forms of wildlife; build their own homes from timber cut from upland areas, where available; gather wood for fuel and frequently make their own clothes from home woven cloth.

Table 2.1 provides comparative household financial data for geographical regions within Thailand. On average, in 1970, families in the Northeast had lower net farm incomes than those of other regions. The level of income was less than half that of farmers in the Central Plateau, the most prosperous area of the country. The high operating expenses of farmers in the Central Plateau reflects their greater use of modern agricultural inputs.

Table 2.1: Average Farm Income (AFI), Average Farm Operating Expenses (AFOE) and Average Net Farm Income (ANFI) per Family for the Crop Year 1969/70 in Thailand (Baht)³

Region	AFI	AFOE	ANFI
Central Plateau	7269	5056	2213
North	2639	1341	1352
South	3280	1696	1586
Northeast	2122	1194	927
All Areas	3877	2390	1486

Source: Division of Agricultural Economics, Ministry of Agriculture: Thailand Economic Farm Survey in 1953/54 and in 1969/70 (in Thai language).

³ Baht - the unit of Thai currency. In 1963 a Royal Decree established the par value of the baht, giving it an exchange rate of 20.80 baht to one U.S. dollar. There has been little variation in the exchange rate since that time.

The people of the northeastern region have strong ethnic ties with Laos, the majority speaking various Thai-Lao dialects. The lack of resources and the poor communications in the Northeast were considered by the Government to provide an ideal climate for insurgency. Although the people are very loyal to the King, as the Central Plains area became more developed commercially, the disparity between the two regions widened. Thus in the past decade, the Government has promoted a large scale economic development plan.

At present the Government is in the early stages of the third five-year plan period, which is largely an extension of the goals and targets set up in the second five-year plan period 1967-71. The principal policy guidelines for the second plan were set out as follows, (N.E.D.B., 1966):

- "(1) To strive towards further accelerating the economic growth rate, with emphasis on more equitable distribution of income and social benefits.
- "(2) To reduce the degree of income inequality and geographical imbalance....
- "(3) To expand employment opportunities and improve the quality of human resources....
- "(4) To accelerate private industrial investment....
- "(5) The primary emphasis will be put on the development of intensive agriculture, raising productivity by greater use of capital and improved techniques, as a means to provide food and employment for a growing population, to provide basic materials for an expanding industry and to provide foreign exchange for the payment of imports.
- "(6) To accentuate the role of science and technology....
- "(7) Economic and social development must be geared to the necessity to strengthen the national security.
- "(8) Financial stability must be maintained as a means of assuring healthy economic growth....
- "(9) Development projects will be implemented in accord with their priority and will be designed to yield the greatest benefit at the least possible cost."

The two largest sectoral allocations of development expenditure were made to Transport and Communications at 30 per cent and Agriculture at 20 per cent. The following table from the same source sets out the financing required for the development plans.

Table 2.2: Finance Required for the Two Development Plans
1961-66 and 1967-71 (millions of baht)

Source	First Plan 1961-1966	Percentage	Second Plan 1967-71	Percentage
Domestic sources	22,019	68.4	41,440	74.9
Foreign sources (Grants and loans)	10,638	31.6	14,435	25.1
Total	32,657	100.0	55,875	100.0

Finance for the development programmes has come partly from Royal Thai Government funds, partly from World Bank loans and partly from foreign aid. In the period 1961-69 inclusive, the foreign grant and technical assistance to Thailand totalled \$US340,430 million. (D.T.E.C., 1970) The programme included improved communications, transport and water supply, the expansion of both educational institutions and rural health centres and the establishment of local industries in some town centres.

The United States has contributed a large proportion of this finance.

"In the last few years U.S. grant aid has been increased with growing emphasis on programs designed to strengthen national security. A great effort has been made to develop the police force through the Civil Police Project, and to expand direct impact rural development programs in sensitive border regions chiefly through the Accelerated Rural Development program. For security reasons the majority of U.S. assistance has been concentrated in the Northeast region." (D.T.E.C., 1970)

New Zealand has provided aid to Thailand under the Colombo Plan Scheme. Financial assistance has been given in the

construction of a road project near Mahasarakham, the establishment of an agricultural faculty at Khon Kaen University, and in the Land Development Department's pasture centre at Borabue. New Zealand V.S.A. volunteers have also worked at many locations in Northeast Thailand.

2.3 The Thai-New Zealand Feeder Road Project

On 10 February 1965 the Cabinet of the New Zealand Government approved a Colombo Plan contribution of \$NZ600,000 to be spread over three years as project aid to Thailand. The money was to be used to assist in the construction of a feeder road in the Northeast. The Thai Government had indicated that the development of a network of all-weather roads was regarded as being of "great political, economic and social importance in improving living standards, allaying discontent and improving security prospects". (N.Z. Foreign Affairs, 1970)

The project selected was a 144 kilometre road link between Borabue and Buriram.⁴ Both Thailand and New Zealand undertook specific responsibilities in the joint project. New Zealand agreed to supply approximately 15 supervisory and instructional personnel, a range of earthmoving, soil investigation and road construction equipment, and spare parts to cover at least one year's usage. The Thai Government agreed to construct the base at Mahasarakham, (about 23 kilometres from Borabue) including offices, workshops, stores and accommodation. They also agreed to provide all land for the road, construction materials, some motor vehicles, fuel, lubricants, plant not listed in the New Zealand contribution and all personnel needed for management and efficient execution of the project. A team of New Zealand Army engineers was selected to carry out the assignment.

⁴ Borabue is a district in Mahasarakham province and is the place where road construction began. Buriram is another province south of Borabue and it is in this provincial centre that the road terminates.

It should be noted at this point that the engineers had a two-fold assignment. The first assignment was to construct the road in co-operation with the Thai personnel. At the same time the second, but no less important assignment was to take place. This was to give instructional training to Thai workers in plant and equipment operation and mechanics.

In the first two years the rate of progress was not up to schedule. Delays were caused by insufficient workshop facilities, lack of and difficulty in procuring spare parts, lack of standardisation in equipment purchased, and insufficient supervisory staff at the road head. It was soon realised that the period of three years was unrealistic to cope with the many problems of supply, terrain, equipment and personnel. The New Zealand financial contribution more than trebled to about two million dollars, the time span for construction increased from three to six years, and the number of New Zealand personnel increased from 15 to a peak of 26. The original specification had not envisaged a sealed road but it soon became apparent that the road would need to be sealed to conserve base-course materials and because road usage warranted it. The full section of road was completed in December 1971.

2.4 Summary

This chapter has provided the reader with background information for the study. In particular the chapter outlines the characteristics of the Northeast region of Thailand and its poverty in comparison with other regions in Thailand. This situation has been recognised by the Royal Thai Government and the aims of a large scale development plan for the region are described. Finance for this development has come in part from foreign assistance and loans, with New Zealand contributing through the Colombo Plan scheme. New Zealand provided assistance in a joint project with the Thai Government in the construction of a feeder road in

the Northeast which was completed in 1971. This study investigates the economic impact of the road, with particular reference to the agricultural development of the region.

Chapter Three

TRANSPORT AND ECONOMIC DEVELOPMENT

In planning and establishing a transport network, a government must consider the suitability, efficiency and possible combinations of road, rail, air, water and piped transportation the particular country requires. This study is concerned only with the role of roads and road transport in economic development. Specifically it is concerned with the impact of one secondary or "feeder road" built in Northeast Thailand.

3.1 The Economic Evaluation of Transportation Projects

3.1.1 Feasibility studies and ex-poste case studies

The economic evaluation of a transportation project is usually conducted before work on the project begins. Such an evaluation is termed a feasibility study.

'Feasibility' studies should do three things: they should make a statement about the economic viability of a project; they should solve, or describe ways of solving the technical problems posed by a project; and they should provide the decision-maker with the information, presented in a form that is acceptable and comprehensible to him, that is necessary for him to decide whether, when and how a project should be implemented."

(United Nations, 1971)

This study has been conducted following the completion of a road construction project and is thus an 'ex poste' case study. The objective of a case study appraisal at such a time is to ascertain the events that have taken place and the reasons for these events after a transport facility has been improved in a

developing region. Knowledge of the trends observed following a particular investment may be used to assist pre-investment analyses of other projects in the same region.

A research worker making either a feasibility or 'ex poste' case study endeavours to isolate the costs and benefits that are directly the result of the particular investment project. This requires a comparison of the economic, social and political conditions in the pre- and post-construction periods.

In the preparation of a feasibility study estimates of the likely costs and benefits must be made on the basis of data available from other projects, statistical records, and projections of existing data. However, much of the data required for an 'ex poste' study will be known with certainty providing statistical records have been made.

Land acquisition costs and construction costs should be available. Depending on the length of time elapsing from completion of the project to the time of the study, maintenance costs may be known or require estimation. Measurement of the benefits resulting from a road investment project is more difficult. It is necessary to define a zone of influence of the completed project and try to measure the changes that have occurred, or can be expected as a result of that investment.

3.1.2 Analytical techniques for an 'ex poste' case study

The most difficult problem in making an 'ex poste' case study is to isolate those events associated with a particular investment project. In a developing region this requires an answer to the question "What proportion of the development that has taken place, if any, is the result of the investment project under consideration?" 'Cross-sectional comparisons' and 'time series analysis' are two techniques used by research workers to help find an answer to this question.

A cross-sectional comparison requires the researcher to

select a reference area homogeneous with that area defined as being affected by the new investment. Production trends of agricultural crops, industrial growth and factors affecting the population of each area are analysed over the same time span, and a comparison is made between the two areas.

While in theory this method should give a measure of the developmental effects of the investment, in practice selection of homogeneous areas is difficult. Aside from the physical factors such as soil type, vegetation cover and climatic conditions, the method assumes that the two populations would be equally motivated, have the same aspirations, and the same capacity to respond to the new investment. There is heavy reliance on statistical data for successive years and it is rare for the data collection areas to correspond with those areas delineated by the researcher.

The time-series analysis approach endeavours to compare the economic, (social and political) conditions prevailing at the time of the study with the prior situation. The only factor deemed to have changed over the time period considered, is the introduction of the investment project. Again, heavy dependence upon statistical data is necessary. Care must be taken to ensure that seasonal and price fluctuations are not ignored in the calculation of the value of output in successive years. In a developing region several investment projects may be undertaken simultaneously over the time span under consideration. It is thus difficult to isolate the development resulting from a particular project using this method.

3.1.3 The limitations of an 'ex post' case study

Any analysis must be appropriate to the data available or the resources available to collect the data. A lack of basic statistics in the developing countries is a major limitation to the type of analysis that can be made. The data available is not well documented and of doubtful reliability. Regional boundaries may be changed and alterations made in the system of collection or

classification of various items, but frequently no mention of this is made in the statistical records.

The full effect of a major investment cannot be completely quantified. The project may have an obvious impact on the economy. Alternatively the effects of the project may interact in such a complex way with those of concurrent projects and trends that it becomes virtually impossible to specify those resulting from any one project. Improved technology, education and social services may accompany a road project, rather than be a direct result of the project itself.

Estimates of the agricultural developmental effect of a road project require many assumptions. The statement that following the construction of a highway, through a previously isolated area, "X hectare of hitherto undeveloped land will be brought into cultivation and that this will result in a benefit of Y dollars to the economy" illustrates this point. Assumptions must be made about such varied matters as the fertility of the soil, the market for certain products, the knowledge and entrepreneurial behaviour of the population, and the level of unemployment or under-employment in the zone of influence of the road.

A compromise must be reached as to the timing of the study. Sufficient time should elapse before conducting the study in order to allow the impact of the project to take effect. On the other hand in a region where there is only a paucity of statistics available, should too great a time elapse before the study is made, the local community will not be able to recall the situation prior to the commencement of the project. Although the present study has been carried out only two years after the completion of the project, the elapsed period is five years for the first 36 kilometre road section.

3.2 The Economic, Social and Political Roles of Road Transport

Transportation has been identified as one of the five essential elements required in any comprehensive development programme if it is to succeed. (Mosher, 1966) While the importance of transportation has been over-estimated in the view of some authors, most agree that an efficient transport system is a major step in improving the economic, social and political welfare of those living in the developing regions. As W. Owen (1966) has observed:

"In the complex process of development, transport plays a special role in facilitating other objectives: getting land into production, marketing agricultural commodities, making forest and mineral wealth accessible, developing industry, expanding trade, conducting health and education programs and exchanging ideas."

This view was also shared by Harral (1965) who wrote

"By moving people and objects for both economic and non-economic reasons, transport creates a link - political and social as well as economic - between people and objects separated in space. In so doing it creates a value (or income) because the objects would not be transported from one place to another unless their value after moving were at least as high as before the movement took place plus the cost of the transport."

The demand for transport is a derived demand depending upon the demand for the commodities carried, or the benefits from personal travel. Likewise the elasticity of demand for transport is largely determined by the elasticity of demand for the things being transported, and the proportion of the transport costs in the value of the delivered product. The price elasticity of demand for transport is likely to be relatively higher in less developed countries. Consequently a large impact in terms of bringing into production the marginal piece of land, marginal worker, or marginal material resource can be expected whenever transport costs can be reduced. (World Bank, 1972)

One research worker has suggested that whenever transport costs are more than one-third the gross value of the product, farmers will not sell. If transport costs are high, vegetables

and other perishable products can only be sold within the village. The same author supplied the following table to support her claim, based on her own research in Southeast Asia.

Table 3.1: Producers Share of Final Product Price in the Marketing of a Staple Food-grain (Rice) Compared with that of Vegetables

	Rice	Vegetables
Final price to consumer in city	100	100
Producers share of price at buying point	38	12.5
Share of intermediaries	62	87.5
made up from:		
(a) Local merchants gross margin	24	54.9
(b) Wholesalers gross margin	12	15.4
(c) City retailers gross margin	26	17.2

Source: Haswell, 1972.

From Table 3.1 it can be seen that producers received 38 per cent of the final price consumers paid for rice, but only 12.5 per cent of the final price paid by consumers for vegetables. Although Haswell has referred to the 'gross margin' received by the various intermediaries, a better terminology would be 'marketing margin'. The high marketing margin for the local merchants is a reflection of the high initial transport cost, risk burden in selling the product, possible product deterioration and the high cost of vehicle maintenance and repair.

In many developing countries, the introduction of a road transport facility has resulted in the development and utilisation of land previously inaccessible to man. Natural forest and vegetation cover is removed and perhaps sold, and farmers put the land into a cash cropping or livestock system. Two case studies demonstrate this effect. A study of the 318 kilometre Littoral Highway in El Salvador by Wilson et al. (1966) showed that in the

post-construction period of the road there was a 90 per cent increase in cotton output almost immediately. The road was built with the specific objective of opening up new areas for cultivation, although the planners had expected an increase in food crops and cattle numbers rather than cotton production.

Eight years after the completion of the Cochamba-Santa Cruz Highway in Bolivia, the output of sugar from the region was ten times greater than the output at the time the road was opened. Wilson (1966) notes, however, that some of the increased output could be due to a temporary mining of the fertility of the virgin soil as it was more economical to clear fresh land rather than use fertilizer.

Road transport can also contribute to economic development if it leads to the establishment or expansion of industry in the region. The industries may be associated with agriculture in the area such as canning or processing factories, rice mills, and factories utilising natural resources or servicing industries for a larger, more diversified community.

Santos-Villaneuva (1958) conducted a socio-economic survey on several recently constructed rural roads in the Philippines, each at least two kilometres in length linking villages to main highways. Generally there were increases in farm prices wherever roads were built, due to the ease of access to markets. The volume of produce sold increased and the reduced transportation costs resulted in an increase in farm incomes if the farmers transported the products themselves, or gave increased profit to merchants buying the products in the village. Land values increased, reflecting the better production possibilities, and a number of small industries were established at the village level.

As Adler (1967) has observed however, certain conditions must be met before it can be said that a transportation investment has stimulated economic development. These conditions can be summarised as follows:

- (a) The economic development would not have taken place in any case without the transport investment.

- (b) The resources used in the new development would otherwise have remained unused or been used less productively.
- (c) The economic activity stimulated does not replace activity which otherwise would have taken place.

Where transport investment does lead to increased output and the above conditions are met, the net value of the additional output is the economic benefit. Care must be taken to see that benefits are not credited to the road investment when they should be credited to other factor changes, such as improved technology in the agricultural enterprises. If economic development can only be achieved by supplying several of the 'essentials for development' then the other requirements must also be considered as part of the project.

"In terms of true development effect no magic has occurred, nor was any expected.... such development potential as the road may have is latent and may be realised only through the provision of supporting investments in other sectors of the Guatemalan economy: irrigation, drainage, public health, power, education and guided resettlement". (Wilson et al., 1966)

This was the conclusion reached in a study of the Atlanta Highway in Guatemala, built primarily to provide competition for a monopolistic railway system. This study shows that economic reasons are not the only justification for constructing a road. It should not be assumed that every road constructed will be accompanied by increased output. Even where there is considerable doubt as to the economic value of a transport investment, the non-economic factors can be of over-riding importance. Social and political considerations may justify the construction of a road.

It is very difficult to place a monetary value on social benefits, but nevertheless they may be very important, and the introduction of an improved transport facility to an area can bring about widespread improvements to the community. Students can attend school more easily, and teachers are more willing to teach in remote areas. Public health and welfare programs can

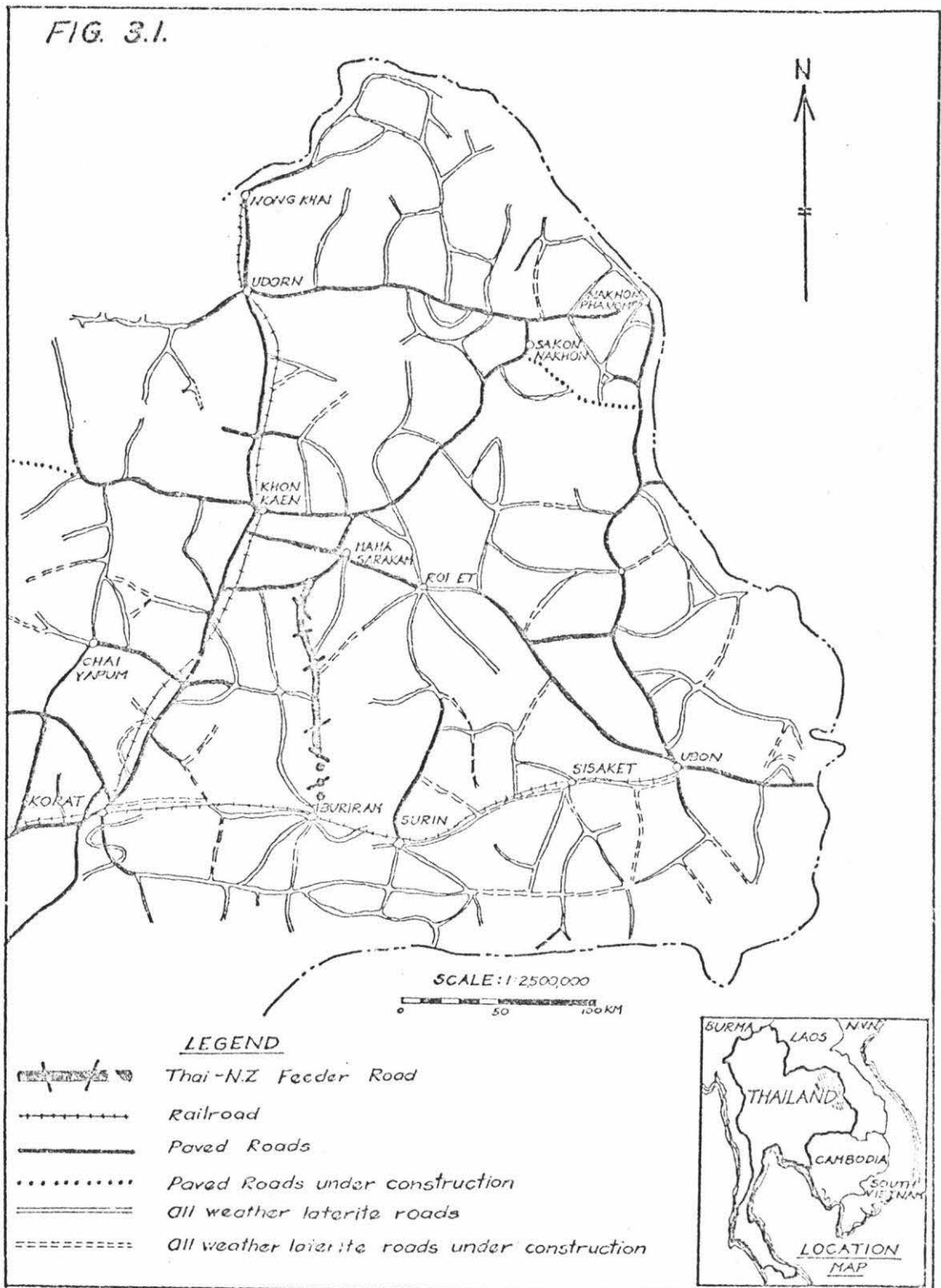
be disseminated over a wider area with improved access to outlying villages. There is also the opportunity for more frequent visits from both government and non-government officials, thereby multiplying the effectiveness of scarce personnel. The increased opportunities for travel, less accidents, travel in greater comfort and reduction in the degree of isolation are other important factors.

Time-savings benefits may result from a road transport investment. Savings in passenger travel time will only have a monetary value when the 'saved time' is put to productive use. For farmers in developing countries, transplanting and harvesting are the busiest times of the year. During these periods they do not travel often but casual labour can benefit from faster travel which allows greater mobility. Long *et al.* (1963) suggest that the alternative opportunities for a farmer's labour in a subsistence economy are low, and hence poor roads only mean discomfort rather than a reduced cash return.

Sanchai (1968) states that a lack of transportation in Thailand has not been a major problem for farmers marketing their goods in the past, because most had only a small surplus to sell. Time savings in the transport of freight can be important, particularly in the transportation of perishable products. The importance of road transport increases with the quantity of saleable produce and as time becomes more valuable.

In some countries the political justification for the construction of a road network assumes the highest priority. Easier and faster military mobility, greater stability through the maintenance of law and order, and the reduction of secessionist and insurgency activities can be major objectives of a country's planning sector, achievement coming about through better 'political contact'.

NORTHEAST THAILAND 1970 TRANSPORT NETWORK



Source: Adapted from Louis Lergier Inc. et al., 1970
 "Northeast Thailand Economic Development Planning
 Advisory Group, Stage 2 Planning Report". Chart 7-4B.

3.3 The Role of Roads in Northeast Thailand

3.3.1 Transportation planning and progress in Northeast Thailand

The Royal Thai Government has invested a large amount of finance in the construction of a comprehensive road network throughout Northeast Thailand. Figure 3.1 shows the extent of this network in 1970. A United Nations (1971) bulletin records that Thailand is one developing country that has published a long term development program with transport elements. The Government is building up the program components on the basis of project by project summations. There appears to be a two-way planning process operating.

From the lower level upwards, there are proposals for transport projects, and priorities are indicated with the estimated costs and benefits, schedules of implementation and detailed evaluations and justifications. From the top downwards the national transport requirements are specified, together with a desired time sequence for economic and traffic growth, and balance sheet statements of the material, human and financial resources available. If these two phases can operate together then a properly planned transport network should result.

The stimulation of agricultural development is the main medium through which the Thai Government hopes to raise the level of income of families in the Northeast region. Transportation and irrigation projects are the major investments being undertaken to achieve this aim.

In addition to the construction of major highways, attention has been given to the construction of feeder roads in the Northeast, in order to accelerate agricultural development and to provide security in remote areas.

"The feeder or provincial road construction program is scheduled to continue during the third plan period (1971-76). The two aspects of this program involve road building based on both traffic criteria and also

agricultural development and security factors."
(Louis Berger Inc. et al., 1972)

In a planned feeder road construction program of 973 kilometres during the third plan period,

146 km are justified using economic criteria
236 km are justified using security and economic criteria
391 km are justified primarily on the basis of security
165 km are to be built by the Khon Kaen Mechanical Centre
and 35 km are an international loan project.

The following table indicates the development which has taken place in roading in the Northeast over the five year period, 1965-1970.

Table 3.2: Length of Road Network in Northeast Thailand
in the Years 1965 and 1970 (Km)

	<u>Road Classification</u>	<u>Length of Road (Km)</u>	
		<u>1965</u>	<u>1970</u>
(a)	Thai Highways Department		
	(i) paved road	855	2806
	(ii) unpaved roads	<u>3033</u>	<u>3114</u>
	Total	3888	5920
(b)	Non-Thai Highways Department		
	(i) unpaved roads	1000	3525

Source: Louis Berger Inc. et al., 1972.

Table 3.2 shows that the total length of paved and unpaved roads doubled in the five year period. The Thai Highways Department constructed most of the paved roads, while the unpaved roads were part of rural community development projects.

Long et al. (1963) recognised the need for further roading when they calculated that the length of road surface per hectare of cultivated area in the Northeast, was considerably less than for the whole Kingdom of Thailand, 1.18 as compared with

1.74 metres. The authors considered a desirable ratio of between 15 and 18 metres per hectare of land cultivated, on the basis of that prevailing in more developed countries.

3.3.2 Transportation studies completed in Northeast Thailand

The Northeast region of Thailand has been the focus of several planning investigations and many reports have been written making recommendations for increased development of the area. Transportation studies, both feasibility and 'ex poste', have also been conducted, either as separate entities or as part of over-all planning studies.

The 166 Kilometre Friendship Highway linking Saraburi (Central Thailand) and Korat (Northeast Thailand) was opened in 1959. Kasiraksa (1963) showed there were substantial increases in the production of upland crops and vegetables in the region of the road as compared with a selected reference area in Northeast Thailand. There was a ready market for this produce in Bangkok.

Patanapanich (1964) conducted a similar study for the East-West Highway in North-Central Thailand. The road alignment passed through a dense forest area with great economic potential but aside from timber production there was little increase in agricultural output.

In each of the two studies cited above there were considerable reductions in journey transport time and cost, with approximately 80 percent of the total daily traffic being made up of trucks and buses. Travel time for the Saraburi to Korat journey was reduced from eleven hours to three hours and the cost reduced from three dollars (U.S.) to fifty cents.

Wilson (1966) has criticised these two studies on the grounds that no data was supplied as to the monetary value of the increased output. Although the rainfall data for the study areas and reference areas was similar, there was no description of the relative population, geographical size, natural resources, freight

rates, or the distribution of production according to type, in the reference areas. Thus the critic states it is difficult to interpret the economic significance of the fact that over a four or five year period, the weight of production in the reference areas grew more slowly than in the areas affected by the highways. The only conclusion that can be made is that there was an increase in output associated with the expanded transport capacity.

In 1966 the Research Division of USOM¹ conducted an 'ex poste' cost-benefit study of three roads in North and Northeast Thailand. They wished to study the costs and effects of alternative road-making efforts in order to maximise the value of roadbuilding projects.

Table 3.3: Data for Three Road Projects Studied by USOM

Road location	Region of Thailand	Length km	Surface	Benefit/cost ratio
Chiengrai	North	140	Quartzite-Laterite	0.75
Khon Kaen	Northeast	59	Bitumen	1.26
Surin	Northeast	18	Laterite	0.78

Source: USOM, 1966.

Future costs and benefits were discounted at a rate of 12 per cent per year, a 15 per cent per year growthrate in traffic was assumed, and consideration was only given to the first five years of the life of the road. Although only one of the roads had a benefit-cost ratio greater than 1.0, important benefits could not be quantified. These benefits included improved marketing, reduced isolation, enhanced effectiveness of government officials, and the value of the major objectives of security and road construction training.

1 USOM - United States Operations Mission - Thailand group of USAID, an American Foreign Aid organisation.

Village merchants stocked a wider range of goods but stated that business declined because people travelled to the larger market towns. As far as agricultural production and income was concerned, 408 of the 611 farmer respondents reported no change in the volume of crops and livestock raised for consumption, and almost the same number noted no change in agricultural sales. There was an increase in the production of fibre crops, but factors other than the new transport facility operating in the area such as drought, disease, high feed prices and low commercial prices for livestock did not allow this effect to be attributed to the roads.

Jittasatra (1967) studied the economic effects of a major northeastern feeder road running between Khon Kaen and Yang Talad.² This road also passes through Mahasarakham Province but does not connect with the Borabue-Buriram feeder road of the present study. Time series changes in agricultural production, forest production and business activity were investigated. In order to ensure that the environmental conditions in the reference area were similar to the study area, the author selected the reference area to be the larger geographical and political division of which the study area was a member. The author reported the following important conclusions.

- (i) Travel time for the complete journey was reduced by five hours with a 50 per cent reduction in passenger fares.
- (ii) There was a large increase in the production of the fibre crop kenaf, output in the study area increasing 7.9 times over the base year, while in the reference area output increased 3.7 times.
- (iii) Increased vegetable production occurred in the study area although output from the reference area fluctuated.
- (iv) The number of pigs in the study area increased by

2 Refer to Figure 4.1 for the location of this road.

4.8 times in one ampher³ and two times in the other ampher over the period 1962-1966. For the reference area, the number of head declined over the same five year period.

- (v) Production of non-teak timber increased 8.7 times in the period 1962-66, while production in the reference area actually decreased over this period.
- (vi) Commercial shops and small business establishments increased in number at a rate of about 20 per cent per year in the study area. The merchants stocked a wider variety and greater volume of produce.
- (vii) Social benefits included the development of more primary schools and health centres in the region.

Unfortunately this study relies heavily on statistical data collected at both the Ampher and Provincial level. It has been this author's experience that this information is not well documented, particularly in the case of agricultural statistical data.

A similar study conducted by Virulhakul (1970) investigated the economic effects of the Korat - NongKhai highway.⁴ This highway is an extension of the Friendship Highway studied by Kasiraksa (1963) and referred to earlier in this section. The only significant agricultural development observed in this study was a substantial increase in the output of the fibre crop, kenaf. There was no effect on rice or vegetable production. Social benefits and commercial development followed a similar pattern, but were more pronounced than those observed in the Khon-Kaen - Yang Talad study.

³ Ampher: a political subdivision of a province (changwat); the English equivalent is district.

⁴ Refer to Figure 3.1 for the location of this road.

3.4 The Economic Success of Transport Investment Projects

A review of various 'ex poste' studies conducted in developing countries throughout the world indicates that the effect of an investment in terms of its contribution to the economic development of a region may range from spectacular to non-significant. Some investments are made with the full realisation that they will not have a developmental effect. These investments may be justified politically or have a social-welfare value.

However, there are investments made with the expectation that they will have a strong developmental effect. Wilson (1966) has suggested that the creation of economic opportunity, and the response to this opportunity, are two factors which determine subsequent economic development in the post-construction period of a highway. The creation of economic opportunity is dependent upon the relationship between the resource base and the transport sector. The resource base for agricultural production consists of the natural physical and climatic factors together with an adequate supply of capital and labour to engage in a particular agricultural enterprise. From the studies reviewed, it can be seen that conditions for agricultural development do exist in some places and where transportation is a limiting factor the construction of roads creates economic opportunity.

Three situations can be recognised in describing the results of a response to economic opportunity. The first is a short-term response when the natural vegetation cover or natural resources are removed from the land. The selling of trees for timber is a common short term response. The East-West Highway study in Thailand describes this situation, when the author found that timber production was the only agricultural product to increase in output. The author of the Bolivian study warned that the increased agricultural output in that region was mainly a result of the natural fertility of the soil and yields would fall once this fertility was removed.

Sustained economic growth, the second possibility, requires that corrective action be taken for the removal of natural resources. This means that the area concerned must be capable of giving a return to the entrepreneur, sufficient to reward him for his inputs. In a developing region this usually requires that the land be capable of producing both the subsistence crops the farmer has been accustomed to growing, and also alternative cropping or livestock enterprises from which an income can be gained. The movement from a subsistence agriculture to commercial agriculture is a gradual process, and villagers are not likely to settle in an area which may have economic potential for cash crops but is not suited to crops such as rice, required for home consumption.

The third result which has been reported is a lack of response to the economic opportunity created. Wilson has suggested that a positive response to a new transport capacity will occur if the villagers are aware of the transport potential, they have available finance, and the magnitude of possible benefits are greater than those from alternative investments. Lack of awareness of the potential of an area is not usually a major problem. In the case of the El Salvador Highway the planning economists had anticipated increased production of food crops and livestock but the biggest development which took place was in cotton production. The farmers quickly learned of the potential for this crop.

It may be necessary to provide financial assistance to villagers if a substantial outlay is required before any revenue can be obtained. In a developing region, where a high proportion of the population are engaged in agriculture, there are few opportunities for alternative investment. However, the incentive for the farmer to increase production will be reduced if he does not receive his expected share of the benefits. This situation can arise if land-owners increase the rent on land, money-lenders charge excessive interest rates, or the benefits pass to middle-men in the marketing process.

As Mosher (1966) has indicated, transportation is only

one of a number of components necessary before agricultural development will take place. If development does not eventuate to the level anticipated following the construction of a road, it is likely that one of these other essential components is lacking. If the expected benefits do arise, the project can be considered successful because a major obstacle to development has been recognised by those responsible for planning, and the situation rectified. Continued economic growth requires a change in attitude of the majority of the population from producing for subsistence, to production for sale.

3.5 Summary

This chapter has outlined the methodology and limitations of techniques used in the economic evaluation of road transportation projects. The role of transport as part of the infrastructure in developing countries and the fact that social and political considerations may justify a project that cannot be recommended on economic grounds has been described.

The Thai Government has recognised that transportation has an important function in helping to improve the economic welfare of the population in Northeast Thailand. Economic studies conducted in this region to evaluate the impact of road projects have recorded fare and freight cost reductions, large increases in the number of vehicles, and increased agricultural output when the study area was compared with a reference area not affected by that project.

An attempt has been made to evaluate the reasons why some road projects can be considered economically successful while others appear to have had little or no impact on their immediate environment. Projects which create economic opportunity, and a population with the motivation to respond both technically and economically to this opportunity, are the key factors which determine a project's success in promoting economic development in a region.

Chapter Four

PROCEDURE AND METHOD OF STUDY

"My own methodological frustrations centre on the rather elementary problem of getting reliable data in a peasant setting. Published materials very rarely and casually, if ever, mention the difficulties encountered in actual research operation. I would like to see detailed documentation on the dynamics of interviewing, the whole process of identifying and finding the respondent, motivating him to answer so-called silly questions and finally concluding the interview in such a way that another researcher may find the respondent more receptive." (Castillo, 1969)

A lack of statistical data has already been mentioned as a major limitation for research workers in a developing country. The available information must be treated with caution, and it is often necessary to supplement it with data obtained from original research. Original data required for this study was obtained from four sources of investigation, viz.

1. Agricultural pilot survey
2. Farmer case studies
3. Land classification survey
4. Road traffic surveys.

This chapter outlines the collection of the information from these sources and the various problems and precautions taken to ensure accuracy in the data obtained.

4.1 Agricultural Pilot Survey

4.1.1 The purpose of the pilot study

Agricultural data is essential if the developmental effects of a road are to be measured. Because of a lack of reliable basic agricultural statistics for the region in the

immediate vicinity of the Thai-New Zealand feeder road, it was necessary to conduct an agricultural survey among local villagers. This survey had three major functions which can be listed as:

- (a) To enable the author to learn about the agricultural, social and cultural activities among villagers in the vicinity of the Thai-New Zealand feeder road.
- (b) To obtain information from the villagers on the subjective value of the sealed road to them.
- (c) To locate farmers who were progressive and clearly deriving benefits from the presence of a sealed road.

4.1.2 Identification of the research worker

Obtaining statistical data can be difficult when the research worker is not familiar with the local language and customs. The Northeastern farmer is reluctant to disclose information to strangers. In addition to the insurgency problem, the villager is afraid that any information he supplies may be used to his disadvantage at some time in the future.

"... the farmers' traditional strong reluctance, based on general fear of officials and of taxes, to report their full holdings or their entire harvest to annual agricultural surveys. Land taxes are very low in Thailand ... but farmers remain suspicious because they have from time to time been obliged to pay informal fees to officials to get official business done. At such times farmers do not wish to be on record as wealthy landowners." (Ingersoll, 1969)

Unless the identity and integrity of the research worker is firmly established, the reliability of the information obtained in an interview is questionable. Prior to the gathering of any information, letters of introduction were taken from the Dean of Agriculture, Khon Kaen University to the Governors of Changwat¹

¹ Changwat: a political subdivision of the Kingdom of Thailand. The English equivalent is province.

Mahasarakham and Changwat Buriram. These letters provided information about the researcher, the nature of his research and a request for every possible assistance to be given. The following chain process of communication operated whereby the researcher received an introduction to the villagers:

Governor of Province → Letter of Introduction → Nai Ampher² → Letter of Introduction → Puyaiban³ of each village in Ampher

Although this line of communication appears somewhat cumbersome and inefficient, it must be adopted by a research worker. The last link in the chain must be satisfied that any instruction has the knowledge of each of his immediate superiors before he will take action. Before the pilot survey began the author, together with his translator, did venture into one village without an introductory letter and asked the Puyaiban several questions. There was an uneasy feeling among the large crowd which had gathered and eventually one elderly village lady asked if the visitors were communists. From the crowd reaction she wasn't alone in her thoughts.

4.1.3 Materials used for the pilot survey

A Khon Kaen University student from the agriculture faculty was employed as a translator throughout the period of the pilot survey. In addition to his excellent ability in speaking English, he was born in Northeast Thailand and was therefore fluent in the local dialect. This is a very important requirement for any research worker conducting an investigation in this region.

Throughout the Kingdom of Thailand there are several language dialects but Central Thai is the official language.

2 Nai Ampher: the chief official government administrator of an ampher (district) in Thailand.

3 Puyaiban: the elected leader of a village.

Most Government officials and merchants speak Central Thai but the villagers in the Northeast Region speak a number of dialects known as Isan to Central Thai speakers and Lao to the villagers themselves. The dialects are closely related to those spoken in Laos.

Two guideline questionnaires were prepared.⁴ The first was designed to obtain information from the Puyaiban concerning statistics for the village as a whole. It was designed to collect information in each of the following broad categories:

1. Village location
2. Population data
3. Village farmland statistics
4. Village amenities
5. Transportation
6. Extension and market information availability
7. Innovations
8. The subjective value of the new road to the village.

The second questionnaire was structured for individual village respondents and included information in the broad categories:

1. Household information
2. Crop production statistics
3. Crop cultivation practices
4. Farm labour employment
5. Livestock data
6. Farm equipment schedule
7. Transport and marketing
8. Extension and credit availability.

The questionnaires were used as a guideline only, and the interviews were conducted on an informal discussion basis. This allowed exploration to a greater depth in the case of very keen respondents. The translator had a clear understanding of the meaning of each question prior to the undertaking of the pilot survey.

⁴ The questionnaires are provided in Appendix Six.

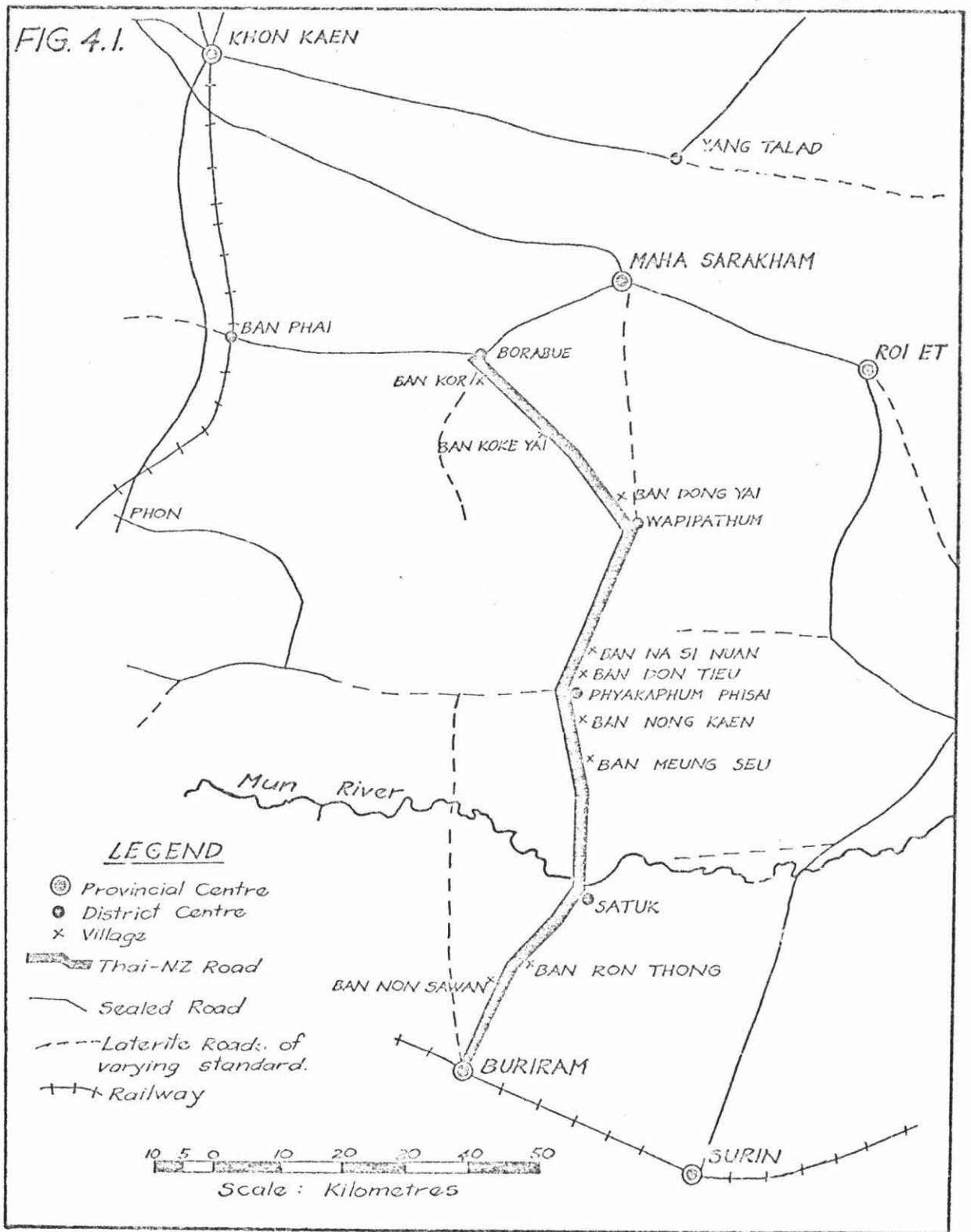
4.1.4 Village selection

A map showing the location of villages adjacent to the Borabue-Buriram highway was obtained from the Thai Highways Department. Selection of the villages took place in each ampher office in consultation with the Nai Ampher. In making the selections the author took the following factors into consideration:

- (a) The villages had to be within walking distance of the Thai-New Zealand feeder road as the researcher usually had no transport, other than public bus transport along the road. All villages selected were within two kilometres of the road.
- (b) Where possible, it was considered desirable to select some villages close to the ampher commercial centre and other villages about 15-20 kilometres from a commercial centre. From a marketing viewpoint, villagers far from a market centre have additional incentives for increased agricultural production where transportation was previously a limiting factor.
- (c) At the northern end of the road (Borabue) the village population is predominantly of Laotian origin. However at the southern end of the road (Buriram) the people are of Cambodian descent. It was therefore necessary to visit villages of both ethnic groups.

The author discussed these considerations with each Nai Ampher and requested him to supply letters of introduction to village leaders in two villages approximately five kilometres from the commercial centre, and two villages 15-20 kilometres from the commercial centre. Although introductory letters were obtained for sixteen villages, interviews were conducted in only nine villages. It was difficult to obtain reliable information from the predominantly Cambodian villages because of dialect differences. The author considered it preferable to conduct more interviews in the villages where he received the greatest co-operation. The location of the villages is shown on Figure 4.1.

LOCATION MAP OF VILLAGES STUDIED



Source: Adapted from Dickie, R. McL. "The Thai-New Zealand Road Project", New Zealand Engineering 28 (3) page 66. 1973.

4.1.5 Within village sample selection and interview technique

The author believed that village people would not understand the theory underlying random sampling methods. Rather they would regard such a method of choosing respondents as being selective and immediately become suspicious of the researcher's motive in asking questions. Thus a purposive sampling procedure was adopted. The sample of respondents interviewed in each village is made up of those villagers who were available and willing to be interviewed when the researcher travelled to that particular village. The interviews were conducted over a period of eight weeks in April and May 1972. On the first visit to any village the translator and researcher were accompanied by a representative from the Ampher office, usually the agriculture officer. While many government officials are regarded with a mixture of awe and suspicion, these officials did appear to be very welcome in the villages and their presence helped to introduce the researcher and his aims.

Upon arrival in a village the author and translator proceeded to the Puyaiban's household. The author was the subject of much curiosity on the part of the villagers, and little information could be obtained on the first visit. General discussion about New Zealand, the road construction project, impressions of Thailand and the eating of local village food, all had an important role in gaining acceptance by, and the confidence of, village people. A willingness to try and practise some local customs and adapt to local conditions are necessary when conducting research in this type of community. Attempts at speaking the native language, the consumption of food in a typical village diet, and living and sleeping in the villagers' houses are three particular efforts that do not pass unnoticed.

The general village interview usually took place on the second visit to the village. Although this interview took place at the Puyaiban's house and he was the chief spokesman, information and opinions were offered by other villagers and often a joint decision would be made. School-teachers, local village merchants

and the district agriculture officers also provided background information at this time.

The Puyaiban was the first respondent to an individual farmer questionnaire. A similar procedure was adopted in administering the two questionnaires. The researcher instructed the translator to ask the respondent a question from the guideline questionnaire. Depending on the respondent's answer, further questions would be asked concerning the same topic or the researcher would move onto the next question. The respondent's answers were given by the translator and recorded in English by the researcher. Where difficulties arose in translation the replies were recorded in the Thai language by the translator and translated at a later date.

Other villagers were interviewed either in the Puyaiban's house or in the villager's own house. The Puyaiban was usually present at all the interviews. This was helpful in informing other villagers about the purpose of the visit and refreshing the memory of the villager when statistical data was required. The Northeastern farmer does not keep records of farm inputs and outputs. Measurements are subjective in many instances. Rice yields are in terms of baskets, kenaf yields in bundles, while frequently villagers do not know accurately the area of land they are farming. Recent events can be recalled easily, but it is the author's firm belief that accurate statistical information cannot be obtained for more than one previous harvesting season.

Each interview occupied at least two hours and very often the discussions took considerably longer than this. Interviews were terminated when the respondent appeared to become weary or bored. Where the information gathered was incomplete, the situation was rectified on subsequent visits. The researcher spoke with some families several times particularly on the occasions when he stayed overnight in a village. It should be mentioned however that the villagers were very willing to provide the information. New Zealand is favourably known and the villagers clearly appreciate a sealed highway access.

Collective information in the general village questionnaires was obtained for all nine villages visited. Individual household questionnaires were administered in five villages as shown in Table 4.1.

Table 4.1: The Percentage Sample for the Pilot
Agricultural Survey

Village name	Total number of households in village	Number of households interviewed	% sample
Ban Kor	97	23	24
Ban Koke Yai	78	24	31
Ban Dong Yai	98	27	28
Ban Na Si Nuan	146	31	21
Ban Don Tieu	158	18	11

Individual interviews were not carried out in the four southern villages largely because of language difficulties. When efforts were made to interview these farmers, they frequently talked amongst themselves in a Cambodian dialect. Neither the researcher nor translator were familiar with this language and there was some doubt as to the reliability of the data. However, it is considered that sufficient information has been gathered to provide a broad knowledge of the agriculture in the region through which the road travels. The data obtained from the pilot agricultural survey is presented in Chapter Five.

4.2 Farmer Case Studies

A preliminary tabulation and analysis of the data from the agricultural pilot survey revealed that few farmers were engaged in a commercial multi-enterprise farm system. The typical farmer was growing rice, a few vegetables for home consumption and

kept a buffalo, pig and chickens. However, there were a few farmers who were commercially minded. The author selected eight case study farmers from the village nearest to the roadhead, Ban Kor. Each of the farmers was engaging in at least one enterprise other than rice. These farmers were visited every three to four weeks throughout the year and records kept of physical and financial data. The case study farmers were selected from farmers in Ban Kor for a number of reasons:

- (1) This was the only village where the author located several farmers engaging in a number of commercial enterprises other than rice production.
- (2) The farmers were close to a market centre (Borabue) and thus are frequently exposed to farm and household inputs. Consequently there is stronger motivation to obtain additional income for the purchase of goods.
- (3) The District Agriculture Officer had been active in this village and had endeavoured to encourage some farmers to engage in other enterprises. His advice was well received in this village.
- (4) The farmers could obtain 'off farm' work in the dry season. There were a number of salt producing factories nearby. Although the work was hard and the pay small, this was an opportunity which villagers further along the road did not have.
- (5) There had been a co-operative movement in the village for about fourteen years. A number of farmers had joined recently in order to purchase fertilizer at a lower price. Some of the other villages had co-operative movements also, in various states of activity.
- (6) The author received considerable co-operation from the Puyaiban and villagers of Ban Kor. This was considered important where many repeat visits were to be made.

The case farm approach permits the study of a few selected farms in detail. In selecting these farmers the author hoped he would be able to obtain accurate data for a small number of farms for one complete year. This information was to be used in the estimation of the potential benefits that would arise from the feeder road, should more villagers engage in a diversified agriculture.

Unfortunately in 1972, the year of the study, there was a severe drought throughout Northeast Thailand and many agricultural crops could not be planted. Few farmers were able to plant kenaf because the first monsoon rains arrived late in the season and farmers had to plough lowland for the rice seedbeds. There was not enough time to plough the upland areas for kenaf planting. The rice seed germinated in the seedbeds but the seedlings died from a lack of water. None of the case study farmers harvested a rice crop. Thus it was not possible to obtain additional yield data for agricultural crops. However, any agricultural business which took place throughout the year was recorded and the return visits made it possible to check the information these farmers had supplied for the 1971 cropping year in the pilot survey.

During this period the author also conducted a small experiment in the village of Ban Kor. At an ASPAC Food and Fertilizer Technology Centre seminar held in Thailand in August 1972 it was suggested that the feed supply for livestock in Northeast Thailand could be increased through the introduction of a legume. A supply of Townsville style (Stylosanthes humilis) legume seed was obtained from Khon Kaen University and planted on trial sites of uncultivated upland soil and also on lowland paddy bunds.⁵

The objective of this experiment in relation to the present study was to observe the reaction of the villagers to a new idea, the planting of pasture seed without prior cultivation of a seedbed. Information was collected from the case study farmers

5 The results of this experiment have been published in ASPAC Food and Fertilizer Technology Centre Newsletter Number 17, May 1973.

when the experimental plots were visited to check on the progress of the legume seedlings. It was thus possible to obtain information from the case study farmers on a casual basis in the course of conversations about the growth of the seedlings. The interest of the villagers in this experiment helped in the acceptance of the author by the villagers, when return visits were made to the village.

4.3 Land Classification Survey

A comparison of land utilisation in the pre- and post-investment phases of a project can help in the measurement of the agricultural development which has taken place. If aerial photographs of the region at these two points in time are available, they can be compared and land use changes can be measured. A knowledge of the requirements of various agricultural enterprises, together with yield and price data will enable the agricultural development to be calculated in monetary terms.

Aerial photographs depicting land utilisation along the Thai-New Zealand feeder road were not available to the author. A cadastral map prepared by the Thai Highways Department in 1965 showed the proposed alignment of the road on a kilometre by kilometre basis. The map showed the utilisation of the land through which the proposed road would pass and the route in relation to existing sections of dirt and laterite cart tracks. This information has been used to help describe the pre-investment utilisation of land in a defined zone of influence alongside the new road.

During the period 28th February to 2nd March, 1973 the author and a student from Kohn Kaen University travelled along the Thai-New Zealand feeder road and recorded the land utilisation in a one kilometre band on each side of the road, kilometre by kilometre, according to the following classification:

- (1) Lowland (rice growing land)

- (2) Upland cropping land which had been cropped in the previous one or two seasons.
- (3) Upland cropping land which had been cropped previously but at that time was covered with re-growth vegetation.
- (4) Forest and scrub areas which had never been cultivated.

The method used to classify the land was to drive along between each consecutive pair of kilometre marker posts and observe the land utilisation on one side of the road only. After stopping the car, the percentage utilisation was recorded on a scale between 0 and 100 per cent for each category. For example:

Road Section: Kilometre 81 to kilometre 82
 Rice growing land: 25%
 Upland cultivated at present: 75%
 Upland not cultivated at present: 0
 Forest land: 0

Land utilisation on the opposite side of the road was recorded on the return journey. At the same time as the land classification took place, observations were made on fruit and vegetable cultivation, roadside shops, health centres and branch roads from the Thai-New Zealand feeder road. It is recognised that a subjective measurement such as this can not be as accurate as an aerial photograph. Whether 50 or 75 per cent of a square kilometre is rice growing land is sometimes difficult to assess but checks on some sections at a later date indicated consistency in the recorded observations. Information from the cadastral map and the land classification survey is presented in Appendix Three, Table A3.1.

4.4 Road Traffic Surveys

In order to investigate the extent of usage of the Thai-New Zealand feeder road, two traffic surveys were undertaken. While counting vehicles may seem a very simple process, it is difficult to obtain accurate figures for a low cost. Manual counting is necessary where information is required as to type of vehicle, the type of goods carried, occupancy rates and origin and destination patterns, but this method of collecting data is expensive. The author did not have sufficient funds to enable a comprehensive traffic survey which would collect data on different days of the week and in the various seasons of the year. The only other traffic information available was the result of a survey conducted by New Zealand engineers on 29 September and 2 October 1971. This information, together with the data collected by the author has been used to estimate the road-user-savings of the road.

The first traffic survey collected information over a full twenty-four hour period beginning at 6.30 p.m. on 24th October 1972. The author and four students from Khon Kaen University, working in shifts, recorded the number of vehicles in various classes moving in each direction of the road, at hourly intervals. The count was made three kilometres from Borabue but it was not possible to stop vehicles and request origin and destination information. Hence it was only possible to record that the vehicles were travelling on the section of road between Borabue and Wapipathum, although passenger buses show the origin and destination of the bus on the front of the vehicle.

The second traffic survey was conducted by the author and two students from Khon Kaen University during the period 6th to 9th March 1973, working between the hours of 6.30 a.m. and 6.30 p.m. each day. Table 4.2 shows the location and dates on which observations were made on the various road sections.

Table 4.2: Location and date of Observation of Road Sections
in the Second Road Traffic Survey

Date	Kilometre location	Road section observed
6th March, 1973	104	Satuk - Buriram Satuk - Phyakaphum Phisai
7th March, 1973	76	Phyakaphum Phisai - Satuk Phyakaphum Phisai - Wapipathum
8th March, 1973	33	Borabue - Wapipathum Mahasarakham - Wapipathum
9th March, 1973	1	Borabue - Wapipathum

The location sites for the traffic counts permitted observations on some road sections for two consecutive days. Separate counts were made in each direction for all road sections. A copy of the traffic survey collection form, together with tabulated data obtained from the surveys is provided in Appendix Four.

4.5 Summary

This chapter has described the methods used by the author to obtain information about the agricultural production and traffic usage along the Thai-New Zealand feeder road. The importance of villager acceptance of the research worker has been stressed. Successful data collection from villagers practising a subsistent or semi-subsistent agriculture, requires that a research worker both respects and adapts to the customs of the local population. A compromise must be made between 'desirable' and available information with respect to resources and the reliability of the information that can be obtained. This means that some techniques used to obtain data in an advanced economy, for example formal questionnaires and statistical sampling, may not be appropriate in a developing economy. These factors have been recognised in selecting the methods that were used to collect information for this study.

Chapter Five

AGRICULTURAL ENTERPRISES IN THE REGION OF THE THAI-NEW ZEALAND FEEDER ROAD

5.1 The Setting of a Typical Northeastern Village

Although Northeastern villages differ greatly in size, both in terms of land area and the number of households, and the populations may have a different cultural heritage and customs, there are a number of features which can conveniently be used to describe a typical village.

5.1.1 Land areas

Generally the landscape can be divided into three regions. There will always be a housing area. The houses are grouped close together on a high piece of land and nearby the village temple and housing for the monks can be found. A primary school may also be located in this area. Frequently there are small garden areas and trees such as banana, papaya, kapok, coconut and other palm trees grow near the houses and in the temple grounds.

Almost every household in the village will own lowland for rice production. The paddy plots are usually located adjacent to each other with no obvious boundaries, but every farmer knows his own plots. The third area of the village is described as the upland area, that is the land which has not been formed into paddies for rice production. The land cannot be cultivated for rice because either it is too high or else the terrain slopes to such an extent that it is difficult to retain water, even within paddy bunds. This land may be part of a shifting cultivation, whereby the land is cultivated for about four years after which time the natural fertility is exhausted. The land reverts to

secondary regrowth for three or four years when planting is resumed.

Table 5.1 shows the variation between the average land area and land type owned by households in the villages surveyed. Most of the land in Ban Na Si Nuan and Ban Don Tieu was suitable for rice cultivation and hence there was comparatively little upland crop cultivation in these villages.

Table 5.1: Average Area of Paddy Land and Upland Owned by Households in the Survey Sample in 1972. (rai)

Name of village	Number of households in the sample	Average area of paddy land (rai)	Average area of upland (rai)
Ban Kor	23	35.4	10.3
Ban Koke Yai	24	23.2	3.6
Ban Dong Yai	27	35.6	8.7
Ban Na Si Nuan	31	34.2	1.4
Ban Don Tieu	18	45.0	2.8

5.1.2 Housing

A typical village house is raised above the ground on stilts and constructed in wood with an iron roof, although poorer families may have thatched walls or a thatched roof. Beneath the house there are pens in which cattle and buffalo are housed during the night. Chickens and pigs may also be kept in pens beneath the house, or underneath the rice storage house adjacent to the living quarters. Unless the village is very close to the ampher township there will be no electricity. Parafin lamps are a source of light and cooking is done on small charcoal burners. In response to health education programmes, nowadays more households are building toilets than previously.

5.1.3 The family

The basic family unit is the father, mother and unmarried offspring. However, within any particular household there will often be a number of relatives living as dependent family members. These may be parents of the husband or wife, married children who may also have families of their own, or merely family friends. The period for which this extended family may live together may be only a few months or indefinitely. In this study the word family is synonymous with household. If a group of people, specified as dependent relatives work the same fields and take food together with the nuclear family then, even though they may not live in the same house, they are considered as one household.

Table 5.2: Distribution, by Size, of Households in the Survey Sample (1972)

Village	Number in household											
	1	2	3	4	5	6	7	8	9	10	Over 10	Mean size
Ban Kor	-	1	-	1	5	1	7	5	-	2	1	5.6
Ban Koke Yai	-	-	1	2	3	4	3	2	3	2	4	7.5
Ban Dong Yai	-	-	2	2	2	5	7	3	3	-	3	7.0
Ban Na Si Nuan	-	-	1	2	1	3	9	7	2	3	3	7.5
Ban Don Tieu	-	-	-	1	4	3	1	4	1	4	-	7.2
Total	-	1	4	8	15	16	27	21	9	11	11	7.0

Table 5.2 shows the distribution of households by size, in each of the villages surveyed in 1972. An average household in the survey sample had seven members. The age distribution of household members was not obtained.

A child's education begins when he is seven years old. According to the most recent government instructions, education is compulsory for seven years but because of the shortage of teachers many village children are only receiving four years, the period stipulated previously.

Aside from children studying in school and people too old for work in the fields, every member of the household can be considered a permanent labour unit and each will have work to do, depending on the time of the year. Table 5.3 shows the available labour in the village families surveyed. This data was obtained in response to a question about the number of persons in the household able to work, such as assisting with transplanting or harvesting during the rice season.

Table 5.3: Household Labour Availability in the Survey Sample (1972)

Village	Number of households interviewed	Total number of persons in sample	Number of persons capable of working	% labour availability
Ban Kor	23	129	81	63
Ban Koke Yai	24	181	96	53
Ban Dong Yai	27	189	100	52
Ban Na Si Nuan	31	234	142	60
Ban Don Tieu	18	130	75	58

Table 5.3 shows that approximately 60 per cent of the total population can be regarded as the labour-force. However, peak labour requirements may result in young children also making a contribution.

The women of the household prepare food which is eaten three times a day, rice forming the main part of every meal. The diet is supplemented by vegetables, eggs, meat, fish and insects although all of these may be in short supply, particularly during the dry season. Meat is generally only eaten on special occasions. However, the health of the children in the villages appeared to be good with few cases of obvious malnutrition. During the rice season the women do the transplanting and assist with harvesting the crop. Other occupations include weaving both silk and cotton cloth, feeding chickens and swine, and shopping at the market.

The men carry out activities such as cultivation of the fields, fishing, house and equipment repairs and village temple maintenance. Younger children have the responsibility of taking care of the cattle and buffalo while they graze throughout the day. Usually the young women and sometimes the young men too, carry water from either the public wells or ponds for household use.

The village temple is the focal point of the village and receives the support of every household. Money is given for temple festivals and repairs while each day households provide a portion of food for the monks. Buddhist ceremonies play an important role in a villager's life. There are ceremonies associated with agricultural production, the dedication of new buildings and family welfare, in addition to the important festivals such as weddings, funerals and ordination. It is usual for every Buddhist male to spend a period as a monk, often soon after his 20th birthday when he may enter the temple as a monk for a period of three months. This can be a very expensive ceremony for a household, 1000 baht being a common amount.

5.1.4 Annual rainfall and work cycle

Figure 5.1 shows monthly rainfall patterns recorded at the Borabue District Centre. The rainfall cycle can be divided into three seasons, viz cold, hot and wet season. During the months November to January, the temperatures are cooler and there is almost no rain at this time. The hot season follows from February to April, and again the rainfall is light. The cold and hot season months are frequently called the dry season months. Monsoon rains in May mark the beginning of a six month rainy season, the period when most of the cropping takes place.

From Figure 5.1 it is difficult to understand why 1972 was a drought year when comparing the rainfall pattern to that of 1971, a more normal year. The daily distribution of the rainfall within the months of May to July is important. In 1972 the

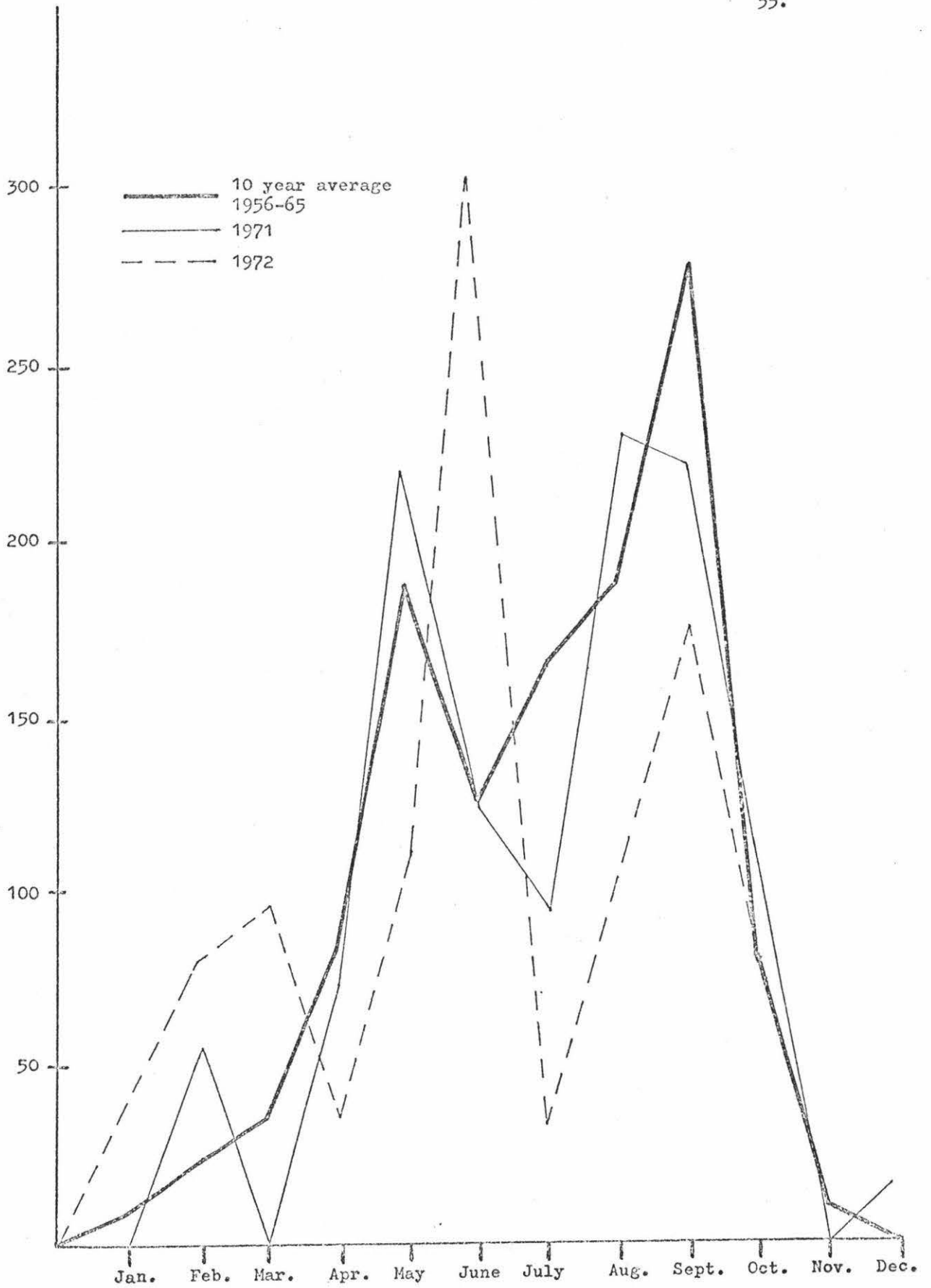


Figure 5.1: Monthly Rainfall Pattern Recorded at the District Office, Ampher Borabue, Mahasarakham. (millimetres)

villagers planted their seedbed rice in April following the rains in March. However, the rainfall in both April and May was below average and the heavy rainfall in June fell over a few days in the latter part of the month. As a consequence the seedling rice plants had either already died or become stunted and unsuitable for transplanting.

Figure 5.2 shows the annual cropping cycle. The planting date of the rice crop depends upon the onset of the wet season which in turn affects the other farming operations. Each year the farmer would plan to first plough the land for the seedbed rice and then the upland for kenaf. He would then continue with the ploughing of the paddy land. However, if the rains come late in the year, the pressure of work for the rice crop may be so great that he must forego an upland crop. There may be insufficient labour, or animals to do all the ploughing. In a season when the rains do fall late in the year there could be a place for ploughing with a tractor.

While there appears to be an evenly spread workload throughout the year, it should be noted that for many households, rice production is the sole enterprise. Labour requirements are at a peak during transplanting and harvesting. Aside from these periods the household members, particularly the males, may have little to do other than fishing in the paddy fields and ponds.

During the post-harvest dry season the farmers engage in household repair work, and temple construction and maintenance. Members of some households may travel to other provinces, particularly Bangkok, seeking employment in occupations such as building construction and weaving. Table 5.4 shows the extent of dry season employment among villagers in the survey sample.

FIG 5.2. ANNUAL CROPPING CYCLE

MONTH	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.
SEASON CROP	WET SEASON					COLD SEASON			HOT SEASON			
RICE	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Ploughing, Harrowing</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Plant Seedbed Plots</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Final Ploughing, Transplanting</div>					<div style="border: 1px solid black; padding: 2px; display: inline-block;">Harvesting</div>						
KENAF	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Ploughing, Planting</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block;">Weeding</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block;">Harvest, Retting</div>			<div style="border: 1px solid black; padding: 2px; display: inline-block;">Seed Harvest, Retting</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block;">Clearing, Burning off</div>		
KAPOK	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Harvest</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block;">Plant Trees</div>								<div style="border: 1px solid black; padding: 2px; display: inline-block;">Harvesting, Selling</div>	
SILK	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Mulberry Harvest</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Worm Cultivation</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block;">Mulberry Harvest, Worm Cult, Weaving</div>				<div style="border: 1px solid black; padding: 2px; display: inline-block;">Mulberry Harvesting, Worm Cultivation, Weaving</div>					
VEGETABLES	<div style="border: 1px solid black; padding: 5px;"> <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 80%; margin: 0 auto;"> (Ploughing, Planting, Weeding, Harvesting) </div> </div> <div style="border: 1px dashed black; padding: 5px; margin-top: 5px;"> Intensive Continuous Cropping / Extent of Cropping depends on water availability </div>											
MONTH	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.

Table 5.4: Dry-season Employment of Household Members
in the Survey Sample (1972)

Village	No. of households with members obtaining dry season work	Number of members undertaking dry season work	No. of members returning for the rice production season
Ban Kor	7	11	8
Ban Koke Yai	9	15	13
Ban Dong Yai	10	18	11
Ban Na Si Nuan	15	24	17
Ban Don Tieu	6	8	8

While the percentage of the total village workforce seeking dry season employment is small, from this survey it appears that in most villages approximately one third of the households had at least one member engaged in this work. The author formed the impression that this practice is increasing in popularity as more workers return to the villages with additional finance. The amount of money the worker provided for the family was extremely variable, amounts ranging between 500 and 1500 baht depending on the nature of the work.

5.2 Rice Production

The cultivation of rice is the most important enterprise for almost every village family. Rice forms the major part of every meal, is frequently the only produce sold for income, and may be the only crop that is cultivated. In any particular year the size of the rice-crop will determine whether a family can support the continued education of a child, the ability to purchase new goods and maintain existing assets, and the spiritual well-being of the family.

Two types of rice are grown in Northeast Thailand. People of Laotian ancestry generally cultivate and eat glutinous rice, commonly known as sticky rice. The sticky nature of the cooked grains is due to the constituent carbohydrates in the endosperm. Compared with other rice types, glutinous rice is usually of poorer quality, with a lower protein but higher carbohydrate content. People who are of Thai, Chinese and Cambodian extraction consume non-glutinous rice, which is the rice familiar to New Zealanders. White rice commands a higher price than glutinous rice except in times when the latter is in short supply. The market for white rice both within Thailand and for export, is very much greater than that of glutinous rice which is largely restricted to the North and Northeast regions. Table 5.5 shows the number of households in the survey sample growing glutinous, non-glutinous or both types of rice.

Table 5.5: Type of Rice Grown by Households in the Survey Sample in the 1971 Season

Village	Number of households interviewed	Number growing glutinous rice	Number growing non-glutinous rice	Number growing both types
Ban Kor	23	21	7	7
Ban Koke Yai	24	24	4	4
Ban Dong Yai	27	27	9	9
Ban Na Si Nuan	31	31	15	15
Ban Don Tieu	18	18	9	9

Only two farmers from the total sample surveyed, were not growing their own rice. These two men each owned upland but not paddy land and thus purchased all the rice they required. There was a higher proportion of farmers growing non-glutinous rice in the southern-most villages surveyed where more of the population are of Cambodian origin. However, all farmers growing this type of rice also grew glutinous rice, reflecting a dietary

preference and an awareness of the higher price margin for non-glutinous rice when sold.

5.2.1 Soil preparation

Ploughing of the land for rice production begins early in the wet season (April/May) as soon as the soil is sufficiently soft. In every village visited, ploughing was done by buffalo and there was no farm mechanisation. Rice is grown in lowland depressions and the fields are terraced, each terrace being enclosed by a low wall (bund) to hold the water. The field is usually ploughed twice, a layer of water frequently covering the surface at the time of the second ploughing, and then harrowed with a wooden rake.

The first one or two terraces ploughed early in the wet season are used for the rice seedling areas. After the soil is thoroughly wet, soft and slushy, the surface is broadcast with seed at the high seeding rate of approximately 40 kilograms per rai. Grain was taken from the bulk of the crop at harvest and stored for seed to be used in the following season. A small proportion of households obtained improved varieties from the Rice Department and saved seed from these plants.

5.2.2 Planting

After about three weeks the seedlings are pulled from the seedbed, tied in bundles and carried to the planting areas. Women and younger members of the family generally transplant the seedlings as the male members of the household are busy with soil cultivation. The young plants are pushed into the muddy fields in groups of about five seedlings, planted in a grid of about 25 centimetres. If a family does not have sufficient members they may hire labour or several families may co-operate together to transplant the seedlings. Table 5.6 shows the number of households hiring paid labour for either transplanting or

harvesting rice in the 1971 season.

Table 5.6: Number of Households in the Survey Sample Hiring Labour for the 1971 Rice Production Season

Village	Number interviewed	No. hiring labour for transplanting	No. hiring labour for harvesting	Number of households with excess labour
Ban Kor	23	9	7	2
Ban Koke Yai	24	13	11	7
Ban Dong Yai	27	1	1	1
Ban Na Si Nuan	31	1	1	1
Ban Don Tieu	18	7	5	2

The hiring of labour is dependent upon labour availability and the climatic conditions prevailing in a particular season. If the rains do not arrive until very late then the farmers must hire labour in order to get their land planted. Otherwise the growing season will be too short. Family members who travel to other parts of Thailand for dry season work frequently return to assist with rice cultivation and harvesting.¹ The rate of payment for transplanting in the 1971 season was six baht per day, the farmers also supplying food to the workers.

5.2.3 Fertilizer usage

The application of chemical fertilizer to the growing rice crop is becoming a more common practice although it only began four or five years ago in most of the villages studied. Fertilizer, in the form of cattle and buffalo dung, had traditionally been applied to the seedbed areas.

¹ Refer to Table 5.4.

It is not realistic to describe the usage of chemical fertilizer nowadays, in terms of an application rate per unit area. The fertilizer is used sparingly and it is not applied uniformly over the fields. Instead the farmer tends to sprinkle it in areas where the crop is not growing well. He talks of usage in terms of the number of bags of fertilizer purchased, and not the weight applied to a certain area.

Table 5.7: Number of Households in the Survey Sample Using Fertilizer, Classified According to the Number of Bags of Fertilizer Used in the 1971 Season

Village	Number of households interviewed	Distribution of households according to quantity of fertilizer used (50 kg bags)				Total number using fertilizer
		1	2	3	>3	
Ban Kor	23	7	4	2	1	14
Ban Koke Yai	24	6	2	-	-	8
Ban Dong Yai	27	2	7	6	9	24
Ban Na Si Nuan	31	8	8	7	7	30
Ban Don Tieu	18	2	6	2	7	17

Table 5.7 shows fertilizer was used by nearly all farmers in the southernmost villages studied but by only a third of the villagers in Ban Koke Yai. Farmers from the latter village had little produce to sell and could not afford to buy fertilizer. More than half of the farmers used less than three bags, an amount which would represent an average blanket rate application of about five kilograms per rai (31.25 kg per hectare).²

The high cost of the fertilizer is the factor which most limits increased usage. The price to the farmer depends upon the trademark, chemical analysis and weight of contents, and the method

² This compares with an average usage in 1966 of 147 kg/hectare in Taiwan and 222 kg/hectare in Japan (F.A.O., 1966).

of payment - whether by cash or credit. The bags weighed either 40 or 50 kilograms and were labelled with an N-P-K rating. The fertilizer most commonly available was 16-20-0, ammonium phosphate, but how accurately this labelling reflected the quality of the contents is not known.

Table 5.8: Household Survey Sample Usage of Fertilizer,
Classified According to Source of Purchase and Method of
Payment (1971)

Village	Total number of bags purchased	Source of purchase			
		Cooperative	Merchant by cash	Merchant on monetary credit	Merchant on product credit
Ban Kor	29	15	12	2	-
Ban Koke Yai	10	1	5	4	-
Ban Dong Yai	77	40	27	10	-
Ban Na Si Nuan	81	2	37	5	37
Ban Don Tieu	96	47	30	-	19

Table 5.8 shows the source and method of payment for the fertilizer used by the villagers in the survey sample. Where a cooperative operated in a village half of the fertilizer was purchased from this source. A price of 100 baht per bag was paid by co-operative members at the time of harvest, while the cash price at the time of planting was about 95 baht. It is not surprising that most of the fertilizer was purchased by cash or from the co-operative on credit. Credit from the merchants was reported to be very expensive, interest rates varying between 20 - 50 per cent. Farmers in Ban Koke Yai stated that fertilizer could be purchased for a cash price of 75 baht per bag but the same fertilizer could only be purchased on credit if the farmer was willing to pay 115 baht per bag at harvest time.

Payment for fertilizer with a quantity of rice at harvest time can be a very lucrative business for the merchant. The volume

of rice to be paid is contracted before the growing season. Merchants were not known to be generous, and if subsequently the harvest was poor, they did not reduce the volume to be paid although the price of rice was higher than normal. They did not provide any other services to the farmer, but having gained part of the rice crop as security, they would lend additional finance for consumption expenditure, again at high interest rates.

Farmers in Ban Na Si Nuan provided data for the practice of payment for fertilizer with rice at harvest time. Table 5.9 sets out actual examples showing the volume of rice the farmer contracted to give in payment, the expected value of the rice at the time of contract in May 1972 and the value in December 1972 following a poor harvest. The merchants expected to receive a profit of 50 - 60 per cent above the cash price for money borrowed only about seven months. However, because of the price increase in rice, their actual profit was approximately 200 per cent.

Table 5.9: Profit Margins of Merchants Selling Fertilizer on Credit, Repayment to be Made in Rice (1972)

Fertilizer cash price per bag (baht)	Volume of rice contracted (tang)	Value at time of contract May 1972 (baht)	Value at harvest time December 1972 (baht)
70	19 N.G.	114 (63)	209 (200)
73	20 N.G.	120 (65)	220 (200)
75	21 G.	105 (40)	210 (180)
75	23 G.	115 (43)	230 (205)

Note: N.G. = non-glutinous rice; G. = glutinous rice.
 Rice price in May 1972 : N.G. 6 baht/tang; G. 5 baht/tang.
 Rice price in Dec. 1972:: N.G. 11 baht/tang; G. 10 baht/tang.
 Figures in brackets indicate the percentage increase above the cash price.

The high cost of fertilizer has been recognised as a limitation to agricultural development by various technical and advisory missions visiting Thailand. A typical criticism from an

F.A.O. (1969) publication stated that the high price is a reflection of a policy to protect domestic manufacture of fertilizers at prices greater than those of imported fertilizer, and is also a result of the multi-tiered marketing system.

5.2.4 Treatment during the growing period

Aside from fertilizer application there are few additional inputs in rice production. Very few farmers mentioned chemical control of either insect pests or weeds. Providing the water level of the paddy field remains at a depth of about ten centimetres weeds are not a problem. Insects can cause considerable damage, the most common being the Gall midge, leaf hoppers, stem borers, and Army worm. Farmers accepted insect attacks as inevitable, stating that insecticide was too expensive and control difficult.

Tins of insecticide were available in the market and general stores at a price of eight baht per can. However no households owned spray application equipment. Three farmers in Ban Kor obtained free insecticide from the ampher agricultural officer who also loaned a knapsack sprayer. The free supply of spray was very limited as were the number of spray units available for borrowing. Farmer income levels at present are not sufficiently high to allow expenditure on insect control.

Little else is done to the rice throughout the growing season. The farmers control the level of the water in the paddy fields by letting water out if there are heavy rains. However, there is always the danger that yields will be considerably reduced through drought.

5.2.5 Harvesting and threshing

In the period November - December, the rice ripens to a yellow colour and the water from the paddy fields is drained away.

The plants are cut near the ground with a sickle, tied into bundles, and transported to the threshing floor in carts hauled by cattle or buffalo. Hand threshing takes place on a piece of hard ground near the farmer's shelter area. The grain breaks from the panicle and lies on the floor, and the threshed sheaves are stacked for livestock supplementary feed in the dry season. During the process of winnowing the grain is placed on a cane tray and tossed into the air several times to allow the wind to carry away impurities. The rice is then ready for sale or storage.

Labour for harvesting is arranged on a similar pattern to transplanting and may be hired or achieved through co-operation of several households. At the end of the harvest the owner holds a party as a reward for the labour, which could cost about 100 baht in cash expenditure for alcohol and food.

5.2.6 Area planted and production yields

The collection of statistical data relating to areas of land planted in specific crops and the yields of those crops is difficult in a developing region such as Northeast Thailand. Farmers do not keep records of crop yields. Particular seasons are remembered as being good or bad in relation to the present situation. Crop yields are measured in terms of basket or cart-loads and it is necessary for the researcher to try and standardise these measurements. While the farmer probably does know exactly how much land he owns, few households sampled had land titles. Farmers tend to underestimate the land area they cultivate to avoid paying high taxes.

In addition to the annual climatic variations and differences in soil type, other factors influence yield. The position of the farmer's land, that is whether it is high or low-lying paddy land, and the number of trees growing on the land are two such factors. These problems make it difficult to calculate average areas planted, average yields and typical gross margins in order to compare production within and between villages. Table 5.10 summarises production data collected from villagers in the survey.

Table 5.10: Yields of Glutinous and Non-Glutinous Rice and Areas Planted by Households in the Survey Sample (1971)³

Village	Glutinous rice			Non-glutinous rice		
	Total area planted (rai)	Average area planted (rai)	Average prod. per rai (tangs)	Total area planted (rai)	Average area planted (rai)	Average prod. per rai (tangs)
Ban Kor	650	31.0	20.9	62	8.9	21.2
Ban Koke Yai	535	22.3	11.4	19	4.8	16.8
Ban Dong Yai	804	30.9	14.1	41	4.5	18.5
Ban Na Si Nuan	803	26.0	12.5	105	7.0	16.1
Ban Don Tieu	504	28.0	16.5	262	29.2	23.2

The yields of non-glutinous rice are higher than those of glutinous rice because the farmers plant this crop on the best land. Non-glutinous rice does not grow as well as glutinous rice in harsh conditions. Table 5.10 shows considerable variability among the average yields for the village samples. Within villages there is also variability as indicated in Table 5.11.

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- 3 (a) Rai - unit of land area. 1 rai = 1600 square metres
6.25 rai = 1 hectare.
- (b) Tang - unit of measure for rice. 1 tang = 20 litres
= 10 kilograms.
- (c) The average area planted has been calculated by dividing the total area planted by the number of farmers planting that particular rice type as shown in Table 5.5.

Table 5.11: Glutinous Rice Production by Households in the Survey Sample, Classified for a Range of Yields (1971)

Village	Production per rai (tangs)						
	<10	11-15	16-20	21-25	26-30	31-35	>35
Ban Kor	1	6	5	1	-	4	4
Ban Koke Yai	11	3	6	2	1	1	-
Dan Dong Yai	7	8	8	2	2	-	-
Ban Na Si Nuan	13	11	5	2	-	-	-
Ban Don Tieu	1	9	6	1	-	-	1

Approximately 50 per cent of the sample households in every village except Ban Kor, had glutinous rice yields of less than 15 tangs per rai. The average yield for Ampher Borabue was 20 tangs/rai and for Ampher Phyakaphum Phisai 21 tangs/rai in the 1971 production season.⁴ These yields are low when it is realised that yields of 57 tangs per rai have been obtained in experiments in Thailand, (Montrakun and Suwasawong, 1970), and the village leader of Ban Don Tieu had an average yield of 43 tangs per rai. The low yields can largely be explained by the depletion of natural soil fertility, which accompanies continuous cropping. New varieties have been selected and released by the Rice Department and while some farmers stated that the new varieties gave higher yields others stated the reverse. Some reasoned that perhaps the new varieties would be better if fertilizer was applied, but they had no money to buy it.

5.2.7 Sales of rice

Farmers, particularly those with debts, often sell rice soon after harvest. The merchant agrees on a price for the rice and arranges transport to his mill or storehouse. Tables 5.12 and 5.13

⁴ Source: Personal communication with Agricultural Officers at Borabue and Phyakaphum Phisai.

show the number of farmers selling rice and the time of year when the rice was sold.

Table 5.12: Sales of Non-glutinous Rice by Households
in the Survey Sample (1971-72)

Village	Number growing non-glutinous rice	Number selling non-glutinous rice	Time of sale	
			At harvest	Post-harvest
Ban Kor	7	7	5	2
Ban Koke Yai	4	4	2	2
Ban Dong Yai	9	7	7	-
Ban Na Si Nuan	15	9	7	2
Ban Don Tieu	9	8	5	3

Farmers in Ban Kor, Ban Koke Yai and Ban Dong Yai generally sold their non-glutinous rice immediately after harvest. The crop was grown specifically for sale and there was a ready market to merchants who came from the nearest ampher town. Not all of the farmers in Ban Na Si Nuan and Ban Don Tieu sold their non-glutinous rice and of those who did, a smaller proportion sold at harvest time. This rice type more frequently forms part of the diet in the southern region of the road. The price received for non-glutinous rice was between six and seven baht per tang at harvest time and in late 1972 rose sharply to about 12 baht per tang following a poor harvest that year.

Table 5.13: Sales of Glutinous Rice by Households in the Survey Sample (1971-72)

Village	Number growing glutinous rice	Number selling glutinous rice	Time of sale	
			At harvest	Post-harvest
Ban Kor	21	7	-	7
Ban Koke Yai	24	6	1	5
Ban Dong Yai	27	14	1	13
Ban Na Si Nuan	31	12	1	11
Ban Don Tieu	18	3	-	3

A different situation applies to the sale of glutinous rice. Comparatively little glutinous rice was sold at the time of harvest, the farmers storing it and selling as they required money. Sales usually take place in the period August to December just prior to the new season's rice harvest when the farmer is sure that the present season's crop will yield sufficiently well to replace the rice sold. It is common for farmers to have a supply of at least one, and in some cases two years of rice in storage, to guard against the possibility of a poor crop. The price received by the farmers for glutinous rice was five baht per tang at harvest time but again the price rose steeply to almost a par with non-glutinous rice in late 1972.

Table 5.14 emphasises the relative importance of glutinous and non-glutinous rice in a largely subsistence economy. The output and sales for individual farmers have been aggregated to show the combined effect, on a sample basis, for each village.

Table 5.14: Production and Sales of Glutinous and Non-Glutinous Rice on an Aggregate Village Sample Basis (1971)

Village	Glutinous rice			Non-glutinous rice		
	Total produced (tangs)	Total sold (tangs)	% sold	Total produced (tangs)	Total sold (tangs)	% sold
Ban Kor	13,560	950	7	1,314	1,254	97
Ban Koke Yai	6,110	870	14	320	320	100
Ban Dong Yai	11,310	1,650	15	757	646	85
Ban Na Si Nuan	10,060	600	6	1,693	1,228	72
Ban Don Tieu	7,640	124	2	6,090	5,100	84

In considering Table 5.14 it must be remembered that the number of villagers in each village sample is not constant. With the exception of Ban Don Tieu, the production of glutinous rice was ten times greater than non-glutinous rice. A higher proportion of the non-glutinous rice produced was eventually sold. Rice that is not sold is stored in the unmilled state in a store-house adjacent to the living quarters. The rice is milled as required, and there is usually at least one rice mill in each village.

5.2.8 Financial Analysis

Table 5.15 provides a financial analysis of the costs and returns associated with rice production for three different situations. The first two situations are based on the agricultural data collected from the pilot survey and reflect the average farmer growing each of the two rice types. The third situation is the result of case-study data collected from the village leader of Ban Don Tieu, the most progressive rice-grower the author encountered.

Table 5.15: Rice Production Costs and Returns per Rai (1971)

Type of rice	Average farmer		Village leader of Ban Don Tieu
	glutinous	non-glutinous	non-glutinous
Yield (Kg)	150	200	430
Price per kg (baht)	0.55	0.65	0.65
Gross revenue (baht)	82.5	130	279.5
<u>Expenditure</u>			
Ploughing (twice)	20	20	20
Barrowing	9	9	9
Seed for seedbed (5kg/rai)	3	4	4
Transplanting			
- pulling			
- tying in bundles			
- haulage			
- replanting (6 baht/man-day)	24	24	24
Fertilizer	7.5	7.5	32
Harvesting			
- cutting			
- tying in bundles			
- haulage			
- threshing and winnowing (6 baht/man-day)	24	28	48
Total Expenditure (baht)	87.5	92.5	137
Gross Margin	-5	37.5	142.5

The costing data presented are those costs that a farmer would be required to pay if all of the work was done under contract. In practice, most farmers only outlay cash for fertilizer. Ploughing and harrowing are done by the farmer himself with his own buffalo. Seed is planted from rice saved from the previous harvest while transplanting and harvesting operations are usually carried out by members of the household.

While a gross revenue has been calculated, it must be realised that this is a valuation of the crop at time of harvest based on the price merchants were paying for rice in the 1971 harvest season. However, most of the crop for any household will be used in family consumption, and revenue is only obtained for that portion of the crop which is sold.

A farmer growing glutinous rice who had to rely on contract work would actually lose money if he planted his fields on the basis of this analysis. The most significant feature of the analysis is the considerably greater gross margin obtained by the case-study farmer using a large quantity of fertilizer. This farmer purchased 32 bags of fertilizer at a total cost of 2400 baht and spread the contents over 80 rai of land. This represents a blanket rate of 20 kilograms per rai. The analysis illustrates profitable fertilizer use, but there are few farmers in this region who can outlay 2400 baht for fertilizer expenditure. There is a need for credit facilities at low interest rates to be made available to farmers in this region.

5.3 Kenaf Production

5.3.1 The plant and growth requirements

Kenaf (Hibiscus sabdariffa var. altissima) is the common name given to the principal fibre crop of Thailand. The soft fibre within the stalks has properties similar to jute and is indeed a jute substitute. The plant has unbranched green stems about 15 millimetres in diameter and varies between one and four metres in height at maturity, depending upon growing conditions.

Nearly all the kenaf produced in Thailand is grown in the Northeast and it is an important cash crop for farmers in this region. The crop is grown as part of a shifting cultivation and although the species can tolerate a drought, warm moist conditions are preferred.

5.3.2 Cultivation practices

Kenaf production takes place on the upland soils because any land that can be flooded is planted in rice. Before ploughing it is often necessary to cut and burn any scrubby vegetation on the land required for the crop.

Ploughing and raking by buffalo begins after the first rain falls in April or May. Most farmers still use a wooden plough and also a wooden rake. Conscientious farmers repeat each of these operations to obtain a better seedbed, thereby improving the germination rate of the very small seeds.

Generally the farmers sow seed they have saved from the previous year's crop. Little attempt is made to choose seed from superior plants, in fact the reverse often occurs when seed is taken from the stunted, later maturing plants. Planting techniques in this area consist of either broadcasting the seed at a rate of about two kilograms per rai or planting four or five seeds in holes about 25 centimetres apart, in rows. Broadcasting is the lazy way of planting kenaf and leads to non-uniform germination, and a poor kenaf stand, difficult to thin and weed. The latter method is carried out by making holes with a stick or hoe, placing the seeds in the hole, and covering them with soil with a movement of the foot by the sower.

Only one farmer interviewed in this survey applied fertilizer to his kenaf land, and for him 1971 was the first occasion. He applied 50 kilograms (one bag) over a total area of seven rai. Farmers do not consider it economic to apply chemical fertilizer to a kenaf stand. This may be due to a lack of experimental evidence of a fertilizer response but the farmers do not wish to obtain fertilizer on credit from merchants, when they do not know the price they will receive or the yields from a crop which will be harvested six months in the future. Indeed the farmers could well be correct in not using fertilizer. A Ministry of Agriculture publication states that a 25 per cent increase has been obtained where fertilizer has been used in experiments at a rate of

40 kg/rai.⁵ With fertilizer costing almost 100 baht per bag cash, and a kenaf price of 2.50 baht per kilogram (1971 farm price) farmers would need to increase their yields by 40 kg/rai to cover costs.

Where practised, weeding of the kenaf stand is done about six weeks after planting. It requires much time and all available family labour together with some hired labour. Ideally the crop should be weeded twice. At the same time as weeding, the farmer may remove some plants growing too close together. Thinning would actually improve the yield from a smaller number of thick stemmed tall plants, but the farmers are afraid of reduced yields. On average, it takes five man-days to weed one rai of kenaf where the seed has been broadcast. Payment rates were seven baht per day, so that a cost of about 40 baht is incurred for weeding each rai of land. The time taken to weed the same area is reduced where the seed has been sown in rows.

The farmers in the survey did not regard pests or disease as a problem in kenaf production. Wherever crops were growing poorly or the yields obtained were low, the farmer usually stated the cause to be the very dry conditions. The curled red leaves and stunted growth of some crops suggests possible insect or nematode damage of which the farmers are not aware.

5.3.3 Harvesting and retting

Harvesting begins near the end of the wet season at the onset of flowering. At this time fibre yield is maximised, whereas harvesting after flowering results in a lower yield. It is also important to begin retting operations while there is an adequate supply of water. Furthermore, farmers are usually in need of finance in the October/November period particularly if their

5 Division of Agricultural Chemistry, Department of Agriculture, "Summarised Report on Fertilizer Experiments and Soil Fertility Research", Bangkok 1966.

stock of rice is depleted and they are buying rice prior to harvesting. Also the kenaf merchants traditionally pay a higher price early in the season. Some farmers harvested their crops in an immature state to try and get the higher price.

The kenaf stalk is cut at groundlevel with a long knife and the stalks are tied into bundles about 15 centimetres in diameter and left standing in the fields for a few days while the leaves dry. The leaves are then shaken onto the ground and the bundles transported by buffalo cart or pick-up truck to the water ponds, for a period of soaking for 16 days in the process known as retting.

Retting is the decay of the vegetative matter surrounding the cellulose fibres in the stem when the kenaf stalks are soaking in water. The bundles are soaked in flooded paddy fields which have not been planted in rice, roadside ditches, swamps, ponds and small streams. Despite the strong odours usually associated with retting facilities it is common for a family to set up a temporary house nearby to guard the retting kenaf from robbers.

As the harvesting season progresses the pressure for retting facilities is greatly increased and the water ponds become more dirty. This in turn results in the fibre being dirty and payment of a lower price by the merchants. Other practices which lead to a low price for the kenaf include incomplete submersion of the bundles, weighting the bundles with earth clods to keep them submerged, and placement of the bundles in muddy ponds.

After the retting process is complete the fibre is stripped from the central woody stem and washed. Stripping is often carried out by women and children. The contract rate was a baht for every seven bundles stripped, a worker stripping about 40 bundles in a day. The retted fibre is usually washed in the same water in which the stalks were retted. Again this is due to the shortage of water but it results in the fibre not being as clean as it should be. The washed fibre is then hung on bamboo poles to dry before rolling it into a bale for later sale.

5.3.4 Area planted and production yields

Table 5.16 shows the extent of kenaf planting in the 1971 season in the villages surveyed.

Table 5.16: Number of Households in the Survey Sample
Planting Kenaf and the Area Planted in 1971

Village	Number of households interviewed	Number of households growing kenaf	Total area of upland (rai)	Total area planted (rai)
Ban Kor	23	10	237	41
Ban Koke Yai	24	14	86	28
Ban Dong Yai	27	19	235	88

Note: There was no kenaf cultivation in Ban Na Si Nuan or Ban Don Tieu.

Not all of the upland available was planted in kenaf in 1971. This reflects the shifting cultivation pattern whereby some land will be fallowed each year. Should the monsoon rains come late in the season, there may be insufficient time to plough for kenaf because the rice crop has priority.

About half of the households in each of the three villages were planting kenaf, but in some cases the area planted was small. Table 5.17 provides information on the average area planted per household and the average yields obtained together with range data for these two parameters.

Table 5.17: Average and Range in Area Planted, and Yields of Kenaf Obtained by Households in the Survey Sample (1971)

Village	Average area planted (rai)	Range in area planted (rai)	Average yield (kg/rai)	Range in yields (kg/rai)
Ban Kor	4.1	2 - 10	115	65 - 200
Ban Koke Yai	2.0	0.5 - 5	72	8 - 150
Ban Dong Yai	4.6	1 - 20	88	40 - 240

Table 5.17 illustrates the extreme variability in both area planted and the yields obtained. Yield variations result from differences in cultivation techniques, climatic conditions, insect attacks and the fertility run-down during the process of a shifting cultivation pattern. The yields calculated for this study, from the information supplied by the farmers, are lower than the average yield of 200 kilograms per rai quoted by other research workers. Crump (1972) investigated kenaf cultivation in a number of Northeastern villages and reported yields varying between 50 and 400 kilograms per rai.

5.3.5 Financial analysis

Table 5.18 sets out the costs and returns for a farmer case study from Ban Kor. The data supplied is for the 1971 cropping season. The table also illustrates the financial return the same farmer would receive if the work operations were carried out at contract rates.

Table 5.18: Kenaf Production Costs and Returns per Rai (1971)

Item	Receipts and payments incurred by case study farmer (baht)	Valuation of all work at contract rates (baht)
<u>Receipts</u>		
Yield in kg/rai	100	100
Fibre price (baht/kilogram)	2.50	2.50
Gross Revenue	250	250
<u>Expenditure</u>		
Land clearing: own labour (2 man-days)	-	25
Ploughing (2 x): own buffalo	-	20
Harrowing (2 x): " "	-	18
Seed cost: saved from previous year (sown at 2 kg/rai)	-	6
Sowing of seed: broadcast	-	2
Hand weeding (1 x); 5 people hired at 7 baht/day + 2 members of family	35	49
Cutting and bundling	20	20
Cartage to retting facilities (own cart and buffalo)	-	3
Retting, stripping, drying: 120 bundles at 7 bundles/baht	17	17
Total Cash Cost	72	160
Gross Margin or Return to Farmer	178	90

Note: Land rental, land tax and depreciation of equipment (buffaloes, plough, rake and cart) have all been omitted from this analysis as they are all fixed costs to the farmer. All of this equipment is also used in the production of rice.

Table 5.18 shows a gross margin of 90 baht per rai would be obtained by this farmer if he had all the work done on contract. In determining the value of a crop, the farmer considers only total revenue and any cash outlays he must make. He largely ignores family labour as a factor cost because there is little other work

for the family at this time of the year. Because of the small areas grown by most villagers, the various operations were usually done by members of the household.

It must be recognised that the yields from small areas, and indeed low yields from larger areas may represent a sizeable proportion of the income of a semi-subsistent farmer. The income from the crop is a cash return which could not be obtained unless some alternative more profitable crop was grown. The poor fertility soils and the dry conditions in this region of the Northeast do not readily lend themselves to alternative crops.

5.4 Vegetable Production

Vegetables form a considerable portion of the villagers' diet but there is either an abundant supply or a severe shortage depending on the season. Many farmers stated that their main problem was a shortage of water in the dry season and given a supply at this time, they would grow more vegetables for household use and to sell.

Garden areas for vegetables may be located nearby the house or near the paddy land, where there is water available. The plots must be close to a water source to minimise the distance to carry it. Chillies, peppers, garlic and other herbs are grown on a year round basis when possible and plants may be dried in the sun and stored for future use. The biggest variety of vegetables are grown during the wet season through to the cold season. Cucumbers, beans, lettuce, kale, onion, eggplants, tomatoes, corn, cabbage, chinese cabbage, spring onions and turnips are all crops which are in plentiful supply at lower prices during this period of the year.

Following cultivation of the soil and planting of the seed, vegetables require a heavy labour input for both weeding and watering. Some farmers applied chemical fertilizer or animal manure and a few stated that they purchased insecticides to control

insect pests. Some farmers were worried about possible side-effects from eating sprayed produce. There was a clear need for the extension service to explain the role of insecticides in vegetable cultivation, and the necessary precautions. In Thailand there is little legal restriction and even less policing, of the sale of pesticides and many farmers are unable to understand the descriptive printed matter on the container labels of toxic substances.

The growing of vegetables in the dry season is even more labour intensive as all water must be carried to the growing crop. Farmers with land near a private or public pond grew small areas, less than two rai, mainly for home consumption. Some produce was sold within the village. Table 5.19 shows the number of households in the survey sample growing vegetables to sell in the dry season of 1972. A small proportion of the villagers had vegetables to sell and the produce was mainly limited to cucumbers, onions and chillies.

Table 5.19: Vegetable Production in the Dry Season, by Households in the Survey Sample (1972)

Village	Number selling vegetables	Main varieties
Ban Kor	2	Beans, cucumbers, chillies, kale, egg-plant
Ban Koke Yai	-	
Ban Dong Yai	5	Cucumbers, onions, chillies, kale, bamboo shoots, cabbage
Ban Na Si Nuan	6	Cucumbers, onions, beans, chillies
Ban Don Tieu	5	Cucumbers, onions, mushrooms, chillies, cabbage

The farmers in Ban Don Tieu had started growing mushrooms in the dry season, two years previously, when the leader heard about cultivation requirements on a radio programme. Mushroom spore is grown on a bed of damp rice straw which must be kept watered and shade is provided by palm leaves. The spore can be purchased from Bangkok for 20 baht per tin and one tin may yield approximately

10 - 15 kilograms of mushrooms. The average price received by the farmers was 12 baht per kilogram. As there is little monetary outlay, the return from produce sold is the reward for the farmer's labour. Each tin of spore had a 30 day cycle and farmers could undertake five or six cycles in a season.

Second cropping, particularly vegetable cultivation, represents a potential source of income for the villagers in this region. At present most of the land is not utilised in the dry season, there is an abundance of labour, and there is transport to take the produce to the market centres. A lack of water is the major obstacle preventing the villagers from engaging in this work. This potential is discussed further in Section 8.2.2.

5.5 Fruit Production

Fruit trees can usually be found close by the housing areas, the most common being bananas, papayas and coconuts. The temple grounds often grow coconut palms and the fruit is eaten when visitors and officials come to the village or a ceremony takes place. Other varieties of fruit grown include mangoes, jackfruit, custard apple and guava. Most of the fruit is grown for household consumption, although a few farmers reported product sales when they required money.

The fruit of the kapok tree is one product that some households sell. The fibre within the dry pods is used for stuffing pillows and mattresses. Kapok trees were growing near the houses and also in upland areas that had not been cleared. Some villagers used the kapok within the household while others sold the ripe pods to local merchants. They in turn took the pods to a market centre such as Borabue or Phyakaphum Phisai, and sold them in the unopened state. Alternatively they might open the pods, remove the fibre and sell only the fibre in the market centre. The majority of the farmers sold their kapok to local merchants because they only had small quantities for sale. Several villagers in Ban Koke Yai acted

as local merchants purchasing kapok from farmers in other villages. Table 5.20 provides data for the sale of kapok.

Table 5.20: Number of Households in the Survey Selling Kapok, Place of Sale, and the Number Acting as Local Merchants (1972)

Village	Number selling to local merchants	Number selling at major centre	Number acting as local merchants
Ban Kor	2	-	-
Ban Koke Yai	4	-	5
Ban Dong Yai	2	2	-
Ban Na Si Nuan	8	-	-
Ban Don Tieu	3	2	-

The farmers received four baht for 100 pods and the income from a large tree was about ten baht. Total income from the sale of kapok pods ranged between 30 and 400 baht per household. Ochse (1961) reported an average yield of 1000 pods per tree in Java but the trees in Northeast Thailand only yielded 200 - 250 pods per tree. The dry conditions do not allow unchecked growth and both early and late fruit falls are heavy even though large numbers of flowers may be pollinated.

The potential for increased fruit production is more limited than for vegetables under present circumstances. There is little land available to increase cultivation close by the houses. Some villagers spoke of theft as being a problem when trees are grown on upland far from the house. The poor fertility, dry upland soils require irrigation before large increases in output can be achieved.

5.6 Buffalo and Cattle Production

Buffalo and cattle have a similar role to play in the work programme of the village farmer. During the rice planting season they plough and harrow the fields. After harvest they may be used to thresh grain from the straw, while at all times of the year they are used for hauling carts.

The meat of neither species is eaten regularly as part of the diet. Rather these animals are usually only slaughtered on occasions such as a wedding or religious celebration. The animals are valuable and while it is true that Buddhists are reluctant to kill animals, particularly those with close family ties, the scarcity and high price does not allow meat to become a regular part of the diet. Buranamas (1963) has noted:

"Nowhere in Thailand are buffaloes raised primarily as meat animals, they are normally slaughtered or exported for slaughter only after having served as beasts of burden as long as they remain strong and durable. Since the national religion of Thailand, Buddhism prohibits animals to be killed, there is a reluctance to practise a strict culling program. This Buddhist precept does not, however, prohibit its followers from eating meat of animals that die of natural causes, or their having been slaughtered by other people. Neither do farmers who profess Buddhism seem to have strong convictions against selling their aged and disabled animals for slaughter."

In the villages surveyed, comparatively few households owned cattle but nearly every household had at least one buffalo.

Table 5.21: Total Number of Buffalo and Working Buffalo Owned by Households in the Survey Sample (1972)

Village	No.households interviewed	No.households owning buffalo	Total No. buffalo	No.buffalo capable of working
Ban Kor	23	19	47	37
Ban Koke Yai	24	23	68	40
Ban Dong Yai	27	25	56	38
Ban Na Si Nuan	31	30	82	56
Ban Don Tieu	18	16	33	30

Those villagers who did not own buffalo, rented them from others during the rice planting season. A common fee for this practice was 300 baht, or payment of 50 tangs of glutinous rice at the end of the harvest season. Farmers who had rented out animals to other farmers spoke of difficulties in obtaining their fees.

Some farmers stated that they formerly owned cattle to haul carts. Nowadays, with improved roads and transport this is not necessary and it is cheaper to hire a pick-up truck. Other farmers considered it very profitable to keep cattle, regarding their herd as a savings bank and selling animals in times of money shortage. This applied also to mature male cattle that were not required for breeding. Most farmers keeping cattle wanted to increase their herd numbers and some regarded cattle as being more profitable than pig production.

Table 5.22: Distribution, According to Age and Sex, of Cattle Owned by Households in the Survey Sample (1972)

Village	Number of households owning cattle	Female Cattle		Male cattle		Total No. cattle
		Age <3 yrs	Age >3 yrs	Age <3 yrs	Age >3 yrs	
Ban Kor	10	14	17	9	4	44
Ban Kcke Yai	7	17	17	13	8	55
Ban Dong Yai	7	12	24	4	7	47
Ban Na Si Nuan	4	3	5	3	2	13
Ban Don Tieu	-	-	-	-	-	-

In the villages of Ban Na Si Nuan and Ban Don Tieu there was a shortage of upland grazing for cattle. For most of the year the animals free-range under the care of children throughout the day. In the evening they are penned beneath the owner's house to reduce the likelihood of theft. Following the rice harvest, the cattle and buffalo feed on rice stalks and plants growing on the dry paddy land, as well as feeding in the upland forest areas. Rice straw is saved at harvest time to feed to the animals in the hot season months.

Buffalo and cattle breeding is largely haphazard and farmers cannot identify the sire of their calves. Exotic breeds of cattle have been introduced to Thailand and the influence of the American Brahman could be seen in many villages. Government Livestock Centres operate purebred herds and have bulls for sale or lease to farmers. Two farmers in separate villages surveyed had purchased Brahman-cross bulls at a reported price of 2500 baht each. One farmer in Ban Kor made his bull available to other villagers at a fee of 20 baht per service.

Rufener (1971) reported that during a full year of observations, the proportion of cows producing living calves was 66 per cent in one village he studied and 55 per cent in another. Buffalo calving percentages were about 5 per cent less in each case. The same author measured weight gains of young cattle and buffalo raised in villages. While growth rates were low, the animals are converting poor quality feed into meat under harsh climatic conditions.

It is difficult to calculate a gross margin for either a cattle or buffalo enterprise operated under village conditions. There are virtually no cash inputs; the animals are bred within the herd, communally grazed, and the purchase of supplementary feed or veterinary medicine is rare. Disease losses, particularly in young stock, are high and result from internal parasites, Haemorrhagic septicaemia and Foot and Mouth disease.

Table 5.23 indicates typical prices for the various classes of stock sold in 1971. Some of the data was collected as part of this study while the remainder was obtained from a price list manual prepared by Crump (1971).

Table 5.23: Typical Cattle and Buffalo Prices in Mahasarakham and Buriram Provinces (1971-72)

Age	Approx. liveweight (kilograms)	Selling price (baht)
<u>Cattle Prices</u>		
3 months	40	200
12 months	160	1500-2000 (breeding)
2-6 years	200-300	1000 (meat)
<u>Buffalo Prices</u>		
1-2 years	150-200	600-700
3+ years	300-500	1500-2000

From Table 5.23 it can be seen that cattle and buffalo are valuable assets. The sale of one beast can exceed the revenue from all other sources in a particular year. Animals are not sold according to a weight on a set of scales, but rather the price is determined subjectively. It depends on the bargaining skill of the two parties. Very few young animals are sold and the price to relatives is sometimes lower than normal. The risk of disease does not appear to influence the farmer in his decision to keep livestock as a form of wealth. It is preferable to have money in stock rather than cash for in the latter it is difficult to justify not lending to needy friends and relatives.

Increased cattle and buffalo production would increase the availability of meat for a villager's diet. Grazing feed shortages, in both the dry season and also in the wet season when the fields are planted, limit the number of animals village areas can support. At present the government is introducing improved breeding and disease control programmes. The potential for increased production from these enterprises is discussed in Section 8.2.1.

5.7 Pig Production

In all villages many of the households kept at least one pig in a pen beneath the house. Three different production enterprise systems could be identified, viz.

- (1) Farmers keeping a breeding sow and selling all or part of the litter at weaning.
- (2) Farmers fattening pigs purchased as weaners. These animals are usually fed to a mature size and sold to merchants, but they may be sold at an earlier age if money is required.
- (3) Farmers acting as merchants purchasing mature or nearly mature animals for later sale to merchants with slaughtering facilities in the ampher township.

Table 5.24 sets out the numbers of such enterprises in the villages studied.

Table 5.24: Pig Production by Households in the Survey
Sample, Classified According to Type of Enterprise (1971)

Village	Number of households interviewed	Classification according to categories of pig production enterprise			
		1	2	3	Total
Ban Kor	23	2	-	8	10
Ban Koke Yai	24	-	4	8	12
Ban Dong Yai	27	7	10	2	19
Ban Na Si Nuan	31	2	12	1	15
Ban Don Tieu	18	3	8	-	11

The pigs are generally the Large White breed and they are fed on rice bran and household wastes. When the farmer takes his rice to the local mill, the mill owner usually keeps the bran as his fee for milling the rice. Should any farmer want rice bran for pigs then it can be purchased at either two baht per basket for coarse

grain or five baht per basket for fine grain. Farmers tended to mix the two grades.

Few farmers spoke of disease as being a major problem in raising pigs. Those who did were farmers experiencing difficulty in successfully raising litters of pigs. The author gained the impression that provided the young pig survived to weaning, then it was likely to grow to a mature weight. Growth rates are slow however, as most farmers reported keeping weaned pigs for about 12 months before being able to sell them at a live-weight of approximately 80 kilograms.

5.7.1 Financial analysis

(1) Farmer with 1 breeding sow selling the litter at weaning:

The data for this analysis was obtained from a farmer case study in the village of Ban Kor.

Cost of breeding sow (aged 2 years):	1500 baht
Cost of hiring boar to service sow:	100 baht (twice)
Number of litters per year:	2
Number of piglets per litter;	11, 10
Number of piglets sold:	10, 9
Cash received per litter:	2600, 2400 baht
Cost to feed sow and litter for 45 days:	approx. 225 baht
Cost to feed sow alone:	600 baht
Interest at 7 per cent on money invested in sow:	100 baht
Depreciation on sow:	300 baht

<u>Expenditure (baht)</u>		<u>Income (baht)</u>	
Boar service fee	200	Sale of 2 litters	5000
Feed for pregnant sow	600		
Feed for sow and litter	450		
Interest on capital	100		
Depreciation on sow	300		
Profit	<u>3350</u>		
	<u>5000</u>		<u>5000</u>

While this enterprise is certainly very profitable for this farmer, it should not be thought that all farmers are doing, or could do equally as well. The profit in this instance is high because:

- (a) The farmer takes great pride in his sow and has a high standard of management.
- (b) The sow is extremely fertile and has good mothering ability. Other farmers spoke of sows giving birth to litters of five piglets, whole litters dying from disease, and problems in getting their sows pregnant. Most of these problems could be overcome with better feeding of both the sow and the litter.
- (c) The costs for the inputs are typical of those found in every village. However, the price received for the weaner pigs is above average (other farmers reported prices of 150 to 200 baht per weaner when purchased from travelling salesman).

(2) Farmer raising weaner pigs to fattening weight:
(average situation)

Cost price of weaner 150 - 250 baht

Cost of rice bran approximately 1.50 baht/pig/day

Average time pigs fed before sale or slaughter 300 days

Average selling price (80 - 90 kg) 750 - 850 baht.

<u>Expenditure (baht)</u>		<u>Income (baht)</u>	
Purchase price of weaner	200	Sale of pig to merchant	800
Feed cost	450		
Transport from purchasing source	10		
Interest at 7%	14		
Profit per pig	<u>126</u>		
	<u>800</u>		<u>800</u>

While again there is a profit for the farmer, there are situations where no profit is realised at all. No allowance has been made in the analysis for losses. The profitability of the enterprise clearly depends on the number of pigs being raised but

most households kept only one or two animals. Where more animals were kept the standard of management appeared to deteriorate and the level of feeding was too low. Outbreaks of hog cholera were more frequently reported, and in some cases vaccine was obtained from the local agriculture officer free of charge. However, it only requires a price increase for the rice bran unaccompanied by a rise in the price of pigs or the death of one or two animals and the profit margin is soon reduced.

(3) Farmers acting as merchants: (average situation)

In Ban Koke Yai there were a number of farmers who acted as merchants in the dry season. They travelled in groups of eight or ten people to other villages within a radius of about 100 kilometres. Pigs purchased in a village were either sold in another village or taken to other merchants for slaughter. Profit margins for these deals were usually between 50 and 100 baht per animal. Careful judgement and skill was required in negotiating both the buying and selling prices, and the animals had to be re-sold within a short period.

Purchase price 750 - 850 baht

Cost of rice bran per pig approximately 2 baht/day.

Usual period of fattening pigs 60 days

Sale price 9 baht/kg.

<u>Expenditure (baht)</u>		<u>Income (baht)</u>	
Purchase price of pig	800	110 kg pig at 9 baht/kg	990
Feed	120		
Transport	10		
Interest at 7% for 60 days	10		
Profit per pig	<u>50</u>		
	<u>990</u>		<u>990</u>

A good example of this type of operation is exhibited in a farmer case study from Ban Kor. This farmer owned a rice mill and thus had a cheap source of pig food.

	<u>Baht</u>
Purchase price of 19 pigs	14000 (approx. 740 baht/pig)
Food for 57 days (approx.)	1700
Transport (to the village)	100
Selling price	19000
Interest at 7% (57 days)	165
Total net profit	3035
Net profit per pig	160

From the above figures it can be seen that the total net profit to the farmer was 3035 baht. A death loss through disease of 20 per cent (4 pigs) would have resulted in a total net loss of about 800 baht. The risk of disease greatly increases when a larger number of animals are raised. The conditions for the animals are more crowded, less hygienic and the farmers tend to underfeed the animals.

The preceding analyses show that there are profits in a pig production enterprise. The most profitable system was to own a sow and sell the litter offspring at weaning. Profit margins for other systems were small and disease could easily reduce any profit to a loss. Again however, the feeding of a pig is a form of saving. Money is spent on buying rice bran and this money becomes available when the animal is sold in a time of financial need.

5.8 Poultry and Duck Production

Almost every household kept poultry, largely for their meat value rather than egg production. Generally the fowls wandered freely about the village to find their own food, which was supplemented by a small portion of rice grain in the evening. Cross-breeding between the native fighting cock strain and introduced breeds has taken place and at any time of the year hens can be seen followed by a brood of chickens. Although the hatchability is reasonable, the mortality rate amongst young stock is high, the principal diseases being Newcastle disease and fowl cholera. Each household had about 10 birds and in addition to their food value they represented a source of readily available income as they could be

sold easily. The average selling price was about 12 baht per kilogram liveweight, a bird typically selling for about 17 baht.

While not as common a sight in the village as fowls, ducks are also kept by some villagers. In Ban Kor there were four villagers who kept ducks on a commercial basis, each with between 300 and 400 laying birds. The ducks are penned beneath the house in the evening and during the day they are herded to water ponds in the fields, someone guarding them in a similar fashion to that of buffalo and cattle. They are fed rice bran and there is a ready market for eggs and also cull birds as meat. The owners said that their biggest problems were the injuries to ducks caused by dogs, and loss through theft.

5.8.1 Financial analysis for a commercial duck enterprise

This information was obtained from a farmer case study in Ban Kor.

Number of birds	300	
Total capital invested in ducks	300 at 15 baht per duck	฿4500
Deaths per year	30	
Cull sales per year	40	
Replacements purchased per year	70	
Cost price of mature replacement duck		18 baht
Selling price of cull duck		11 baht
Number of days per year birds in lay		200
Number of eggs per day from 300 birds		200
Total number of eggs laid per year (200 x 200)		40,000
Sale price of 100 eggs		40 baht
Feed cost: 1 bag of bran at 80 baht per bag will feed 300 ducks for 3 days		

•• Cost per day is approximately 30 baht.

<u>Expenditure (baht)</u>		<u>Income (baht)</u>	
Feed cost: 365 days at 30 baht/day	10,950	Egg sales	16,000
Replacement stock	1,260	Cull ducks	440
Interest on capital at 7 %/yr	315		
Transport	200		
Profit per year	<u>3,715</u>		
	<u>16,440</u>		<u>16,440</u>

The calculated annual profit for this duck enterprise is approximately 3700 baht. This represents the labour reward for managing the enterprise and marketing the produce. The profit represents a substantial cash income when compared with the income from livestock and cropping enterprises discussed previously in this chapter. Ban Kor is close to the Borabue commercial centre and low transport costs contribute to the profitability. Rice bran was purchased within the village. A lack of suitable watering facilities in some villages limits other farmers in establishing similar enterprises. Those farmers with duck enterprises did not have problems in marketing their produce, but market demand would need to be assessed before advising more farmers to engage in such an enterprise.

5.9 Fish Production

Fish are found in public and privately owned ponds as well as the paddy fields in the wet season. Fish forms an important part of the diet and is consumed in soups, curries, fish sauces or in a preserved form, (either salted or dried). Most ponds and fields contain native fish with common names like catfish and serpenthead fish. The Inland Fisheries Department can supply farmers with other varieties such as carp and tilapia. However, farmers spoke of difficulties in raising these species, the main problem being that native fish cannibalize the introduced species.

Private ponds are approximately 0.5 rai in area and about two metres deep while public ponds vary in depth and may cover an

area of about five rai. Several ponds, both public and private were built as a by-product of the Thai-New Zealand feeder road construction project. The soil was required as filling to build up the crown and shoulders of the road to the designed levels.

Fish in private ponds are fed rice bran or finely chopped vegetable material but the fish in the fields are not supplied with additional food. During the dry season some ponds dry up and fish of some species, particularly catfish, may migrate overland to a new water supply but they can also survive in the moist mud for short periods.

Most households owning private ponds consumed the fish within the household. The village leader of Ban Don Tieu was the only farmer interviewed who sold fish from a private pond. He owned two ponds, one of which provided fish for home consumption. The contents of the other pond were sold for 2,600 baht, the purchaser having to catch the fish himself. At a market price of ten baht per kilogram, the farmer would need to catch 260 kilograms of fish to break even. Fish cannot be purchased at prices lower than this and in the dry season may be as high as 20 baht per kilogram. The potential for an improved fish culture system, under village conditions, is discussed in Section 8.2.3.

5.10 Silk Production

Thailand is world-famous as a producer of high quality silk and production is widespread in the Northeast as a village handicraft industry. All facets of silk production can be found in almost every village including mulberry growing, worm rearing, cocoon reeling, the dyeing of threads and silk weaving. Not every household will engage in all of these segments of the production process but the weaving of silk on a wooden loom is a very common occupation of village women. Most of the silk produced is used for clothing within the household. The men wear silk sarongs and the women silk pasins. The silk produced is usually more coarse than factory reeled Thai silk.

Mulberry bushes are grown on upland areas of about one rai near the house. In Ban Koke Yai four households were selling mulberry leaves to other villagers, the income averaging about 80 baht per year. The life cycle of the silk worm is about 40 - 45 days. The worms are kept on cane trays inside the house and feed on mulberry leaves. After about 30 days the worms cease to eat and spin their cocoons. A few days later the cocoons that are to be used for silk are placed in boiling water and the strands from several cocoons are spun off into a single thread. It is estimated that 200 kilograms of mulberry leaves are converted into 10 kilograms of cocoons which in turn can be made into one kilogram of raw silk.

Table 5.25: Silk Production by Households in the
Survey Sample (1971)

Village	Number producing silk for household use only	Number producing silk for sale	Total quantity sold (kg)	Value of silk sold (baht)
Ban Kor	8	3	8	1650
Ban Koke Yai	9	2	5	750
Ban Dong Yai	13	6	12.5	2795
Ban Na Si Nuan	22	2	3	600
Ban Don Tieu	11	3	9	2120

In each sample village about half of those households surveyed were engaged in silk production. The price received by the villagers varied within a range of 150 to 270 baht per kilogram depending on quality. Merchants either came to the village to buy the silk or the women sold it in the market. Silk production has been recognised as having potential in raising villager incomes. The improved technology, and potential income from a village based sericulture industry, are discussed in Section 8.2.4 of this study.

5.11 Marketing of Produce

From the previous description of the various agricultural enterprises, it is apparent that many households have only a small surplus of production for sale. A marketing system consisting of a chain of middlemen connecting the producer with the final market centre has arisen to service this economy. The following diagram shows the marketing channels for the sale of un-milled rice.

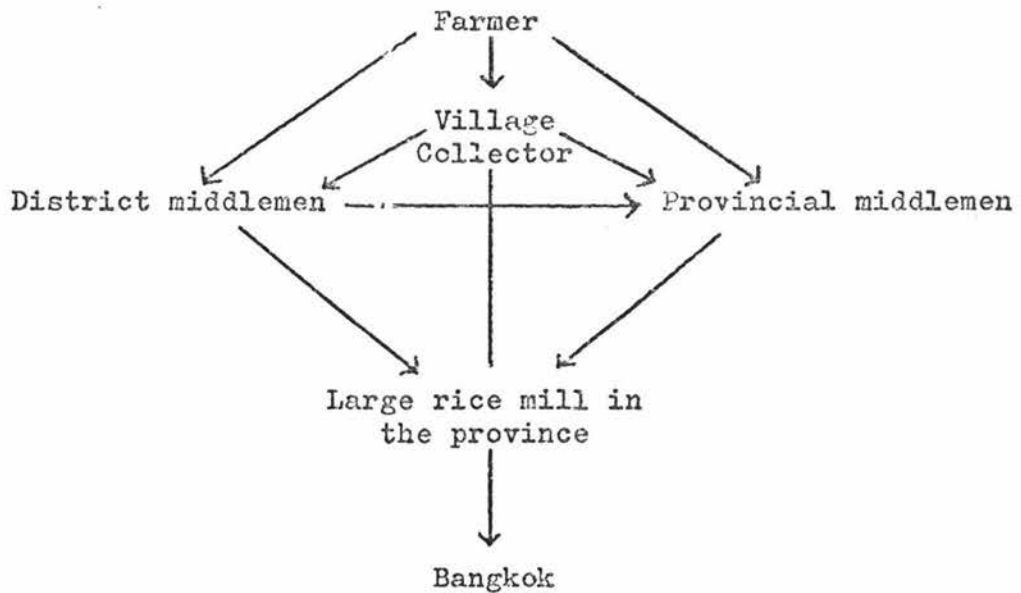


Figure 5.3: Marketing Channels for the Sale of Unmilled Rice

Rice consumed by the household is milled locally as there is usually at least one rice mill in a village. Surplus rice is sold in the unmilled state to either a village collector, district middleman or provincial middleman. The village collector is frequently either the local mill owner, storekeeper or a wealthy farmer who offers credit to other villagers. District middlemen usually own vehicles and travel to villages buying directly from farmers or village collectors while provincial middlemen have large warehouse facilities and wait for the lower level buyers to bring the rice to them.

A similar marketing pattern operates for the sale of kenaf and indeed the same middlemen may purchase both rice and kenaf. Perishable products including vegetables, fruit and fish, together with chickens and ducks may be sold by the producer to other villagers or to local merchants who in turn sell to stall-keepers in the market. Silk and cotton material is also sold to merchants in the market centres.

The margins received by villagers who act as local merchants collecting perishable produce from other villagers are small. With the improved transportation facilities, nowadays more households take the produce to the markets themselves. Sales to local merchants are usually only made when a household has a small quantity of product to sell and it is not worthwhile for them to transport it to the market. These same local merchants also frequently purchase perishable produce at the market and resell it in smaller quantities when they return to the village.

Large livestock such as cattle, buffalo, and pigs are sold on a different basis. Villagers may travel in groups buying stock in one village and selling in another at a small profit. Alternatively merchants from the district or provincial centre may travel to the villages in search of animals suitable for slaughter, and bargain with the farmers directly.

The farmers had few complaints concerning the marketing of the various agricultural products as they are aware of the final price. Dissatisfaction was more commonly expressed at the high rates of interest charged when the villagers asked the merchants for credit.

The present system fulfills the three conditions, identified by Mosher (1966), that are necessary in a marketing system:

- (1) Someone, somewhere who wants to buy farm products ...
- (2) Someone through whom to sell farm products ...
- (3) Farmer's confidence in the working of the system.

A general satisfaction with the marketing system has arisen because the villagers are accustomed to this system and as they have

small quantities of produce to sell they don't consider an alternative. As Stent (1969) has observed:

"The present middleman system of marketing agricultural production is well adapted to a semi-subsistence type of agriculture and to a countryside where communications and transportation are bad, villages are isolated from major marketing centres and the peasantry is predominantly uneducated."

5.11.1 The role of the Thai-New Zealand feeder road in produce marketing

For the past three years, the farmers interviewed for this study have not been in "a countryside where communications and transportation are bad (and) villagers are isolated from major marketing centres...." While the traditional marketing framework still prevails there are changes which are the direct result of the improved transportation facility.

The construction of the Thai-New Zealand feeder road has resulted in reductions of at least 50 per cent of the cost of transport for both passengers and produce. Prior to construction the passenger fare between Borabue and Wapipathum (36 km) was 12 baht while in 1972 it was only five baht. Table 5.26 shows the transport charges for passengers and selected agricultural products prevailing in 1965, prior to construction, and in 1972.

Table 5.26: Transportation Costs for Passengers and Produce in 1965 and 1972 (baht per kilometre)

Item	1965	1972
Passenger	0.33	0.13
Rice (50 kg bag)	0.28	0.14
Kenaf (100 kg)	0.60	0.25
Pig (30 kg)	1.50	0.70
Baskets of produce	0.17	0.05

The table shows transport cost calculated in the unit 'baht per kilometre', but in practice the smallest unit of payment by a passenger for travel on a pick-up bus was one baht. This amount was paid over any distance within the first seven kilometres and from the eighth to the fourteenth kilometre the passenger paid a further baht. Goods and passengers travel together in the pick-up trucks, and larger buses.

The dramatic increase in the availability of transport has had an effect on the marketing of agricultural produce. Whereas previously there were only three or four local transport vehicles per day travelling between Borabue and Wapipathum, in 1972 there were more than 50 travelling in each direction.⁶ Villagers can now sell small quantities of rice directly to the district merchants as they require the money. In the past the villagers could only sell to those merchants who came to the village.

Fresh vegetables and other perishable goods can be sold more easily with the increased frequency of vehicles operating between the towns. However, other factors essential for development, particularly irrigation, are necessary before maximum advantage can be obtained from the transport facility in this respect.

Farmers reported a definite advantage from the road in the marketing of kenaf. Previously after arranging transport to the town, a farmer was often forced to sell his kenaf for a low price. The merchants were in a stronger bargaining position, knowing that the farmer could not afford to transport the kenaf back to the village. Nowadays more merchants come to the village wanting to buy the kenaf and the additional competition discourages them from cheating the farmers.

The marketing of livestock has not been greatly affected by the construction of the road. Buffalo and cattle bought and sold by itinerant merchants are usually walked between villages while pigs and poultry are transported in pick-up trucks. Improved

6 Refer to Appendix Four, Table A4.4.

transportation has resulted in more frequent visits by provincial merchants wanting stock for slaughter.

Table A4.4, Appendix Four shows that multipurpose pick-up trucks are the vehicle type most frequently using the road. The deep rutted dirt tracks of the past were not suitable for this vehicle type and the villagers had to travel on heavier truck and truck-bus transport. These were beset with mechanical breakdowns, and repair costs were high. Reduced transport cost has resulted in more frequent visits to the market centres but the number of monthly journeys depends on the distance from the market centre, the quantity of produce to sell or the purchases required. Villagers in Ban Kor travelled to market often while those in Ban Koke Yai stated that they only travelled once or twice a month. Meat, fruit and vegetables were the items commonly purchased in the market, but unless a household member had other business in the ampher, he would not travel to market specifically for fresh produce.

Improved transportation has resulted in various companies selling household products including toothpaste, soap, medicine and health drinks. These are sold in conjunction with village promotion campaigns, screening outdoor movies and selling the product during the frequent intermissions. The villagers were eager to sample these new products. There was no evidence of merchants travelling to the villages to sell farm inputs such as fertilizer or insecticide. These items were sold by stores in the market centre.

5.12 Summary

This chapter has outlined those agricultural enterprises practised by farmers adjacent to the Thai-New Zealand feeder road. The enterprise descriptions are based on the author's observations of cultivation practices by case study farmers in Ban Kor while the physical and financial information has been derived from both the agricultural pilot survey and farmer case studies.

The rice crop is the most important factor affecting the welfare of a household. The quantities of rice available for sale are small but income is derived from upland crops, particularly kenaf, and the sale of livestock, vegetables and silk. Generally the quantities for sale are small and the chapter concludes by describing the marketing system for the various agricultural products. This system had arisen to service a subsistence agriculture in an area with poor transport and communications but changes are already apparent following the construction of the Thai-New Zealand road.

Chapter Six

THE STUDY AREA IN RELATION TO CHARACTERISTICS AND MEASUREMENTS OF SUBSISTENCE AGRICULTURAL PRODUCTION

Although transport has been identified as one of the basic requirements for economic development to proceed, the extent of usage of a new road transport facility depends upon the nature of the local economy. A commercially oriented population will make extensive use of a road as they travel to the markets and towns selling their produce and purchasing other goods. In contrast, the population of a predominantly subsistence economy, characterised by each household producing for its own requirements with few produce sales or input purchases, will make less use of a road.

Where the latter conditions exist, if better use is to be made of a road asset, subsistence farmers must be encouraged to engage in commercial agricultural enterprises. This is the aim of national policy makers in developing countries, but these aims may conflict with the objectives and attitudes of the local farmers. An apparent lack of response to the presence of a new road could lead to the conclusion that the farming population is not 'economically minded' and has failed to recognise the potential benefits of the facility. In some circumstances this conclusion may not be justified. Before making an economic evaluation of the Thai-New Zealand feeder road it is therefore necessary to establish the category of production in which farmers of this region are engaged and the conditions under which the road should be evaluated.

6.1 Characteristics of the Subsistence Farmer

Subsistence farmers cannot be categorised as a homogeneous group. They can be found in widely different

ecological, social, cultural, political and economic settings but they do have common features which allow a description of their essential characteristics. Wharton (1969) has observed:

"The most common starting point for a definition of a 'subsistence farmer' or 'peasant' is that the farm family's goal of production is for family food rather than for commercial sale. There is a direct and close interrelationship between production and consumption. The goal of productive activity in cultivation is family survival."

Wharton goes on to suggest that the farmer characterised by pure subsistence production is rarely found in the real world. What is involved is a continuum with pure subsistence and pure commercialisation at the two extremes. Situations falling to the left of the '50 per cent production sold' midpoint can be described as 'subsistence' or 'semi-subsistence'.

Mellor (1966) has noted that there is frequently a divergence between society's objectives, as expressed in a country's economic plans, and farmers' practice and level of achievement. This divergence can arise from inefficiency on the part of the farmers in achieving those objectives they have in common with government plans, or from a difference between the objectives of the farmers themselves, and the objectives that have been set for them. Mellor believes that the divergence generally derives from an over-simplification of farmer objectives by planners rather than differences in underlying values.

Plans for the agricultural sector often assume that farmers will maximise output, which in turn implies farmers attach a high value to material goods and the forms of output which can be sold to purchase those goods. Development plans may also attach greater importance to change in enterprise systems and technology rather than security, and a high value to future income relative to present income. Rather than consider 'cash costs' however, subsistence farmers are more concerned with the cost of hard work, leisure or ceremonies forgone, the ridicule that failure of a new technique would bring upon the household, the difficulty of breaking from tradition, and the desire to avoid risk.

Mellor has suggested that subsistence farmers may appear to farm inefficiently because they are judged by criteria different from those they use in making their decisions. He examined the rationale used by subsistence farmers in the decision-making processes of allocating existing resources, using additional resources, and responding to price and technological change. Given their environmental conditions and objectives, Mellor concluded these farmers were acting efficiently. Schultz (1964) shares this viewpoint and has stated that traditional agriculture has been organised along extremely rational lines at its given level of technology, the farmer having welcomed any real opportunities to increase production and profits.

Within the environment of subsistence agriculture, a high degree of efficiency in allocating resources can be expected because the farmers have had considerable time to move toward an optimal solution within a fairly constant level of technology. The lack of use of additional inputs is a reflection of the farmer's reluctance to increase debt when the returns are uncertain. Response to product price changes frequently depends upon the availability of household labour to cultivate more land, or increase the output from existing land by improving cultivation practices such as weeding. This requires a re-allocation of time devoted to work and to leisure. Before accepting a new innovation, the farmer must have a desire to increase his material welfare and confidence that a specific innovation will increase his wealth.

Penny (1964) endeavoured to inter-relate technological, economic and social changes to measure the extent to which farmers in North Sumatra, Indonesia actually participated in the development process. From an index of economic mindedness he had constructed, Penny showed that farmer behaviour and attitudes towards economic activity differed from village to village. The two factors which differentiated the villages where the farmers were economically minded from those where they had remained 'subsistence minded' were cultural heritage and secondly, the nature of the main commercial crop grown. Farmers were most influenced in making economic decisions by the customs and norms

of the village in which they lived. The farmers demonstrating economic mindedness lived in villages where successful vegetable cultivation requiring the adoption of fertilizer, new tools and careful management could be carried out. Cultivation of rubber and coffee was less demanding in terms of requiring the adoption of new practices, and villagers growing these crops remained 'subsistence minded'.

If the belief is correct that the subsistence farmer operating in a relatively static physical, economic and cultural environment is a rational profit-maker at his level of technology, there are implications for agricultural development planners. As economic development provides a dynamic environment, it may be necessary to help farmers develop into better decision-makers once the conditions have been changed. This becomes more important when complex technological innovations are introduced or the technology has a lower rate of return to the farmer in the short-term. Provision of the essential elements for economic development identified by Mosher (1966), particularly education programmes and cheaper sources of credit, will assist farmers in moving towards the goals of national plans.

6.2 Applying Measures of Subsistence to the Villagers Studied

Research workers have applied both qualitative and quantitative assessments in measuring the degree of subsistence of a group of villagers. The criteria used seek to measure the extent of inter-action and inter-dependence of the subsistence household with the world outside the village. Both the nature and degree of involvement are considered important. Wharton (1969) has classified these criteria as being either socio-cultural, developmental, or economic. Socio-cultural criteria include the extent to which non-economic factors influence the decision-making process in agricultural production, the external contact farmers have beyond the immediate village, the nature of interpersonal relationships and psychological factors influencing goals and

achievement. The purpose of this study has been to measure the economic impact of the Thai-New Zealand feeder road. Thus while socio-cultural criteria are important, their measurement is outside the scope of this study. Economic and developmental criteria are inter-related and they are discussed in greater detail.

The 'sale of farm products ratio' is one measure of a farmer's degree of subsistence orientation. It is measured as the ratio of production sold to total production, a small ratio indicating a high level of subsistence. Table 5.14 showed that for each village studied less than 15 per cent of the total production of glutinous rice, the staple diet crop, was sold. However, more than 70 per cent of the non-glutinous rice, and almost all of the kenaf grown was sold. It is therefore necessary to consider the purpose of each of the agricultural enterprises in which the farmers engage before using this ratio measure. Small areas of the latter crops were grown specifically for sale.

The agricultural enterprise descriptions outlined in Chapter Five indicated that the proportion of households engaged in a particular enterprise varied between the villages sampled, as did the scale of operation within a village sample. Frequently the quantities of produce sold were small and indeed some households stated that they sold no produce during the 1971 year. For some households this statement may not have been true and they could have sold small quantities of rice, fish, or chickens. Alternatively they may have obtained credit to make purchases from the market. Table 6.1 shows the number of households from each village sample engaged in the sale of various agricultural products.

Table 6.1: Number of Households in the Survey Sample Selling Various
Agricultural Products in 1971

Village	Number interviewed	Number without sales	Glutinous rice	Non-glutinous rice	Kenaf	Vegetables
Ban Kor	23	4	7	7	10	2
Ban Koke Yai	24	3	6	4	14	-
Ban Dong Yai	27	2	14	7	19	5
Ban Na Si Nuan	31	2	12	9	-	6
Ban Don Tieu	18	2	3	8	-	5
	Fruit	Silk	Pigs	Buffalo	Cattle	Misc.*
Ban Kor	3	3	10	1	4	2
Ban Koke Yai	4	2	3	-	-	4
Ban Dong Yai	2	6	10	2	1	-
Ban Na Si Nuan	9	2	10	-	-	-
Ban Don Tieu	4	3	4	1	-	1

* Fish, ducks, eggs, chickens, mulberry leaves.

In constructing Table 6.1, rice sales made to merchants to pay for fertilizer purchased on credit, have been included, but the table excludes farmers who were engaged in an enterprise purely as local merchants. From Table 6.1 it is clear that the villagers largely depended upon rice, kenaf and pig production as sources of income.

Table 6.2 demonstrates the wide variation in household total net cash incomes from their own agricultural enterprises. Income from local merchant activities has been excluded. The net cash income from cattle or buffalo enterprises is the sale price while those of pig production enterprises have been calculated on the basis of the gross margins presented in Section 5.7. Net returns for cropping enterprises have been calculated by subtracting the cost of all purchased inputs from the value of any produce sold.

The table shows that in each village surveyed, there were some households with deficit or zero cash incomes from their agricultural enterprises. Deficits arise in the case of farmers paying for inputs of fertilizer or hired labour but reporting no produce sales. The largest deficit incurred was 700 baht, most having deficits of less than 300 baht. These households were not necessarily in debt, although many were. Some had members acting as local merchants and the small profit margins could cover the deficit while other households had members undertaking work in the dry season.

Table 6.2: Total Net Cash Income From Agricultural Enterprises in 1971,
for Each Household in the Survey Sample (baht)

Village	Range of Income (baht)					
	Number in sample	Deficit or zero income	1-200	201-400	401-600	601-1000
Ban Kor	23	6	-	1	1	5
Ban Koke Yai	24	4	4	6	4	2
Ban Dong Yai	27	3	2	3	3	3
Ban Na Si Nuan	31	7	8	4	3	5
Ban Don Tieu	18	5	4	-	-	-
	1000-2000	2000-3000	3000-4000	More than 4000	More than 8000	Average income
Ban Kor	3	1	2	4	-	1813
Ban Koke Yai	3	1	-	-	-	509
Ban Dong Yai	7	1	2	3	-	1582
Ban Na Si Nuan	3	1	-	-	-	445
Ban Don Tieu	3	3	2	-	1	1912

In each village sampled at least 35 per cent of the households had net cash incomes of 600 baht or less. At least 50 per cent of the households received less than 1000 baht. The average net farm income per Northeastern family in the 1969/70 cropping season was 927 baht.¹ This author has no knowledge of the method of collection or preparation of the data in Table 2.1 or whether 1969/70 was a better or less favourable year for Northeastern farmers. Nevertheless the average incomes for the households in the two villages of Ban Koke Yai and Ban Na Si Nuan were considerably below the average for the Northeast in the 1969/70 year, but the average incomes for households in the other three villages studied were higher. The relatively high average incomes in the three villages concerned are the result of the higher incomes accruing to a few households.

The households with net cash incomes greater than 4000 baht were generally multi-enterprise farmers selling rice, kenaf, pigs, silk and vegetables. Those farmers selling buffalo and cattle also fall into this category, and as this policy is not necessarily an annual event, their incomes in 1971 may have been greater than in another year. The highest total net cash income, 14,000 baht, was obtained by a case study farmer in Ban Don Tieu. His scientific approach to agriculture, including fertilizer usage and mushroom cultivation, has been described in Chapter Five.²

Another economic criterion used by research workers is the 'hired labour or purchased factor input ratio'. The amount of hired labour relative to total labour, and purchased factor inputs to all inputs used in production, give a measure of farmer involvement and integration in the wider economy. The enterprise descriptions in Chapter Five have indicated the heavy dependence upon family labour and reciprocal labour exchange. Table 5.4 showed that most of the villagers who obtained work in the dry season returned home to assist the household with the rice crop in the wet season.

1 Refer to Table 2.1.

2 Refer to Section 5.2.8 and Section 5.4.

Purchased inputs for the various cropping enterprises described were negligible aside from fertilizer for the rice crop. There were few capital inputs for the livestock enterprises aside from the cost of the stock itself and purchased feed for pig and poultry production. From the results of several studies, Wharton (1969) suggested that as modernisation proceeds, the fraction of total product sold on the market in the early stages increases faster than the fraction of inputs purchased. This may be true for the villagers in this study region, in that while diversification and increasing commercialisation is apparent, the use of paid factor inputs is still minimal. Additional inputs such as insecticide and antibiotics were used by the villagers if they were supplied free by the local agricultural officer.

The level of technology employed in the agricultural enterprises has been used to measure subsistence, the implication being that subsistence farmers use less productive or simpler techniques. While the tools of the Northeastern farmer are simple it is not possible to say they are less effective than more modern equipment. The farmers' preferred use of a buffalo rather than a hired tractor is a reflection of the high cost rather than a lack of knowledge. They knew that, particularly in a year when the wet season came late, a tractor could plough their fields faster than a buffalo and they could therefore gain valuable time. Similarly, they would have used more fertilizer but for the high cost and a desire to minimise debt.

Improved cultivation practices including the planting of kenaf in rows rather than broadcast seeding, weeding of the kenaf stands, and the application of free insecticide are examples of new technology farmers have adopted because there was no financial outlay. This implies that either the cost of other technological practices is too high and prices should be reduced, or finance should be made available to the farmers at reasonable interest rates for them to purchase additional factor inputs.

The use of credit and the uses to which borrowed money is put is another criterion to measure economic activity, borrowing for consumption rather than production indicating a low

level of economic mindedness. In the villages surveyed the most common source of credit, aside from loans from friends and relatives, was obtained from money-lenders and merchants. The villagers sometimes had to offer part of their crop as security to obtain the loan, and repayment was frequently negotiated in terms of the amount of product to be paid.³ The quantities of purchased production inputs used by villagers in this region were described earlier in this section. Aside from fertilizer they are minimal yet a group of villagers in Ban Kor estimated that at least 50 per cent of the households in that village had loans of between 1000 and 2000 baht in November 1972. Three villagers in Ban Kor loaned money to other villagers at interest rates of about five per cent per month. One of these money-lenders stated that he had loaned money in April/May 1972 to about 30 farmers for personal living expenses and to assist in kenaf production. Interest was to be made at the rate of five kilograms of kenaf for every 100 baht borrowed, representing an interest rate of about 20 per cent for a six months loan.

At the time when these farmers arranged their loans they did not foresee that the 1972 cropping year would be a drought. They were not able to harvest a crop and most were unable to repay their debts. As a result of the drought several farmers said they would probably require more money to purchase rice. Because these farmers had not been able to plant rice crops there had been no necessity to purchase fertilizer or other inputs. But the borrowed money had already been used for consumption and not production.⁴ Farmers were thus going to carry debts into the 1973/74 cropping season and borrowing to purchase productive inputs such as fertilizer would further increase their debt level.

Although no socio-cultural measurements were conducted in this study, a few of the author's subjective observations can be stated here. Rogers (1969) has suggested that the subsistence farmer is characterised by mutual distrust, suspiciousness and

3 Refer to Section 5.2.3.

4 Peters (1966) in his study reported that almost half of the credit obtained by Northeastern farmers was used for family living.

evasiveness in interpersonal relationships, low aspiration levels, unwillingness to defer gratification, and exhibits a high degree of localiteness. These characteristics apply, at least in part, to Northeastern villagers.

Villagers enclose their livestock beneath the house in the evenings, and each farmer guards his rice crop day and night as the harvest season approaches, both measures as a precaution against robbers. They stated that robbers could come from within their own village or from other villages. The villagers can cooperate in transplanting and harvesting rice and in projects such as the building and repair of a temple or preparation for ceremonies. While most older family members appear to have low aspiration levels for themselves they have strong hopes for their children. A farmer making many personal sacrifices to spend money on education is thinking of the whole family's future. Should his son succeed academically, he will be able to obtain a well-paid job and provide more money for the family.

The Northeastern villager is characterised by an unwillingness to postpone immediate gratification in anticipation of future rewards. Few farmers appeared to save for specific goals. Typically a farmer suddenly finds he wants or needs money for some purpose and he looks to see what can be sold to obtain it. A fatalistic outlook on life, the feeling that an individual's efforts cannot determine his future, could result in a villager failing to see a relationship between work and his economic condition. However, the Northeastern villager recognises that progress requires hard work and the number of people seeking dry season employment supports this viewpoint. Several villagers interviewed, recognised that better market access is a direct result of the road construction project. With the desire to increase incomes to further family education, better opportunities for produce sales could be expected to encourage enterprises such as vegetable cultivation and fish farming. For many, however, the cost in terms of reduced leisure and the effort required dissuades them. Cultivation of vegetables by more households is possible if the people would carry water by hand from ponds one or two kilometres distant from the fields.

Localiteness, as defined by Rogers, is the degree to which individuals are oriented within, rather than externally to, their social system. Few villagers the author interviewed had ever travelled to Bangkok,⁵ most stating that prior to construction of the present road network it was not uncommon for families to never leave the village during the year. The increasing number of villagers, particularly young people, returning from seasonal employment in the cities has resulted in more extensive travelling by many other villagers. Contact through the mass media, mainly the transistor radio, has also increased villagers' awareness of the world around them.

6.3 Summary

This chapter has reviewed the characteristics of subsistence agricultural production and a number of economic and developmental criteria have been applied to production levels in the region of the Thai-New Zealand feeder road. Analysis of household net cash incomes from agricultural produce shows that the income levels in many cases are low. The use of modern technological inputs is low but the lack of purchased inputs is largely the result of excessive cost rather than a lack of knowledge. In 1972 many farmers in the case study village of Ban Kor were in debt, most having borrowed money for household living rather than for the purchase of production inputs.

These factors, together with the brief sociocultural comments, suggest that the farmers are operating under subsistence conditions. But there is a degree of commercialisation and most households were selling some produce, usually either rice, kenaf or pigs. The Thai-New Zealand feeder road will be evaluated under conditions which are more closely subsistent rather than commercial. The problems associated with the movement towards greater commercialisation will also be discussed in Chapter Eight, in order to more fully investigate the potential worth of the road to the region.

5 A distance of approximately 400-500 kilometres.

Chapter Seven

ECONOMIC EVALUATION OF THE THAI-NEW ZEALAND FEEDER ROAD

7.1 Introduction

Chapter Three of this study described the role of transport in economic development, using material from transportation studies conducted within Thailand and in other developing countries. Subsequent chapters have described the data collection procedure and the information required to make an 'ex poste' economic analysis of the Thai-New Zealand feeder road. This chapter utilises the data obtained to assess the impact the road is making under the conditions of a predominantly subsistence agriculture outlined in Chapter Six.

7.2 Method of Evaluation

The methodology commonly practised for a standard benefit-cost analysis will be used to evaluate the economic impact of the Thai-New Zealand feeder road project.¹ This technique requires the quantification, in monetary terms, of costs and benefits associated with or resulting from the project over the period of time defined as being the project life. The total cost and benefit flows are then discounted to a single point in time, usually the beginning of project construction, and economic measurements are made to judge the value of the project under various circumstances.

While it is desirable to quantify as many of the costs and benefits as possible, difficulties are encountered when the

1 For a detailed description of benefit-cost analysis and project evaluation the reader is referred to Prest and Turvey (1967) Mishan (1972), and Gittenger (1972).

benefits are social or political rather than economic and therefore not easily quantified. These items must be considered in conjunction with the measurements performed on the quantifiable data in drawing conclusions as to the value of the investment. Before making the analysis it is necessary to define and discuss the policy adopted in this study with regard to the parameters affecting a benefit-cost analysis.

7.2.1 Project life

Estimation of the economic life of a road is a highly subjective process depending on assessments of factors such as the physical length of life, maintenance and repair levels, the demand for usage, and future development of any alternative transport systems. Theoretically, providing adequate funds are available for maintenance, and the required maintenance is carried out, roads should be capable of carrying the loads for which they were designed almost indefinitely.

An economic analysis relates costs and benefits resulting from a project so as to measure the profitability of that project. Data for the analysis is based upon past and present trends but in many cases these trends, particularly price information and patterns of usage, cannot be accurately projected several years into the future. It is thus usual in an analysis to limit the life of a project, at the same time recognising that future benefits may continue after this date. While the major project costs occur in the years of construction, benefit flows may not begin until the project is complete and hence they are more likely to be underestimated by designating a limited project life.

Engineers have two viewpoints when they consider the life of a road.² Either it is assigned a life which depends on the

2 United Nations (1971) "A Guide to Highway Feasibility Studies", pp.37-38.

physical ability of its component parts to withstand use over time, or a life is presumed to continue until the route requires upgrading to relieve traffic pressure. A life limited by physical deterioration implies absence of proper maintenance. If allowance is made in the economic analysis for maintenance expenditure, it is not logical to define the project life on this basis. A more logical approach is to limit the life to the period in which it can economically carry the loads demanded of it. At the end of this period a decision can be made as to whether the road should be upgraded or not. At this time a residual value³ can be assigned to the present project and subsequent costs and benefits will accrue to a new project.

The procedure of limiting the life of a road to the period before major upgrading is undertaken, is unsatisfactory from an economic viewpoint. In the period following the year designated as the end of the project's life, further costs and further benefits will/may accrue to the original project. The magnitude of the value of these extra costs and benefits will depend on three inter-related factors:

- (1) The physical state of the road at the end of the 'road's life'.
- (2) The nature of any upgrading that is undertaken in the years following the end of the 'road's life'.
- (3) The use that can be made of the road in that period.

The physical state of the road at this time will depend on the use, abuse in terms of the loads carried for which it was not designed, and the maintenance levels during the period designated as the road life. These parameters can not be predicted with high accuracy. Similarly the nature of the upgrading will depend on the demand for a new facility and finance availability, but these too cannot be accurately forecasted by the analyst. At this time engineers may decide to spend no further money on the road or alternatively the road could be widened, re-aligned, or

³ The concept of residual value is discussed in Section 7.2.2.

reconstructed. In making an ex post analysis, the accuracy in measuring the likely physical condition and the course of action as far as upgrading is concerned, will be improved the closer to the end of the project life the analysis is made.

A 15 year economic life is the basis for calculations used by the Thai Highways Department in their economic analyses. At present in Thailand, more emphasis is being placed on the provision of a sealed highway network to cover the Northeast and less attention is devoted to the maintenance of existing roads. This economic analysis also assumes a project life of 15 years from the time of completion of road construction. Traffic began using sections of the road as soon as earthwork formation was completed. This facet of road construction was completed for the final road section between Satuk and Buriram early in 1971.

7.2.2 Residual value

If, at the end of the project life there is no upgrading of the road, a residual value for the project should be selected to represent the discounted present value of the extra benefits accruing in the 'post-project life' period. The following hypothetical example demonstrates this situation. Assume

- (1) A project involving construction of several bridges with an estimated life of 50 years, connected by a road alignment, has been completed.
- (2) The project was assigned a 20 year project life and at the end of this time the road is impassable but the bridges are in perfect condition.

If at the end of 20 years a decision is made not to upgrade the road, the residual value of the project is zero despite the fact that the bridges are good. The whole project will have no further benefits accruing to it because the road cannot be used. If the road could be used for two further years, then the residual

value should be calculated to represent the benefits resulting from two years further use.

If at the end of the project life there is upgrading, the residual value of the road can be defined as the difference in cost between:⁴

- (a) Upgrading the road using the structure remaining from the first project, and
- (b) Upgrading or building the road if the first project had never been constructed.

Using this definition of residual value, the 'cost-saving' at the time of upgrading is the only benefit beyond the end of the project life, imputed to the original project. When a feasibility study is made for the upgrading project, the original project will be sunk capital with no residual value and all the benefits after this date accrue to the upgrading.

From an economic viewpoint this definition of residual value is also unsatisfactory. The 'cost-saving' at the time of upgrading bears no distinct relationship to the benefits that would or do accrue to the original project in the period following that designated as being the end of the project life. Future benefits are made possible by carrying out an upgrading programme but the magnitude of those benefits will not necessarily equal the cost-savings in construction.

Rather than consider these benefits as resulting from a new project it would be more logical economically to treat the upgrading as a major repair cost to the original project, occurring X years after construction has been completed. The flow of benefits thereafter would then accrue to the original project. This, however, has the same effect as increasing the life of the project, and the problem in forecasting data several years into the future for an evaluation was described in Section 7.2.1.

⁴ United Nations (1971) pp. 38-39.

Conflict therefore arises in the way to calculate a residual value for the Thai-New Zealand feeder road. Figure 3.1 showed that this road is an integral part of a roading scheme for Northeast Thailand. Thus at the end of the assumed project life in 1985, the present route will probably still be used as a major road. It is difficult to estimate the extent of future usage, whether law enforcement will restrict the loads carried, and the maintenance that will be undertaken, but if upgrading is undertaken (as seems likely), then the road will have a residual value at this time.

For this analysis, the residual value in 1985 has been calculated by assuming a proportion of the net benefit (total benefits less maintenance cost) in that year will occur in perpetuity. This means the residual value for the project will vary according to the level of benefits in each particular analysis. The proportion of net total benefits considered are 0, 25, and 50 per cent.

The interpretation of the residual values calculated is that they represent the net present value of all discounted costs and benefits occurring after the designated end of the original project life. In this context each figure may represent the discounted value of the remaining benefits without any upgrading. A decision not to upgrade could be made on the basis that the discounted benefits would not exceed the cost of the upgrading. This decision would be logical economically although there could be situations in which a road is upgraded for other than economic reasons and the future benefits are less than the cost of the upgrading. These circumstances are not considered here. Alternatively, each figure may represent the discounted value of the remaining benefits, less the cost of the upgrading programme.

Variation of the proportions of the capitalised total net benefits will allow measurement of the importance of a residual value in the economic evaluation. It will also be possible to calculate the residual value required for the project to be profitable in terms of the economic criteria used for evaluation. A subjective assessment must then be made as to the likelihood of achieving this level of net benefit in the 'post-project life' period.

7.2.3 Project costs

Project costs may be of two types. Direct costs include the value of goods and services used in constructing, operating and maintaining the project. Indirect costs are the additional costs required to make the immediate products or services of the project available for use or sale. The following direct cost items have been considered in this analysis and are described in Section 7.3.

(1) New Zealand Government Contribution

- (a) Advisers salaries and allowances.
- (b) Machinery and equipment.

(2) Royal Thai Government Contribution

- (a) Accommodation for New Zealand personnel, wages for labour, materials, machinery and equipment operating expenses, bridge construction.
- (b) Acquisition payments for land, buildings and trees.
- (c) Road maintenance and repairs.

Indirect costs include the cost of farm inputs such as seed, fertilizer and also transport. These costs are deducted from the gross value of output when calculating the net value of increased production in the region due to the developmental effect of a road. Section 7.4.2 discusses the treatment of these costs in an economic analysis.

7.2.4 Project benefits

Project benefits are defined as the increase in value of goods and services resulting from conditions with the project as compared to conditions without the project. They are measured net of direct and indirect costs and can be classified as either tangible (T) or intangible (I) benefits. The former are those

benefits which can be expressed in monetary terms while intangible benefits are those which cannot be satisfactorily expressed in money terms in a formal analysis. A further classification is recognised in that benefits, whether tangible or intangible, are primary (P) if they directly result from the project and secondary (S) if they are an indirect result. The following benefits have been classified and are described in Section 7.4 of this analysis.

(1) Transportation benefits

- (a) Savings in vehicle operating costs (T,P)
- (b) Accessibility (I,P)

(2) Agricultural benefits

- (a) Upland cropping (T,P)
- (b) Lowland rice farming (T,P)
- (c) Marketing (T,P)
- (d) Potential agricultural developments (T,P)

(3) Commercial and employment benefits

- (a) Business and commercial activities (T,S)
- (b) Salt production (T,S)
- (c) Dry season employment (T,S)

(4) Social benefits

- (a) Improved living conditions (I,S)
- (b) Villager mobility (I,P)
- (c) Health (I,S)
- (d) Education (I,S)

(5) Political benefits

- (a) Improved political awareness and contact (I,S)
- (b) Strategic value (I,P)

- (6) The project in relation to training Thai personnel in road construction techniques (I,P)

7.2.5 Discount rate

In all the literature written about project evaluation there is probably no aspect which has received more attention than that of the appropriate rate of interest to use in discounting benefit and cost flows over the period of the project life. Ideally the discount rate selected should reflect society's rate of time preference for money and equal the marginal productivity of investment. Economists disagree as to how closely market rates of interest reflect the social discount rate, or whether the market rates of interest bear any close relationship to the marginal productivity of investment.

After a detailed review of literature concerning choice of an appropriate discount rate Ecstein (1961) concluded that "the choice of interest rate must remain a value judgement".

In practice the usual procedure is to select an interest rate, or range of interest rates, on the basis of those observed ruling in the country at the time of project construction.

In a technical report prepared by T.P. O'Sullivan and Partners (1971) the following comments were made with regard to interest rates in Thailand:

"A twelve per cent rate of interest is the normal commercial bank interest rate for safe customers for vehicle purchase and the rate used by the Highways Department in its feasibility studies. A twelve per cent rate of interest is generally lower than private sector returns; for instance a major oil company said that twelve per cent was an absolute minimum after tax. However, the return in constant prices at the margin is unlikely to exceed twelve per cent ... and the long term rate of interest is likely to fall in the 1970's."

Long term Thai Government bonds were yielding an interest rate of eight and one half per cent in April 1973 while prime long term industrial bonds were yielding ten per cent in the same month. (Investor, 1973)

Twelve per cent has been used by other research workers and technical missions working in Thailand. Discount rates of ten, twelve and fifteen per cent per year have been used in this study.

The use of three discount rates allows the measurement of the effect of discount rate on the profitability of the project.

7.3 Project Cost Estimates and Assumptions

Table 7.1 provides a flow of expenditure for the Thai-New Zealand feeder road project. In allocating the various cost items throughout the time horizon considered to be the project life, the following assumptions have been made.

- (1) Cost contributions from the New Zealand Government were recorded in terms of the financial year in which they were made (e.g. 1966-67), while Thai Government cost contributions were recorded for the calendar year (e.g. 1966). To provide uniformity for an analysis, it has been assumed that the New Zealand payments were made in December of the financial year while the Thai payments were made in December of the calendar year specified. This requires that the first contribution from New Zealand be made in December 1965, although construction did not begin until mid-1966.
- (2) The Salaries and Allowances paid to the New Zealand advisers and their families have been included as a cost to the road. While this considerably increases the cost, the benefit from this expenditure should be reflected in the standard of road building and the technical knowledge passed on to the Thai personnel for use in future projects.
- (3) The total cost of all machinery and equipment purchased with New Zealand Government finance has been charged as a cost to the road. At the termination of the project, some of this equipment had further economic life. Appendix Five, Table A5.1 shows an inventory of the state of repair, and the original cost of the machinery and equipment purchased, at project completion. As this equipment can be used on other projects, the value at project termination represents a benefit to this project. Valuing unused

Table 7.1:

Cost Flow for the Thai-New Zealand Feeder Road 1965-85 (\$U.S.)

Financial Year Calendar Year	1965-66 1965	1966-67 1966	1967-68 1967	1968-69 1968	1969-70 1969	1970-71 1970	1971-72 1971	1972-73 1972
<u>New Zealand Contribution</u>								
a) Salaries and Allowances		69,922	143,712	213,815	281,810	255,422	143,400	-
b) Machinery and Equipment	617,078	143,380	223,010	32,678	69,909	658,760	27,200	-
Total N.Z. Contribution	617,078	213,302	366,722	246,493	351,719	914,182	170,600	-
<u>Royal Thai Govt. Contribution</u>								
a) Accommodation, wages, materials, operating costs	-	456,731	721,154	793,269	982,692	1,355,769	1,420,673	-
b) Acquisition of land, trees and buildings	-	-	-	21,346	21,346	21,346	21,346	21,346
c) Repairs and Maintenance	-	-	-	-	-	-	-	106,587
Total Thai Contribution		456,731	721,154	814,615	1,004,038	1,377,115	1,442,019	127,933
Total Cost	617,078	670,033	1,087,876	1,061,108	1,355,757	2,291,297	1,612,619	127,933
Year	1973	1974	1975	1976	1977	1978 to 1985 inclusive		
Acquisition Costs	20,566	20,566	20,566	20,566	20,566			
Maintenance Cost	96,202	96,202	96,202	96,202	96,202	96,202/year		
Total Cost	116,768	116,768	116,768	116,768	116,768	96,202/year		

Source: Thai Highways Department, Royal Thai Government; Ministry of Foreign Affairs, New Zealand Government.

equipment at purchase cost, and all serviceable equipment, except domestic equipment, at 20 per cent of purchase cost results in a salvage value benefit for machinery and equipment of \$U.S.291,500 in December 1971.

- (4) Compensation payments for land, trees and buildings required or removed for the road construction project had not been finalised as at 31 March 1973. At that date settlement claims totalling \$U.S.106,730 had been made, mainly for trees and buildings. The estimate for unsettled claims for land compensation was \$U.S.102,830.

For the purpose of this analysis it has been assumed that settled claims were made in five equal payments in the years 1968-72, and pending the result of legal discussions, outstanding payments will be made in five equal payments in the years 1973-77. It is assumed the latter will not exceed the estimates of the Thai Highways Department.

- (5) Repair and maintenance expenditure are future costs and require estimation. The definition of project life presented in Section 7.2.1 implies that maintenance on the road will be at a level to enable benefits to accrue to the road, at least until 1985. In 1972 'special repairs' were made to a 38 kilometre section of the road showing heavy deterioration near Phyakaphum Phisai, in addition to normal maintenance.

This analysis assumes a constant annual maintenance expenditure of \$U.S.668 per kilometre,⁵ the 1972 maintenance expenditure allocation, and no further special repairs are anticipated. The effect of doubling the annual maintenance expenditure is also shown in the analysis.

5 T.P. O'Sullivan and Partners (1967) suggest \$U.S.960 per kilometre as an average annual maintenance cost for sealed Northeastern roads.

7.4 Project Benefit Estimates and Assumptions

Of the benefits listed in Section 7.2.4, the major tangible benefits arise from vehicle operating cost savings and the development of agricultural land.

7.4.1 Vehicle operating cost savings

Improvements in the road network of a country result in savings for the road user. A better road or shorter distance will save him time (which has a money value) and will reduce the operating costs of his vehicle through lower fuel and oil consumption, tyre wear, depreciation, repair and maintenance costs.⁶ These cost savings to transport operators should be reflected in lower transportation costs of both people and freight.

Transport economists recognise three classes of vehicles using a new road route; normal traffic, diverted traffic, and generated traffic.⁷ Normal traffic is defined as that traffic using the new road which also previously used the same route. Diverted traffic is that traffic which previously used some other route but the operators now find it is more profitable to use the new route. Generated traffic is that traffic which travels along a new road as a result of increased demand following a reduction in transportation cost.

While some motorised vehicles did travel on parts of the route at present traversed by the Thai-New Zealand feeder road in the dry season months, the number was small. No statistical data was available but the monthly progress reports submitted to New Zealand, by the New Zealand Engineering Team, stated that motorised transport began using the road in large numbers as soon as earthworks were completed. For this study, it has therefore been assumed that

6 de Weille (1966).

7 United Nations (1971), pp.25-26.

all of the traffic using the road falls into the category of generated traffic.

Two classes of generated traffic can be recognised and the benefits due to each class are calculated differently.

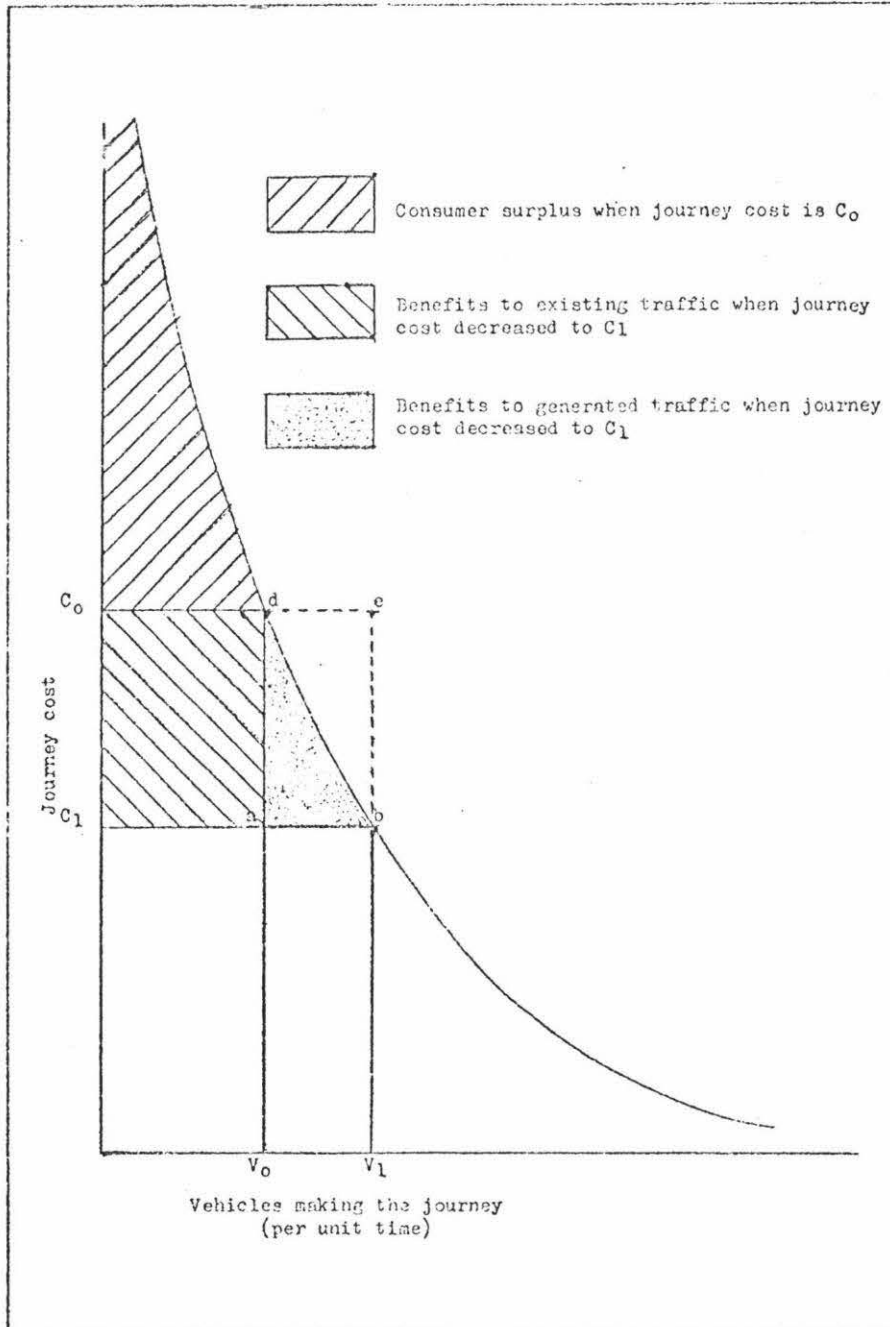
Class A: These are vehicles that did not previously travel along the route because it was inconvenient or too expensive. They carry passengers who were already in the area and also their produce that was formerly carried by buffalo cart or other transport. The benefits for this type of vehicle are based on Figure 7.1 and an explanation of the derivation of these benefits is provided beneath the figure.

Class B: These vehicles operate in the area because of extra activity generated by the new road such as the transporting of produce from previously uncultivated land. They are called 'development traffic' and their benefits are calculated on a 'value added' basis from the sale of additional produce by the farmer.⁸

Calculation of the benefits for generated traffic, Class A requires knowledge of vehicle operating costs on both sealed and earth surfaces, and also estimates of the number of vehicles using the road in each year of the project life. Operating cost data for vehicle categories on different road surfaces in Thailand have been prepared by T.P. O'Sullivan and Partners, Engineering Consultants to the Thai Highways Department. The data is shown in Appendix Four and is based on a standard methodology prepared by the World Bank.⁹

8 Agricultural development benefits are explained in Section 7.4.2.

9 For a detailed description of the World Bank methodology refer to de Weille, 1966.



Source: United Nations (1971) "A Guide to Highway Feasibility Studies", page 31. Figure 2.

Figure 7.1: Benefits From Generated Traffic, Class A

In Figure 7.1 the cost of a vehicle making a journey along the route prior to the construction of the new road was C_0 and the number of vehicles travelling on the route was V_0 . Following construction of the road, journey cost is reduced to C_1 and the number of vehicles increases to V_1 . The value of the journey to each generated vehicle lies between C_0 and C_1 and their consumer surplus is represented by the area abd . In most cases the average benefit for all generated vehicles can be taken as $\frac{ad}{2}$ and is thus half the benefit to a unit of existing traffic.

In the absence of any statistics showing traffic volumes using the Thai-New Zealand feeder road, it has been necessary to calculate traffic volumes in each year of the project life on the basis of traffic surveys conducted in 1971 and 1973.¹⁰ The vehicles using the road have been subdivided into two classes:

- (a) Light vehicles: cars, taxis, pick-up passenger and goods vehicles.
- (b) Heavy vehicles: trucks, buses, truck-bus transport.

The traffic volumes for each year were calculated on the following basis.

- (1) In the years 1971 and 1973, the average vehicle count figures obtained in the road traffic surveys have been used as the average daily traffic volumes.¹¹
- (2) In 1972, average daily traffic volume figures have been calculated assuming a constant growthrate between 1971 and 1973. During this two year period light vehicles increased by five per cent and heavy vehicles increased by 47 per cent.
- (3) The average daily traffic volume figures for all other years have been calculated assuming the following annual growthrates.

	<u>Pre-1971</u>	<u>Post-1973</u>
Light vehicles	5%	2½%
Heavy vehicles	20%	5 %

It has been assumed that sections of the Thai-New Zealand feeder road were first used by vehicles according to the following timetable:

-
- 10 Details of the traffic surveys were described in Section 4.4 and the data is presented in Appendix Four.
 - 11 Class B vehicles should be excluded from the traffic counts before calculating vehicle operating cost-savings to Class A vehicles. No deduction has been made at this stage of the analysis and hence this project benefit may be overestimated. This possibility is discussed further in Section 7.6.2.

1967	Borabue - Wapipathum	(36km)
1968	Wapipathum - Phyakaphum Phisai	(40 km)
1969	Phyakaphum Phisai - Satuk	(28 km)
1970	Satuk - Buriram	(40 km).

The average distance between any two adjacent major towns is 36 kilometres. It is therefore assumed that each vehicle of the average daily traffic volume travels a distance of 36 kilometres.

The vehicle operating cost savings can be calculated from the information shown in Appendix Four Table A4.5 and summarised here.

Vehicle class ¹²	Op. cost on av. earth surface (cents/km)	Op. cost on good sealed surface (cents/km)	Difference (cents/km)
Light (car)	3.43	2.01	1.42
Heavy (truck)	24.07	9.61	14.46

The difference calculated represents the Vehicle operating cost savings (V.O.C.S.) to a unit of normal traffic travelling on a sealed rather than earth surface. As each unit of generated traffic, Class A, receives only half the benefit of a unit of normal traffic,¹³ the V.O.C.S. to be used in this analysis are:

Light vehicles 0.71 cents/km
Heavy vehicles 7.23 cents/km.

The total yearly cost savings is the sum of the annual cost savings for light and heavy vehicles. The annual cost savings for each vehicle class are the product of the average daily volume, the cost savings per kilometre and the average distance travelled of 36 kilometres, converted to an annual basis. Average daily

12 Technical Report No. 26 states that operating costs of a pick-up passenger or goods vehicle are higher than those of a car, but can be assumed comparable. Similarly the operating costs of a heavy bus are higher than those of a heavy truck. The operating costs of the two vehicle categories used in this analysis will tend to underestimate this road benefit.

13 Refer to Figure 7.1.

traffic volumes and the annual cost savings for each vehicle class are shown in Table 7.2.

It must be stressed that the average daily traffic volumes shown in Table 7.2 are not the volume of traffic travelling the full 144 kilometre length of the road. They are the daily total number of vehicles travelling between any two adjacent major towns for an average distance of 36 kilometres. In the early years the number of light vehicles exceeds the number of heavy vehicles. Pick-up vehicles, often owned by wealthy businessmen in the ampher, are the most common vehicles operating on a new road. They transport passengers and produce. In applying the same cost-saving to a pick-up vehicle as a car, the total cost-savings for light vehicles may be slightly under-estimated although these vehicles were not always fully laden or fully occupied.¹⁴

Heavy vehicles, particularly trucks, are more restricted to the provincial centres. The traffic count data in Appendix Four, Table A4.4 shows that the number of trucks operating on the Satuk-Buriram section exceeded the combined volume of trucks on the other road sections. Buriram is a provincial centre and a railway centre. Produce from other provinces is brought here and sent to Bangkok by rail and in addition Buriram is a distribution centre for goods from Bangkok going to other areas. Trucks carrying earth and gravel for road construction projects branching from the Thai-New Zealand feeder road were based here. Because of the high cost savings per kilometre for a heavy vehicle, the total cost savings for this class greatly exceed the total cost savings for light vehicles.

The effect of varying the growthrates of traffic in the region is shown in a sensitivity analysis in Section 7.6.

¹⁴ Occupancy rates for one traffic survey are shown in Appendix Four, Table A4.3.

Table 7.2:

Average Daily Volume and Vehicle Operating Cost Savings 1966-1985 (\$U.S.)

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Av. Daily Vol. L.V.	162	298	506	533	731	770	791	812	832	853
Yearly C.S. (L.V.)	15,114	27,802	47,207	49,726	68,198	71,836	73,796	75,755	77,621	79,580
Av. Daily Vol. H.V.	14	45	104	130	413	516	638	759	797	836
Yearly C.S. (H.V.)	13,300	42,751	98,802	123,503	392,148	490,211	606,114	721,067	757,168	794,218
Total Yearly C.S.	28,414	70,553	146,009	173,229	460,346	562,047	679,910	796,822	834,789	873,798
Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Av. Daily Vol. L.V.	874	896	918	941	965	989	1,014	1,039	1,065	1,092
Yearly C.S. (L.V.)	81,539	83,591	85,644	87,790	90,029	92,268	94,600	96,932	99,358	101,877
Av. Daily Vol. H.V.	877	920	966	1,014	1,064	1,117	1,172	1,230	1,291	1,355
Yearly C.S. (H.V.)	833,169	874,020	917,721	963,322	1,010,823	1,061,175	1,113,426	1,168,527	1,226,478	1,287,280
Total Yearly C.S.	914,708	957,611	1,003,365	1,051,112	1,100,852	1,153,443	1,208,026	1,265,459	1,325,836	1,389,157

L.V. = Light Vehicles; H.V. = Heavy Vehicles; C.S. = Cost Savings.

7.4.2 Agricultural development estimates

The standard formula¹⁵ used to calculate agricultural development benefits resulting from a road project is defined as

$$\frac{\text{(Agricultural output with the road - output without the road)}}{\text{x (The net value added per unit of agricultural output)}}$$

The value of the agricultural produce must be calculated for every product sold in each year of the project life. The total value of agricultural development benefits is the sum of the value of each product sold in that year.

Where a road promotes development of formerly uncultivated land there are several people who profit from the increased production. The farmer's net return is the total income he receives, less the cost of inputs such as seed, fertilizer and transport. The businessmen who provide these inputs receive their profit on the basis of the mark-up on the cost price to them. The merchants purchasing the produce receive their profit through grading, processing, storage and further marketing.

However, the standard formula calculates only the net value of the produce to the farmer as the benefit to the road. The costs of inputs are deducted from the gross value of the output on the assumption that they could have been used elsewhere in the economy, or they represent foreign exchange which could have been spent on other items. They therefore have an opportunity cost. Similarly, the profits of the businessmen and merchants are not considered as benefits to the road on the assumption that these people providing the inputs and services would have profited anyway, by investing their capital somewhere else.

As this study has been made from a national viewpoint these assumptions are legitimate. But it should be noted that the inputs and services are essential to achieve development benefits and the desired regional economic development. The presence of the

15 This definition is provided in United Nations (1971), page 20.

road created profitable investment opportunities in this region for these businessmen and merchants.

Section 4.3 described the land classification survey undertaken to estimate the utilisation of land within a one kilometre band either side of the road in 1972. This information has been extrapolated to cover an area within five kilometres either side of the road.¹⁶ Similarly the observations of land utilisation from the 1965 cadastral map have been extrapolated over the same area. A comparison has been made of the land utilisation in the two time periods, and a proportion of the difference is assumed to be the result of the improved transport facility. Information outlined in Chapter Five has been used to select yield and price data for the agricultural products grown on the newly developed land.

The method of calculation described above is essentially a 'before and after' situation modified to give a 'with and without the road' situation by assuming a proportion of the changed land utilisation has resulted from the road project. It is recognised that there is a large scope for inaccuracy in the measurement of agricultural benefits using the method outlined above. Any error in classifying the land utilisation at either point in time is magnified five times in extrapolating the data from a one kilometre band to a five kilometre band. Table 7.3 provides a summary of the data presented in Appendix Three, Table A3.1 expressed on a five kilometre band basis.

16 A five kilometre band has been chosen on the basis that farmers relying on animal hauled transport to the main road would not travel more than a 'ten kilometre round trip' in one day.

Table 7.3: Land Utilisation in a Five Kilometre Band on Each Side of the Thai-New Zealand Feeder Road in the Years 1965 and 1972 (Km²)

Year	Rice land	Cultivated upland	Uncultivated upland
1972	1000	330	110
1965	945	131	364
(1972-1965)	55	199	-254

Table 7.3 indicates that in 1972 approximately seventy per cent of the land alongside the road was flat land used in rice cultivation. In many areas this land type can be viewed for a distance as far as the eye can see. During the period between the two surveys Table 7.3 shows a relatively small increase in the area of land planted in rice. This is to be expected because in any populated area practising a subsistence agriculture, the land best suited to growing the staple diet crop is cultivated first. The alignment of the Thai-New Zealand feeder road was selected to pass and link as many villages and towns as possible. It thus traverses a populated region. As the village populations increase there is a greater necessity to cultivate land that is even marginally suitable for a rice crop. The small difference in land utilisation is as expected and for the calculation of agricultural benefits it has been assumed that the increased area planted in rice is the result of population pressure rather than the improved transport facility.

Errors are likely to be greater in the estimation of the cultivated and uncultivated upland areas. In some places it was difficult to judge the distance from the road that an area of cultivated or uncultivated upland extended. This must be accepted as a limitation of the method. Table 7.3 shows that in the seven year period between the two surveys there was a substantial increase in the area of cultivated upland. This increase occurred particularly alongside the southern-most sections of the road.

The most important upland crop grown in Northeast Thailand is kenaf and the output from the region has been increasing in recent years. While smaller areas of other crops such as corn and cassava are grown it is convenient for this analysis to assume that the increased land area cultivated was planted in kenaf. Appendix Three, Table A3.2 shows the predominance of kenaf as a cash crop in comparison with the areas of other upland crops grown in Buriram province. It is considered the assumption that kenaf is the only crop grown does not cause serious error in the analysis.

In assessing the benefits from increased upland cultivation the following assumptions have been made.

- (1) An area of 200 square kilometres of upland which had not formerly been cultivated has been brought into production since construction of the Thai-New Zealand feeder road began.
- (2) The land was brought into production according to the following time horizon:

Year	1966	1967	1968	1969	1970	1971	1972
New Area (km ²)	-	10	15	25	30	45	75

The above time horizon has been constructed on the basis of the trends shown in Appendix Three, Table A3.1 and Table A3.2. Table A3.2 indicates there has been a rapid increase in the area planted in kenaf in the years 1969-71 while Table A3.1 shows the greatest areas of upland cultivated since 1965 are adjacent to the southernmost sections of the road. These sections were not completed until 1970-71.

- (3) The cost of the initial clearing of the land was 100 baht per rai or \$U.S.3005 per square kilometre. This amount per rai is sufficient to allow 10 man-days at 10 baht per day or the hiring of a tractor at 50 baht per rai and 5 man-days of labour. This amount is possibly greater than the average cost of development. Ploughing and cultivation costs are included in the gross margin figures for the crop.

- (4) The practice of a shifting cultivation pattern was described in Section 5.1.1. This analysis assumes a crop is grown three successive years and the land is then allowed to fallow for three successive years but in practice farmers do not necessarily observe this particular cycle.
- (5) Three gross margin levels are used in the analysis. The median gross margin of 175 baht per rai was that calculated for the case study farmer in Section 5.3.5 based on a yield of 100 kilograms per rai and a fibre price of 2.50 baht per kilogram. A 50 baht change either side of this figure allows for the situation where either yields or prices could be higher or lower than those used in calculating the median gross margin of 175 baht per rai. The three gross margins used are:

Gross margin per rai (baht)	125	175	225
Gross margin per kilometre ² (\$U.S.)	3756	5258	6761

- (6) The total output of kenaf from the Northeast has increased in recent years as a result of the higher prices the crop has fetched on world markets, brought about by wars in Pakistan and Bangladesh reducing the output of jute in those countries. The increased production of kenaf was a developmental feature of the Thailand transportation studies outlined in Section 3.3.2. Jittasatra (1967) calculated that output in his study area increased at a rate four times faster than that of the reference area.

The central question in estimating the benefits resulting from agricultural development is "what proportion of the 200 square kilometres cultivated in the period 1965-72 would have been cultivated in the absence of the Thai-New Zealand feeder road?" Without statistical data this question cannot be answered. Based on the observations of the studies discussed in Section 3.3.2 it has been assumed that 50 per cent is a conservative estimate of the increased area cultivated as a direct result of the presence of the road.

It should be noted that all kenaf grown within the five

kilometre band either side of the road can now be transported at a considerably cheaper rate than before. However, the transport savings resulting from this aspect are accounted for in Class A vehicle operating cost savings calculated in Section 7.4.1. A situation of double counting would arise if the cost savings in the transport of kenaf were directly added to vehicle operating cost savings as the latter reflect the benefit to producers through reduced passenger fares and freight charges.

- (7) For the purpose of estimating the actual agricultural benefits that have resulted it has been assumed that no further land will be developed after 1972. Table 7.3 shows that there were 110 square kilometres of uncultivated land in 1972. While some of this land may be cultivated in the future it must be remembered that the last land to be cultivated is likely to be the poorest land in the area.

The flow of benefits resulting from the increased production of kenaf is shown in Table 7.4 for the three gross margin levels specified. An irregular flow results because of assumption four, introduced to allow for shifting cultivation practices.

7.4.3 Other tangible benefits

Section 5.11.1 outlined the effect of the Thai-New Zealand feeder road on villager produce marketing. The greater number of merchants travelling to the villages has resulted in competition to obtain the produce and the villagers are placed in a stronger bargaining position. With the cheaper, more frequent transport they can also sell smaller quantities of produce throughout the year rather than selling immediately after harvest. Perishable produce can be sold more easily. The presence of the road increases the scope for expansion and improvement of several of the

Table 7.4:

Net Agricultural Development Benefits,* 1966-85 (\$U.S.)

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Area developed (km ²)	-	10	15	25	30	45	75	-	-	-
Area planted (km ²)	-	10	25	50	70	100	150	130	100	50
Cost of development	-	30,050	45,075	75,125	90,150	135,225	225,375	-	-	-
Net return G.M. \$3756	-	3,755	24,413	56,338	86,385	120,188	169,013	244,140	187,800	93,900
Net return G.M. \$5258	-	11,265	43,188	93,888	138,955	195,288	281,663	341,770	262,900	131,450
Net return G.M. \$6761	-	18,780	61,975	131,463	191,560	270,438	394,388	439,530	338,100	169,025
Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Area planted (km ²)	70	100	150	130	100	50	70	100	150	130
Net return G.M. \$3756	131,460	187,800	281,700	244,140	187,800	93,900	131,460	187,800	281,700	244,140
Net return G.M. \$5258	184,030	262,900	394,350	341,770	262,900	131,450	184,030	262,900	394,350	341,770
Net return G.M. \$6761	236,670	338,100	507,150	439,530	338,100	169,025	236,670	338,100	507,150	439,530

* Net return figures calculated incorporate assumption 6, that only half the area planted is the direct result of the road.

agricultural enterprises described in Chapter Five. The potential of the region for further agricultural development and the possible benefits are discussed in Chapter Eight.

There has been a rapid growth in commercial activity in the major towns along the road, particularly in businesses associated with motor vehicles: petrol stations; repair shops for cars, trucks and motorcycles; bus stations; and also food shops catering for the large numbers of people travelling to the towns. These commercial enterprises provide employment for some villagers who previously only worked in the wet season on family farms. Dry-season employment in the villages studied was described in Section 5.1.4.

A local household industry which has developed near the towns of Borabue and Wapipathum is the manufacture of salt. Subterranean water near these towns has a high salt concentration, and after pumping the water into pans, the salt is recovered by evaporating the water. At Borabue there were about 300 households engaged in salt production while the number near Wapipathum was about 20. The Thai-New Zealand feeder road contributes to this industry, in that some of the logs, used as fuel to evaporate the water, are transported in trucks along the road. Bagged salt is also carried to other towns and provincial centres in the Northeast. Operating cost savings accrue to vehicles carrying the fuel and the salt along the road. However, Borabue is well serviced by other roads and it was not the Thai-New Zealand feeder road which led to the development of this enterprise.

Although the benefits described in this section could be measured, no value has been placed upon them in this analysis. It is difficult to assign a value to the contribution of the road in terms of bringing more merchants to a village or employment opportunities to a region without conducting a comprehensive regional survey. Nevertheless these benefits should be considered in the same way as the intangible benefits, discussed in the next section, when evaluating the impact of the road.

7.4.4 Intangible benefits

Projects which have an objective to improve the economic and social welfare of a local population may bring about benefits which cannot be measured in monetary terms. Often, these are the benefits most frequently mentioned by the local inhabitants when they are asked what the project is worth to them. Such is the case for the Thai-New Zealand feeder road. Not all of these benefits are the direct result of the road alone. Rather they should be considered as being associated with the presence of the road, and together with the road they contribute to improved conditions in the region.

(1) Social welfare benefits

Villagers were quick to mention the hot dusty conditions of the dirt tracks in the dry season, lack of access to the towns in the wet season, and the long delays at all times of the year, in the years prior to construction of the road. Now they can travel more quickly and in greater comfort.

Within the villages there were signs of improved living conditions including iron rather than thatched roofing on the houses, metal water tanks for the storage of drinking water, and construction of household toilets. The following description by Fleckinstein (1971) provides a summary of changes that can be seen in any Northeastern village.

"People were using many goods and services that had only recently been introduced into the community. Buffaloes were tethered with nylon ropes, sweets and fruits were put into plastic bags, transistor radios were carried to the fields, rides were taken on trucks and buses, rice was milled by motorised mills, movies were shown by sellers of antibiotics, injections were given to all and sundry by everyone for all ailments, electric generators provided electricity ... for temple fairs at which folk opera singers sang through microphones, and young men raced across the countryside on bounding red motorcycles."

Three health centres have been established at locations beside the road between Wapipathum and Buriram, and there is another in Borabue. These centres have facilities for treating minor

illnesses, giving vaccinations, and caring for women during pregnancy. They are usually staffed by a married couple, the wife acting as a nurse, and free accommodation is provided. Although the doctors do not have medical degrees, they have received training in a hospital. A motorcycle is supplied and this allows the doctor to travel into villages to treat the sick.

Previously the villagers could only obtain treatment at the hospitals in Mahasarakham and Buriram and the road journey was arduous for sick patients. The road has helped in that villagers can travel to the hospital in greater comfort and more quickly, drugs and medicine can be delivered to the clinics as required, and minor illnesses can be treated in the local health centres.

Raising the number of years of compulsory education from four to seven has resulted in more children studying and more children attending secondary school. The secondary schools are located in the major towns and provincial centres. Many students travel each day, and with the new road this is now cheaper and less difficult. The headmaster of a secondary school in Phiyakaphum Phisai said there were twice the number of students at his school in 1972 compared with 1967. The village leader of Ban Dong Yai stated that more children from his village travelled to schools in Borabue and Wapipathum now that the road had been built.

An important factor in relation to both education and health improvements is the fact that staff for both can be persuaded to work in country areas if communications are good. This enables the staff to travel to the major centres at times when they are not working or even live in the major centres and travel to the villages to work each day.

(2) Political benefits

Figure 3.1 showed the Thai-New Zealand feeder road in relation to the roading network in Northeast Thailand in 1970. The road forms an important part of the paved network and there are several political benefits resulting from the project.

The first lies in the construction of the project itself.

The government has a plan to improve the economic and social welfare of villagers in Northeast Thailand. The construction of a road provides tangible evidence of action and concern on the part of the government for the people of the region. This improves the popularity of the government and at the same time reduces the appeal of insurgent elements to the villagers.

The second benefit lies in the strategic value of a sealed highway. In the neighbouring countries of Laos and Cambodia there has been active fighting in the 'Asian War'. The Thai Government has also been faced with an insurgency problem in the Northeast. A sealed highway network enables the faster movement of troops and weapons if required. However, to date the Thai-New Zealand feeder road has not been used for military purposes because the road does not link districts or provinces where military bases are located.

The road also creates the opportunity for greater political awareness and contact between government officials and the villagers. Officials can conduct their work more efficiently, particularly those whose work requires travel to villages such as agricultural officers and rural health workers. The latter can take mobile health units into the villages and give inoculations to villagers, particularly children, against diseases including cholera and smallpox. Police can investigate robberies and other crimes more promptly. In addition the government is able to get better information on the conditions, problems, and requirements of the villagers through the collection of statistics and thereby maintain better records.

(3) Training objective

In the 'memorandum of understanding' signed by the two governments in 1965, emphasis was placed on the fact that in addition to the financial contributions for the construction of the road, New Zealand's technical personnel were to provide training to Thai personnel in facets of road construction. This was regarded as an important contribution by the governments of both countries. On-the-job training was provided in techniques of road

construction and the operation and maintenance of roadbuilding equipment. A certificate of competence was given to Thai workers worthy of the award as an additional incentive. It was estimated that about 600 Thai personnel received instruction in some facet of roadbuilding. This knowledge should be put to good use in the many construction projects planned for the future.

7.5 Economic Analysis

Project evaluation using discounting techniques requires that the various flows of project costs and project benefits be discounted to a common point in time. Following this operation, economic measurements can be applied to the discounted flows and the results of these calculations can be used, in conjunction with the intangible costs and benefits, to ascertain the worth of the project.

Table 7.5 shows the total cost and selected benefit flows presented in this chapter, discounted at three interest rates. The expenditure and revenue items in each year have been discounted to the value each would have on the 1st January 1966 and then added to provide a total discounted cost or benefit figure.

Table 7.5: Present Value of Project Costs and Benefits
for Three Discount Rates (\$U.S.)

Discount rate	10%	12%	15%
Total cost	6,637,820	6,187,540	5,607,450
Vehicle operating cost savings	4,924,400	4,034,900	3,052,700
Value of increased kenaf production at a gross margin of 175 baht per rai	1,411,554	1,172,061	903,289
Salvage value of equipment	164,544	147,684	126,023
Residual value of the project ($\frac{1}{4}$ net benefit in 1985 assumed to occur in perpetuity)	506,232	353,055	208,088
Total Benefits	7,006,730	5,707,700	4,290,100

The discounted cash flows which have been totalled in Table 7.5 can be used to help evaluate the worth of the project by applying one of three possible economic measures.

7.5.1 Net present value

If the present value of the total cost stream is subtracted from the present value of the total benefit stream then the result is termed the 'net present value of the project'. If the present value of the costs exceeds the present value of the benefits at a particular interest rate, then the net present value will be negative. If there were no intangible factors to consider and the analyst was certain that the discounting factor used reflected the true opportunity cost of capital, then he would conclude that the project was not profitable.

When this operation is performed on the data in Table 7.5 the net present values on the 1st January 1966 are calculated as:

Discount rate	10%	12%	15%
Net present value (1966)	368,910	-479,840	-1,317,350

By using the mathematical relationship

$$NPV_t = NPV_0 (1 + r)^t$$

where NPV_t = Present value in year t

NPV_0 = Present value in the base year

r = Discount rate expressed as a decimal

the answer can be obtained to the question "What is the net present value of the project in 1973? This operation has been performed to yield the following information:

Discount rate	10%	12%	15%
Net present value (1973)	718,900	-1,060,770	-3,504,180

Clearly the net present value obtained is dependent upon the discount rate selected. The difficulties in obtaining the correct discount rate were outlined in Section 7.2.5. The market rate of interest was assumed to be 12 per cent per annum at which rate this project has a negative net present value. However, there are a large number of intangible benefits which were presented in Section 7.4.4. These must be considered in conjunction with the net present value figure calculated before the project can be dismissed as being unprofitable.

7.5.2 Benefit-cost ratio

A second measure of a project's worth used by economists is the benefit-cost ratio which, as the name implies, is the ratio of total discounted benefits to total discounted costs. This presentation of a project's worth is an alternative way of expressing the same data used to calculate the net present value. The following benefit-cost ratios have been calculated for this project, based on the data presented in Table 7.5.

Discount rate	10%	12%	15%
Benefit-cost ratio	1.06	0.92	0.77

A benefit-cost ratio greater than unity indicates that the benefits from the project exceed the costs at the selected discount rate. The absolute value of the benefit-cost ratio depends on the discount rate chosen; the higher the interest rate, the smaller the resulting ratio. Again, only the tangible costs and benefits can be included in the calculation.

The benefit-cost ratio measures the return per unit of cost or investment, and hence the meaning of the ratio can be written as 'the dollar returns per dollar of outlay'. At a discount rate of 12 per cent, the return for each dollar invested in this project is 92 cents. This suggests that the value of the investment is not being recovered, because the present worth of the benefits is less than the present worth of the costs. The intangible benefits must also be considered in conjunction with the ratio before the project profitability can be evaluated.

7.5.3 Internal rate of return

From Table 7.5 it can be seen that the present value of the project costs and benefits decrease as the interest rate increases from 10 to 15 per cent. The total cost flow decreases at a slower rate than the total benefit flow because the costs are incurred in the initial years of the project life, while the benefits increase throughout the life of the project.

At some value for the discount rate, the total discounted costs will exactly equal the total discounted benefits. This discount rate is called the 'internal rate of return of the project', and it represents the average earning power of the money used in the project, over the life of the project. When internal rate of

return is used as a measure of project worth, a project is considered profitable if it has an internal rate of return greater than the opportunity cost of capital. The problem in specifying a discount rate to reflect the opportunity cost of capital was discussed in Section 7.2.5. The internal rate of return criterion requires an assessment of the market rate of interest for comparative purposes.

The measure is used by international agencies, such as the World Bank, for project evaluation in developing countries. In these countries it is difficult to select a market rate of interest, but it is known that the opportunity cost of capital lies within a certain range. The lowest acceptable internal rate of return can be specified and a project which, in a feasibility study, has an internal rate of return outside the lower range limit is rejected.

Using the data presented in Table 7.5, the internal rate of return for this project has been calculated at 10.79 per cent. This rate of return is less than the interest rate of 12 per cent believed to reflect the opportunity cost of capital in the Thai economy. A 12 per cent rate has been chosen for these analyses on the basis of information available suggesting a range of between 10 and 15 per cent. When viewed in conjunction with the intangible benefits, the project is also profitable on the basis of this criterion.

7.6 Sensitivity Analysis

This economic evaluation of the Thai-New Zealand feeder road has been based on certain key assumptions. Each assumption has been discussed at the time it was introduced into the analysis and an effort has been made to justify the choice of data for the calculations. Although an attempt has been made to estimate the most likely course of future events, it is useful to investigate the sensitivity of the economic worth of the project to variations in the values of some of the more uncertain costs and benefits.

7.6.1 Effect of varying the maintenance expenditure level

Because this is partly an 'ex poste' study, the costing data is historical except for the maintenance expenditure estimates. While it is unlikely that maintenance costs will be any less than those shown in the analysis, increased maintenance could well be necessary if the volume of heavy traffic continues to increase rapidly and there is no control on the weight of the loads carried.

Table 7.6 shows the effect of doubling the annual maintenance expenditure on the net present value of the project at a discount rate of 12 per cent. All other costs and benefits are at the levels shown in Table 7.5.

Table 7.6: The Effect of Doubling Annual Maintenance Expenditure on the Net Present Value of the Project (\$U.S.)

Maintenance level \$U.S./year	Total maintenance cost discounted at 12 per cent	Project net present value (1966) at a 12 per cent discount rate
96,202	327,700	-479,840
192,404	650,800	-802,940

Doubling the maintenance expenditure further reduces the net present value of the project. However, it should be noted that the discounted cost of maintenance expenditure over the project life represents only five per cent of the discounted total cost of the road at a maintenance level of \$U.S.96,202 per year.

7.6.2 The effect of varying vehicle operating cost savings

An examination of the discounted benefits in Table 7.5 shows that the benefits from vehicle operating cost savings considerably outweigh the benefits from other sources. In Section 7.4.1 it was noted that vehicle operating cost savings should only

be calculated for generated traffic Class A. In this analysis operating cost savings have been calculated for all vehicles using the road and some of these are Class B or developmental traffic.

The only development benefits that have been considered in this analysis are those arising from increased kenaf production. The average annual production of kenaf in this category is approximately 2.5 million kilograms. This quantity could be carried by 5000 vehicles each with a capacity of a 500 kilogram load. The vehicle operating cost savings for these vehicles travelling an average distance of 36 kilometres amount to approximately \$U.S.15,000 or less than two per cent of annual vehicle operating cost savings. Alternatively if this same quantity was carried in 100 kilogram loads in pick-up trucks, although 25000 vehicles would be required, the operating cost savings would amount to only \$U.S.6,400. Hence it is not expected that vehicle operating cost savings are overestimated to a large extent by including the savings due to all vehicles using the road.

Table 7.2 indicated that the greatest contribution to vehicle operating cost savings is derived from heavy vehicles. The cost savings are very dependent upon the projected growthrate in vehicle usage which has been based on the traffic survey data of 1971 and 1973. More traffic surveys should have been made to improve the accuracy of the analysis but this was not possible because of budgetary constraints.

Two aspects of vehicle operating cost savings can be investigated. The first is to assume that the survey data collected is a good representation of current traffic usage and calculate the vehicle operating cost savings for a range of vehicle growth rates in the post-survey period 1974-85. Table 7.7 investigates this situation.

Table 7.7: Total Vehicle Operating Cost Savings for Varying Rates of Traffic Growth in the Period 1974-85 Discounted at 12 Per Cent, Assuming the Traffic Survey Data to be Accurate (\$U.S.)

Growthrate of light vehicles (% per year)	Growthrate of heavy vehicles (% per year)		
	0	5	12
0	3,465,000	4,008,000	5,153,000
2½	3,491,000	4,034,900*	5,180,000
5	3,525,000	4,067,000	5,212,000

* Figure used in economic evaluation, Table 7.5.

The rate of growth in light vehicle numbers has a less significant effect on vehicle operating cost savings than the growthrate in heavy vehicle numbers. The economic analysis assumed an annual growthrate of 2½ per cent in light vehicles and 5 per cent in heavy vehicles. In the case of heavy vehicles this growthrate is only 25 per cent of that shown in the traffic count data of 1971 and 1973. Should there in fact be no increase in the growthrate of either light or heavy vehicles, vehicle operating cost savings would be reduced \$U.S.570,000 below the level used in this analysis.

Table 7.8 investigates the second aspect of vehicle operating cost savings. In this table vehicle operating cost savings have been calculated assuming the traffic surveys in 1971 and 1973 both over-estimated current vehicle usage by 20 per cent.

Table 7.8: Total Vehicle Operating Cost Savings for Varying Rates of Traffic Growth in the Period 1974-85 Discounted at 12 Per Cent, Assuming an Over-estimation of 20 Per Cent in the Traffic Survey Data (\$U.S.)

Growthrate of light vehicles (% per year)	Growthrate of heavy vehicles (% per year)		
	0	5	12
0	2,771,000	3,240,000	4,133,000
2½	2,792,000	3,261,000	4,154,000
5	2,817,000	3,287,000	4,180,000

Table 7.8 reinforces the trends shown in the previous table but the important feature to note is the magnitude of the effect of a 20 per cent error in the traffic survey counts. A comparison with Table 7.7 shows that the difference is almost one million dollars when any two corresponding entries are compared. This represents a source of possible major error in the analysis.

The average daily traffic volumes shown in Table 7.2 are based on the traffic counts between the hours of 6.30 a.m. and 6.30 p.m. No correction factor was applied to raise the actual counts to the volume using the road on a 24 hour basis. In the only full 24 hour count that was undertaken,¹⁷ 80 per cent of the light vehicles and 70 per cent of the heavy vehicles travelled between the hours of 6.30 a.m. and 6.30 p.m. However, raising the other traffic counts on the basis of one observation at one location could not be justified. While the count figures obtained do under-estimate the traffic volumes for the days on which they were obtained, it is by no means certain that the figures used in the analysis under-estimate the average daily traffic volume throughout the year. Because of insufficient data, the estimation of average daily traffic volumes, traffic growthrates, and hence vehicle operating cost savings must be accepted as a major limitation in this evaluation.

17 Refer to Appendix Four, Table A4.2.

Table 7.9 shows the contribution of heavy vehicle operating cost savings to project net present value at a 12 per cent discount rate for varying heavy traffic annual growthrates. The vehicle operating cost savings for light vehicles are calculated for an annual growthrate of $2\frac{1}{2}$ per cent. All other costs and benefits are at the levels shown in Table 7.5.

Table 7.9: Effect of Varying Heavy Traffic Growthrate on Project Net Present Value at a 12 Per Cent Discount Rate (\$U.S.)

Heavy vehicle annual growthrate	Project net present value (1966) at a 12% discount rate (\$U.S.)		
	0	5%	12%
Traffic survey data accurately reflecting current usage	-1,023,740	-479,840	665,260
Traffic survey data over-estimating current usage by 20 per cent	-1,722,740	-1,253,740	-360,740

7.6.3 The effect of varying the value of kenaf production

Although the benefits from increased kenaf production are only one third of the vehicle operating cost savings, they do represent a large contribution to the total benefits of the project. The stimulation of agricultural production, thereby raising the level of farm incomes, is a major plan objective and hence these development benefits are important.

The limitations of the method used to calculate the development benefits have been discussed in Section 7.4.2 and an estimate has been obtained. Rather than paramatise the area that may have been developed because of the road project, it is more appropriate to assume the area calculated is a reasonable estimate and paramatise the gross margin for the kenaf crop. A change in

the gross margin can reflect either a change in price, a change in yield, or both. The kenaf gross margin used in the economic analysis of Table 7.5 assumed a yield of 100 kilograms per rai and a price of 2.50 baht per kilogram.

Table 7.10 shows the effect of varying the kenaf gross margin on the net present value of the project at a discount rate of 12 per cent. All other costs and benefits are at the levels shown in Table 7.5.

Table 7.10: The Effect of Varying the Kenaf Gross Margin on the Net Present Value of the Project (\$U.S.)

Kenaf Gross margin		Total agricultural benefits discounted at 12 per cent	Project net present value (1966) at a 12 per cent discount rate
per rai (baht)	per km ² (\$U.S.)		
125	3756	790,815	-861,085
175	5258	1,172,061	-479,840
225	6761	1,553,810	-98,090

The total discounted agricultural benefits for the two extreme kenaf gross margins deviate from those calculated for the median gross margin of 175 baht per rai by almost half a million dollars. The price for the kenaf gross margin calculation was at the level received by farmers in 1972. World shortages of jute could result in a price increase in the future. However, the soil where this crop is grown is of low fertility and marginal for the crop. The assumption that a yield of 100 kilograms per rai can be obtained for three consecutive years may be incorrect although farmers would not plant a crop if yields are likely to be below this level. Hence a gross-margin of 175 baht per rai represents a conservative or minimum likely return during the period of analysis.

7.6.4 The effect of varying residual value

In the analysis, the residual value of the project in 1985 has been calculated as 25 per cent of the total benefits occurring in 1985, discounted to infinity. Table 7.11 shows the contribution of residual value to project net present value at a discount rate of 12 per cent. All other costs and benefits are at the levels shown in Table 7.5.

Table 7.11: The Effect of Varying Residual Value on the Net Present Value of the Project (\$U.S.)

Proportion of total benefits in 1985 discounted to infinity (per cent)	0	25	50
Project residual value in 1985 (\$U.S.)	0	3,405,680	6,811,355
Project net present value in 1966 at a 12 per cent discount rate (\$U.S.)	-832,895	-479,840	-126,783

The contribution of residual value to the project worth is less significant than either vehicle operating cost savings or the increased production of kenaf. The concept of residual value was discussed in Section 7.2.2 and at that time it was noted that the residual depends on the use and maintenance of the road throughout the project life and future use after 1985, the year designated in this analysis as being the end of the project life. A residual value of 60 per cent or more of the net benefit in 1985, assumed to occur in perpetuity, gives the project a positive net present value at a 12 per cent discount rate.

7.6.5 Joint variation of factors affecting the economic worth of the Thai-New Zealand feeder road

The previous sections of this sensitivity analysis have considered the effect of varying one of the factors determining the economic worth of this project. It is also possible to investigate

joint variation of these factors and thereby calculate a range of values for the project depending upon the various circumstances that might eventuate.

Table 7.12 shows project net present values and internal rates of return calculated for three levels of vehicle operating cost savings, three kenaf gross margins, and two levels of residual value. All analyses in which there is zero residual value at the end of the project life have annual maintenance expenditure at a level of \$U.S.96,202. All analyses in which a residual value is included have annual maintenance at a level of \$U.S.192,404. This same information is shown graphically on Figure 7.2 and Figure 7.3.

Both Figure 7.2 and Figure 7.3 are useful diagrams to show the outcome when the factors influencing project worth are varied. For example, a comparison of the points along the line $AH_{12}M_1R_{\frac{1}{2}}$ and those along the line $AH_{12}M_0R_0$ shows the contribution of residual value and a high level of maintenance to project worth, when the annual heavy traffic growthrate is 12 per cent and the kenaf gross margin is varied at three levels. Similarly line $AH_5M_0R_0$ compared with line $(A-20)H_5M_0R_0$ shows the effect on the two economic criteria, of a 20 per cent over-estimation of traffic usage in the 1971 and 1973 traffic surveys, at the three gross margin levels for kenaf.

The two figures show that the factors most affecting the results of the analysis are the accuracy of the traffic counts in representing current traffic usage in the years of the survey, and the annual traffic growthrate. The gross margin for kenaf is the third factor in order of importance although the contribution of a residual value to project worth is high when the total benefits in 1985 are large, because of the definition of residual value used in this study.¹⁸

Figure 7.2 shows that the project has a positive net present value at a 12 per cent discount rate in two sets of

¹⁸ Refer to Section 7.2.2.

Table 7.12: The Effect of Varying Kenaf Gross Margin, Count Data and Annual Growthrate of Heavy Vehicles, Road Maintenance Expenditure and Residual Value, on the Economic Criteria of Net Present Value (1966) at a 12 Per Cent Discount Rate (\$U.S. million) and Internal Rate of Return (Per Cent).

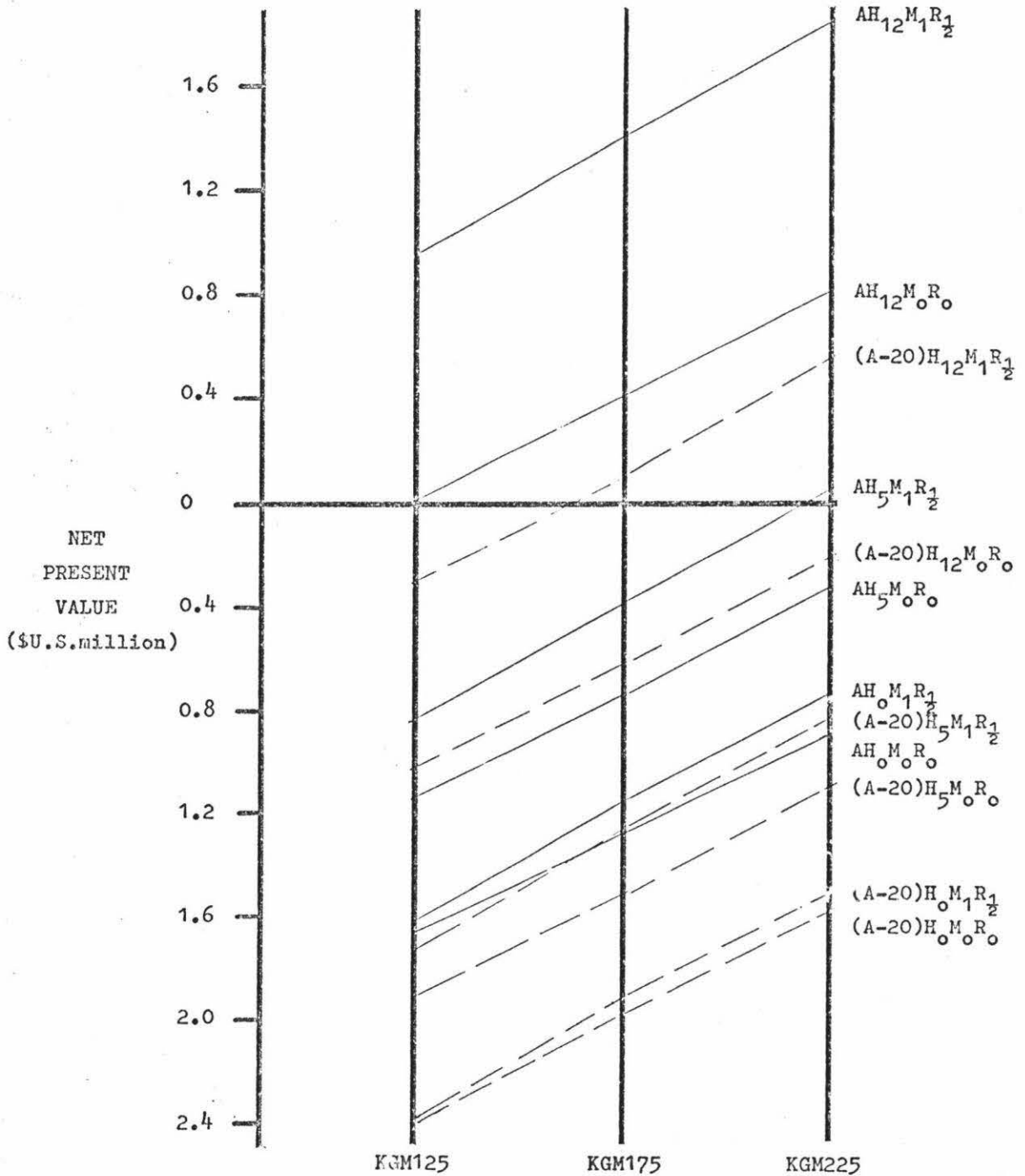
Traffic data based on:			Actual survey counts in 1971 and 1973			Survey counts in 1971 and 1973 both reduced by 20%		
Vehicle growthrates in the period 1973-85			$L_{2\frac{1}{2}}H_0$	$L_{2\frac{1}{2}}H_5$	$L_{2\frac{1}{2}}H_{12}$	$L_{2\frac{1}{2}}H_0$	$L_{2\frac{1}{2}}H_5$	$L_{2\frac{1}{2}}H_{12}$
Kenaf Gross Margin 125 baht/rai	M_0R_0	NPV IRR	-1,758,018 6.41	-1,214,195 8.58	-69,173 11.84	-2,457,047 3.81	-1,917,535 6.14	-1,094,784 9.29
	$M_1R_{\frac{1}{2}}$	NPV IRR	-1,703,263 7.20	-914,858 9.80	886,735 13.65	-2,473,443 4.65	-1,784,810 7.50	-386,078 11.23
Kenaf Gross Margin 175 baht/rai	M_0R_0	NPV IRR	-1,376,715 7.70	-832,892 9.67	312,131 12.72	-2,075,744 5.22	-1,606,652 7.32	-713,481 10.24
	$M_0R_{\frac{1}{4}}$	NPV IRR	-1,023,740	-479,840 10.79	665,260	-1,722,740	-1,301,692 8.58	-360,740
	$M_1R_{\frac{1}{2}}$	NPV IRR	-1,279,789 8.46	-491,384 10.83	1,310,209 14.43	-2,049,969 6.06	-1,361,336 8.62	37,396 12.07
Kenaf Gross Margin 225 baht/rai	M_0R_0	NPV IRR	-995,024 8.93	-451,201 10.75	693,821 13.60	-1,694,053 6.56	-1,224,961 8.47	-331,790 11.19
	$M_1R_{\frac{1}{2}}$	NPV IRR	-898,098 9.53	-67,467 11.84	1,734,127 15.22	-1,626,051 7.39	-937,418 9.70	461,313 12.91

Key: $L_{2\frac{1}{2}}H_0$: Annual increase in light vehicle numbers 2½%, heavy vehicles zero.

M_0R_0 : Maintenance expenditure \$U.S.96,202 per year, zero residual value in 1985.

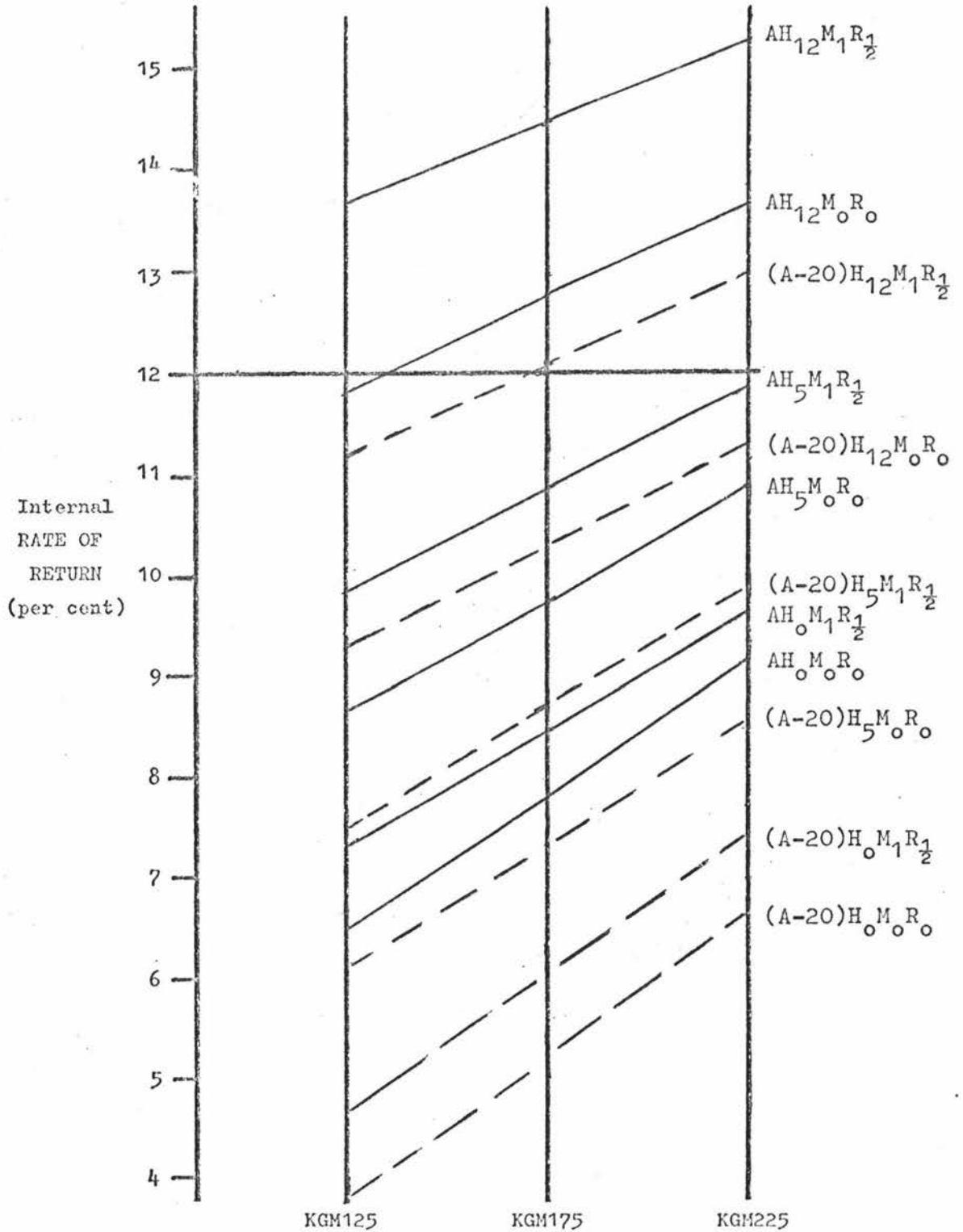
$M_1R_{\frac{1}{2}}$: Maintenance expenditure \$U.S.192,404 per year, residual value half the discounted benefits in the 'post project life' period.

NPV : Net Present Value, IRR : Internal Rate of Return.



Key: A, (A-20): Traffic volume actual counts, counts less 20 per cent.
 H_0, H_5, H_{12} : Percentage annual increase in heavy traffic volume.
 M_0, M_1 : Annual maintenance expenditure \$96,202 or \$192,404.
 $R_0, R_{1/2}$: Residual value in 1985 zero or $\frac{1}{2}$ the net benefit in 1985 assumed to occur in perpetuity.
 KGM: Kenaf Gross Margin (baht per rai).

Figure 7.2: The Effect of Varying Uncertain Costs and Benefits on Project Net Present Value in 1966 at a 12 Per Cent Discount Rate (\$U.S. million)



Key: A, (A-20): Traffic volume actual counts, counts less 20 per cent.
 H_0, H_5, H_{12} : Percentage annual increase in heavy traffic volume.
 M_0, M_1 : Annual maintenance expenditure \$U.S.96,202 or \$U.S.192,404.
 $R_0, R_{\frac{1}{2}}$: Residual value in 1985 zero or $\frac{1}{2}$ the net benefit in 1985 assumed to occur in perpetuity.
 KGM125, 175, 225: Kenaf Gross Margin (baht per rail).

Figure 7.3: The Effect of Varying Uncertain Costs and Benefits on Project Internal Rate of Return

circumstances: when the heavy traffic growthrate is increasing at an annual rate of 12 per cent, and when the heavy traffic growthrate increases at five per cent per year and the gross margin for kenaf is at a high level. A 12 per cent annual growthrate in heavy traffic vehicles is half the growthrate in heavy vehicle usage calculated from the 1971 and 1973 traffic surveys. It is therefore a possibility, as is the higher return of 225 baht per rai for kenaf. Under these circumstances the road is profitable using the economic criteria alone, without consideration of the intangible benefits.

There are several sets of circumstances which would lead to a project internal rate of return of between nine and 12 per cent. For example $AH_5M_0R_0$ at a kenaf gross margin of 175 baht per rai, and $(A-20)H_5M_1R_{\frac{1}{2}}$ at a kenaf gross margin of 225 baht per rai. Any one of these outcomes could eventuate although it is unlikely that the project will be worth nothing at the end of the project life. If the project has an internal return greater than nine it should be regarded as successful when both the tangible and intangible benefits are viewed together. The social benefits and the objective of training Thai personnel in road construction are two important factors which increase the value of the road above the level shown in the economic measurements.

The worst outcome analysed shows a situation in which the traffic counts over-estimated current traffic usage by 20 per cent, there is zero annual growthrate in heavy vehicles using the road, and at the end of the project life the project has no residual value. In these circumstances $[(A-20)H_0M_0R_0]$ the project has a negative net present value of about \$U.S.2.4 million and an internal rate of return of about four per cent. In the event of this situation occurring, the project could be regarded as a failure in that no agricultural development has taken place and the usefulness of the road to carry passengers and goods within the area is small. The road may have been better located in a region with greater potential for usage. Alternatively economic planners need to look at the region to identify other factors which may be preventing economic development and thereby reducing the usefulness of the road. While the region along the Thai-New Zealand feeder road

does have further agricultural potential,¹⁹ there are indications of increasing agricultural production and it is unlikely that the project has an economic worth of less than 10 per cent.

7.7 Summary

An economic evaluation of the Thai-New Zealand feeder road has been outlined in this chapter. As the study is partly an 'ex poste' analysis some of the information, mainly the road costs, is known with certainty. Information from an agricultural survey, road traffic surveys, and a land classification survey have been used to estimate the other costs and benefits, in the absence of statistical records. The road has been evaluated using the three economic criteria of project net present value, benefit-cost ratio, and project internal rate of return. Several intangible benefits from the project have been identified and these must be viewed in conjunction with the economic criteria in assessing the project worth.

The economic analysis has shown the road project to have a net present value in 1966 of -\$U.S.479,840 and a benefit-cost ratio of 0.92 at a discount rate of 12 per cent. The project internal rate of return is 10.79 per cent. A sensitivity analysis has also been carried out to investigate some of the more uncertain costs and benefits influencing the profitability shown by the three economic criteria. When both the intangible and tangible benefits are evaluated together, the project can be regarded as a profitable investment if the data and assumptions that have been used accurately reflect events since road construction began and the events that will occur in the remaining years of the project life.

19 The economic potential of the region is discussed in Chapter Eight.

Chapter EightPOTENTIAL BENEFITS FROM THE THAI-NEW ZEALAND FEEDER ROAD8.1 Introduction

Throughout this study emphasis has been placed on the fact that provision of a transport facility is only part of a whole package of requirements necessary before the population in a region can practise commercial rather than subsistence agriculture. The previous chapter evaluated the Thai-New Zealand feeder road under the present predominantly subsistent conditions. Most of the tangible benefits were derived from reduced vehicle operating costs for traffic generated by the new facility and a smaller proportion were derived from increased agricultural development.

This chapter examines the agricultural potential in the region and the scope for development within the agricultural enterprises in which the villagers are engaged at the present time. Several technical missions visiting Northeast Thailand in recent years have made recommendations and suggested improved techniques that could be applied to these agricultural enterprises. Although there have been no previous studies in the immediate vicinity of the Thai-New Zealand feeder road, the recommended practices of these technical missions are applicable to the study region because it is typical of many parts of the Northeast. A number of problems and obstacles preventing the more widespread adoption of these practices are outlined together with a strategy for their solution.

An evaluation of the possible contribution of the Thai-New Zealand feeder road in a developing commercial economy will be undertaken in this chapter. Potential benefits from the road will be calculated under the assumption that a proportion of the villagers will adopt the improved technological practices described. If the absence of the road was the only factor limiting

increased production, the potential benefits calculated would all accrue to the road. If transportation is not the only limiting factor then it should be recognised that where other inputs are supplied, the resulting benefits are due to the introduction of all the inputs, including the road.

8.2 Estimates of Agricultural Productivity and Profitability

Although the government has invested heavily in the infrastructure components of the economy in Northeast Thailand, this expenditure is likely to fail in its intended developmental objective, unless the incentive for farmers to increase production is improved. The various technical missions have suggested that both agricultural production, and household incomes could be raised if improved techniques were applied in the enterprises undertaken at present. This section examines some of these suggestions.

8.2.1 Livestock as a potential source of income

Cattle and buffalo have traditionally been used as working animals although their value as a source of income is recognised by farmers. Poor management policies, particularly in breeding and disease control, reduce the potential income from these animals.

Most reports offer recommendations similar to those of the ADB - ARD COMPAC technical mission in 1971.¹ This mission recommended the upgrading of native village cattle in cross-breeding programmes with an introduced breed such as the American Brahman. A scheme was proposed whereby purebred Brahman bulls

1 A joint Asian Development Bank - Accelerated Rural Development investigation of the agricultural potential of selected amphers in Thailand, including some in the Northeast, was carried out during 1970-71.

would be made available to villagers and a fee charged for mating with their native cattle. One farmer within the village would own the bull and provide an area of pasture to feed it as well as keep records of the progeny performance of that bull. The district veterinarian was to blood-test cattle for disease and all other male cattle in the village were to be castrated.

The ADB - ARD COMPAC mission estimated that a native cow and her female progeny performing under average village conditions accumulate a total of 17 offspring during the 15-year life span of the first female parent. During this period sales of four-year old male progeny worth 8200 baht can be made. Under the same conditions it has been estimated by the mission that a cross-bred cow and her progeny could accumulate 29 offspring in addition to sales worth 25,000 baht during the same period.

The indigenous Thai buffalo is of good quality and there is not the same opportunity to introduce superior exotic strains as with cattle. The mission report recommended that bulls with faster growth rates should be selected to upgrade village buffalo. These bulls should be the offspring of a selected strain with a high calving percentage.

Crump (1972) has suggested that if a mass oversowing of legumes into the natural forest and village grazing areas was initiated, and the present system of cattle management was maintained, the economic returns would be greater than if areas were fenced into farms and paddocks. This strategy he states:

"has the lowest capital cost, the highest return on invested capital, the lowest operating expenditure and the lowest cost of production."

Each of the two systems outlined is designed to increase the profitability of raising cattle and buffalo. The ADB - ARD COMPAC proposal is designed to achieve this aim through a breeding programme while the method described by Crump would achieve this objective by increasing the quantity of feed available to stock. Ideally they should both be put into effect. The latter system is perhaps easier to operate in that once legume establishment is

achieved, the programme is self perpetuating. There is no requirement on the part of the villagers to change any management policy. However, the system has not been tried on a commercial basis. Until large quantities of legume seed can be introduced and the system tested, the potential benefits can only be estimated.²

Livestock breeding programmes have been started in some villages. Brahman-cross bulls are expensive (approximately 3000 baht) and hence only the wealthier villagers can afford to purchase them. In the villages studied, the farmers who owned Brahman-cross bulls charged a fee of 25 baht per service. Although this fee is not expensive, castration of other male cattle in the village had not taken place and the mating of cattle was still haphazard. Unless other male cattle are castrated, progress in a breeding programme will be slow under a communal grazing management system. Records of the bull or progeny performance were not kept by the owners of Brahman-cross bulls. While there is therefore scope for improvement in both cattle and buffalo enterprises, schemes designed to increase production are difficult to put into effect.

A benchmark survey investigating the agriculture of farmers in an area to be supplied with irrigation, about 100 kilometres distant from this study, was summarised in the Asian Development Bank, Nongwai (1971) report. This report noted that pig enterprises, particularly the sale of weaner pigs, could be a very profitable enterprise, confirming the observations in Section 5.7 of this study. Other reports suggest there is a shortage of breeding sows in the region and scope for selecting boars with high growthrates at the government-operated livestock stations. These could be made available to villagers on a similar basis to the improved cattle programme outlined in this section.

Under the present system of management little improvement can be expected in the performance of chickens and ducks. The Nongwai report estimated that native village hens rear approximately

2 A World Bank project investigating the feasibility of a legume oversowing scheme, similar to that described in this study, commenced in 1973.

ten live chickens per year and lay about 80 eggs. The report notes that "the highly attractive price offered for chicken meat did not appear to have influenced the average village family to think of their poultry as a primary income earner." Ducks laid approximately 80 eggs per year but the report stated that a laying breed such as the Khaki Campbell could lay 200-240 eggs per bird. The duck enterprise presented as a case study in Section 5.8 had an average per bird production of 150 eggs. Four households in Ban Kor had laying duck enterprises. In addition to the ready market for the eggs, this village had a large watering area where the ducks could be driven during the day. A lack of water was a barrier to households in some villages engaging in large scale duck production.

6.2.2 Vegetables and upland crops as a potential source of income

Northeast Thailand is a net importer of vegetables and the need for a larger supply of both vegetables and upland crops has been recognised by every advisory group visiting the region. The two major factors preventing the cultivation of larger areas are the low fertility soils and the uneven spread of rainfall.

"It has often been postulated that this primitive agriculture continues as the farmer in the Northeast lacks initiative and is backward and unenterprising. On the other hand one does not have to look far for the reason for his failure to do better. The heavy rainfall during the wet season and poor soil drainage makes crop husbandry other than rice culture impossible His failure to do better in the dry season beyond the cultivation of 2% of the land in vegetables is explicable on the grounds that he lacks water."
ADB, -Nongwai, (1971)

The ADB - Nongwai Pioneer project for irrigated agriculture investigated the potential for vegetable and upland crop production following the introduction of a large-scale irrigation scheme in Khon Kaen province approximately 100 kilometres from the Thai-New Zealand feeder road. The technical mission reasoned that large quantities of produce would lower prices in the Khon Kaen market

and they suggested that processing industries should be developed in conjunction with the scheme to maintain or even increase price levels to the farmer.

The 1971 and projected prices for various crops are shown in Appendix Three, Table A3.4 while Table A3.5 uses these prices to calculate crop gross margins when the scheme has been operating four years and again after ten years. Estimated gross margins for selected crops are summarised in Table 8.1.

Table 8.1: Estimated Gross Margins for Selected Crops
Grown in an Area Supplied With Irrigation (baht)

Crop	Gross margin after 10 years of irrigation
Non-glutinous rice	370
Maize	310
Sweet corn	410
Peanuts	490
Soybean	410
Cotton	770
Kenaf	450
Mixed vegetable cultivation	3,860
Banana	1,570
Mango	790
Papaya	1,430
Sesame	370
Tomato	2,430
Onions	2,640

Source: Appendix Three, Table A3.5.

Table 8.1 shows that there are several crops more profitable than rice. A permanent irrigation system would allow the cultivation of two rice crops in the same year. Although the return is less, farmers might grow a second rice crop because they are sure of a market outlet. However, as processing is a new

concept they cannot be sure of a market for vegetables or fruit. The gross margins after 10 years of irrigation are estimated to be greater than those in the earlier years because in theory the farmers should have more knowledge about the use of irrigation. Also, there are heavy inputs of fertilizer, insecticides and weedicides.

Appendix Three Table A3.6 shows the gross margins for selected crops grown at Khon Kaen University, about eight kilometres from the Nongwai project. These crops were high yielding varieties grown as trials and consequently they were supplied with fertilizer, adequate water and correct cultivation practices throughout the growing period. The prices used in these calculations were estimates of the amount the farmer would receive based on 50 per cent of the prevailing Khon Kaen fresh market price which allows for loss through spoilage and a mark-up in price by the stall-keepers.

Thus providing there is a market for the crops and the necessary inputs of fertilizer, agrochemicals, irrigation water and transport are available, there is scope for the profitable cultivation of several vegetable and fruit crops.

8.2.3 Fish culture as a potential source of income

The ADB - ARD COMPAC Technical Mission in 1970 suggested introducing carp as the most suitable breed for three fish culture systems. Each of these systems has applicability in the region of the Thai-New Zealand feeder road.

For pond culture the mission recommended a minimum pond size of one rai with a water depth of about 100 centimetres. Fingerlings at the rate of 5000 - 7000 per rai can be introduced to the pond when about six centimetres in length. In addition to feeding on the naturally growing plankton, it is necessary to provide supplementary feed, preferably high in protein. Three to four hours work a day by one man is enough to manage a one-rai pond.

The fish are harvested in a single harvesting each year and the mission suggested a target of 1000 kilograms of fish per rai.

Paddy field culture is labour extensive and combines fish farming with rice production. A minimum area of five rai was recommended with a ditch one metre wide and 50 centimetres deep dug around the edge of the paddy bund. This provides a refuge for the fish when working with the rice or the water levels fall. In addition to stocking the field with 600 fingerlings per rai it is likely that 'invader' fish will enter the field. These may be predators of the introduced fingerlings. It is not usual to provide supplementary feed and hence the average fish weight of 200 grams is lower than for pond culture. With no feeding, yields of 30 kilograms of fish per rai can be obtained but with feeding, the mission estimated 300 kilograms would be possible.

Lowland fish culture uses land otherwise useless for farming and no rice is grown with the fish. The minimum economic size is five rai with a water depth of 30 centimetres. No supplementary feed is provided and the water is stocked with brood fish at the start of the wet season. The fish are harvested when the water level is low during the dry season.

Table 8.2 summarises the financial information for the three methods of fish culture outlined above. Detailed budgets for the three methods are provided in Appendix Three Table A3.7.

Table 8.2: Financial Data for Three Methods of Fish Culture Recommended by Asian Development Bank - ARD COMPAC Technical Mission 1971*

Costs and returns (baht/rai)	Method of Culture		
	Fish pond	Paddy field	Lowland culture
Capital cost	9,800	400	230
Total income	15,000	4,500	750
Variable costs	3,970	1,910	318
Net income	11,030	2,590	432
Interest on capital at 12%	1,180	48	27
Labour reward	9,550	2,542	405

* Figures used in calculating the returns for fishpond and paddy field culture are estimates. Those for lowland culture are from a case study.

From Table 8.2 it can be seen that the returns from pond and paddy field fish culture are high and if the costing data is realistic it is surprising more farmers do not engage in these enterprises. The high capital cost of a fish pond probably explains the absence of this system. Farmers who did practise paddy culture spoke of the problems of predator species. The weight of fish obtained depends on the level of supplementary feeding. Farmers prefer to feed rice bran to pigs whereas the budgetary analyses require high protein feeds to be supplied to the fish. Such feeds are in short supply in Thailand, although increased cultivation of peanuts and soybeans could increase the supply and lower the cost in the future.

8.2.4 Sericulture as a potential source of income

The demand for raw silk for both handloom and machine woven textiles exceeds production and the ADB - ARD COMPAC Technical Mission investigated three methods of improving the output of village silk. The first system was to improve existing yields of mulberry leaf. This may be achieved by introducing improved techniques of land preparation and composting, growing new varieties with a better layout of the mulberry stand, more weeding and disease control and following recommended pruning, trimming and thinning practices.

The second system was to select the best silk-producing worms from the native Thai worms in addition to upgrading the mulberry production. The selected worms have high resistance to local temperature and humidity fluctuations as well as to local diseases. Through the introduction of these two improvements a higher income can be achieved.

The third system proposed by the mission was the introduction of hybrid worms rather than selected native worms. The hybrids can produce higher quality silk and are more efficient than selected native worms since they require only 107 kilograms of leaf to produce one kilogram of raw silk. Selected native worms require 160 kilograms of fresh leaf while ordinary native worms require 200 kilograms of leaf to produce one kilogram of raw silk.

Table 8.3 summarises the financial information for the various sericulture systems based on detailed budgets presented in Appendix Three, Table A3.8.

Table 8.3: Financial Data for Four Sericulture Systems
Recommended by ADB - ARD COMPAC
Technical Mission 1971

Cost and returns (baht/rai)	Existing system	Existing system improved mulberry	Improved mulberry selected Thai worms	Improved mulberry hybrid worms
Capital costs	990	2,140	2,140	3,680
Total income	309	1,175	1,791	3,842
Variable costs	5	240	465	690
Net income	304	935	1,326	3,152
Interest on capital at 12%	119	257	257	442
Depreciation on housing and equipment	59	174	174	328
Labour reward	126	504	895	2,382

Table 8.3 shows that the returns calculated for silk production under the existing system are very low and for the time involved in producing a kilogram of woven silk it is not surprising that silk is produced mainly for household requirements. However, there are increased returns from a greater efficiency of leaf conversion and better quality silk under the improved sericulture conditions. It may be possible to sell cocoons to a central reeling plant rather than each household reel and weave their own cloth. Alternatively the members of some villages could specialise in weaving cloth from purchased silk thread. An example of this latter proposal is the pilot scheme which has been established at Ban Chonnabot, a village about 50 kilometres from the Thai-New Zealand feeder road. The rate of propagation of the improved mulberry plants and the ability of the silk stations to multiply and distribute the eggs of hybrid worms are the factors which will determine the rate of adoption of the improved techniques.

8.3 Problems Preventing Increased Agricultural Production and Strategies for Their Solution

Technical reports written to assist the Royal Thai Government in its development planning or to support international loan applications, identify many reasons for the low productivity of Northeastern agriculture.³ The limited education of the majority of the population is seen as an obstacle to rapid economic development. It is only within the past 10 years that the number of years of compulsory education has been raised from four to seven. There is a need to improve the general level of education in the rural areas and make it relevant to rural life. Agricultural education and training should be available to the sons of village farmers, but at present a high school education is a pre-requisite to further study in an agricultural college. Few students from farm families reach this level of education.

Farmers in this region concentrate heavily on rice production. This situation arises from the subsistence nature of the economy and the efforts of each family to be self sufficient in the staple food crop. The average area of paddy land cultivated by the farmers in the pilot agricultural survey was 35 rai. The rising population throughout the area is forcing farmers to grow rice on increasingly marginal land. For most farmers, however, it is the poor fertility of the land that is limiting yields. A reduction in the price of fertilizer or the provision of credit to enable farmers to purchase more fertilizer would bring about increased yields.

A lack of finance is the major obstacle to improvement in the existing enterprise structures. The following examples illustrate the extent of credit requirements for a household to adopt some of the suggested practices.

- (a) A farmer with the average area of 35 rai of paddy land wishes to apply fertilizer to his fields at a rate of 20

3 For a comprehensive economic planning report refer to Louis Berger Inc. et al. (1971).

kilograms per rai. If the cash price of fertilizer is 100 baht per bag then he will require 1400 baht. Should he also wish to apply insecticide a further 700 baht is required. To pay for the additional inputs the farmer must increase his average yield per rai by 80 kilograms. While this may be possible in a normal season, the unpredictable rainfall pattern means an average farmer cannot take this risk.

- (b) A woman presently engaged in traditional silk production wishes to adopt the new sericulture technology. Assuming there is a supply of selected native or hybrid worms available and improved mulberry strains have been established, this woman must find 1100 baht for expenditure on capital equipment and another 400 baht each year to cover variable costs. There is less risk involved in that the equipment could always be resold. The woman could also establish the mulberry and purchase the equipment out of revenue from the sale of leaves.
- (c) Similarly the financial requirements for a farmer wanting to engage in fish culture are high. Probably the best plan for a farmer would be to engage in paddy field culture on a more scientific basis than now, and invest the returns in the construction of a pond. A farmer would still require approximately 2000 baht to purchase prepared food and fingerlings although more money would be necessary if the farmer wished to combat a problem of predator fish entering his fields.

Several factors inhibit the development of livestock industries including disease problems such as foot and mouth disease and brucellosis, poor breeding practices, a lack of control over slaughtering practices, a lack of relevant research into livestock production under Northeastern conditions, and poor security in some areas for livestock protection. While the present system of cattle and buffalo management, operated by a large number of small scale operators, is less capital intensive than pasture or paddock farming, this system makes it difficult to introduce disease control or breeding

programmes. Disease control programmes are expensive and need to be administered on a regional basis. Laws regarding the movement of animals between various regions must be strictly enforced. For these reasons it is suggested that the system outlined by Crump (1972) which concentrates on raising productivity by increasing feed availability, may have more potential at the present time.

The low fertility of Northeastern soils, and the irregular patterns of rainfall can not support a cash crop economy. Kenaf is the only crop for which the Northeast appears to have a relative advantage over the rest of the country. In the region of the Thai-New Zealand feeder road, the introduction of an irrigation scheme is the prime requirement before farmers can begin to practise dry-season cropping of rice or vegetables. Processing industries would then become necessary to avoid saturation of the local markets but this would provide increased employment opportunities and farmers meeting quality standards would have an assured income.

There is also a need to improve research and demonstration projects by making them relevant to Northeastern conditions. The Northeast Agricultural Centre and Khon Kaen University are two institutions within 100 kilometres of the Thai-New Zealand feeder road, that can be expected to conduct research of benefit to farmers in the study region. The knowledge gained from research should be spread to the villagers via an effective extension system. Extension officers must be skilled in practical agriculture and able to communicate with the villagers. This means it will be necessary to educate the sons of Northeastern farmers and train them to be effective extension workers.

Transportation, particularly the provision of essential feeder roads to move agricultural products to markets, is frequently cited as an essential factor to promote economic development in the Northeast. Construction of the Thai-New Zealand feeder road has provided an all-weather road and business entrepreneurs have provided the vehicles to transport both passengers and produce along it. Competition between the transport owners has led to the establishment of fares and freight rates the villagers can afford to pay. Transportation is no

longer a barrier to increased agricultural production in the study area.

The problems preventing increased production and the various solutions outlined in the preceding paragraphs embrace several inter-related factors necessary in the development process including education, provision of credit, irrigation, research and extension.⁴ These same factors are also embodied in the 'essentials' and 'accelerators' recognised by Mosher (1966) as being part of the development process. They were discussed in Chapter One.

8.4 Potential Agricultural Benefits

As this is partly an 'ex poste' study, the author has been able to measure the extent to which improved technological practices have been adopted by villagers along the Thai-New Zealand feeder road. From the data obtained in the pilot agricultural survey of 1972 there was little evidence to suggest that farmers have adopted the practices outlined in this chapter: quantities of fertilizer used were small and few households engaged in dry season vegetable production or fish culture. However, in Ban Don Tieu a Silk Producer's Co-operative had been established for one year with about 25 members. These members had received cuttings of improved mulberry varieties for planting and hybrid worm eggs from a North-eastern silk station.

The agricultural benefits calculated in Chapter Seven were based on production in 1971 and 1972 and assumptions were made as to likely production trends in order to calculate the benefits throughout the project life. Construction of the Thai-New Zealand feeder road was completed in late 1971 but the road section between Borabue and Wapipathum opened in 1967, five years prior to the collection of information for this study. Clearly, the absence of

⁴ For a general discussion of many of these problems in Thailand, refer to a paper by Schwass and Crump (1972).

a road was not the only factor limiting agricultural production and the other problems outlined in Section 8.3, particularly a lack of irrigation and cheaper credit facilities, continue to prevent the realisation of the potential in the region.

The benefits from the adoption of modern agricultural practices can be calculated but it must be emphasised that these benefits would be the result of several inputs to the region and not the Thai-New Zealand feeder road alone. The following assumptions have been made in the calculation of these benefits:

- (1) The estimated number of agricultural households within a five kilometre band either side of the feeder road is 17,800. This figure has been calculated by dividing the average area of paddy land owned by a household in the pilot agriculture survey, into the total area of paddy land calculated from the land classification survey.
- (2) In addition to the benefits calculated in Chapter Seven, a number of agricultural development benefits are considered in this analysis. The additional benefits will accrue from
 - (a) Improved technological practices applied to the rice crop.
 - (b) The cultivation and sale of produce from an area of vegetables.
 - (c) The sale of fish from a paddy culture system.
 - (d) The production of silk under conditions of improved mulberry cultivation and the use of selected native Thai worms.
 - (e) Increased cattle production based on improvement in the range grazing system as outlined by Crump (1972).
- (3) It is assumed that improved technological practices applied to the rice crop will increase the gross margin from rice by 25 baht per rai. At an application rate of 20 kilograms of fertilizer per rai, the average yield per rai must rise by 100 kilograms to pay for the fertilizer and increase the gross margin by 25 baht. The average yield in the pilot

agricultural survey was 150 kilograms per rai; the increase necessary would raise the average to 250 kilograms per rai which is still less than the national average yield. This level of fertilizer usage is the same as that of the village leader of Bon Don Tieu described in Section 5.2.8. It is not expected that the whole area would increase in productivity. The benefits when 25 per cent of the paddy land is cultivated under increased fertilizer usage are shown in Table 8.4.

Table 8.4: Value of Additional Returns From Improved Rice Cultivation (\$U.S.)

Year	1973-85
Annual area in production (km ²)	250
Additional annual returns (\$U.S.)	187,800
Net present value (1966) at a 12% discount rate	545,688

- (4) In calculating the returns from vegetable production it has been assumed that a household could cultivate an area of two rai in a dry-season crop. The analysis assumes crops are tended by family labour because the gross margin data in Appendix Three Table A3.5 does not include labour as a variable cost. Rather than calculate possible returns for several combinations of crops, the analysis is based upon an average gross margin of 400 baht per rai. A review of Table 8.1 shows that this gross margin level can be obtained from several crops. The benefits when 50 per cent of the households each grow two rai of vegetables for sale are shown in Table 8.5.

Table 8.5: Value of Additional Returns From Vegetable
Production (\$U.S.)

Year	1973-85
Annual area in production (km ²)	28.5
Additional annual returns (\$U.S.)	342,308
Net present value (1966) at a 12% discount rate	994,640

- (5) Estimates of possible returns from fish culture are difficult. It is unlikely that every household would engage in production and of those that did, not all would have produce to sell. Some would consume all the fish within their own families. As an estimate of returns, the analysis assumes that 25 per cent of the households would practise paddy fish culture and half of the produce can be sold. This has the effect of reducing the annual return from fish production to 1200 baht per rai. The additional benefits are shown in Table 8.6.

Table 8.6: Value of Additional Returns From Paddy
Fish Culture (\$U.S.)

Year	1973-85
Number of households engaged in fish culture	4,450
Additional annual returns (\$U.S.)	256,730
Net present value (1966) at a 12% discount rate	745,980

- (6) Similarly, not every household would engage in sericulture. Some households engaged in vegetable production would require women members to assist in this enterprise and there would be little opportunity for silk weaving although the sale of mulberry leaf would be possible. Table 8.7 shows the additional benefits from silk sold by 25 per cent of the households at an average return of 500 baht per household.

Table 8.7: Value of Additional Returns From Sericulture
(\$U.S.)

Year	1973-85
Number of households engaged in sericulture	4,450
Additional annual returns (\$U.S.)	106,970
Net present value (1966) at 12% discount rate	310,825

(7) In calculating the potential additional production from beef cattle in the region it has been assumed that the estimated total area of uncultivated upland within a five kilometre band either side of the road, could be oversown with legumes to increase cattle feed availability.⁵

(a) Area of land available for oversowing = 110 square kilometres
= 68,750 rai.

(b) If each rai planted produces 200 kilograms of extra dry-matter per year the total extra dry-matter produced = 13,750,000 kilograms.

(c) The actual dry-matter requirement for each additional beef cattle unit is 2000 kilograms, but allowing for 50 per cent loss before utilisation, the requirement becomes 3000 kilograms. Hence the number of additional beef cattle units that could be carried is

$$\frac{13,750,000}{3000} = 4,583 \text{ beef cattle units.}^6$$

(d) The annual income from a B.C.U. is calculated at 313 baht based on a meat price of 5 baht per kilogram live weight

$$\begin{aligned} \therefore \text{Total annual extra income} &= 4,583 \times 313 \\ &= 1,434,479 \text{ baht.} \end{aligned}$$

5 The calculation follows the methodology outlined by Crump (1972).

6 A beef cattle unit (B.C.U.) has been defined as a male or female cattle beast more than three years of age.

(e) Annual extra costs associated with an oversowing development programme are the cost of animal health and the interest charge on the total capital requirements.

(i) Animal health:

4,583 B.C.U. at 8 baht per B.C.U. = 36,664 baht.

(ii) Capital cost of development:

Seed: $\frac{1}{2}$ kg per rai at 5 baht per kilogram = 171,875 baht
 Labour to spread seed, 1 baht per rai = 68,750 baht
 Capital stock: 4,583 at 1000 baht per B.C.U. = 4,583,000 baht
 Total capital cost = 4,823,625 baht
 .*. Interest on capital at 12 per cent = 578,835 baht

(f) Budget summary:

Additional annual income = 1,434,479 baht
 Additional annual costs = 615,499 baht
 Surplus = 818,980 baht
 = \$U.S. 39,374.

Table 8.8: Value of Additional Returns From Cattle Production (\$U.S.)

Year	1973-85
Total area oversown (km ²)	110
Additional annual return (\$U.S.)	39,374
Net present value (1966) at a 12 per cent discount rate	114,409

When the benefits presented in Table 7.5 are combined with the potential benefits calculated in this section the contribution of the Thai-New Zealand feeder road in a developing commercial economy can be evaluated.⁷ Table 8.9 shows the total discounted costs and benefits that would prevail under such conditions.

7 It is not appropriate to calculate vehicle operating cost savings for the additional vehicles using the road carrying this agricultural produce. This traffic is generated traffic, Class B. (Refer to Section 7.4.1.)

Table 8.9: Present Values of Total Cost and Estimated Potential Benefits Discounted at a Rate of 12 Per Cent (\$U.S.)

Item	Present value at a 12 per cent discount rate (\$U.S.)
Total cost	6,187,540
Vehicle operating cost savings	4,034,900
Value of increased kenaf production at a gross margin of 175 baht per rai	1,172,061
Salvage value of equipment	147,684
Additional returns from rice	545,688
Additional returns from vegetables	994,640
Additional returns from fish	745,980
Additional returns from sericulture	310,825
Additional returns from beef	114,409
Residual value of the project ($\frac{1}{4}$ net benefit in 1985 assumed to occur in perpetuity)	533,820
Total benefits	8,600,007

While the additional benefits that have been calculated in this section are possible they are by no means probable. The most likely circumstances are those evaluated in Section 7.5. The potential benefits calculated have been assumed to commence in 1973 but irrigation schemes take many years to construct, and a legume oversowing programme could not be implemented immediately. Credit facilities could be offered to villagers if the finance was available but the adoption rate of improved practices would not be rapid.

At a 12 per cent discount rate, the present value of total benefits in 1966 exceeds the discounted total cost of the road project by \$U.S. 2,412,467. The net present value in 1966 calculated in Section 7.5 at the same discount rate was \$U.S. -479,840. The additional returns from each of the enterprises described in this chapter are large, particularly those calculated for vegetable, rice and

fish cultivation. The project residual value is also high under these circumstances and at the designated end of the project life an upgrading programme would almost certainly eventuate.

The additional returns calculated assumed a 25 per cent adoption rate in improved rice cultivation, fish culture and sericulture practices; a 50 per cent adoption rate of vegetable cultivation; and oversowing of the total area of uncultivated upland in a five-kilometre band either side of the road. A 25 per cent adoption rate in the three enterprises described is moderate and if an irrigation scheme was constructed in the area the quantity of vegetables produced would probably exceed that assumed here. An oversowing programme would either be introduced to the whole area or not at all.

It is worthwhile calculating the potential returns from a very low adoption rate of each of the recommended practices. A six per cent adoption in each enterprise aside from an oversowing programme is feasible without the provision of an irrigation scheme or credit facilities. There were farmers interviewed in the agricultural survey with incomes from agriculture substantially higher than those of the average household. At a six per cent adoption rate, the present value in 1966 of total additional benefits is almost \$U.S.504,000, an amount sufficient to give the project a positive net present value in 1966 at a 12 per cent discount rate. In this situation the project would be considered profitable on the basis of the tangible benefits alone.

Thus the value of the road as an investment would be considerably improved if the potential production in the area could be realised. But it is not appropriate to assign the full value of the potential benefits calculated in this section to the road project, as the road is not the factor limiting realisation of this potential. However, it is important to note that as each successive year passes without the provision of the other essential developmental inputs, the value of the Thai-New Zealand feeder road as an investment to promote economic development is also reduced.

8.5 Summary

Although agriculture in the region of the Thai-New Zealand feeder road is predominantly subsistent at the present time, this chapter has shown that there is potential for increased productivity within the enterprises that the villagers are practising. Realisation of this agricultural potential is dependent upon the provision of further 'developmental inputs' to the region. A lack of credit facilities and irrigation are the two factors seen as being most essential before large scale development can take place. Water is the input the villagers maintain they need most urgently. If the conditions for development in the enterprises outlined do eventuate the Thai-New Zealand feeder road will have a major role in transporting the agricultural produce to markets and the economic value of the road as an investment will be high.

Chapter Nine

SUMMARY AND CONCLUSIONS

Transportation has been identified as an essential element in a comprehensive regional development programme. Economic, social and political benefits can result from the construction of a road in a developing region. However, although the promotion of economic development may be the prime motive in constructing a road, success is dependent upon both the creation of economic opportunity, and a response to that opportunity on the part of the local population. Opportunity for increased output and produce sales may be provided with the introduction of a road and its associated inputs. A response from the local population will be forthcoming if there are no other factors preventing development and the population has a desire to increase production.

The objective of this study has been to make an economic evaluation of the Thai-New Zealand feeder road in Northeast Thailand. This 144 kilometre paved road was completed in 1971 and links five major towns in two provinces while passing through a region of populated villages. Construction of the road was partly financed by the New Zealand Government as a Colombo Plan aid project. Northeast Thailand is the target of a large scale development programme, in which provision of a transport network is a high priority. Stimulation of agricultural development is necessary to raise regional household incomes, which have in the past been lower than those of other regions in Thailand.

An understanding of the local conditions prior to the introduction of a developmental input such as a road, together with those at the time of the study, are pre-requisites to such an economic evaluation. This knowledge can be used in an 'ex poste' study to measure the developmental impact of the input. Hence a

large part of this study is devoted to a description of the agricultural enterprises practised in the region, the problems preventing economic development, and the potential for further development following construction of the Thai-New Zealand feeder road. This data has been used to assess the impact of the road at the present time and the likely impact under various circumstances which might eventuate in the future.

Because of a lack of statistical records in the region deemed to be affected by the Thai-New Zealand feeder road, the author has relied on data collected from original research. Agricultural information was collected in a survey of households in villages alongside the road. The 'free form' format of the questionnaires used, allowed the author to learn about the agricultural, social and cultural activities from the local population. The informal interviews led to villager acceptance of the author, and in the relaxed atmosphere it is thought that more reliable information has been obtained than might be the case with a formal questionnaire applied to a statistically selected sample. Repeat visits were made throughout the year to a number of case study farmers to obtain more detailed information about the village agricultural enterprises.

There were no aerial photographs available for the author to measure present land utilisation in villages along the road and compare this with the utilisation prior to road construction. A cadastral map prepared by the Thai Highways Department recorded utilisation in 1965 within a one-kilometre band along the proposed road alignment. A land classification survey was conducted by the author to describe the utilisation in 1972 within a one-kilometre band alongside the road and the information obtained was compared with that shown on the cadastral map. In this way the agricultural development has been estimated but it is recognised that this method is subject to error. This error is magnified when the data is extrapolated to a five-kilometre band either side of the road, the area deemed to be directly affected by the road.

Traffic usage of the road was measured in two surveys undertaken by the author. The first was a 24 hour survey at one

site, designed to ascertain the number and types of vehicle travelling along the road and the hours of greatest usage. The second was a four-day survey at four sites with the objective of measuring usage on the various sections of the road. The results of these surveys, together with data collected in a survey by the New Zealand Army engineers in 1971, have been used as a basis for calculating the 'operating cost savings' of vehicles using the road. Again there are limitations in this data. Ideally more traffic surveys should have been undertaken on each day of the week and in the various seasons of the year, but budgetary constraints did not allow additional surveys to be made.

The results of the pilot agricultural survey were presented in Chapter Five. These showed that the rice crop is the most important factor affecting the welfare of a household. Kenaf was grown on the low fertility upland soils as part of a shifting cultivation. Buffalo were used to plough the fields while both cattle and buffalo hauled carts for transport. Pigs, chickens and ducks were also kept by many households. The quantities of produce for sale were small and the household incomes were low. Some households were able to supplement their incomes from agriculture by acting as local merchants while members of other households obtained employment in the dry season months when there was little work within the village.

Purchased inputs were not common. Most households had begun applying fertilizer to the rice crop but the high cost prevented heavier usage, the common practice being to sprinkle the fertilizer where the crops were not growing well. A few farmers had applied insecticide, obtained free from the agricultural officer, to vegetable crops. A lack of water was considered by most farmers to be the greatest barrier to increasing production.

Examination of the agricultural enterprise data suggested that the households are practising a predominantly subsistence agriculture although there are signs of increasing commercialisation. Hence the economic evaluation of the Thai-New Zealand feeder road has been made under conditions which are more closely subsistent than commercial. In evaluating the economic impact it has been

necessary to make certain key assumptions.

Methodology for a standard benefit-cost analysis has been used to evaluate the road. This method requires the analyst to discount the flow of quantifiable costs and benefits throughout the project life. Economic measurements are applied to the discounted flows and the profitability of the project can then be evaluated in conjunction with those cost and benefit items that can not be quantified. A project life of 15 years from the year of completion of the road has been assumed and at the end of this time the project may have a residual value. The opportunity cost of capital in the Thai economy is estimated to be 12 per cent but this analysis has used three interest rates 10, 12, and 15 percent in the discounting of the various project cost and benefit flows.

As this is partly an 'ex poste' study there is the advantage that the project costs, with the exception of repairs and maintenance expenditure, are known fairly precisely. The flow of costs throughout the project life is based on data obtained from the Royal Thai Government and the New Zealand Government. Some of this data was published in a booklet to mark the official opening of the road.¹ Estimates of maintenance expenditure throughout the project life are based on the expenditure in 1972 and 1973. At a discount rate of 12 per cent, the present value of the total cost of the road in 1966 has been calculated at \$U.S.6,187,540.

The greatest quantitative benefits from the road are in the form of reduced vehicle operating costs to transport operators. The cost of operating a vehicle on a paved road surface is substantially lower than the operating cost on an earth surface. The cost savings have generated traffic to carry the passengers and produce that formerly made the journey by buffalo cart or heavy truck transport. The villagers can travel in greater comfort, journey time has been considerably reduced, and there has been a dramatic increase in transport availability at all times of the year, whereas previously travel in the wet season was impossible in

1 "Dedication Ceremony, Borabue-Buriram Highway, December 15th 1971", distributed by Thai Highways Department.

many places. The savings to transport operators are reflected in the reduced transport charges for both passengers and freight. The survey data indicated reductions of at least 50 per cent had occurred following construction of the road. At a discount rate of 12 per cent the present value of benefits in 1966 from vehicle operating cost savings have been calculated to total \$U.S.4,034,900.

A problem in making any 'ex poste' study is to decide the events that would have taken place in the absence of the project. In this study the problem was to decide the proportion of land that would have been cultivated. The land classification survey estimated that an additional 200 square kilometres of upland alongside the Thai-New Zealand feeder road had been cultivated. The major upland crop grown is kenaf, the only crop for which the soils of the Northeast appear to have an advantage over the remainder of Thailand. Based on results from other studies it has been assumed that 50 per cent of the upland cultivated since 1965 is a direct result of the presence of the road. At a discount rate of 12 per cent the present value of benefits in 1966 from increased kenaf cultivation have been calculated to total \$U.S.1,172,061. Although the area of land cultivated for rice had increased, this is more likely the result of increased population pressure on uncultivated land rather than a developmental effect of the road.

At the end of project construction, some of the machinery and equipment purchased for use on the project had not been used, while many of the other items had further economic life and could be used on other road construction projects in Thailand. At a discount rate of 12 per cent the present value of benefits in 1966 from the salvage of machinery and equipment has been calculated to total \$U.S.147,684.

Villagers can now market their produce in smaller quantities as finance is required, and they are also in a stronger bargaining position with the merchants. Previously the merchants could offer low prices for produce such as kenaf when they knew the villager could not afford to transport the goods back to the village. Nowadays, more merchants travel to the villages seeking produce and the additional competition discourages them from cheating the

farmers. Fresh vegetables and other perishable produce can also be sold more easily.

There has been rapid growth in commercial activity in the major towns along the road, particularly in businesses associated with motor vehicles. These commercial enterprises provide employment for some villagers who previously only worked in the wet season on family farms. In addition, off-farm dry season employment is increasing with villagers travelling to work in other provinces, particularly Bangkok, and returning in the wet season to help with rice cultivation.

Associated with the construction of the road has been the establishment of at least three health centres alongside the road with facilities for treating minor illnesses, giving vaccinations and providing ante-natal care. Additional schools have also been constructed and more village children are travelling to the secondary schools located in the larger towns. Improved road communication should result in more staff working in country areas as they can now live in the larger towns and travel to work each day.

Construction of the road has political benefits in that the project has provided tangible evidence of concern for the welfare of the local population on the part of the government. This reduces the appeal of insurgent elements to the villagers. The road also creates the opportunity for increased contact between government officials and villagers. As the road is part of a sealed network in Northeast Thailand it has strategic value but to date it has not been used for military purposes.

New Zealand technical personnel provided training to Thai personnel in both the maintenance and operation of roadbuilding equipment in addition to instruction in techniques of road construction. Not all of those trained continued to work for the Thai Highways Department. However, there is a severe shortage of good machine operators and mechanics throughout Thailand and the knowledge gained can be put to good use in the many road, irrigation and other construction projects planned for the future.

The Thai-New Zealand feeder road forms an integral part of a roading scheme for Northeast Thailand. At the end of the assumed project life in 1985, the present route will probably still be used as a major road. Although annual maintenance expenditure of \$U.S.96,202 has been allowed throughout the project life, an upgrading of the road would probably be necessary to further increase the economic life of the road. The road can be expected to have a residual value in 1985. This has been calculated by assuming 25 per cent of the net total benefits in 1985 occur in perpetuity. The actual residual value will be determined by usage and maintenance in the period prior to 1985 and the estimated future usage after that date. At a 12 per cent discount rate the present value of this residual, in 1966, is estimated to be \$U.S.353,055.

Three economic criteria used to measure project profitability have been applied to the discounted flows of costs and benefits to yield the following results:

Discount rate (%)	10	12	15
Net present value in 1966 (\$U.S.)	368,910	-479,840	-1,317,350
Benefit - cost ratio	1.06	0.92	0.77
Internal rate of return	10.79%		

A sensitivity analysis was applied to the data used in the evaluation. This showed that the factors most affecting the outcome of the evaluation are the accuracy of the traffic counts in representing current traffic usage in the years of the survey, and the annual growthrate in traffic using the road.

The best outcome analysed assumed that the traffic surveys accurately reflected current usage; the growthrate in light vehicles will be 2½ per cent per year and in heavy vehicles 12 per cent per year; the gross margin received for kenaf will be 225 baht per rai; and the residual value of the road in 1985 has been calculated by assuming 50 per cent of the net total benefits in that year, will occur in perpetuity. Under these conditions the project had a net present value in 1966 of \$U.S.1,734,127 at a 12 per cent discount rate, and an internal rate of return of

15.22 per cent. This situation is a distinct possibility, particularly if other developmental inputs are provided.

The worst outcome analysed assumed that both traffic surveys overestimated current usage by 20 per cent; the growth rate in light vehicles will be $2\frac{1}{2}$ per cent and in heavy vehicles 0; the gross margin received for kenaf will be 125 baht per rai; and there will be no residual value at the end of the project life in 1985. Under these conditions the project had a net present value in 1966 of -\$U.S.2,457,047 at a 12 per cent discount rate, and an internal rate of return of 3.81 per cent. In the event of this unlikely situation the project could be regarded as failing to promote economic development and the road might have been better sited in a different location.

Information from the pilot agricultural survey and the case study farmers, together with the reports of various technical missions visiting Northeast Thailand, suggests that there is potential for increased agricultural production within the enterprises at present practised by villagers alongside the Thai-New Zealand feeder road. Fertilizer could be profitably used if applied to the whole of the rice crop. An irrigation system would allow cropping of either vegetables or rice in the dry season. A legume oversowing programme of uncultivated upland could result in the raising of larger numbers of beef cattle and buffalo. A scientific approach to fish culture through feeding fish in paddy fields or ponds with high protein feeds would result in fish being available for sale. Improved mulberry varieties and hybrid silk worms would improve the efficiency of silk production.

The problems preventing increased production and adoption of improved technology within the agricultural systems embrace several inter-related factors necessary in the development process including education, provision of credit, irrigation, research and extension. Cheaper credit sources would allow the purchase of more fertilizer for the rice crop and bran for fish culture in the paddy fields. At present there is little opportunity for the villagers to increase production in other enterprises without assistance from the government in the form of construction of an irrigation scheme,

livestock improvement programmes and silk worm multiplication centres.

The additional returns from a 25 per cent adoption rate in improved rice cultivation, fish culture and sericulture practices, a 50 per cent adoption of vegetable cultivation and oversowing of the total area of uncultivated upland in a five kilometre band either side of the road have been calculated. At a 12 per cent discount rate the present value in 1966 of the total estimated additional returns are \$U.S.2,711,542, assuming these returns could be obtained from 1973 until the end of the project life in 1985. If only a six per cent adoption rate in the enterprises eventuates, the present value in 1966 of the discounted total additional returns would be \$U.S.504,000. This latter amount is sufficient to give the project a positive net present value in 1966 at a 12 per cent discount rate. Should the higher rates of adoption prevail, the net present value in 1966 would be approximately \$U.S.2,500,000.

When the economic criteria are viewed in conjunction with the benefits to which no monetary value can be assigned, the project should be considered a profitable investment. Construction of the Thai-New Zealand feeder road should be regarded as the provision of one input essential for economic development in the region. Other inputs will be necessary before the full benefit of the road can be obtained. The road has already had a significant economic impact and if the potential within the existing agricultural enterprises can be realised, the road will have an even greater role in the economic development of the region.

APPENDIX ONE

Glossary of Terms, and Units of Measurement

Used in the Study

Terms

- Ampher : A political subdivision of a province. The English equivalent is district.
- Ban : The English equivalent is village.
- Changwat : A political subdivision of the Kingdom of Thailand. The English equivalent is Province.
- Isan : Northeastern, referring to the region or the dialect.
- Kamnan : Elected leader of a group of villages.
- Nai Ampher : Official government administrator of a district.
- Paddy : This word is used in two different senses:
 (1) To denote the area where rice is grown.
 (2) In the rice trade it is defined as rice in the husk after threshing, and without any portion of the stalk.
- Puyaiban : Elected leader of a village.

Units of Measurement

- Baht : Unit of Thai currency.
 One dollar (U.S.) = 20.80 baht.
 i.e. One baht is approximately 5 cents (U.S.) and 4 cents (N.Z.).
- Rai : Unit of land area
 1 rai = 1600 square metres = 0.16 hectare = 0.395 acres.
 6.25 rai = 1 hectare.
- Tang : Unit of volume or weight.
 1 tang = 20 litres = 10 kilograms of paddy rice.

APPENDIX TWO

A Description of the Villages Studied

The location of the villages studied was shown on Figure 4.1. The following descriptions of each village are the cumulative result of interviews conducted with village leaders and other respected village members, school teachers, local health officers and ampher agricultural officers. These interviews were carried out on an informal basis with the aid of a guideline questionnaire provided in Appendix Six.

1. Ban Kor Tambon Non Jik Ampher Borabue Changwat Mahasarakham.

Population: 91 households, 550 persons.

Population movement: In the past 5 years there has been a small net population migration increase of about 10 families.

Land characteristics: Paddy land 3000 rai; upland 1000 rai; no undeveloped land.

Major produce: Glutinous rice, kenaf, kapok, buffalo, cattle, pigs, poultry, vegetables, fruit (coconuts, bananas, papaya), silk.

Product sales: Rice, kenaf, kapok, pigs cattle.

Major markets: Borabue (2 km), Mahasarakham (28 km), Ban Phai (42 km).

Village amenities: Temple 1; rice mills 2; general stores 0, food stores 2; children attend primary school at Ban Non Jik (3 km) and secondary school at Borabue (2 km).

Extent of water supply: Drinking water from tanks and community ponds. Village has a non-functional water pump. Private ponds 10. Adequate water supply for household use.

Medical facilities: Public health centre Borabue (2 km), hospital Mahasarakham (28 km).

Co-operative membership: Began about 15 years ago. Most farmers are members but only joined within the last 2 years.

Village extension: Ampher agriculture officer visits village at least once per month. A number of farmers are exhibiting innovator behaviour.

Innovations: (1) Nearly all farmers use fertilizer, first introduced 5 years ago.

(2) Some farmers have sold or rented out land for salt production.

(3) some farmers engage in small scale vegetable production in the dry season because the village is close to Borabue.

(4) A few villagers have obtained free insecticide from the agriculture officer to apply to vegetables.

Village problems: Lack of water for growing vegetable crops in the dry season.

2. Ban Koke Yai Tambon Nong Muang Ampher Borabue Changwat Mahasarakham.

Population: 78 households, 477 persons.

Land characteristics: Paddy land 2500 rai; upland 500 rai; no undeveloped land. Low fertility sandy soil.

Major produce: Glutinous rice, kenaf, kapok, pigs, buffalo, chickens, vegetables, silk.

Product sales: Rice (small quantities), kenaf (small quantities), kapok, pigs.

Major market: Borabue.

Village amenities: Temple 1; rice mills 0; general stores 0; food stores 0; children attend primary school at Ban Non Muang (2 km) and secondary school at Borabue (16 km).

Extent of water supply: Both drinking water and washing water come from a public pond 2 km from the village. Severe shortages in dry season mean water must be carried 4-5 km.

Medical facilities: Public health centre Borabue (16 km), hospital Mahasarakham (42 km).

Co-operative membership: No farmers in this village are members.

Village Extension: Visits by any extension officer are rare, perhaps once every 3 months.

Innovations: (1) Fertilizer usage - no farmers used any 2 years ago, now approx. 1/3 of the farmers apply it.
(2) Farmers travel in groups buying and selling pigs, with small profit margins.

Village problems: (1) Lack of good quality drinking water - the leader would like a bore sunk.
(2) The lateral road from the main road is very sandy.
(3) Shortage of buffalo in the village for ploughing.
(4) There is insufficient land suitable to feed cattle and buffalo.
(5) Some farms are too small - approximately 35 households have a paddy land area of less than 20 rai.
(6) Some farmers have no produce to sell.

3. Ban Dong Yai Tambon Dong Yai Ampher Wapipathum
Changwat Mahasarakham.

Population: 98 households, 683 persons.

Population movement: Approximately 10 families have moved away from the village in past 10 years.

Land characteristics: Paddy land 2500 rai; upland 500 rai; little undeveloped land. Soil type sandy and sandy loam, low fertility.

Major produce: Glutinous rice 80%, non-glutinous rice 20%, kenaf, kapok, fruit (coconut, mangoes, bananas, papaya, jackfruit), vegetables, cattle, buffalo, pigs, chickens, silk.

Product sales: Rice, kenaf, kapok, fruit, pigs, cattle, silk.

Major markets: Rice - Borabue, Ban Phai and Wapipathum; kenaf - Borabue, Ban Phai; vegetables - Wapipathum (6 km).

Extent of water supply: Drinking water from bore with hand operated pump. Public ponds 3; private ponds 10. In dry season there are water shortages.

Medical facilities: Public health centre (2 km), hospital Mahasarakham (57 km).

Co-operative membership: The Rice Farmers Co-operative has approximately 40 members and the Upland Farmers Co-operative 50 members. Both have been in existence approximately 10 years.

Village extension: Agriculture officer visits the village 3 or 4 times each year in the rice season.

Innovations: (1) Fertilizer usage - nearly all farmers use fertilizer, some for the past 5-6 years.
(2) New rice varieties have been used following dispersal by the Rice Co-operative.
(3) Large numbers of villagers travel to other places for summer work.

Village problems: (1) Shortage of water in the dry season.
(2) There is a shortage of machinery or capital to allow purchase/hire of equipment.
(3) Shortage of labour for transplanting, harvesting in good seasons.

4. Ban Na Si Nuan Tambon Na Si Nuan Ampher Phyakaphum Phisai
Changwat Mahasarakham.

Population: 146 households, 1200 persons.

Population movement: Static.

Land characteristics: Nearly all land is paddy land, approximately

5000 rai, aside from upland area near houses. Sandy soil, low natural fertility.

Major produce: Glutinous rice 60%; non-glutinous rice 40%; fruit (coconuts, jackfruit, bananas, papaya), vegetables, pigs, cattle, buffalo, chickens, silk, cotton, fish.

Product sales: Rice, fruit (coconut, jackfruit), pigs, fish.

Major markets: Phyakaphum Phisai.

Village amenities: Temple 1; rice mills 3; general stores 2; primary school, children attend secondary school at Phyakaphum Phisai or Wapipathum.

Extent of water supply: Drinking water obtained from ponds and tanks. Public ponds 3; private ponds - many near paddy land.

Medical facilities: Public health centre in village; hospital at Mahasarakham (88 km).

Co-operative membership: Rice farmers Co-operative in operation for about 6 years and approximately 60 farmers are members.

Village extension: Ampher agriculture officer visits this village at least 1 time per month.

Innovations: (1) Fertilizer has been used about 8 years and now almost all farmers use it.
 (2) Farmers have obtained free insecticide from the agriculture officer.
 (3) Farmers are cultivating fish in ponds but have little surplus to sell.

Village problems: (1) Require more water in the dry season to enable vegetable growing.

5. Ban Don Tieu Tambon Gampu Ampher Phyakaphum Phisai Changwat Mahasarakham.

Population: 164 families, 1105 persons.

Population movement: Static.

Land characteristics: Mostly paddy land (5000 rai) apart from garden and house areas. Community land approximately 100 rai. No undeveloped land. Sandy soil, low fertility.

Major produce: Glutinous rice 50%; non-glutinous rice 50%; fruit (bananas, coconut, custard apple, papaya, guava), kapok, vegetables, pigs, buffalo, fish, silk, mushrooms.

Product sales: Rice, fruit (bananas, coconuts, custard apple), vegetables, mushrooms, pigs.

Major market: Phyakaphum Phisai.

Village amenities: Temple 1; rice mills 2; general stores 0; children attend primary school (2 km) and secondary school at Phyakaphum Phisai (3 km).

Extent of water supply: Drinking water obtained from 3 wells without pumps. Public ponds 3; private ponds 20.

Medical facilities: Public health centre; hospital Mahasarakham (100 km).

Co-operative membership: Rice Co-operative had 34 members and a Silk Producers Co-operative had been formed for 1 year with about 25 farmer members.

Village extension: Ampher Agriculture Officer lives in this village. The village leader is also very progressive.

Innovations: (1) Farmers are growing more non-glutinous rice as a cash crop.
 (2) Nearly all farmers are now using fertilizer, some using large quantities. First introduced about four years ago.
 (3) Several farmers are cultivating mushrooms as a cash crop.
 (4) Fish culture is increasing.
 (5) Silk production may be increased as farmers improve varieties of mulberry.

Village problems: (1) Lack of water for dry season cropping.

6. Ban Nong Kaen Tambon Palarn Ampher Phyakaphum Phisai Changwat Mahasarakham.

Population: 116 households, 840 persons.

Population movement: Static.

Land characteristics: All paddy land 4500 rai. Sandy soil, low fertility.

Major produce: Glutinous rice 50%; non-glutinous rice 50%; fruit (bananas, coconuts, mangoes, jackfruit, papaya, custard apple, guava), vegetables, cattle, buffalo, pigs, chickens, silk.

Product sales: Rice, fruit (bananas, coconuts), pigs, silk.

Major markets: Phyakaphum Phisai, Nakorn Ratchasima.

Village amenities: Temple 1; rice mills 2; general stores 2; primary school, children attend secondary school at Phyakaphum Phisai.

Extent of water supply: Drinking water obtained from village wells without pumps. Public ponds 1; private ponds 3.

Medical facilities: Public health centre Phyakaphum Phisai (2 km), hospital Mahasarakham (104 km).

Co-operative membership: Rice Farmers Co-operative began about 5 years ago and approximately 60 farmers are members.

Village extension: Ampher agriculture officer visits the village 4 or 5 times per year.

Innovations: (1) Nearly all farmers use fertilizer which first appeared in the village 5 years ago.

(2) Farmers are planting improved Mulberry strains for silk production.

(3) Farmers are tending to grow more non-glutinous rather than glutinous rice.

Village problems: (1) The farmers want better drinking water facilities.

(2) Lack of water in dry season prevents vegetable production.

7. Ban Muang Sua Tambon Palarn Ampher Phyakaphum Phisai
Changwat Mahasarakham.

Population: 135 households, 850 persons.

Population movement: Static.

Land characteristics: All paddy land except for house and garden area. Sandy loam soil.

Major produce: Glutinous rice 20%; non-glutinous rice 80%, vegetables, kapok, fruit (mangoes, bananas, coconuts, papaya), pigs, buffalo, silk.

Product sales: Rice, vegetables, fruit, pigs.

Major markets: Phyakaphum Phisai, Buriram.

Village amenities: Temple 1; rice mills 2; general store 1; primary school, children attend secondary school at Phyakaphum Phisai.

Extent of water supply: Drinking water obtained from 2 wells, no pumps. Public ponds 5; private ponds 0.

Medical facilities: Public health centre at Phyakaphum Phisai. Hospitals at Mahasarakham (112 km) and Buriram (60 km).

Co-operative membership: No Co-operative.

Village extension: Ampher agriculture officer comes to the village once a month.

Innovations: (1) The majority of farmers use fertilizer, having applied it for the past 3 years.

- (2) A number of farmers are trying to grow vegetables and fruit for cash sales.
- (3) A few farmers have obtained insecticide from the agriculture officer and applied it to vegetables.
- (4) Fish culture is being investigated but only for home consumption.

Village problems: (1) Shortage of water in the dry season.

8. Ban Ron Thong Ampher Satuk Changwat Buriram.

Population: 198 households, 1370 persons.

Population movement: In the past 5 years approximately 20 families have moved to other districts because of a shortage of land and the availability of undeveloped land elsewhere.

Land characteristics: Paddy land 5000 rai; upland 1000 rai. Undeveloped or community land 200 rai. Sandy soil, low fertility.

Major produce: Non-glutinous rice 90%; glutinous rice 10%, kenaf vegetables, fruit, pigs, cattle, buffalo.

Product sales: Rice, kenaf, pigs.

Major markets: Satuk, Buriram.

Village amenities: Temple 1; rice mills 3; general stores 3; primary school, children attend secondary school at Buriram (26 km).

Extent of water supply: Drinking water from tanks and large public ponds (2).

Medical facilities: Health centre Satuk (19 km), hospital Buriram (23 km).

Co-operative membership: No members.

Innovations: (1) Fertilizer usage by about 90% of farmers since first introduced 4 years ago.
(2) New rice varieties from the Agriculture Officer at Satuk have been introduced.

Village problems: (1) Lack of good water supply - a pond built by the Government contains water unsuitable for drinking as too dirty.

(2) Farmers must pay high interest rates to obtain credit.

9. Ban Non Sawan Tambon Ban Dan Ampher Muang Changwat Buriram.

Population: 67 households, 532 persons.

Population movement: Static.

Land characteristics: Paddy land approximately 2500 rai; upland approximately 1000 rai. Undeveloped land 500 rai. Sandy loam soil, land fairly fertile.

Major produce: Non-glutinous rice 70%; glutinous rice 30%; kenaf, kapok, pigs, buffalo, fruit, vegetables, silk.

Product sales: Rice, kenaf, kapok, fruit, vegetables.

Major market: Buriram.

Village amenities: Temple 1; rice mill 1; general stores 3; local merchants 4; primary school, children attend secondary school in Buriram (16 km).

Extent of water supply: Drinking water obtained from a well with no pump. Public ponds 1; private ponds 3.

Medical facilities: Hospital, Buriram (16 km).

Co-operative membership: Majority of farmers are members of the Rice Farmers Co-operative.

Village extension: The Agriculture Officer from Buriram visits the village twice a month in the rice growing season.

Innovations: (1) Only about 20% farmers apply fertilizer as believe the land is sufficiently fertile.
(2) Insecticides are used on vegetable plots.
(3) Vegetables produced for cash sale.

Village problems: (1) Shortage of water in the summer prevents the growing of more vegetables.

APPENDIX THREE

Agricultural Information

Table A3.1: Land Utilisation in a One Kilometre Band on Each Side of the Thai-New Zealand Feeder Road in the Years 1965 and 1972 (square kilometres)

Road Section		Borabue to Wapipathum	Wapipathum to Phyakaphum Phisai	Phyakaphum Phisai to Satuk	Satuk to Buriram
Lowland for rice	1972	47.25	66.50	45.50	40.75
	1965	40.2	64.20	42.00	42.60
	Difference (1972-1965)	7.05	2.30	3.50	-1.85
Upland - cultivated	1972	17.75	10.00	10.50	27.75
	1965	11.8	4.40	0	10.00
	Difference (1972-1965)	5.95	5.60	10.50	17.75
Upland - not cultivated	1972	7.00	3.50	0	11.50
	1965	20.00	11.40	14.00	27.40
	Difference (1972-1965)	-13.00	-7.90	-14.00	-15.90

- Source:
1. 1965 data obtained from a cadastral map "The Thai-New Zealand Feeder Road" held by the Thai Highways Department.
 2. 1972 data obtained from a land classification survey conducted by the author.

Table A3.2:

Area Planted and Production Yields of Selected Crops Grown in
Changwat Buriram in the Years 1969-1971

Year	1969		1970		1971	
<u>Crop</u>	<u>Area planted</u> (rai)	<u>Total production</u> (tonnes)	<u>Area planted</u> (rai)	<u>Total production</u> (tonnes)	<u>Area planted</u> (rai)	<u>Total production</u> (tonnes)
Rice	1,749,487	529,599	2,100,219	721,695	1,751,055	499,050
Kenaf	100,000	20,000	117,720	30,842	226,757	46,485
Corn	12,000	3,600	10,740	3,222	35,238	3,171
Sesame	10,000	3,000	11,237	1,688	*	*
Tobacco	10,000	1,000	2,335	23	*	*
Pepper	6,000	600	6,123	606	*	*
Alfaifa	100	10	396	79	*	*
Vegetables (mixed)	10,000	*	16,598	*	*	*

* No data available.

Source: Agricultural Statistics for Changwat Buriram, Unpublished (in Thai language).

Table A3.3: Comparative Profitability of Three Strategies for Beef Cattle Raising in Northeast Thailand

Measure	Units	Strategy		
		1	2	3
Capital costs*	Baht**/B.C.U.***	6,000	2,810	1,050
" "	Baht/rai****	1,841	610	70
Return on capital:				
(a) Fancy prices*****	Baht/100 baht of capital/annum	-3.2	8.2	46.5
(b) Meat prices		-6.3	1.7	29.0
Annual operating expenditure	Baht/B.C.U.	1,108	462	82
Cost of beef production	Baht/kg. liveweight	17.7	7.4	1.3

* Capital cost includes purchase cost of stock.

** Baht 23.50 = N.Z.\$1.00.

*** B.C.U. = beef cattle unit.

**** 6.25 rai = 1 hectare; 2.5 rai = 1 acre.

***** Prices ruling for animals sold for draft or breeding purposes.

Strategy 1: The development of intensive pasture grazing farms for beef production. This necessitates clearing of bush by bulldozing, cutting, burning, cultivation and the planting of selected grass legume mixtures. A full set of buildings and structures including fencing, housing for manager and workers, yards, sheds, and night housing for cattle must be provided. A full set of machinery for cultivation and fodder conservation is also required.

Strategy 2: The development of beef farms by oversowing legumes into standing bush. This strategy is similar to the first but there is no pasture conservation or cultivation and planting of special grasses. Legume seed is broadcast by hand into existing range grazing land, the area is fenced into blocks and the animals rotationally grazed. This strategy has not been physically tested under commercial conditions.

Strategy 3: The improvement of range grazing lands used by village cattle. No attempt is made to change the present structure and management of village cattle raising. Legumes are introduced into the village upland grazing areas. This strategy has not been physically tested under commercial conditions.

Source: Summarised from Crump, D.K., (1972) "The Economics of Pasture and Forage Crop Production in Southeast Asian Countries". New Zealand Colombo Plan Agricultural Notes No. 8, 1972.

Table A3.4: Producer Prices for Agricultural Products
in Nong Wai

Product	Present prices (baht)	Projected prices (baht)	Unit
Paddy			
glutinous	0.65	0.65	p. kg
non-glutinous	1.00	1.00	p. kg
Kenaf	1.90	1.90	p. kg
Maize	0.90	0.90	p. kg
Soybean	2.00	2.00	p. kg
Mung bean	2.70	2.25	p. kg
Sorghum	0.90	0.90	p. kg
Sesame	4.00	4.00	p. kg
Peanuts	2.00	2.00	p. kg
Cashewnuts	60.00	25.00	p. kg
Silk			
grade A	240.00	240.00	p. kg
Cotton	4.00	4.00	p. kg
Mulberry (leaf)	0.50	0.25	p. kg
Vegetable	2.00	1.25	p. kg
Sweet potato	1.90	0.75	p. kg
Onion	2.80	1.00	p. kg
Tomato	6.00	1.25	p. kg
Sweet corn	20.00	12.00	p. 100
Mango	10.00	4.00	p. kg
Papaya	4.00	1.00	p. kg
Buffalo			
draught animals	1,000.00	1,000.00	p. head
culled animals	1,600.00	1,600.00	p. head
Cattle			
draught animals	1,500.00	1,500.00	p. head
culled animals	1,200.00	1,200.00	p. head
Pigs			
weaners	200.00	200.00	p. head
culled sows	800.00	800.00	p. head
Poultry			
culled hens	12.00	12.00	p. head
chickens	12.00	12.00	p. head
culled ducks	12.00	12.00	p. head
chicken eggs	0.20	0.20	p. egg
duck eggs	0.40	0.40	p. egg
Fish	5.00	5.00	p. kg

Source: Table V111-2
Asian Development Bank "Nong Wai Pioneer Project for
Irrigated Agriculture Vol. 11 Statement of Works,
June 1971.

Table A 3-5 Costs and returns per rai for selected crops, 4 years and 10 years following the introduction of irrigation.

Item (/rai)	Rice N.G.	Rice G.	Maize	Sorghum	Sweet Corn	Peanuts	Soybean	Mungbean	Cotton	Kenaf
Yield (kg) in Year 4	340	340	300	250	5,000 (ears)	200	160	140	220	260
Year 10	550	550	600	500	7,000	400	300	250	400	400
Gross Production Value (Baht) Year 4	340	225	270	225	600	400	320	315	880	490
Year 10	550	360	540	450	940	800	600	565	1,600	760
Variable Costs (Baht) Year 4, Year 10										
Seed	5, 5		2, 2	5, 5	30, 30	30, 30	20, 20	5, 5	5, 5	2, 2
Fertilizer	60,85		100,140	90,130	200,290	80,120	70,100	70,100	85,125	110,160
Agrochemicals	20,60	Same	- , 60	5, 15	50, 70	80,120	30, 50	20, 40	400,500	50, 70
Incidentals	10,30		8, 28	10, 20	20, 40	20, 40	10, 20	10, 30	50,100	18, 38
Transport										40, 40
Total Variable Costs (Baht) Year 4	95	95	110	110	300	210	130	105	540	220
Year 10	180	180	230	170	430	310	190	175	830	310
Net Production Value (Baht) Year 4	245	130	160	115	300	190	190	210	340	270
Year 10	370	180	310	280	410	490	410	390	770	450

Item (/rai)	Sweet Potato	Mixed Veg. Cult.	Banana	Mango	Papaya	Cashew (Kernels)	Mulberry leaf	Sesame	Tomato	Onions
Yield (kg) in Year 4	1,400	3,000	6,000	125	1,400	20	4,000	90	1,400	1,900
Year 10	3,000	4,000	6,750	300	2,000	40	6,000	150	2,500	3,000
Gross Production Value (Baht) Year 4	1,050	3,750	2,000	600	1,400	500	1,000	360	1,750	1,800
Year 10	2,250	5,000	2,250	1,200	2,000	1,000	1,500	600	3,125	3,500
Variable Costs (Baht) Year 4, Year 10			(1)		(2)					
Seed	50, 50	50,150	100,100	10, 10	10, 10	2, 2	20, 20	5, 5	30, 30	30, 30
Fertilizer	200,290	300,430	300,430	10, 10	320,460	8, 8	110,160	75,125	180,265	140,230
Agrochemicals	20, 30	250,360	-	60, 90	-	100,140	60, 80	60, 80	150,300	60,150
Incidentals	50,100	200,200	100,150	50,150	50,100	50,100	40, 80	10, 20	50,100	50,150
Total Variable Costs (Baht) Year 4	320	700	500	180	380	160	170	150	410	580
Year 10	470	1,140	680	420	570	250	260	230	695	860
Net Production Value (Baht) Year 4	730	3,050	1,500	420	1,020	340	830	210	1,340	1,220
Year 10	1,780	3,860	1,570	790	1,430	750	1,240	370	2,430	2,640

NOTES. (1) Cost spread over 5 years.
(2) Replant trees every 3½ years.

Source; Compiled from Nong Wai Pioneer Project for Irrigated Agriculture, Vol II, Statement of Works. Asian Development Bank, June 1971.

Table A3.6:

Income and Costs per Rai for Selected Crops Grown at Khon Kaen
University, Khon Kaen, Northeast Thailand 1970-71

Item	Baby corn ⁽²⁾	Peanuts ⁽³⁾	Tomatoes ⁽⁴⁾	Egg plant ⁽⁵⁾
Yield (kg) ⁽¹⁾	80	845	7,983	12,232
Variable costs (baht)				
Contract ploughing	60	50	60	60
Seed	13	-	119	70
Irrigation at 10 baht per hour	150	400	302	318
Soil treatment	13	123	-	-
Fertilizer and lime	541	506	819	950
Weedicide	66	66	-	-
Insecticide	53	152	770	458
Trellis work	-	-	172	-
Total variable costs	896	1,297	2,292	1,856
Price per kg - high	21	2.30	6	2
- low	15	1.50	1	1
Gross revenue (baht) - high price	1,680	1,944	47,898	24,464
- low price	1,200	1,268	7,983	12,232
Gross margin (baht) - high price	784	647	45,606	22,608
- low price	304	-29	5,691	10,376
Man-days per crop	6.75	no data	137	53
Gross margin per man-day (baht) - high price	116	no data	252	392
- low price	45	no data	42	196

- Notes: (1) Yield data presented are the best yields obtained for the varieties grown.
(2) Baby corn planted at a spacing of 60 cm x 10 cm and has a growing season of 55 days. Hence 4 crops in one year are feasible with irrigation.
(3) Peanut variety 211/24-7 sown 30.12.70, seed supplied free of charge.
(4) Tomato variety Hawaii 476.
(5) Egg plant variety Local Long.

Source: Adapted from New Zealand Ministry of Foreign Affairs: New Zealand Colombo Plan Agricultural Notes No. 5, pages 30-34; No. 6, pages 31-34.

Table A3.7: Income and Costs for Three Methods of Fish Culture - Recommendations From ADB - ARD COMPAC Technical Mission 1971 (baht)

Item	Fish pond culture		Paddy field culture		Lowland culture	
	Description	Cost (baht)	Description	Cost (baht)	Description	Cost (baht)
<u>Capital costs:</u>						
Construction	Hand digging 1 rai pond	9,000	Hand constr. of dykes and catching pond	400	Hand constr. of dyke	230
Manure	400 kg	800				
Total		9,800		400		230
<u>Income:</u>						
Fish sales	1000 kg/rai/yr at ¥15/kg	15,000	300 kg/rai/yr at ¥15/kg	4,500	50 kg/rai/yr at ¥15/kg	750
Total		15,000		4,500		750
<u>Variable costs:</u>						
Fingerlings	7000 carp at ¥0.10	700	600 carp at ¥0.10	60	380 carp at ¥0.10	38
Feed	1500 kg mixed feed at ¥2/kg	3,000	900 kg mixed feed at ¥2/kg	1,800	Rice bran	230
Fertilizer	100 kg super	200		-		-
Lime	20 kg	20		-		-
Nets and sundry		50		50		50
Total		3,970		1,910		318
Net income per rai		11,030		2,590		432
<u>Less:</u>						
Interest on added capital	9800 at 12%	1,180	400 at 12%	48	230 at 12%	27
Less rice income foregone		300				
Labour reward		9,550		2,542		405

Source: Adapted from Tables 4, 5, 6 COMPAC Programme Fresh Water Fish Culture, Project Prospectus. ADB - ARD COMPAC Technical Mission (1970).

Table A3.8:

Income and Costs per Rai for Four Sericulture Systems Based on Recommendations

Made by ADB - ARD COMPAC Technical Mission 1971 (baht)

Item	Units	Existing system	Existing system with improved mulberry	Improved mulberry and selected native Thai worms	Improved mulberry and hybrid worms
<u>Capital costs:</u>					
Land	baht	400	400	400	400
Equipment (trays, baskets, screens etc.)		590	1,740	1,740	3,280
Total	baht	990	2,140	2,140	3,680
<u>Variable costs:</u>					
Disinfectant	baht	-	-	225	450
Fertilizer	baht	-	120	120	120
Lime	baht	-	100	100	100
Worm eggs	baht	5	20	20	20
Total	baht	5	240	465	690
<u>Yields and income:</u>					
Yield of leaf	kg	400	1,500	1,500	1,500
Wt. of leaves/kg raw silk	kg/kg	200	200	160	107
Quantity of silk produced	kg	2	7.5	9.4	14.0
Value of 1st grade silk	baht	1.3 kg at $\text{฿}200/\text{kg}$ 260	5.0 kg at $\text{฿}200/\text{kg}$ 1,000	6.3 kg at $\text{฿}240/\text{kg}$ 1,512	9.4 kg at $\text{฿}350/\text{kg}$ 3,290
Value of 3rd grade silk	baht	0.7 kg at $\text{฿}70/\text{kg}$ 49	2.5 kg at $\text{฿}70/\text{kg}$ 175	3.1 kg at $\text{฿}90/\text{kg}$ 279	4.6 kg at $\text{฿}20/\text{kg}$ 552
Total gross income	baht	309	1,175	1,791	3,842
Net farm income	baht	104	935	1,326	3,152
Less interest on capital at 12%	baht	119	257	257	442
Less depreciation on housing and equipment at 10%	baht	59	174	174	328
Labour reward	baht	126	504	895	2,382

Source: Adapted from Tables III, IV, VI and VIII COMPAC Programme; Sericulture Prospectus; ADB - ARD COMPAC Technical Mission 1971.

APPENDIX FOUR

Traffic Information

Table A4.1: Number of Vehicles Using Sections of the
Thai-New Zealand Feeder Road

Location: see Table. Date: 29 September, 2 October 1971.

Time of Survey: 6.00 a.m.- 6.00 p.m.

Date	Distance from Borabue (km)	Road Section	Type and number of vehicles		
			Bus	Truck	Other*
29 September 2 October Average	Junction at km 33	Mahasarakham and Wapipathum**	37 38 37	9 17 13	94 88 91
29 September 2 October Average	20	Borabue and Wapipathum	4 12 8	36 32 34	227 196 211
29 September 2 October Average	52	Wapipathum and Phyakaphum Phisai	48 36 42	27 25 26	156 158 157
29 September 2 October Average	92	Phyakaphum Phisai and Satuk	50 42 46	37 59 48	182 264 223
29 September 2 October Average	122	Satuk and Buriram	54 46 50	252 271 262	175 183 179

* Includes pick-up passenger and goods vehicles, cars and taxis.

** 'Back' road Mahasarakham to Wapipathum surveyed for comparison.

Source: Survey conducted by Thai-New Zealand Feeder Road Project Engineers. Published in the programme for the official road opening ceremony entitled "Dedication Ceremony Borabue - Buriram Highway, December 15th 1971."

DATE OF SURVEY: _____		ROAD SECTION: _____		TIME: _____			
		DIRECTION: _____		Kilometre Location _____			
Time	Vehicle type	Destination	Passenger vehicles			Pick-up (goods) and trucks	
			How full is the vehicle? 0 25% 50% Full Crowded			How full? 0 50% 100%	What is it carrying?

- Note:
- (a) Time recorded at hourly intervals.
 - (b) Vehicle type: Pick-up passenger, pick-up goods, car/taxi, truck, bus, truck-bus, motorcycle.
 - (c) Destination: recorded if displayed on vehicle.
 - (d) Occupancy or load: visual appraisal.

Figure A4.1: Traffic Survey Data Collection Form Prepared and Used by the Author.

Table A4.2: Number of Vehicles Using the Thai-New Zealand Feeder Road on the Road Section Between Borabue and Wapipathum
Location: 3 kilometres from Borabue. Date: 23-24 October 1972
Time of Survey: 24 hours.

Road section and time	Type and number of vehicles					
	Pick-up (passenger)	Pick-up (goods)	Car/taxi	Trucks	Bus/truck-bus	Motor cycles
6.30 a.m.- 6.30 p.m.						
Borabue to Wapipathum	59	28	23	27	8	29
Wapipathum to Borabue	61	25	21	19	8	27
Total in 12 hour period	120	54	44	46	16	56
6.30 p.m.- 6.30 a.m.						
Borabue to Wapipathum	20	7	4	11	2	3
Wapipathum to Borabue	8	6	9	9	3	1
Total in 12 hour period	28	13	13	20	5	4
Total in 24 hour period	148	67	57	66	21	60
% vehicles travelling in the period 6.30 a.m.- 6.30 p.m.	81	81	77	70	76	93

Source: Traffic survey conducted by the author.

Table A4.3: Vehicle Type and Percentage Occupancy or Load at Various Times of the Day Using the Data Collected in the 24 Hour Survey 23-24 October 1972.

Time	Vehicle type and percentage occupancy or load																			
	Pick-up Passenger					Pick-up goods				Car/taxi			Trucks			Bus/truck-bus				
	0	25	50	100	Crowded	0	25	50	100	25	50	100	0	50	100	0	25	50	100	
<u>Road Section: Wapipathum to Borabue</u>																				
6.30 a.m.-7.30 a.m.		2			2															
8.30		1		1	3	2				1		1	1		1			2		
9.30		2	3	3	1	1		1	1	1	1		2	1	3				2	
10.30		1	1	2	1	2					1	3			1				1	
11.30		2			2	1		1				1		1				1		1
12.30	1	2			1	1		1		2	1				1					
1.30	1	2	2					2		1	1	1	1		1					
2.30		1	3			2				1					1					
3.30			1	1		3				2	1									
4.30		3	4	4		3		2		1	1			2					1	
5.30		2	2			2														
5.30 p.m.-6.30 p.m.		1	2	1		1				1			1	1	1					
6.30 p.m.-6.30 a.m.	5	2	1			4		1	1	8		1		1	8			3	0	
<u>Road Section: Borabue to Wapipathum</u>																				
6.30 a.m.-7.30 a.m.	2	2		1		1				1										
8.30		2			1	2			1	1			4	1	2					
9.30				2			2		3	3				1	2					
10.30	1	2	1	2			1		1	1	1	1			1					
11.30			2	5		2			1			2	1		1					
12.30	1		1	5	2				1			1		2	1					
1.30			3	2	1	1		1	1	1			2	2	1			1		
2.30	1	1		1	1	5	1			1		2	3	2	1				2	2
3.30				2								3		1						
4.30	3	1			3	2	1			1	1	1						2		1
5.30	1		1	3						1				1	1					
5.30 p.m.-6.30 p.m.			1	2					1											
6.30 p.m.-6.30 a.m.	14	2	2			4	1		1	4			6		5			2		

Table A4.4: Number of Vehicles Using Sections of the Thai-New Zealand Feeder Road

Location: see Table. Date: 6, 7, 8, 9 March 1973. Time of Survey: 6.30 a.m.- 6.30 p.m.

Date	Distance from Borabue (km)	Road Section	Type and number of vehicles				
			Pick-up (passenger)	Pick-up (goods)	Car/taxi	Truck	Bus/truck-bus
8 March	33	Mahasarakham and Wapipathum*	16	5	12	18	45
8 March	33	Borabue and Wapipathum	103	7	57	60	15
9 March	1		113	7	35	61	23
Average			108	7	46	61	19
7 March	76	Wapipathum and Phyakaphum Phisai	172	11	14	42	73
6 March	104	Phyakaphum Phisai and Satuk	137	32	29	93	68
7 March	76		196	17	57	50	60
Average			167	25	43	72	64
6 March	104	Satuk and Buriram	154	33	32	344	84
Total average daily traffic volume on the Thai-New Zealand feeder road			601	76	135	519	240

* 'Back' road Mahasarakham to Wapipathum surveyed for comparison.

Source: Traffic surveys conducted by the author.

Table A4.5: Operating Costs for Vehicles Travelling on Different Types of Road Surface in Thailand (U.S. cents/kilometre net of taxes)

Type of vehicle	Average passenger car			Ten ton capacity truck		
Type of road surface	Good paved	Average gravel	Average earth	Good paved	Average gravel	Average earth
Operating speed (km/hour)	80	64	56	72	56	48
Motor fuel	0.41	0.43	0.50	1.14	1.35	1.59
Lubrication	0.02	0.03	0.04	0.06	0.09	0.12
Tyres	0.13	0.26	0.46	1.96	3.93	8.85
Spare parts	0.23	0.29	0.39	1.71	2.56	4.25
Maintenance labour	0.03	0.03	0.04	0.13	0.19	0.33
Depreciation	0.67	0.93	1.27	1.93	2.96	4.88
Interest	0.52	0.66	0.73	1.16	1.50	1.77
Driver's wages	-	-	-	1.32	1.70	1.98
Overheads	-	-	-	0.20	0.20	0.30
Total	2.01	2.63	3.43	9.61	14.48	24.07

Source: Adapted from T.P. O'Sullivan and Partners (1967) "Vehicle Operating Costs". Technical Report No. 26 to the Thai Highways Department.

APPENDIX FIVE

Valuation of Equipment

Table A5.1: Purchase Cost of Machinery and Equipment with N.Z. Government Finance and the State of Repair in December 1971 (\$U.S.)*

Item	Purchase cost and state of repair			
	Unused	Serviceable	Unserviceable	Used beyond repair
(1) Construction equipment and vehicles		1,088,864	8,326	10,122
(2) Workshop equipment	8,501	99,188	92	13,904
(3) Servicing equipment	958	76,415	5,137	2,903
(4) Mobile field accommodation		34,639		
(5) Survey equipment		8,400	607	
(6) Soil testing equipment		6,049		
(7) Communications equipment		5,972		
(8) Exchange assemblies and modifications	18,109			258,018
(9) Domestic equipment		13,692	240	
(10) Miscellaneous		954		
Total cost	27,568	1,333,173	14,402	284,947

* The original data was expressed in \$N.Z. and an average exchange rate of \$N.Z.1.00 = \$U.S.1.20 has been applied to that data. As the exchange rate varied through out the period the equipment was purchased, there is a discrepancy between the total cost of equipment in Table 7.1 and this table. The data in Table 7.1 takes account of exchange rate fluctuations and accurately reflects the payments in each year.

Source: Ministry of Foreign Affairs, New Zealand Government.

APPENDIX SIXSurvey Questionnaires

Section 4.1.5 described the interview techniques used in this study. Discussion with the respondent moved freely from topic to topic and although this technique takes a lot of time it helps to gain the confidence of the respondent. It also enables the researcher to learn from, rather than about, the farmer. The questionnaires supplied here are guidelines the author prepared to aid him in covering important points relevant to the study. Each farmer was not asked every question and some farmers were questioned in greater depth than others.

(5) Locality Information

	<u>Name</u>
a. Distance from nearest local market _____	km
b. " " " regional market _____	km
c. " " " major local market _____	km
d. " " main highway _____	km
e. " " railway station _____	km

(6) Transportation

- a. Can trucks and buses come to this village at all times of the year?
- b. Have vehicles always been able to come to this village?
- c. Do any of the families in this village have a motor vehicle
 - (i) motorcycle
 - (ii) truck
 - (iii) taxi
 - (iv) tractor.

(7) Extension and Market Information

- a. How many of the families in this village have a radio?
- b. How many of the families in this village read a newspaper each day?
- c. How many shops or stores are there in this village?
- d. Are the shops owned by people living in the village?
- e. Is there a co-operative in this village?
- f. Innovation information:

Item	When first purchased	Purchased from co-op/private store	Available in village now	Present price
Fertilizer				
Insecticides				
Improved seeds				
New farming tools				

Indicate number of farmers now using above items regularly.

- g. Do the farmers in this village grow more/less/same amount of land
 - (i) in rice now as they did 5 years ago?
 - (ii) in kenaf " " " " " " " " ?
 - (iii) in other crops now as they did 5 years ago?
- h. How many farmers in this village sell produce from their farms?

- i. Do these farmers change the kind of crops they grow when the prices they get are low/high?
- j. Do the farmers discuss the prices received for produce amongst themselves frequently?
- k. In the past 5 years has there been any change in the number of villagers who travel each year to:
- (i) Bangkok _____
 - (ii) Mahasarakham _____
 - (iii) Buriram _____
 - (iv) Local village centre (name) _____
- l. Each year, do any farmers from this village go to work for short periods in:
- (i) Bangkok
 - (ii) In a town in another province (name) _____
- m. Can you tell me how this new road has helped the farmers in this village?
- n. What are the main problems in this village?

A6.2

VILLAGE FARMER QUESTIONNAIRE

Name _____ Village _____

Number of years lived in village _____

(1) Land Area (rai)

	Rice land	Upland	Other land
Owned			
Rent to other farmers			
Rent from other farmers			

Discussion points:

- a. Do you plant more than 1 crop on the same piece of land in any particular year? YES/NO REASONS.

Future plans. Which crops? Area?

- b. Method of payment for rented land (per rai)

	Cash	Rice	Other crop
Received from			
Paid to			

- c. Do you have a title of ownership to your land?

- d. Have you bought/sold land in the last 5 years?

Price

Class of land

Who from/to? e.g. government, other farmer.

Reason for sale/purchase? e.g. farming is profitable or not profitable, security, land has good potential, size of household requires more land.

- e. Have you brought any new land into production in the last 5 years? (Describe)

- f. What taxes or fee must you pay each year for your land?

(2) Crop Yields in the 1971 Harvest

Crop	Rai planted		Yield last harvest (tangs)		Av. yield (last 5 years)	
	Paddy	Upland	Paddy	Upland	Paddy	Upland (if known)
Rice: glut.	.		.		.	
non glut.	.		.		.	
Kenaf	.		.		.	
_____	.		.		.	
_____	.		.		.	
_____	.		.		.	
_____	.		.		.	

Discussion points:

- Are you planting the same area of land for each of your major crops as you did 5 years ago?
- Have you tried growing any different crops in the last 2 or 3 years? (REASONS) Diversification?
- Are you planting the same varieties of each crop as you were 5 years ago?

Do farmers know of any improved varieties?

Do they usually plant seed they have saved from previous crops?

Are improved varieties useful in their fields?

Where do they learn about and obtain new varieties?
Price?

(3) Cultivation Practices*

Crop	Ploughing		Harrowing		Planting M	Fertilizer		Weeding		Harvesting M
	M	T	M	T		M	T	M	T	
Rice										
Kenaf										
Other										

* M = month; T = number of times.

Discussion points:

- Ploughing: Buffalo Own Hire Rate of hire
Tractor Own Hire Rate of hire

Are tractors available? Price?

- b. Harrowing (as above).
- c. Planting: Broadcast/transplanting. Cost? Seeding rate?
- d. Fertilizer usage: YES/NO
1. Crops used for
 2. Chemical or animal manure
 3. Results of use
 4. Reasons for use/not use
 5. Expected yield if used/didn't use
 6. Is it profitable at present price and the price fert. should be
 7. How long been using for
 8. Number of bags purchased
 9. Rate/how applied.
- f. Disease, weed and pest control
1. Are there more/less/same quantity of weeds in crops nowadays?
 2. Do you weed your crop (specify) by hand?
 3. Do you use chemical herbicide for any crops? Name source, price, effectiveness.
 4. Insecticide usage - name source, price, effectiveness.
 5. Where did you learn about these chemical control agents? How long ago?
- g. Harvesting - method? Cost? (specify crop).

(4) Livestock and Poultry Schedule

Name	Age	Male	Female
Buffalo	>3 1-3 <1		
Cattle	>3 1-3 <1		
Pigs Breeding Fattening			
Chickens Ducks Fish Other			

Details on Sales/Purchases throughout the year.

Discussion points:

- a. Are you increasing/decreasing stock numbers of any enterprise?
- b. Do you buy any feedstuff for your stock?
 - Rice straw from other farmers
 - Bran from rice mill
 - Maize/grain from merchant.

- c. Do you use any animal medicines or vaccinations?
 d. Have you mated your cows with a bull from a breeding centre? Breed?

(5) Schedule of Equipment

Plough, harrow, water pump, cart, weedsprayer, scythe, hoe, shovel, share in tractor, others _____

- a. Do you make most of your own tools?
 b. Are you using any agricultural tools that you did not know about 5 years ago? YES/NO Specify, (Reasons).
 1. Tools required for special crops farmer grows now.
 2. Tools farmer had not seen before.
 3. Motorised tools.
 4. Tools made of steel rather than wood.

(6) Farm Labour Employment

- a. Number of people in household?
 b. Number of people capable of working e.g. transplanting/harvesting rice.
 c. Nature of work.

Family	Months on farm	Work at	Months off farm	Work at	Income (baht)
Husband					
Wife					
Other					

- d. Do you hire labour to work for you each year? (complete schedule)

Sex	Nature of work	Number	Number of man-days	Rate of pay		
				baht/day	Kg.rice	Other
Male						
Female						

Details required for both rice and kenaf will need sufficient information to calculate gross margins.

- e. Do you engage in reciprocal labour exchange? Details.

(7) Transport and Marketing

Crop	Where sell	Quantity	Price received	Total income	Cost and method of transport

Livestock	Number sold	Reason for selling	Purchaser	Reason for buying	Price
Buffalo					
Cattle					
Pigs					
Chickens					
Ducks					
Fish					
Other					

Discussion points:

- a. During the past 5 years a new road has been constructed near your village. As a farmer does this road help you? (Check list).
1. Better access in rainy season.
 2. Better access to local market centres.
 3. Improved transport of produce.
 4. Improved passenger transport.
 5. Other
- b. How are the main products from your farm transported for sale?
1. Merchants come in trucks and buy at the farm.
 2. Transport by mini-bus.
 3. Transport by taxi.
 4. Ox-cart or cattle cart.
 5. Other.
- c. Have there been any changes in transport availability during the past 5 years? e.g.
1. More/less trucks come to the village.
 2. Heavier trucks come to the village.
 3. Merchants from farther away than local centres come to buy crops.
 4. Vehicles can come to the village at all times of the year.

- d. Have there been any changes in the way you sell your produce in the past 5 years?
1. Always sold produce to 1 merchant previously.
 2. Store some of crop to get higher prices later in the year.
 3. Sell crops in places where didn't sell before.
e.g. Mahasarakham, Borabue, Buriram.
 4. Compare prices offering in various markets and sell at the market giving the highest price.
- e. Do more merchants or agents come to buy produce from your farm?
- f. Do you travel to local markets more often than before?
How often? _____ Why? _____
1. For purchasing more articles for the house.
 2. For selling articles more frequently.
 3. To check on prices offered by merchants.
 4. To look at farm demonstration centres.
 5. To look for farm inputs.
 6. To visit friends in another village.
 7. Because they like to travel.
- g. What is the cost of transporting the following items to the nearest market centre?

Market Centre _____

Item	Cost (baht)
Passenger	
Rice (bag)	
(basket)	
Kenaf	
Pig	
Chickens	
Other	

- h. Other transport information (frequency, availability etc.)
- i. Do you sell all of the product of any particular crop at the same place? _____ At the same time? _____
- j. If you thought the price offered by a merchant or at the market was too low what would you do? Was this the case prior to road construction?
1. Go to another merchant in the same market.
 2. Store for a period.
 3. Sell at low price.
 4. Go to another market centre and look for better prices.

- k. Have you ever grown a crop and then been unable to sell the produce? YES/NO. If YES then why couldn't you sell?
1. No transport available.
 2. Prices too low.
 3. No buyers.
 4. Dishonest merchants.
 5. Insect damage.
 6. Drought damage.
 7. Flood
 8. Other.
- l. Can you name any products you can buy in the towns which you did not know about 5 years ago?

(8) Extension and Gaining Knowledge

- a. Has any district officer, official from rice department, or Agricultural officer ever visited your farm.
- b. Did he help you: (i) Without charge at your own request.
(ii) Without charge without you asking him.
(iii) In return for payment of some kind.
- c. Have you ever visited any place where research is being done, for example Borabue Demonstration Farm.
- d. Are there any organisations in this village which help farmers to improve their incomes?
- e. Are you a member of any such organisation? Example, Credit Co-operative, Agriculture Dept. Farmers Group.
- f. Do you think these organisations are helpful to farmers? (Check reasons)
1. Provide financial assistance.
 2. Encourage farmers to work together.
 3. Obtain better prices for all farmers.
 4. Meetings helpful/not helpful.
 5. Which organisations are most useful? Why?
- g. How do you think one of these organisations could help you?
- h. How do you know the price you should receive for your crops (reports in newspaper, radio etc.)?
- i. Have you seen any new crops which you may be able to grow on your farm? Where? How would you find out where to get seed, cultivation requirements and marketing systems for this new crop?
- j. If you have any spare money do you spend it on agriculture or lend it to a farmer or other person?

- k. What is the best way you can use any spare money in agriculture? (Buy fertilizer, buy pure seed etc.)
- l. What problems do you have in growing crops on your farm now?
1. Lack of finance.
 2. Poor yields.
 3. Insect damage.
 4. Flooding.
 5. Lack of water in summer.
 6. Lack of knowledge concerning new crops.
 7. Not enough land.
 8. Other _____
- m. Would you borrow money so that you could purchase something for your farm? (e.g. fertilizer, seed, buy new land etc.) (Define purpose in borrowing, if farmer ever has borrowed, if in debt at present time etc.)

(9) Other Information About Farmer or Farm

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