THE DEVELOPMENT AND EVALUATION OF A VILLAGE-BASED PARASITE CONTROL PROGRAM FOR SWAMP BUFFALO AND CATTLE IN NORTHEAST THAILAND

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF PHILOSOPHY

AT MASSEY UNIVERSITY

NOPADON MEEMARK

NOVEMBER, 1988

ABSTRACT

Internal parasitism is a major problem in large ruminants in Thailand, especially nematodes in newborn calves and liver fluke in adults. Veterinary services are sparse, and can offer only very limited assistance at the village level. There are about 20,000 villages in the north-east of Thailand, where this study was conducted. To combat these major logistic problems a Basic Animal Health Service (BAHS) is being developed progressively within the region. The first component of the service to be developed was a "farmer self-help worm control program", commenced at a pilot level in 1983. Village farmers are selected on aptitude for the task, trained as BAHS "keymen" for one day, and then provide extension advice to farmers in up to 10 villages about disease control, with the initial emphasis being on internal parasites. This local effort is supported by wider promotional campaigns. Keymen are taught to dispense drugs for each type of parasite, and receive part of the price paid by farmers for the drugs. Purchase and distribution of drugs is supported out of a special revolving fund.

Experience in the program since 1983 has shown that overall adoption of the program has been high, but that drug sales have varied greatly between keyman areas. A comparison was therefore made of "high adoption" and "low adoption" keyman areas, to determine levels of knowledge about parasites and the BAHS, and to assess which of a range of factors might be most closely associated with program success at the local level. Adoption rate was judged by sales of anthelmintics by each keyman. Results in four provinces which had participated in the program for either one or three years were compared with two provinces which had not yet begun the program. In total 420 farmers and 16 keymen were interviewed using a standardised questionnaire form.

Farmers were classified into those showing high acceptance (understood the BAHS and had used the drugs within the last year), medium acceptance (understood the BAHS, but had not used the drugs for at least a year), and low acceptance (unfamiliar with the BAHS and its relevance to them, and had not used the drugs), Overall, 64% of farmers in the "high adoption" areas showed high acceptance of the program, compared with only 16% in the low adoption areas - producing a mean of 40% across the whole sample.

Users of the control system were very satisfied that treatment provided economic benefits, and this view was supported by empirical evidence from the study, which showed that owners who carried out treatment had lower calf mortality, higher market value of treated animals, and improved calving rates.

The single most important determinant in the success of the program is the energy of the keyman in promoting the program and the sale of drugs, and acceptance of the program is almost entirely a function of this factor, rather than issues beyond the keyman's control. A number of quite simple and cheap modifications to details of the BAHS should further increase the already exceptionally high adoption rate. These include replacing ineffective keymen, increasing the density of keymen so that travel is not a limitation, and strengthening further the regional promotion effort to give maximum credibility to the keyman's local work.

An economic analysis based on the data showed a return of US$143 to the typical farmer in the region for an investment of US$0.69, making very conservative assumptions about the nature and scale of the benefits. In contrast, the keymen make only a very small income from their efforts, estimated at US$0.70 per day worked on the program. The net benefit of the program across the six provinces studied was estimated at US$33.64 million. This can be increased by various improvements to the program, and costs and returns for such improvements were calculated. If 80% of farmers in the six provinces treated all of their animals, the net benefit to the region would be US$118 million for an investment of about $1 million, the costs being shared equally by Government and the farmers. Small scale farmers share more favourably in the benefits than is the case for many improvements in village agricultural practices.

The program has been very successful, primarily because it deals with a problem which farmers recognize as serious, and because everything the farmers need to carry out the program is available within the village. Various simple improvements identified in the study will further improve its acceptance and its benefit to the country.

ACKNOWLEDGEMENTS

A large number of individuals and institutions have contributed generously toward completion of the research reported. I wish to thank all of them for their help, interest and encouragement during my study.

Firstly I wish to particularly thank my supervisor, Professor R.S. Morris, for his guidance, advice, enthusiasm and optimism that the project could be completed satisfactorily, and acknowledge his patient assistance in completing the thesis. I am grateful to him for giving me the opportunity to undertake this study.

Dr.W.A.G. Charleston, my second supervisor, I thank for his inspiration, helpful suggestions and comments in my academic work, especially in the field of parasitology.

I gratefully acknowledge the assistance of Dr.Chris Boland for his helpful advice on preparation of the questionnaire forms, and Dr.Craig Tanner, Dr.Peter Jolly, Dr.Dirk Pfeiffer, Dr.Chockchai Chaimongkol, Dr.Eugene Lañada, Dr. Bryan McKay and Mr.Barry Butler for their kind help in thesis discussion and teaching me how to use various computer programs. I wish also to thank Mrs. Frances Allen, Mrs.Fiona Dickinson and Ms.Debbie Lovelock for their great assistance in the initial proof reading of this manuscript and the preparation of some of the illustrations.

I am indebted to the Department of Veterinary Clinical Sciences, Massey University, for providing the opportunity and facilities for this study, and for producing the first Thai veterinary postgraduate student in New Zealand.

I am particularly grateful to my boss, Dr.Somchai Srihakim, for his enthusiasm and encouragement and for providing various facilities during the study period. I am specially grateful to the German staff in the Thai-German Animal Health Project in Khon Kaen - Dr.K.F Löhr, Dr. R. Baron von Kruedener, and Dr.K.Leidl for their encouragement and helpful advice.

My thanks go to all staff in the project, especially Dr.Manvika Polpark, Dr.Lertruk Srikitjakarn, Ms.Rungsuda Sukamol, Mr. Arrt and Mrs.Siriphan Wapakpeth, and Mr. Apirom Charoenchai for their great cooperation in the field survey and data entry.

This study would not have been possible without the help and cooperation of 142 village headmen, 288 farmers and 22 keymen in the area interviewed. In addition the active participation of the six Provincial Livestock Officers and the twenty four District Livestock Officers of Mahasarakam, Surin, Khon Kaen, Loei, Udornthanee and Kalasin has been appreciated.

I would also like to acknowledge the financial contribution of the German Academic Exchange Service [Deutscher Akademischer Austauschdienst (DAAD)] of the Federal Republic of Germany, which kindly provided funding for my study in New Zealand.

For their help, encouragement and enduring faith, a very special thank you for my parents.

Lastly for Malliga, and my lovely daughters, Supattra (Nan) and Supavadee (Noiy) for their patience and tolerance while I spent a long period of study in New Zealand.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CONVERSION FACTORS

	1	rai	=	1600	square meters
			=	0.16	hectares
			=	0.395	acres
	1	square kilometre	=	247.1	acres
			=	100	hectares
			=	0.386	square miles
	1	kilometre	=	0.621	miles
US$	1		=	25	baht(approximately)
NZ$	1		=	15	baht(approximately)

CHAPTER ONE

BACKGROUND TO THE PROJECT

INTRODUCTION

Thailand is a country which is undergoing rapid development, and is generally regarded as moving at present from being a developing country to join the group of newly industrialised countries. The urban population of the country is sharing in this rapid economic development, but it has as yet had only limited effect on the lifestyle and wellbeing of the village farmers in more remote parts of the country, such as the north-east region.

In this area, the Isaan[1] farmers live and work in a much more traditional fashion - they grow a variety of crops for market but their staple crop is rice. This is used mainly for home consumption but also for sale when they have a surplus over family needs. Swamp buffalo *(Bubalis bubalis)* are vital for crop production, transport and other functions. Buffalo and cattle also serve as an important form of financial reserve, which can be turned into cash if the need arises.

These large ruminants therefore serve important functions in family and village life, and their protection is crucial to the maintenance and development of the economy of the region. Disease adversely affect the usefulness of these animals in various ways, as described by Morris (1979a):

1. It reduces the economic, social, cultural or religious value of animals to their owners or to the community as a whole; or it may initiate zoonotic disease in the people of the area.

2. Reduction in yield of product. Animals affected by a disease usually produce less usable product than animals free of that disease, and in some cases may die from the disease.

3. Reduction in reproductive performance. Animals affected by disease may have reduced fertility or fecundity due either to direct effects on reproductive function, or indirect effects through reducing body weight.

4. Reduced productive life. Animals affected by a disease may have to be replaced earlier than disease-free animals.

5. Reduced quality of products or services (for example, reduced capacity for work). These may also result from the presence of the disease.

This thesis examines the effect of parasitic and other diseases on large ruminants in north-east Thailand, as seen through the eyes of the village farmers, and evaluates the effectiveness of a parasite control program which has been undertaken in selected provinces within the region. The objective of the study is to determine how well the program has been accepted by village farmers, and their attitudes towards it. Using this information, an economic study was carried out to assess the benefits of the existing program, and the expected results of various possible improvements which could be made.

---

[1] The term Isaan is used to describe the local people of the north-east (*khon isaan*). It comes from the Mon-Khmer kingdom of Isana, which flourished some centuries ago in north-east Thailand and part of Cambodia. The Thai spoken by the Isaan people contains strong Lao influences, and there are distinctive cultural characteristics which mark out the people and traditions of the north-east.

THE PROJECT AREA

Northeast Thailand consists mainly of a plateau 170,225 sq km. (17 million ha.) in area, with an average altitude of 100-200 m. above sea level. Out of the total population of 16.5 million people, 14 million live in approximately 20,000 villages while 2.5 million live in 17 Provincial capitals and 180 District Towns (Amphurs). The population of the north-east accounts for one third of the national population of 55 million.

The area has a long harsh dry season of up to six months, followed by monsoon rains commencing in about June. Rainfall averages 1,300 mm. Agriculture is the livelihood of 80% of the population, and the vast majority of the land is in small-holdings. Agricultural holdings total 46 million rai (7.4 million ha.). The rai is the Thai unit of land area, equivalent to 0.16 hectares. The most important crop is rice, grown on about 34 million rai (5.4 million ha.). Only 3% is under irrigation. Other major crops are cassava and jute, grown on about 9 million rai (1.4 million ha.). 0.2 million rai (0.03 million ha.) are used specifically as pasture land for livestock, but most grazing livestock are kept on harvested rice paddy land and on road and cropland margins. Animals are also fed on conserved crop by-products such as rice straw, especially in the late dry season and early wet season when feed supplies are at an absolute premium.

Government statistics for 1979, prior to the beginning of the aid program of which this study forms part, estimated that the gross regional product for the Northeast was 54,498 million baht, with 48% of this derived from agricultural products. The exchange rate in October 1988 is approximately 15 baht to NZ$ 1, and 25 baht to US$ 1. Average annual agricultural income per family was 16,750 baht (US$ 670), 69% of which was from crops, 15% from sale of buffalo and cattle and 16% from other livestock (Prapertchob et al, 1983). The income for the north-east compares unfavourably with an average annual income of 30,161 baht per family in Bangkok, and the north-east is considered the poorest part of the country. Soils are generally poor,and rainfall fluctuates greatly between years. Drought years are quite common, and farming systems in the region must be well-adapted to coping with extended periods of low rainfall, which sometimes last for two or three years.

Cattle and buffalo raising is usually part of a small scale farming operation. The swamp buffalo (Bubalis bubalis) is the most agriculturally important species, with 3.7 million head in the region. They serve principally as draught animals for crop cultivation, but are also used for manure production, transport and meat. The other livestock are 1.5 million cattle, 1.2 million pigs and 16 million poultry. The total number of buffalo in the region is approximately twice the number of cattle (Appendix 1).

There is concern over the fact that there has been a lack of growth in swamp buffalo numbers in north-east Thailand over a number of years, in the face of large requirements for draught power and increasing demand for buffalo meat. This gap between buffalo supply and demand is due to both the expanding human population and growing per capita purchasing power in the region (Prapertchob et al, 1983). The productivity of buffalo in this region of Thailand is considered low, especially meat output and reproductive performance. Some authors (Kamonpatana et al, 1978; Bhannasiri, 1980) have advocated raising productivity through methods such as genetic improvement programs.

HISTORY OF DEVELOPMENT OF SCHEME

Background Information on the Animal Health Service and Livestock Development in Northeast Thailand

Veterinary services are provided by two Regional Veterinary Officers (RLO), 17 Provincial Livestock Officers (PLO), 194 District Livestock Officers (DLO), 12 Provincial Veterinary Clinicians and the Northeast Veterinary Research and Diagnostic Centre (NE-VRDC), which is the Regional Centre. They are under the control of the Department of Livestock Development (DLD), which has its headquarters in Bangkok.

Although the northeast produces the largest number of cattle and buffalo in the country, the offtake rate is low, and population size has remained constant or declined slightly, despite the demand for increased number of animals. Major aspects of livestock production which require improvement can be classified as follows:

1. Animal management practices
2. Sanitation and disease control
3. Genetic improvement and cross-breeding
4. Feed supply
5. Extension services and farmer acceptance of recommended practices
6. Marketing of livestock

Of these six issues, the ones of direct relevance to this thesis are sanitation and disease control, extension services and farmer acceptance.
In 1981, the Thai-German Animal Health Project in the North-East of Thailand commenced a major development program for animal health services, based on a series of epidemiological studies of village livestock in the region.

Between 1981 and 1985, a variety of disease prevalence surveys, productivity evaluations and epidemiological studies were carried out on health problems in the region by the staff of the NE-VRDC at Tha Phra, Khon Kaen in cooperation with German project personnel. These study have clarified the animal health situation in the area considerably, and the following are some examples of the findings.

Diseases caused by internal and external parasites in livestock are important factors contributing to the slow development of livestock production in the Northeast. The parasitic problems caused by fascioliasis in adult buffalo and cattle and gastrointestinal parasitism in calves under 6 months of age, combine with the drastic seasonal changes in feed supply to severely reduce the potential offtake of animal products from the region. These diseases are responsible for poor condition, weakness, emaciation, and especially for a high mortality rate in calves. Helminthiasis appears from field studies carried out by the NE-VRDC to be one of the biggest health problems in the region.

Mineral deficiencies (for example causing "tetanoid syndrome" and lameness) occur in some areas. The "tetanoid syndrome" is a condition only recently reported from the project area, and still not fully elucidated. It occurs only in buffalo, mainly in the late dry season and early wet season, and affects all age groups. Evidence obtained so far suggests that it is due to the low level of vitamin E in rice straw which is being fed as the sole feed at this time, and it is probably associated also with selenium deficiency. This joint deficiency causes the clinical signs of the condition-locomotory problems ranging from stiffness and staggering gait to "sawhorse posture", with a case fatality rate of 20 to 25% (Leidl et al, 1984; Morris, 1986a).

Bacterial, viral and protozoal diseases are considered to be of fairly minor importance overall, although on some occasions serious outbreaks may occur. Haemorrhagic septicaemia and foot-and-mouth disease are believed to be the most important epidemic diseases of buffalo and cattle in the area. Trypanosomiasis due to Trypanosoma evansi is endemic in the area, and there is strong circumstantial evidence that T. evansi infection causes abortion in late pregnancy in buffalo in Northeast Thailand (Löhr et al, 1986a).

COMMON PARASITES IN NORTHEAST THAILAND

Parasites cause various signs in buffalo and cattle such as loss of weight, anorexia, emaciation, diarrhoea and lowered disease resistance. Death can occur if infection is heavy. The nature and severity of clinical signs depends on the kind and number of parasites with which the animals have been infected. The following parasites are of importance in northeast Thailand.

A. Nematodes

Thelazia rhodesii

T. rhodesii is an eye worm commonly detected in buffalo in Thailand. This parasite occurs in the inner canthus of the eye beneath the third eyelid. It is a milky-white worm, males are 8-12 mm long and females 12-18 mm (Soulsby, 1982).

Life cycle and epidemiology

T. rhodesii are parasites of the conjunctival sac of domestic animals. The female worm deposits thin-shelled eggs containing first stage larvae. The development of T. rhodesii requires flies of the genus Musca as intermediate host. When the intermediate host is infected by larvae, they migrate from the gut through the abdominal cavity and develop in ovarian follicles into the second and third stage. The latter stage migrates from the ovarian follicle to the mouth parts of the fly, from which the infective form is transferred to buffalo or cattle. The development takes 15-30 days and the infective larvae are liberated from the proboscis of the fly when it imbibes the lachrymal secretion of animals. The development cycle in the final host takes 20-40 days. T. rhodesii may remain in the eyes for several months (Soulsby, 1965).

Clinical signs and pathogenesis

T. rhodesii causes conjunctivitis with lachrymation. There may be marked congestion, with the conjunctivae swollen to cover the eyeballs (Soulsby, 1965). Photophobia and corneal opacity may occur.

Control and treatment

The drug of choice for T. rhodesii is levamisole, applied as a 1% aqueous solution to the eye. It may also be administered systemically by subcutaneous injection. Treatment by either route produces rapid clinical recovery following a single dose (Corba et al, 1969).

Mecistocirrus digitatus

M. digitatus occurs in the abomasum of both cattle and buffalo. The nematode is red in colour when alive; males are up to 31 mm and females up to 43 mm long (Soulsby, 1982). The male has long thin spicules which distinguish it from Haemonchus spp.

Life cycle and epidemiology

Development of infective larvae from eggs passed in the faeces is rapid under favourable conditions, taking about 7 days at 28°C. After ingestion the larvae exsheath and develop in the gastric glands or on the surface of the mucosa. Development to maturity is relatively slow with a minimum prepatent period of about 60 days. Inspection of cattle and buffalo is common in the region and severe losses in young stock are caused by this parasite.

Clinical signs and pathogenesis

Like Haemonchus spp., this parasite is blood-sucking - causing severe anaemia with associated clinical signs, loss of condition and deaths of heavily infected animals. Loss of plasma proteins also gives rise to tissue oedema and transudates in body cavities.

Haemonchus placei also occurs in the region but is of minor importance.

Control and treatment

This is described in the general section on control and treatment of gastrointestinal parasites.

Toxocara vitulorum

T.vitulorum, the bovine large roundworm, mainly occurs in the small intestine. The males measure up to 25 cm in length and 5 mm in width, and females 30 cm by 6 mm (Soulsby, 1982).

Life cycle and epidemiology

Adults of T.vitulorum are found commonly in buffalo calves under 6 months of age. After embryonated eggs are ingested, they do not develop to a patent infection, but larvae are distributed to various tissues where they remain dormant until the latter part of pregnancy in female cattle and buffalo.

Larvae pass to the mammary gland during the eighth month of pregnancy (Warren, 1971). Larvae in colostrum are ingested by a newborn calf, and the infection develops (Soulsby, 1982). The epidemiology and prevalence of T.vitulorum in cattle and buffalo in Thailand are described later.

Clinical signs and pathogenesis

The predominant clinical signs are diarrhoea, anaemia and emaciation. Intestinal colic may occur and may cause death. The severity of ascariasis depends on many factors, for instance, the number of larvae infected, calf condition and health management. The critical period when the animal is at risk of death is when the calf is under 2 months of age. The most common signs which farmers recognize are mud-coloured, evil-smelling faeces; presence of worms in faeces, and pot-belly in some cases. Both the obstruction of the intestinal lumen by T.vitulorum in the upper part of small intestine and penetration of the parasite through the bowel causing peritonitis and death have been reported in Thailand. The highest number of T.vitulorum found in the intestine of a dead calf was 537 (Sukhapesna, 1981). The cause of death in parasitised buffalo calves under 6 months of age is principally T.vitulorum, but with contributory effects from S.papillosus infection. Diagnosis is made by faecal examination.

Control and treatment

There are numerous broad spectrum anthelmintics which are effective against these parasites, but successful treatment of ascariasis can also be achieved by using one of the piperazine compounds. As piperazine citrate is very cheap and is effective against T.vitulorum it is commonly used in northeast Thailand. The recommended dose for oral treatment is 220 mg/kg body weight.

Strongyloides papillosus

S.papillosus, a thread worm, occurs in the upper part of the small intestine of sheep, goats, cattle and other ruminants. It is 3.5-6.0 mm long and 0.05-0.06 mm thick.

Life cycle and epidemiology

Embryonated eggs are passed in the faeces, hatch rapidly and may develop directly into third stage infective larvae (homogonic cycle) at 27°C within 24 hours or develop to free living males and females which may subsequently produce infective larvae (heterogonic cycle). In the heterogonic cycle the first stage larvae are rapidly transformed, so that within 48 hours sexually mature free living males and females occur. Following copulation, the free living females produce eggs which hatch in a few hours and these larvae metamorphose to become infective larvae (Reinecke, 1983; Soulsby, 1982). Infection is required by penetration of the skin by infective larvae and by the ingestion of larvae in colostrum (Soulsby, 1982). The prevalence of this parasite is discussed later.

Clinical signs and pathogenesis

In heavy infestation of S.papillosus in calves and growing animals there is marked intermittent diarrhoea and emaciation, loss of weight and sometimes presence of blood and mucus in the faeces.

Mature parasites are found in the duodenum and proximal jejunum and if present in large numbers may cause inflammation with oedema and erosion of the epithelium. This results in a catarrhal enteritis with impairment of digestion and absorption (Urquhart, 1987). Animal condition is more severely affected where strongyloidosis is associated with concurrent ascariasis.

Control and treatment

Generally S.papillosus eggs are first detected when calves are 5-9 days of age, reach a peak at about 30 days of age, and are last detected at 96 days (Sukhapesna, 1978). Strategic control should be combined with that for T.vitulorum. In other words, the first deworming in calves should take place at 3 weeks of age and the second treatment at 6 weeks of age, using a mixture of piperazine and thiabendazole. This combination is highly effective against S.papillosus and T.vitulorum in calves.

Both of the drugs are available in Thailand and cheaper than other more recently developed drugs. However for those who can afford it fenbendazole is also a drug of choice, and levamisole can also be used by injection.

Bunostomum phlebotomum

B.phlebotomum, the bovine hookworm, mainly occurs in the duodenum of cattle. The male is 10-18 mm long and the female 24-28 mm.

Life cycle and epidemiology

Infection of the host occurs through the mouth or skin, then the larvae pass to the lungs where ecdysis occurs. The fourth stage larvae reach the intestine again after 11 days and the infection becomes patent at 30-56 days after infection. The adult worms attach themselves to the intestinal mucosa and suck blood. This parasite is commonly found in post mortem examinations of cattle and buffalo in Thailand (unpublished observations) but nothing has been published on to prevalence or epidemiology.

Clinical signs and pathogenesis

Progressive anaemia is the characteristic feature, with consequent changes in blood composition. Hypoproteinaemia and oedema develop, leading to submandibular swelling, commonly known as bottle jaw. Diarrhoea is not frequently seen but sometimes occurs in the terminal stage of the disease.

Control and treatment

This is described in the general section on control and treatment of gastrointestinal parasites.

Oesophagostomum radiatum

O.radiatum occurs in the colon of buffalo and cattle. The male is 14-17 mm long and the female 16-22 mm.

Life cycle and epidemiology

Ingested larvae exsheath in the small intestine and enter the wall of both small and large intestines. They spend 5-7 days to become L4 larvae and then return to the lumen 7-14 days after infection, pass to the large intestine and moult 17-22 days after infection to the adult

stage. The prepatent period is 32-42 days (Roberts et al, 1962). Sukhapesna (1977) reported this parasite is common in buffalo calves but no details of its prevalence or epidemiology have been published.

Clinical signs and pathogenesis

In severe cases, a long period of watery diarrhoea may be observed. At postmortem, a large number of deep red petechial haemorrhages can be found in the intestinal mucosa. There is a marked eosinophilia at the site. A digestive disturbance develops, causing anorexia, abdominal pain and black foetid diarrhoea. Faeces may be streaked with blood. Death may occur within a week, when infections are heavy. In calves, the distinctive clinical signs are profuse diarrhoea and frequently anaemia. Recovery is also slow and chronic unthriftiness may occur.

Control and treatment

This is described in the next section.

Control and Treatment of Gastrointestinal Parasites

The aim of any control program is to prevent or minimize contact between the free-living stage of the parasite and its host. The best control of the parasite is based primarily on strategic anthelmintic use associated with appropriate manipulation of grazing management. Effective control requires knowledge of the epidemiology of each gastrointestinal parasite and of larval ecology. Farmers tend to rely on treatment of clinically affected animals, but a much sounder approach is to strategically use a suitable anthelmintic at epidemiologically appropriate intervals in all animals at risk. This should be combined where possible with changes in grazing management to minimise exposure to infective stages of each parasite.

The choice of time to use anthelmintics is very important so that the drug achieves maximum kill and (in the case of parasites which have them) is highly effective against hypobiotic larval stages. The newer benzimidazoles and ivermectin appear to be the most effective against the hypobiotic stage.

Appropriate drugs include the following:

Thiabendazole given at a dose rate of 66 mg/kg body weight orally to animals. Thiabendazole is highly effective against the adult and immature stages of gastrointestinal nematodes especially Strongyloides spp.

Fenbendazole given at a dose rate of 7.5 mg/kg body weight, it is also ovicidal, and kills eggs in the gastrointestinal tract at the time of treatment.

Albendazole given at a dose rate of 5.0 mg/kg body weight.

Levamisole given at a dose rate of 7.5 mg/kg is highly effective against both mature and immature gastrointestinal nematodes and lungworm. It may be administered as a drench,in feed or by subcutaneous injection.

Nitroxynil given at a dose rate of 10 mg/kg is highly effective against mature Haemonchus placei, Mecistocirrus digitatus and Oesophagostomum radiatum.

Ivermectin is one of a new class of drugs with broad spectrum anthelmintic, insecticidal and acaricidal activities at 50-200 µg/kg They have excellent efficacy against immature and adult stages of gastrointestinal nematodes of ruminants.

B. Trematodes

Fasciola gigantica

F.gigantica is a common liver fluke of adult cattle and buffalo in tropical countries.

Life cycle and epidemiology

Chompoochantra et al (1976) studied the lifecycle of F.gigantica and reported that at normal temperature (25°-30°C) liver fluke eggs hatch to produce a miracidium at between 8 and 14 days. Soulsby (1982) reported that the hatching period takes 17 days at 26°C. The development of the miracidium in the aquatic snail Lymnaea auricularia rubiginosa, the intermediate host, requires 35-48 days. Cercariae transform to be metacercariae within 24 hours, as they encyst on water plants. The prepatent period is 114-116 days. The prevalence and epidemiology of fasciolosis in Thailand is discussed later.

Clinical signs and pathogenesis

The chronic form of liver fluke infection is the main one which occurs in adult cattle and buffalo in Thailand. Liver fluke infestation causes substantial economic loss in northeast Thailand. Fascioliasis causes anaemia in severe cases, loss of weight, poor condition, weakness and loss of working ability. Submandibular oedema may also be found in some chronic cases. In the dry season where feed supply is insufficient, animal condition suffers and death may occur in severe cases. Pathogenesis of fascioliasis is principally due to the anaemia caused by the blood sucking ability of adult flukes. This results in anaemia, hypoalbuminaemia and loss of red blood cells and plasma into the bile ducts. In advanced cases there may be hyperplastic cholangitis and calcification of the bile ducts (Soulsby, 1982).

Control and treatment

On a world-wide basis, the five fasciolicides mainly used for the treatment of bovine fascioliasis are hexachlorophene, oxyclozanide, niclofolan, nitroxynil and rafoxanide. Niclofolan and nitroxynil are the only two injectable fasciolicides available in Thailand.

Niclofolan is highly effective against adult flukes at a dose rate of 3 mg/kg body weight. A higher dose is required to remove the immature stages, but frequently causes side effects. Toxicity occurs at four times the recommended dosage rate.

Nitroxynil is highly effective against mature and has some activity against the later parenchymal stages, i.e. fluke more than six weeks old. The standard recommended dose is 10 mg/kg body weight, and the maximum tolerated dose is 3-4 times the recommended dosage rate. Toxic reaction can be recognized by a rise in body temperature and increased respiratory rate (Armour, 1983).

Schistosoma spindale

S.spindale is found in mesenteric blood vessels of ruminants such as buffalo and cattle. The male is 5.5-13.5 mm in length and the female 7-16.2 mm. The eggs are spindle-shaped and 200 by 70-90 μm with a terminal spine (Soulsby, 1982). The intermediate hosts are snails of the family Planorbidae, especially Indoplanorbis exustus (Soulsby, 1965).

Life cycle and epidemiology

The female in the a mesenteric venule produces eggs which penetrate the vessel endothelium assisted by the spine and muscular movements of the gut, passed into the lamina propria of the mucosa and eventually entering the gut lumen; they are then passed out in the faeces. The eggs hatch in minutes in water and miracidia penetrate appropriate snails. The development period in the snail can be as short as five weeks. Development to the cercarial stage occurs without a redial form and there is no metacercarial phase. Penetration of the final host by the motile cercariae occurs via the skin or through mucosal surfaces following ingestion. After penetration or ingestion, the cercariae lose their forked tails. The schistosomules travel via the blood stream through the heart and lungs to the systemic circulation. In the liver they locate in the portal veins and become sexually mature before migrating to the final site, the mesenteric vein. The prepatent period is 6-7 weeks. The epidemiology of Schistosoma spp. is very similar to that of F.gigantica and Paramphistomum spp., Schistosoma spp. being totally dependent upon water as a medium

for infection of both the intermediate and final host. The fact that percutaneous infection may occur encourages infection where livestock are obliged to wade in water (Urquhart et al, 1987).

Clinical signs and pathogenesis

Pathological changes occur in the small and large intestine, in which the parasite causes petechial haemorrhage. The animal shows signs of diarrhoea, which is sometimes blood-stained and containing mucus, anaemia, anorexia and emaciation. Acute disease characterised by diarrhoea and anorexia occur 7-8 weeks after heavy infection and is entirely due to the inflammatory and granulomatous response to the deposition of eggs in the mesenteric veins and their subsequent infiltration in the intestinal mucosa (Urquhart et al, 1987). This was also report by Chantaraprateep et al, (1985) who studied the pathogenesis of S.spindale in buffalo calves and found extensive haemorrhagic enteritis extending from the stomach to large intestine. However there was also a severe infection with T.vitulorum in the intestinal lumen. Extensive fibrinous and fibrotic lesions of hepatitis were found. The cause was identified as S.spindale, which were numerous in hepatic tissue. Large numbers of eggs of the parasites were present in the faeces of buffalo calves.

Buckley (1938) reported the cercariae of S.spindale infection of the water buffalo as the cause of "rice paddy itch" in Malaya. S.spindale has been commonly found in north-east Thailand for many years (Harinasuta et al, 1964). Where a heavy infection of T.vitulorum is associated with schistosomiasis, S.spindale may exacerbate the poor condition of the animal and finally cause death (Chantaraprateep et al, 1985). Further research on the pathological effects of S. spindale to young stock of cattle is being carried on at the NE-VRDC.

Control and treatment

Urquhart et al (1987) recently reported that praziquantel appears promising for treatment of human schistosomiasis, but it has still to be evaluated in animals.

Paramphistomum cervi

P.cervi is a fluke which occurs in the rumen and reticulum, and may be seen in virtually every buffalo and cattle beast in Thailand (Sukhapesna, 1981). The adult worms are essentially non-pathogenic even though large numbers may be present. The immature stage of paramphistomes in the abomasum, duodenum and upper part of the ileum are responsible for pathological changes (Soulsby, 1965), and can on occasions produce clinical disease. However this form of the infection has not been reported in Thailand.

Life cycle and epidemiology

Eggs in faeces develop to miracidia, the development time mainly varies with the temperature between 26°and 30°C and is approximately 12-21 days. Miracidia swim in the surrounding water and penetrate through the posterior wall of the mantle cavity of the intermediate host, one of various kinds of water snail of Planorbis sp. Then miracidia transform progressively to elongated sporocyst, rediae, and then cercariae. Cercariae emerge from the snail and encyst on herbage or other objects in the water, becoming metacercariae.

Encystment is complete in about 10 minutes and the new metacercariae gradually darken to an almost black colour. Such stages remain viable for about 3 months (Soulsby, 1982). Urquhart et al (1987) report that after the ingestion of encysted metacercariae with herbage, development in final host occurs entirely in the alimentary tract. Following excystment in the duodenum and ileum, over a period of six weeks the young flukes migrate forward to the forestomachs where they reach maturity. The prepatent period is between 7 and 10 weeks. An outbreak of paramphistomiasis may occur in the drier months, when animals are more likely to graze herbage in wet areas where snails have lived and metacercariae are encysted on the plants.

Clinical signs and pathogenesis

Although there have been some contrary views expressed (Blood et al, 1983), the adult forms in the rumen are generally considered to be essentially non-pathogenic even though large numbers may be present. The cluster of paramphistomes there may cause localized loss of rumen papillae (Soulsby, 1982), but in general the parasite does not appear to significantly lower productivity. In contrast, the immature form in the abomasum and duodenum can cause quite severe gastroenteritis during development. In such cases there is a foetid diarrhoea, dehydration and loss of plasma proteins. Death can occur in 10 to 14 days.

Control and treatment

Many different anthelmintics have been used for treatment of paramphistomiasis, but the commonly used drugs vary considerably in their efficacy against adult and immature stages. Niclosamide and oxyclozanide are effective against this parasite and available in Thailand. For the treatment of an outbreak due to immature stages, rafoxanide and niclofolan are recommended at a dose rate 2-3 times the level recommended for fascioliasis. The flukicide, oxyclozanide, is effective against adult paramphistomes (Urquhart et al, 1987). Control can also be achieved by appropriate management procedures on commercial livestock farms. Buffalo and cattle should be raised in areas away from swamps, and localized areas of water should be fenced off. Drainage of pools or swamps, and duck raising for control of the intermediate host snails are appropriate control measures. However these are difficult to achieve reliably under village conditions.

C. Protozoa

Trypanosoma evansi

T.evansi is a blood protozoan in horses, cattle, buffalo and other species. Its size is 15-34 μm in length with a well developed undulating membrane, free flagellum and subterminal kinetoplast (Soulsby, 1982).

Clinical signs and pathogenesis

Many buffalo and horses in Northeast Thailand were studied by the NE-VRDC and widespread evidence was found of T.evansi infection. Clinically affected buffalo showed clinical signs of high fever (104°-106°F) in acute cases, lethargy, marked muscular weakness and lameness, with watery diarrhoea, and conjunctivitis in some cases. Without appropriate treatment death may occur within a few days. Diagnosis of an acute infection is carried out by direct microscopic examination of freshly stained blood smears or the haematocrit centrifugation technique (Woo, 1969). In chronic cases, diagnosis is confirmed by thick and thin blood smears on consecutive days.

Epidemiology

T.evansi affects a wide range of hosts, but in Thailand the horse and swamp buffalo are most commonly affected. Cattle and buffalo are considered to be the main reservoirs of the infection for equines (Soulsby, 1982). The infection can be transmitted by biting flies, for instance, Tabanus spp., Stomoxys spp., etc. The prevalence of disease is relatively high when seasonal conditions favour breeding of the flies, as at the beginning of rainy season from May to August. (Löhr et al 1986a) reported abortion in late pregnancy in buffalo, caused by T.evansi infection.

Control and treatment

Control of T.evansi depends on therapy and elimination of blood sucking flies, but it is rather difficult under village conditions. Essentially, the trypanocidal drugs available now are

curative or prophylactic (Soulsby, 1982). The compounds in common use for animal trypanosomiasis are as follows:

1. Suramin (Naganol) is given as a single dose of 4 gm/45 kg in the horse, intravenously.

2. Diminazine aceturate (Diamidine, Berenil) is given at a dose of 7-10 mg/kg by subcutaneous or intramuscular injection. (This drug is used only for epidemiological study in the NE-VRDC, not available from other sources).
3. Quinapyramine (Antrycide) is given as a 10% solution in water, subcutaneously at a rate of 5.0 mg/kg. It is very effective against T.evansi.

D. Ectoparasites

Sarcoptes scabiei var.bubalis (Sarcoptic mange mite)

Skin disease mainly occurs in the buffalo in the dry season, between February and April each year, especially when places for wallowing are not available. In a study of 455 buffaloes in 8 villages in north-east Thailand, moderate sarcoptic skin lesions were found in 44% of animals and severe lesions in 2% (Löhr et al, 1986b).

Clinical signs and pathogenesis

The sarcoptic mite causes pruritus as it tunnels through the skin sucking lymph. It may also feed on young epidermal cells, and as a result produces marked irritation, which causes extreme itching. This may adversely affect the condition of animals. Affected areas become inflamed, and serum exudes and dries on the skin surface to form crusts. The skin may be much thickened and wrinkled. Hair loss may also occur. Sometimes the buffalo constantly rubs against fences, poles, or trees that may serve as a scratching post. Infection is spread mainly by contact. In this way wandering larvae, nymphs and fertilized young females are transferred between animals. Once water for wallowing is available, natural control minimizes the problems, and lesions may heal spontaneously at the beginning of the rainy season.

Psoroptic mange can also be seen in some cases, occurring on the head (especially the ears) and the withers.

Control and Treatment

Effective treatment is essential to reduce irritation as quickly as possible. Individual cases are treated with acaricidal solution applied by spraying, sponging or dipping. Dipping is the most thorough method of application for large groups of animals. There are several kind of acaricides available for treatment of sarcoptic mange in the buffalo, including the following.

1. Sulphur It is one of the oldest miticidal drugs and is a harmless remedy for mange treatment. Sulphur is still used because it is cheaper than others and quite effective against mange. Lime-sulphur solution is diluted 1:40 with warm water and applied as a dip or wash. Treatment is repeated at 10-12 days intervals. Because it is of very low toxicity, there are no dangers associated with frequent application of lime-sulphur (Georgi, 1985).
2. Lindane Applied at a concentration of 0.016-0.03% in water as a wash, spray or dip to control mites, lice and ticks. Treatment should be repeated on two or three occasions at an interval of 10-14 days. Repeat treatment is necessary to kill larvae hatching from eggs (Soulsby, 1982).
3. Asuntol (Coumaphos) A wettable drug powder used at working strength of 0.05%.
4. Dursban (Chlorpyriphos) Applied as a solution at 0.05% active ingredient.

Prevention

Supportive measures include improved nutrition and good hygiene. Pens and all other

infected sites should be cleaned out and disinfected by spraying with lindane solution, lime-sulphur dip or organophosphate and left unused for 2 weeks (Soulsby, 1982). Where the chemical compounds are not available, lime-sulphur dip containing 1.5% polysulphide sulphur may be applied as a spray by means of a brush.

Haematopinus tuberculatus (Blood sucking lice)

H.tuberculatus is the old world louse of water buffalo. These sucking lice are usually large, up to 5 mm, with small, pointed head and terminal mouth parts. Louse eggs are glued onto hairs and are easily seen when heavy infestation develops. Louse transmission usually occurs by direct contact.

Clinical signs and pathogenesis

Pediculosis is manifested by pruritus and dermal irritation which cause annoyance and disturbed feeding. In the young calf, extreme infestation with sucking lice can cause anaemia or loss of condition. The animal may develop unthriftiness, and will rub against fences to relieve the pruritis. As a result, wounds and secondary infections may develop (Griffiths, 1978).

Control and treatment

Louse control requires direct dermal application of insecticides as follows:

1. Coumaphos 0.125% suspension
2. Sevin 0.5% suspension

Spraying or dipping should be thorough. Usually 2 treatments 2 weeks apart will eradicate lice. Dipping, however, is more dependable than spraying (Soulsby, 1982).

Boophilus microplus

B.microplus is a one host tick which transmits babesiosis and also causes severe loss of production in cattle.

Life cycle and epidemiology

After engorging on the host the female lays several thousand eggs on the ground beneath vegetation over a period of up to six weeks. The eggs hatch in 14-146 days, depending on conditions, and unfed larvae can survive up to 20 weeks (Soulsby, 1982). The larvae ("seed-ticks") are very active and climb onto the grass to reach a passing host. Once on a host the larvae engorge, moult to nymphs which feed and moult to adults which feed in turn before dropping off the host. Copulation occurs on the animal. Ticks are most numerous on exotic cattle breeds and their crosses; native cattle are resistant to ticks and carry few. In Northeast Thailand B.microplus occurs all year round but numbers increase in the wet season.

Clinical signs and pathogenesis

With a heavy infestation, animals become restless and irritated. Most animals tolerate a few ticks, especially Zebu cattle. If the ticks are present in large numbers, severe anaemia usually occurs. If animals are not resistant to Babesia spp., transmission of piroplasmosis may kill the animal rapidly due to the haemolytic anaemia.

The most susceptible animals to Babesia in Thailand are newly imported cattle. The indigenous breeds and local Zebu cross breed cattle tolerate B.microplus and show very low levels of infestation.

Control and treatment

When only a few ticks are present on an animal, they may be removed by hand. In the case of heavy infestation, where ticks attack most parts of the bodies of the animals, treatment has to be applied regularly to the whole body and the whole herd. It may be conducted by dipping the animals in a tank containing an aqueous solution or suspension of acaricide. Spraying may be utilised with the same acaricides.

For smallholders in Thailand, they may use a portable sprayer filled with acaricide solution. Animals are led into a long narrow bamboo race, then systematic spraying covers the whole body surface of each animal. Acaricides of choice in present use in Thailand are as follows:

Asuntol (Coumaphos) as a wettable drug powder at an effective strength of 0.05%.
Dursban (chlorpyrifos) applied as a solution at 0.05%. active ingredient.

Biting flies

The other ectoparasites which are widely distributed through the area of animal raising are biting flies such as Stomoxys calcitrans, Tabanus spp. and Hippobosca spp. The old world screw worm fly, Chrysomya bezziana, also commonly attacks wounds on animals.

Importance to ruminants

Production losses are due to principally to annoyance and blood loss and may also serve as a mechanical vector for anthrax, trypanosomiasis etc.

MAJOR PARASITIC DISEASES IN NORTH-EAST THAILAND

Ascariasis and Strongyloidosis

During investigation of helminthiasis in young cattle and buffalo in Northeast Thailand between 1981 and 1983, infection rates in buffalo calves under 6 months of age with Toxocara vitulorum and Stongyloides papillosus of 49% and 58% respectively were reported (Löhr, 1982; Hörchner et al, 1986: Srikitjakarn et al 1987). The overall mortality rate in buffalo calves in the first six months of life has been reported as 30-35% mainly due to milk-transmitted T.vitulorum and S.papillosus (Löhr, 1982, 1984b, 1985).

Srikitjakarn et al (1987) reported that the percentage of animals which were excreting eggs of the roundworms S.papillosus and T.vitulorum were as high as 85% and 58% respectively, during the first three months of age. T.vitulorum infection in native cattle (and even in crossbred calves) is generally not associated with serious clinical signs. However, in buffalo calves, ascarids are commonly associated with severe clinical signs and death (Griffith, 1974).

The first detection of T.vitulorum eggs in buffalo calves varies from 21-26 days of age with an average of 23.5 days, whereas the first detection of S.papillosus eggs varies from 5-9 days of age with an average of 7 days. The greatest numbers of S.papillosus and T.vitulorum eggs were found in buffalo calves aged 40 and 50 days respectively (Sukhapesna, 1978). Muanguai et al (1980) studied variation in the number of nematode eggs in buffalo calves in Thailand and found the average prepatent period of T.vitulorum and S.papillosus was 24 and 14 days respectively.

Yutisri, (1978, 1980) reported that buffalo calves in the central and northeastern part of Thailand were found to have a prevalence of 88% for T.vitulorum infection between 20 and 75 days of age, and 92% for S.papillosus infection at 8-119 days of age. Larvae of S.papillosus were detected in the milk of buffalo cows at 5-15 days after calving.

From the age-specific prevalence of Toxocara and Strongyloides eggs it would appear that the best time for anthelmintic treatment would be when calves are 3 and 6 weeks of age instead of 3 and 10 weeks, and this has been confirmed by an epidemiological study (Srikitjakarn, 1986; Hörchner et al, 1988). This study revealed that some calves treated in accordance with the initial recommendation, at 3 and 10 weeks, died shortly after the second treatment. This indicated that the early treatment of calves at three weeks of age is critical and that subsequent treatment at ten weeks of age is already too late. It would appear that administering the second treatment at six weeks of age would be more beneficial than treatment at the tenth week as first recommended. The treatment of calves at 3 weeks of age removes most of the worms derived from the colostrum before they mature. The second treatment at 6 weeks removes any surviving or later developing worms. Srikitjakarn et al (1987) concluded that the timing of the first treatment at three weeks post-partum is critical, and that the second treatment should follow three weeks later for greater effect. They suggested further advantages may be gained by increasing the doses of anthelmintic used to 240 mg of piperazine citrate and 80 mg of thiabendazole per kilogram bodyweight.

Fascioliasis

The most important parasitic disease in adult cattle and buffalo is fascioliasis, which causes severe economic loss throughout Northeast Thailand (Dissamarn, 1961, 1955; Usanakornkul et al, 1980; Löhr, 1982).

Dissamarn (1955) reported the infection prevalence of fascioliasis in buffalo and cattle in Bangkok slaughterhouses was 30%. The parasitology division of the Department of Livestock Development also reported in 1964 that the infection rate had increased to 42%, and the economic loss from fascioliasis in buffalo and cattle was assessed at not less than 100 million Baht.

Wongsongsarn et al (1967) reported that a field survey on parasite problems in cattle and buffalo was carried out in several northeastern villages by veterinary investigators from the Department of Livestock Development. The results from faecal examination of 1359 cattle and 2065 buffalo showed the prevalence of rumen flukes (Paramphistomum spp.) infection in cattle and buffalo was 50% and 65%, and the prevalence of liver fluke (Fasciola gigantica) infection in cattle and buffalo was 9% and 15% respectively.

A more recent investigation revealed that the average prevalence of Fasciola gigantica infection in this region was over 25% in buffalo and 15% in cattle, for animals up to 6 months of age (Hörchner et al, 1986). Infection rate varied considerably between villages, however, from 0-85%. Viboolyavatana (1981) reported that Lymnaea auricularia rubiginosa, an aquatic snail, is considered to be the intermediate host of F.gigantica in Thailand and neighbouring countries.

Most fasciolicides available on the Thai market have an efficacy of over 90% but are only effective against the bile duct stages of fluke and clearance of parenchymal stages is minimal; as a result liver fluke eggs usually re-appear in the faeces of treated animals within a few weeks of treatment. Therefore, a prophylactic program designed to prevent the reappearance of fluke eggs in the faeces and prevent infection of the snail intermediate host would require an impractical number of annual treatments. In practice, one or two annual treatments are given at the time of increasing number of adult flukes. Armour (1983) advised that in temperate zones, where adult flukes (F.hepatica) are known to accumulate during the winter and early spring, the recommended times for liver fluke treatment are December and April in endemic areas or a single treatment in January or February.

During 1982-1984, the epidemiology of F.gigantica and its intermediate host in Thailand was also studied to determine the preferred habitat of the intermediate host, and to ascertain possible seasonal changes which might affect development of F.gigantica and its cercarial stages in the snail. The snail population notably increased between December and May each year under field conditions, because at the end of the rainy season and through the dry season is the favourable development period for the snail. The highest incidence of infected snails occurred between December and February. This means the snails were invaded by

miracidia from the end of September (Hörchner et al, 1988). The liver fluke infection of animals in northeast Thailand can be found throughout the year, but the peak of incidence is in September, and is a consequence of the peak of cercarial infected snails during December to May. The larval development period (from miracidium to cercaria) requires about 45 days before December, so if the animal is treated at the beginning of September with an effective drug against adult flukes, the infection of Lymnaea snail should be prevented, and the infection cycle of F.gigantica. would be interrupted.

Srikitjakarn (1986) showed that with strategic treatment against F.gigantica the percentage of the cercarial infected snails was remarkably reduced from 30% at the beginning of treatment to 5% and 1% 3 and 4 months later respectively. A single treatment of all Fasciola spp. infected animals once a year at the beginning of September causes a large reduction of cercarial infected snails during the following season. Therefore, it considerably reduces the reinfection of snails, and if carried out regularly once a year for a series of years, would result in a major reduction of infection levels, comparable to that achieved in other countries with very different climatic conditions (Hörchner et al, 1988).

It would give the best therapeutic effect if a second treatment was carried out at the end of dry season in April, when most flukes have matured; and especially because by that time the condition of most animals is at its worst, due to the cumulative effect of successive months of starvation compounding the effects of the parasitism. Because flukes lower feed conversion efficiency, improvement of the feeding of animals infected with Fasciola spp. will not give as good a result as it should, unless the liver fluke problem is controlled at the same time (Morris, 1979a).

The perfect control program for fascioliasis should consider also snail population control. At the present time use of molluscicides is usually impractical under village conditions due to the large body of water involved and their possible effect on fish and other life.

REASONS FOR PROMOTION OF PARASITE CONTROL IN VILLAGES

Basic Animal Health Service Objectives

Most farmers have never taken any kind of preventive measures, nor sought veterinary advice except in some cases after an outbreak of disease has occurred. Farmer interest in and basic knowledge of parasitism were both very low due to lack of effective extension effort and irregular contact with veterinary services. DeBoer (1972) mentioned that animal health technology is generally unavailable at the village level. Vaccines are available from the PLO, but local knowledge on when or how to administer them is lacking. The normal pattern is one visit per year by the local veterinary officer, and only a widespread outbreak of a fatal disease brings additional visits.

The veterinary service infrastructure and other forms of government assistance are too sparse for farmers to be able to call for veterinary help whenever they really need it. Long distances to the nearest chemist's shop, and the remarkably high costs for simple modern drugs aggravate the situation. Thus a new approach to solving animal health problems in the villages was clearly needed.

Moreover the experience and knowledge of village farmers of disease control and prevention is also sparse or virtually non-existent. Very often traditional and superstitious cures have been used on sick animals. The occasional distribution of drugs free of charge to the villagers through representatives of the DLD is unlikely to have any long term benefit or to contribute significantly towards improvement of health and production.

In order to solve animal health problems in rural areas, the ideal approach would seem to be to place the farmer into a situation where he can help himself in solving his livestock health problems. Therefore it was considered after an evaluation of the situation that

progress towards controlling the most important diseases, notably internal parasites in calves and adult animals, would require the development of a service based firmly in the villages themselves.

Requirement for Implementation of the Basic Animal Health Service

The hypothesis was that this could be achieved if:

1. The government could provide drugs constantly as cheaply as possible for sale to farmers in their villages.

2. The farmer received extension services from trained fellow farmers, termed **"village keymen"**, who would teach farmers about the benefit from use of these drugs, and supervise treatment of animals.

CHAPTER TWO

STRUCTURE AND METHOD OF OPERATION OF THE PARASITE CONTROL PROGRAM

INTRODUCTION

Initial work on the health and productivity of swamp buffalo and cattle carried out under the Thai-German Animal Health Project, as described in Chapter 1, demonstrated that internal parasitism was a major factor in calf mortality and also in lowering body weight of adult animals. Toxocara vitulorum and Strongyloides papillosus were shown to be the main factors in the calf mortality, and Fasciola gigantica in the debilitating effects on adult animals, which in some cases caused death.

Epidemiological studies had shown the feasibility of control of both problems, but village farmers lacked both the knowledge of the parasite problem to enable them to take action, and a readily available source of effective drugs to carry out treatment at the epidemiologically appropriate times. It was also clear that the existing veterinary infrastructure could not be stretched to provide these services in addition to their existing functions.

It was concluded that the solution lay in a cooperative form of animal disease control, whereby volunteer farmers were given elementary training in the epidemiology and control of these important parasites, and supplied with drugs which they could dispense to treat animals belonging to farmers in their own and nearby villages. They would thus act as extension agents on behalf of the DLD, and as distributors for suitable effective drugs. They would be motivated to carry out their role by receiving a percentage of the retail price of each dose of drug they sold.

The proposed program was termed the "farmer self-help worm control program", which was envisaged to be the core of a broader "basic animal health service" which would be operated by village farmers trained as program "keymen". They would carry out their functions under the guidance of veterinary staff of the DLD, with drugs being supplied down through the veterinary hierarchy to the keyman, and payment being sent back up through the same hierarchy. The first step in adopting this approach was, however, considered to be a small scale pilot project in which the feasibility of the approach was tested in a limited area before wider adoption was attempted.

FARMER SELF-HELP WORM CONTROL PROGRAM - THE PILOT PROGRAM

Therefore such a pilot program was developed in 20 villages of 4 provinces (Ubonrachathanee, Sakonakorn, Loei and Surin) for a two year period in 1983-1984. This provided a suitable test group on which to evaluate farmer interest in the program.

The purposes of the pilot program were to find out if the farmer is interested in controlling worm problems in his livestock. It also tested whether he is prepared and able to pay for drugs made available in his own village at a price which just covers essential costs, if he also receives extension services promoting the scheme from his village keyman. For this pilot study, five villages were selected from each of four provinces with a total of 1874 farmers who kept buffalo and cattle. These farmers owned 8304 animals above 18 months old. Discussions were held in the villages and farmers subsequently selected one keyman in each of the 20 villages.

The village keymen were trained by veterinary officers from the NE-VDRC in the following subjects:

1. Basic knowledge of the health problems caused by helminthiasis.
2. Principles of parasite control and prevention
3. Use of forms for simple accountancy to monitor drug use.

The keyman, at that time, was visited at least every two months by veterinary investigators of the Northeast Veterinary Research and Diagnostic Centre. Keymen accounted to the veterinarian for drugs sold and stock remaining, and were paid 10% commission on drug sales they had made since the last visit.

The results of the Worm Control Farmer Self-Help Program are tabulated below:

	1st year	2nd year
Number of provinces	4	2
Number(percentage of total) of farmers who participated one or more times (47%)	839/1865 (45%)	437/930
Number of calves born	930	875
Number(percentage of total) of calves treated at 3 weeks (60%)	499/924 (54%)	205/342
Number(percentage of total) of calves treated at 7 weeks (47%)	355/934 (38%)	161/343
Number(percentage of total) of animals treated for liver fluke (16%)	1160/8286 (14%)	578/3613

The results of the pilot program proved that a substantial proportion of the farmers care for the health of their animals and that they are prepared to pay for drugs, if they can buy them cheaply in their villages and if they receive relevant extension services (Löhr et al, 1984b). Motivated by the positive results and public interest, proposals for large scale implementation were submitted to and accepted by the Thai government. From 1984 onward the program was introduced progressively in seven provinces.

OPERATION OF THE EXPANDED SCHEME COVERING ADDITIONAL PROVINCES

Because the first year results were better than expected and stimulated great public interest, they were submitted to the Thai government, together with proposals for large scale implementation of this program. It was pointed out that the program is based on the following principles:

1. Farmers can help themselves in providing animal health care and asking trained keymen for extension services with respect to parasite control measures. A revolving fund provides financial backing for continued drug purchases and ensures constant drug supply in villages.

2. The farmer can buy drugs at any time and have his animals injected for liver fluke at a very low cost. The program is not profit-making, but covers costs.

3. The farmer receives extension services from his village keyman, who is selected by villagers.

4. A chain of incentives from the PLOs down to the village keyman is built in and should also minimise the risk of loss of drugs and to motivate participants to commit time and effort to the program.

5. The financial support of the program is a revolving fund administered by the Department of Livestock Development in Bangkok with a sub-centre in the Region.

Funds to purchase the original drug supply were provided by the Federal Republic of Germany, but the fund has subsequently been maintained out of income from drug sales, returned by keymen to the revolving fund through the hierarchy of the Department of Livestock Development.

Advantages of the program are:

1. Losses in livestock production from poor animal health can be reduced at farm and national level.

2. The Department of Livestock Development establishes permanent access to even very remote villages, thus allowing additional livestock improvement measures to be implemented. No additional government staff are needed.

3. The government incurs minimal extra costs for administration.

4. The program enables the farmer to help himself independently in solving his animal health problems over the long term. Since he pays for the drugs, he will be motivated to use them effectively.

5. It ensures that effective drugs are always available at the village level at a cheap price.

6. Farmers can purchase drugs from the keymen on credit if necessary for a period, instead of paying cash.

After development proved successful in the first two provinces, a proposal to enlarge the scheme was accepted and the program was progressively introduced in further provinces. By 1988 seven provinces of the 17 in the north-east were participating.

MANAGEMENT OF PARASITE CONTROL FARMER SELF-HELP PROGRAM

Criteria for Area Selection

Initial selection of provinces in which to conduct the program was based on these issues:

1. It was decided that the program should be conducted in areas of high prevalence and incidence of helminthiasis in buffalo and cattle calves, and of fascioliasis in adult buffalo and cattle. The villages with a high density of farmers and animals could be expected to benefit most from the establishment of this scheme.

2. To achieve the goals of the scheme, active participation of the PLO and DLO are important requirements. The scheme, therefore, should be expanded in provinces where the farmers have been most supportive and most interested to the scheme, and veterinary staff in the area have been enthusiastic.

3. The program will be most useful to farmers located in remote areas far from any official veterinary extension services.

Criteria for Keyman Selection

It was also decided that:

1. The keyman should be a male between 20 and 50 years of age. Those who are too young will be unacceptable and unknown to farmers, while a farmer whose age is over 50 years might be inactive and too old to perform the extension service in villages.

2. The keyman should be a permanent resident in that village, so that the neighbouring villagers will trust him.

3. He must be able to read and write, and must volunteer to participate in the scheme.

4. Two farmers should be selected from villagers in each Tumbon[1] to become keymen in that area. They would work under the supervision of the Tumbon councils[2] and the DLOs, with respect to their individual performance and responsibilities.

5. The best keyman will be one who is able to transfer ideas or knowledge obtained from his training to encourage farmers to use the modern parasite control methods.

Revolving Fund Organization and Functions

The revolving fund administration is based at the Department's Headquarters, assisted by the NE-VRDC. It has the following responsibilities:

1. Timely purchase of drugs, syringes and needles;

2. Calculation and official posting of drug prices;

3. Design, printing and supply of all delivery and receipt accountancy, booklets, price posters, guide leaflets and shoulder bags (keyman's drug container);

4. The organization and co-ordination of training and refresher training for keymen, extension work and supply of drugs via provincial and district authorities.

Drug Supplies and Incentives

The main drug stock is held in the DLD which supplies products directly to the PLOs. The PLOs supply the drugs to their DLOs who supply the keymen. At least every two months, or when the keyman's drug stock is nearly exhausted, he contacts the DLO and receives a new supply. Farmers therefore purchase drugs directly from the keymen; 13% of drug sale income is retained by the keymen as an incentive to actively promote the program, while the remaining 87% of money from drug sales is forwarded to the DLO.

When the DLO's drug stock is nearly exhausted or every month, he reports and accounts to the PLO and receives new supplies. Then, he will officially receive for himself from the PLO 3% of the sum he has accounted for. This 3% covers the DLO's risk of operational loss of drugs and provides a small incentive payment for his work.

The PLO pays the money into the special account at the bank of the Provincial Administration, from where the money is passed to the revolving fund administration in the Department of Livestock Development Headquarters in Bangkok. Then he will receive from the fund administration 2% of the money he has accounted for to cover his risk and as an incentive.

---

[1] A Tumbon is a small rural sub-district comprised of approximately 5-15 villages with the number of 1000-4000 buffalo and cattle, administered by "Gumnun" who is selected by families from village headmen in that particular area. The Gumnun's house is known as the Tumbon's office.

[2] The Tumbon council is a working group of people supervised by the Gumnun, and includes all village headmen. The opinions of the council on village and Tumbon matters represent those of farmers in that area.

EXTENSION ACTIVITIES

Training Program for DLOs and Keymen

One day training courses for DLOs were normally conducted in October by the staff of NEVRDC and DLD. These courses dealt with the principles underlying the new concept of the Worm Control Farmer Self Help Scheme and provided training on how to organise drug supplies to keymen through the revolving fund and on keeping accounts of transactions. Subsequently over the next month or so, and assisted by the Tumbon Council, the DLO selected the two farmers in each area who were to become keymen.

The best time for the initial training of keymen is between November and January (the peak of the calving season). This then gives the newly trained keymen the opportunity to provide their extension service to farmers at a time when they have newborn calves so that the benefits of following their recommendations will be immediate and self-evident.

In their training the keymen were given instruction in parasite control methods, drug uses and simple techniques for promotion of the scheme in their own areas. They serve an average of 5-8 villages covering 100-300 families. Groups of 100 keymen received a one day training course. In the first half day the scheme was outlined. They were shown videotapes on the activities of NE-VRDC, including a sample story of a well trained keyman and his actions involved with the scheme. They were also shown a videotape on drug administration, and slides concerning common animal diseases in the Northeast. In the second half day of training, drug administration was practised by the trainees in groups. Each keyman was given a shoulder bag containing the initial supplies of anthelmintics effective against roundworm in calves and liver fluke in adult buffalo and cattle together with a syringe and needles. Posters promoting the scheme were also distributed at the conclusion of the course.

Keyman Refresher Training Courses

Keyman refresher training courses were conducted every 6 months during the first two years of the scheme in each participating province. The purpose of these training courses was primarily to stimulate the keyman's activities, but also to encourage the activities of field veterinarians. This training was mainly organized and performed by the staff of NE-VRDC, with some assistance from DLD staff.

The extension packages provided for training are two videotapes on parasite control methods and the keyman's duties, plus some additional slides of local animal diseases in which keymen are able to effect cures with drugs obtained from the scheme. Material for keymen on how to carry out the parasite control methods in their Tumbons was also covered. Many questions from keymen were raised and discussed with a small group of them in each district. The questionnaire forms for collecting the initial information and forms for recording drug stock usage of participating keymen were also explained. These training courses provided a boost to the revolving fund and use of drug supplies in the areas which participated in the scheme.

Extension Packages for Keymen

After finishing the first training course, each keyman was given an extension package which contained the following materials for the extension services in his own areas.

1. Five copies of a attractive, colourful poster on the life cycle of each of the two major parasites, the common round worms of calves and liver fluke in adult buffalo and cattle. These posters should be shown to farmers as soon as possible in order to create farmer understanding of the parasite control methods. Keymen were encouraged to promote the program, using poster demonstration in their own and other villages. The posters have been used within the villages in different ways, such as the following:

* Posters have been displayed in the public place in villages called **"Sala Klang Ban"** where the farmers usually come for a village meeting.

* Posters have also been displayed in front of the keyman's house.

* Keymen asked for assistance from the village headmen to hold a village meeting either in their own or other villages, so that they would have a good opportunity to explain to farmers the knowledge on parasitism which they obtained from training, associated with a poster demonstration. Furthermore, by this method, farmers could ask questions related to parasite control from keymen. This method proved to be the best way of transferring knowledge on parasitism from keymen to farmers, because a most important concept of this scheme is farmer understanding of parasitism.

2. Two drug price list posters giving details of the official recommended prices which need to be shown at the same places as mentioned above.

3. A keyman's manual of the parasite control method describing the prophylactic treatment and offering substantial information on parasitic problems. Keymen have been strongly advised to read this manual regularly to improve their own understanding and to help them transfer their knowledge to other farmers.

4. A shoulder bag containing the two anthelmintics, three other essential medicaments and a good quality plastic syringe with a few needles.

It is most important for the development of the keyman's extension services (after they have completed the first training course) that they should immediately explain to the neighbouring farmers what they have learned and how they could assist in solving animal health problems. These activities can be effectively organized under the leadership of the village headmen in the keyman's village and in other neighbouring villages.

Anthelmintics Used in the Scheme

During the first two years of the scheme (1984-1985), only two kinds of anthelmintic drugs were administered.

1. Piperazine-Thiabendazole (Pip-Thip)

Muanguai et al (1980) reported that anthelmintic drugs against both parasites can be mixed in the proper ratio and may be administered at the same time. This deworming drug in mixed powder form was administered to calves in two doses to control T. vitulorum and S. papillosus as follows:

1.1. Pip-Thip Formula 1

Drug powder was packed in a paper bag, each containing 13.5 gm in a ratio of Piperazine:Thiabendazole 2:1 (w/w) in the form of piperazine citrate (98%) and thiabendazole (50% as "Thibenzole", Merck Sharp and Dohme) in powder form. The package was labelled in red letters, "Highly recommended for calves at 3 weeks of age as the initial dose". Fifty packages were initially supplied to each keyman. The official recommended price to the farmer was 7 baht (NZ$0.50, US$0.30) per package.

1.2. Pip-Thip Formula 2

Drug powder was packed in a paper bag containing 19.5 gm of the same drugs and ratio as in Formula 1, labelled in blue letters, "Particularly recommended for growing calves at 10 weeks of age as the second dose". For the initial supply, thirty packages of Formula 2 were given to each keyman. The recommended price to the farmer was 10 baht (NZ$ 0.66, US$ 0.40) per package.

The effect of anthelmintic treatment as described at 3 and 10 weeks of age in buffalo calves under village conditions was studied by a staff member of the NE-VRDC. There was a reduction in the combined morbidity/mortality rate from 32% to 10% ($P<0.05$). However further observational studies on the strategic treatment of both parasites suggested that better gains could be made by giving the second treatment at six (instead of ten) weeks of age, and by increasing the dosage of the drugs (Srikitjakarn et al, 1987).

2. Niclofolan (Bilevon)

This injectable solution is very effective against mature liver fluke in adult cattle and buffalo. The drug was distributed in bottles of 100 ml. and recommended to be injected subcutaneously at a dose of 2 ml per 100 kg. bodyweight. The best time for the injection in areas of low incidence is once a year in September, but in the areas of high incidence a further injection is desirable in April when most animals are suffering from the combined effects of fascioliasis and inadequate feed supply.

Keymen were carefully trained in drug administration at the first training session and this was reinforced by their DLOs after that period. This injectable drug is potentially dangerous for the animal and may be fatal if a severe overdose is administered. Only keymen were therefore allowed to inject the drug. The initial supply for a keyman was four bottles. The recommended prices were as follows:

100-200 kg.body weight (approx.)	4 ml of drug	7.00 baht(US$ 0.28)
>200<350 kg.body weight (approx.)	5 ml of drug	8.50 baht(US$ 0.34)
>350 kg.body weight (approx.)	7 ml of drug	11.00 baht(US$ 0.44)

The following drugs have been added in the scheme since 1986:

1. Asuntol

This drug is administered by keymen for external parasite control in buffalo and cattle. Drug powder is packed in a paper bag of 10 gm. The official recommended price is 16 baht (NZ$ 1.06, US$ 0.64) per package. Successful treatment may require more than one application.

2. Eye drops for use against buffalo eye worms (Thelazia spp.)

2.5 gm amounts of levamisole (Concurat) in powder form are packed in each of three small plastic bags contained in one paper bag. This is for the convenience of the farmer. The recommended dose is one-fourth of the amount of drug in a small bag (i.e. 0.6 gm) dissolved in 20-30 ml. of clean water. This solution, dropped directly into the eye, causes the death of the eye worm immediately. The official recommended price of a complete packet of drug is 22 baht(NZ$ 1.46, US$ 0.88).

3. Wound powder

40 gm of Negasunt containing coumaphos, propoxur and sulphanilamide in powder form is packed in a plastic bottle. External application by direct spraying on the wound is recommended. This drug is also highly effective for screw worm. The official recommended price is 38 baht (NZ$ 2.53, US$ 1.52) per bottle.

RESPONSIBILITIES OF KEYMEN

Because the keymen are very important to the project they must be carefully selected by the Tumbon council and the DLO in particular; those selected should be highly respected by the villagers.

Desirable Characteristics of Keymen

Keymen need to be very carefully selected in order to contribute fully to the program. The following criteria are used for selection:

1. They should have a high sense of responsibility;

2. They must be willing to cooperate with the DLO in carrying out the work of the program;

3. They should be able to successfully promote the sale of drugs used in the scheme and manage their drug supplies to the satisfaction of the DLO;

4. They should be able to successfully transfer the knowledge gained from the training and their DLO to the farmers in their Tumbons;

5. They should exercise a high degree of care and responsibility for the drugs and equipment entrusted to them;

6. They should be willing and able to regularly account to the DLO for drugs sold and send accounts and money received on a regular basis.

FARMER PARTICIPATION IN THE SCHEME

In previous assistance programs in the north east, the government had provided vaccines and drugs through the DLOs to the farmer free of charge. However this approach does not necessarily motivate the farmers to use the drugs in the right way, and the organizers of this project believed it would be better for farmers to accept responsibility for helping themselves. Therefore the drugs were made available at a price which covered all costs but was still well within the capacity of the farmers to pay. Some farmers quickly adapted themselves to this new concept, but the majority took quite a long time before participating in the scheme.

The keyman is himself a farmer, and must be seen to use the drugs on his own animals to demonstrate both that he knows what is he doing and that the drugs are safe and effective. Thus he will convince the other farmers that the scheme is valuable. It inevitably takes time to build up confidence among non-participants.

At the beginning of the scheme the level of farmer participation was low. Once results on the keyman's farm were available, other farmers joined the scheme because of confidence built on his practical results. The level of farmer participation was further encouraged through the availability of the drugs from the keyman at a low price, whenever required. In cases where the keyman is also the village headman, the level of farmer participation may be even higher than in other areas because of his position of power, but the headman has many other responsibilities, and the aim was to encourage farmers to participate mainly on the basis of results they could see for themselves, so that their motivation to use the drugs would continue in the long term.

THE ROLE OF VARIOUS INDIVIDUALS IN PROMOTION OF THE SCHEME

Five individuals from various organizations are mainly concerned in the promotion of the scheme:

1. The keyman
2. District Livestock Officer (DLO)
3. Provincial Livestock Officer (PLO)
4. Provincial Veterinary Officer (PVO)
5. Regional Livestock Officer (RLO)

The Keyman

The keymen can make simple promotional efforts through introducing themselves to the farmers in their areas and providing their help to village headmen. They will explain what the system offers, and what they have learned from their training. The Tumbon (Sub-district) served by the keymen contain 5-15 villages so the keymen have to travel to each village to undertake extension work concerning the scheme throughout the area.

The next step is to distribute and display posters obtained from the keyman training course, showing parasite life cycles. In addition, the keyman must prepare and set up a roadside sign in front of his house giving details of drugs available for animal health.

The keyman has to convince the farmer of the necessity for prophylactic treatment and also of the need for farmers to start helping themselves. The keyman is provided with promotional materials for distribution throughout his area, in the form of pamphlets.

The keyman must be able to communicate clearly to the farmer that the drugs are supplied at a very modest price, but are not free of charge. The farmers must know that they should contact the keyman for the drugs.

The District Livestock Officer(DLO)

These officers are expected to support the keymen in their areas by instructing the village headmen to assist the keymen in their work. The DLO should also provide a list of names of keymen, to be distributed to all village headmen.

The DLO is responsible for ensuring that farmers who approach him directly for drugs are sent back to the keymen in their areas. The DLO is responsible for the ordering of drugs from the PLO and supplying drugs to keymen, making sure there is an adequate supply on hand at all times. He is also the local keyman's advisor on methods of improving animal health. He oversees drug usage and is the accounting officer for drug sales.

The Provincial Livestock Officer(PLO)

The PLO is responsible for promotion of the system at provincial level, and holds a large stock of drugs obtained from the Department Headquarters in Bangkok. As part of their promotional scheme PLOs often run "a week of worm eradication" (fully described in Chapter 5) in selected areas which have a higher than normal incidence rate of parasitic problems. As a result there will usually be a sharp increase in drug usage and a corresponding decrease in parasite prevalence. Such a decrease can be shown, for example, by liver fluke egg counts in faecal examinations.

The Provincial Veterinary Officer(PVO)

The PVO is a veterinary clinician, working in the PLO's office, responsible for the prophylactic program at the provincial level. PVOs provide operating guidelines and technical direction to both DLOs and keymen.

The Regional Livestock Officer(RLO)

The Northeast area is designated as comprising both the third and the fourth veterinary regions in the country. Each of these is controlled by a Regional Livestock officer.

It has been decided to use the RLO's office as a training centre. The DLOs and PVOs will attend training courses on the Basic Animal Health Service and expand their overall knowledge of the scheme. They will subsequently pass on their knowledge to the keymen in their own areas.

ROLES OF THE NE-VRDC IN THE SCHEME

The NE-VRDC was established in 1978 and is providing laboratory diagnostic, scientific and technological information for field veterinarians and farmers, to assist in disease control measures in the 17 northeastern provinces. The centre is located in Tha Phra, a town about 15 km from the provincial capital Khon Kaen. These activities are a joint venture between the Royal Thai Government and the Government of the Federal Republic of Germany.

The centre is responsible for disbursing funds received from the Federal Republic of Germany and is accountable for its operations to the Department of Livestock Development. As mentioned in the section on extension activities, the NE-VRDC also provides the initial training and refresher training course for keymen. A further function is to act as a liaison office between keymen, the DLO and the PLO within each area.

ROLE OF THE DEPARTMENT OF LIVESTOCK DEVELOPMENT, BANGKOK

The headquarters of the Department in Bangkok is responsible for administering the revolving fund which pays for continued supplies of drugs to be purchased, and also for approving policies related to the overall administration of the scheme, and plans for its further development.

CHAPTER THREE

DESIGN OF SURVEY PROCEDURE TO EVALUATE FARMER ACCEPTANCE

OVERALL OBJECTIVES OF THE STUDY

By 1986 the farmer self-help worm control program was well established, and covered six provinces. In general the program was working well, but it had become clear that there were large differences in the level of drug sales between different keyman areas. Since decisions would have to be made on how to further expand the program, it was decided to undertake a study to identify factors responsible for the variation in adoption, and to provide guidance on the direction which should be taken in the future development of the program.

The objectives of the survey were defined as follows:

1. To investigate factors influencing farmer acceptance of the scheme in provinces which had participated for either one or three years.

2. To evaluate factors influencing the effectiveness of keymen in serving farmers in their assigned areas, by comparing farmer knowledge of parasitism and attitudes towards the parasite control scheme between **"high adoption areas"** and **"low adoption areas"**. The "adoption rate" for classifying keyman areas was judged on sales of anthelmintics by each keyman.

3. To investigate differences in level of understanding of parasitism between farmers in provinces which did not yet participate in the scheme and those in provinces which had participated for either one or three years.

4. To collect data necessary to carry out an economic analysis of the benefit provided by the existing scheme, and the costs and benefits of various enhancements which could be made to it.

IMPLEMENTATION OF THE SURVEY

The survey was carried out in a number of stages, to ensure that the data obtained was accurate, and properly represented the views of farmers in the selected study areas. The stages were as follows:

1. The Thai translation of the questionnaire was evaluated by an advisory group at the NE-VRDC to ensure both that the meaning of each question was the same in both English and Thai, and that the questions were worded appropriately to obtain accurate responses from Thai farmers.

2. The survey forms were pretested on groups of farmers and keymen outside the proposed study areas to test the validity of the questionnaire designs and eliminate any difficulties in obtaining useable answers. Adjustments were made to each questionnaire after the pre-test in the light of experience with the pre-test, before it was used on the genuine survey population. Since the aim of the pretest was only to determine the validity and thoroughness with which the questionnaire forms could be completed, and whether or not interviewees would understand the questions, the results from this group of farmers were not utilised further in the analysis.

3. In phase 1 of the survey a single province which had participated in the scheme for three years (Mahasarakam) was studied in depth, both to gather results and to decide if a less intensive sampling would be adequate in the remaining five provinces.

4. In Phase 2 a second province which had participated for three years was studied, plus two provinces which had participated for one year. Two provinces which were due to join the program in future were also studied.

FIGURE 3.1

THE PROVINCES IN THE STUDY AREAS

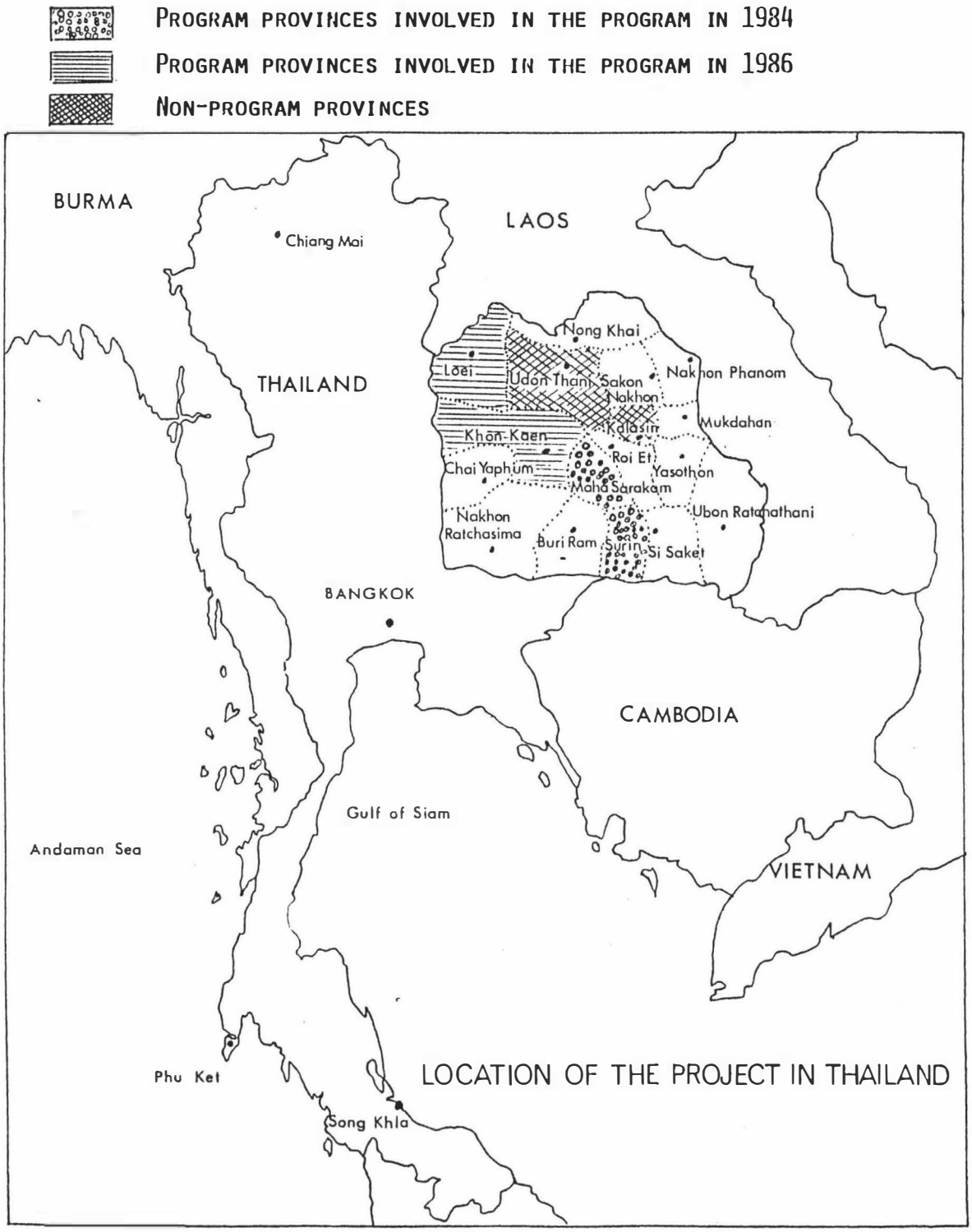


Figure 3.2 Photograph - Interviewing Farmers for the Study

Figure 3.3 Buffalo Are Essential Sources of Work Energy

Figure 3.4 Buffalo Must Survive Through the Hot Dry Season When Feed Shortage and Other Stresses Are Severe

Figure 3.5 There Are Many Habitat Sites for the Intermediate Host of Fasciola gigantica

Figure 3.1 shows the provinces of the north-east, and identifies the provinces included in the study. Appendix 4 contains maps showing in detail the provinces and the Tumbons in which interviewing was undertaken. Further details of the survey population and the procedure followed are given below.

QUESTIONNAIRE DESIGN

The instruments used for field data collection were three questionnaires, one for farmer interviews, one for village headman interviews and one for keyman interviews. The questionnaires followed a similar pattern, but were targeted to the different information which could specifically be provided by each of the three types of respondents. The questionnaires were designed in the Department of Veterinary Clinical Sciences, Massey University, then translated into Thai so that the meaning would be clear both for Thai farmers and for each of the participating interviewers. Appendix 2 contains examples of each of the three questionnaires in English, and examples of the farmer and keyman questionnaires in Thai.

The Questionnaire Forms for Farmers and Village Headmen

The questionnaire forms for farmers and village headmen were divided into eight parts, covering the following subjects:

1. Basic farming information
2. Animal ownership and trading of animals
3. Animal management
4. Disease problems in buffalo and cattle, and health care practices
5. Farmer knowledge concerning parasitism
6. Farmer attitudes towards participation in the worm control farmer self-help scheme
7. Farmer attitudes to keymen
8. The effectiveness of various types of publicity in promoting the scheme.

Farmers and village headmen were interviewed using basically the same questionnaire forms, but some extra questions were asked of the village headmen, such as the size of the human and animal population in the headman's village.

The following is a summary of the various parts of the questionnaire forms completed with the farmers and headmen:

1. Basic farming information

These questions provided information concerning the name, address, age, and sex of the farmer, the number of people in the family, the main and subsidiary farming activities undertaken, area owned and income of farmers from various sources.

2. Animal ownership and trading of animals

This section covered the numbers of buffalo and cattle the farmer owned, purchased and sold during the year under consideration. The market value of animals in different age groups was also obtained for the economic analysis in Chapter Six.

3. Animal management

Farmers were asked about the uses they make of buffalo and cattle and which member of the family took primary responsibility for various aspects of care for the animals. Enquiries were also made about hiring of animals for ploughing, supplementary feeding of the animals, and the costs of keeping animals.

4. Disease problems in buffalo and cattle, and health care practices

This group of questions comprised the major part of the questionnaire. The questionnaire asked farmers and village headmen about their animal health problems, comparing them between the previous (1985) and present year (1986). They were asked what action they took when an animal was sick, both now and five years earlier. They were also asked about the sources of animal health advice they used, and the sources of drugs which they used to treat their animals. The questions dealt separately with the health problems of calves and adult animals.

5. Knowledge concerning parasitism

Information was also sought which would help to identify the level of knowledge of the farmers concerning the various major parasites which occur in the area. This was done by showing them specimens of Toxocara, Fasciola and Lymnaea. They were asked first for information which could be obtained by accurate observation in the field, and then for epidemiological information which would only be accessible through an extension program such as the farmer self-help scheme.

6. Farmer participation in the scheme and attitudes towards it

Questions were asked to ascertain the knowledge of farmers concerning the organization of the farmer self-help worm control scheme, and how they should obtain supplies of the drugs. They were also asked about the benefits of the scheme, both through its effect on calf survival and its effect on the value of adult animals treated for liver fluke. These results were required from the farmers to include in the economic analysis.

7. Farmer attitudes to their keymen

Farmers were asked about their knowledge of the keyman in their area, and their understanding of his activities. They were also asked questions which evaluated whether or not they thought the keyman was effective in his role.

8. The effectiveness of various forms of publicity in promoting the scheme

Finally, farmers were asked a series of questions about promotional material they remembered, to help determine which of the publicity methods used to promote the program had been most effective.

The Questionnaire Form for Keymen

Sixteen keymen from the selected areas in the four program provinces were interviewed, using the special keyman questionnaire forms. The first half of the keyman questionnaire was similar to the farmer questionnaire, because information was needed on their farming practices, for comparison with those of the other farmers. Therefore they were interviewed on basic farming information, animal ownership, animal management, diseases occurring in their buffalo and cattle, and animal health care practices.

The second half of the keyman questionnaire covered the nature of work as a program keyman, including experiences and difficulties. Since all keymen perform their activities differently due to individual personalities, questions were asked which would clarify the differences among keymen in their approach to the job which might help to explain the variation in their effectiveness in selling anthelmintics. Information was therefore sought on each keyman's activity, their impression of farmer knowledge about the parasite control program, and their approach to administration of the scheme in their area. Questions were also asked to test each keyman's retention of the knowledge about parasitism provided in the one-day initial training course, and especially in follow-up training given in the year prior to the survey (1986). Details of the issues covered are provided in the sample questionnaire in Appendix 2.

SELECTION OF STUDY AREAS

The questionnaires were administered to farmers, headmen and keymen in selected keyman areas within six provinces. The aim was to compare the situation in areas where the farmer self-help worm control program was well established with areas where it was relatively new and areas where the program did not yet exist. In the last case, this would provide an assessment of such matters as the level of knowledge of farmers concerning parasitism in the north-east in the absence of a control program for parasitism.

In subsequent discussion of results, the four provinces in which the program was functional at the time of the study are referred to as the **"program provinces"**. Those which had been in the program for three years at the time of the study are referred to as **"three year program provinces"** and those which had joined a year before the study are called **"one year program provinces"**.

The other two provinces, which at the time of the study were designated to be the next to join the program, are identified as the **"non-program provinces"**.

Selection of Provinces

The provinces which were selected to meet these criteria had to be drawn from a short list of choices, and the ones chosen were considered to represent the situation as broadly as possible across the region, and to have no atypical features. The province names and the abbreviations which are used throughout the thesis to represent them are as follows:

1. Mahasarakam (MK) and Surin (SR), provinces which joined the program in 1984.
2. Khon Kaen (KK) and Loei (LE), provinces which joined the program in 1986.
3. Udornthanee (UD)and Kalasin (KS), provinces which are to join in the future.

The location of these provinces is shown in Figure 3.1.

Selection of Keyman Areas Within Provinces

Within each program province, four keyman areas were selected as study sites. Two were chosen to be **"high adoption"** keyman areas and two **"low adoption"** keyman areas. Adoption of the program was measured for this purpose by the only realistic indicator - the scale of drug sales achieved in the recent past by the particular keyman. Provincial Livestock Officers keep records of all drugs for the program dispensed to each of the keymen, so these records plus local knowledge of the areas were used to select areas in which the keyman had achieved sales in the highest quartile of the range (high adoption) or the lowest quartile (low adoption). The selection criteria were explained to the PLO of each province, and selection was then carried out by the PLO in consultation with the DLO for the particular area. It was necessary to ensure that study areas were accessible by road and that there were no unusual circumstances either about the area or about the reason for drug sales being at the extreme ends of the range, but apart from these limitations, selection was as far as possible random.

Selection of Interviewees Within Keyman Areas

Once a keyman area had been chosen for inclusion in the study, the DLO was asked to arrange for the selection of interviewees in each area. As explained in more detail below, this involved choosing villages within the keyman area which met defined criteria about distance from the keyman's own village, and then selecting a random sample of two farmers within each village. This was done by contacting the headman of each village, explaining that a study concerning the farmer self-help worm control program was being conducted, but without explaining in any more detail the objective of the study or the fact that high and low adoption areas were being compared. The headman was requested to randomly select two farmers and ask them to come for an interview at the designated time. Headmen were asked

not to select close associates, but rather to choose in an appropriate random way. The headman was also asked to participate, and to arrange for the keyman to be interviewed if this was a village in which a keyman lived. All reasonable efforts were made, therefore, to ensure that respondents were representative of the overall views of the farmers of the area, and no evidence emerged in the interview process or the analysis of the data to raise questions about the adequacy of the method of sample selection. Given the fact that no central sampling frame exists from which a sample could have been chosen completely objectively, and that in any case that may have proved unsatisfactory because of local factors unknown to the research workers, the method used seems to have worked satisfactorily under Thai circumstances.

The selection of two farmers per village was based on experience in Phase 1, together with the practical need to keep the number of interviewees per village low enough that adequate coverage of a number of areas could be achieved within the time and cost constraints of the study. It had been found in Phase 1 that there was only a modest amount of variation within villages, as distinct from the much larger variation in response between villages, depending on location in relation to the keyman and other factors. As well as the four farmers, the headman of each village was himself asked to participate. This was because the headman is involved in most activities in the village, and would for example normally arrange any meetings at which the keyman might speak about the program. Therefore it was considered that the headman would provide an "informed" interviewee, against which the responses of other more "typical" farmers could be compared. Since the village headman is always himself a farmer, this made a total of three farmers per village in the sample.

Composition of the Final Sample of Interviewees

Using these criteria described above, specific areas were chosen for interview. This was carried out in two phases, since before the study started it was unclear what difficulties might arise in the selection and interview process, and how many farmers would be required in order to obtain a representative sample of a village and a keyman area. The composition of the total sample interviewed in the course of the study in phase 1 is shown in Table 3.1.

Table 3.1 Distribution of areas and farmers interviewed in phase 1

Province	Years in program	Adoption levels	Area interviewed	Number of F/VH/KM		
MK	3	High	Borabue	37	20	1
			Payakhapumpisai	39	21	1
		Low	Gosumpisai	40	20	1
			Chiengyuen	42	21	1
				158	82	4
			Total		244	

F = Farmers
VH = Village headmen
KM = keymen

Operation of Survey in Phase 1

The field work for the overall survey was carried out between March and July 1987 (Appendix 3). Mahasarakam province was selected as the location for phase 1 of the survey, carried out during March-April 1987. Four keyman areas (all in different Tumbons) were studied - two high adoption areas and two low adoption areas. Overall 158 farmers, 82 village headmen and 4 keymen were interviewed in the four areas, making a total number of 244 interviews. Diagrammatic maps of the areas and specific villages in which farmers were interviewed are shown in Appendix 4.

Interviewing was carried out by four people who worked as a team, all interviewing people in different parts of a village at the same time. A period of training in the administration of the questionnaire was given before interviewing commenced, and review sessions were held daily after interviewing had been completed, to ensure that all interviewers were completing questionnaires identically. All interviewers were people with direct knowledge of the subject matter of the questionnaire, and all were native Thai speakers familiar with the variety of Thai spoken in villages in the north-east.

Mahasarakam was selected to do the field survey in phase 1 for the following reasons:

1. Mahasarakam was one of the first two provinces to join the program, and thus had participated for three years. It was therefore believed that keymen and farmers would have accumulated enough experience of the program and its operation to provide an informed assessment, and to give a sound appraisal of the number of farmers who should be interviewed in the remaining provinces in order to adequately represent the population.

2. The questionnaire forms would be well-tested by use on a large population in a small number of localities, and any defects would become clear. The survey form could then be reviewed and any slight modifications could be made to improve clarity if necessary, before commencing interviewing in five further provinces in phase 2.

3. By using four interviewers who worked simultaneously in each area, four different insights into the problems of administration of the questionnaire and interpretation of results could be obtained. This helped greatly in identifying ambiguities and other small difficulties immediately, and reaching a solution before any further interviews were undertaken.

4. The province is close to the NE-VRDC, and this made it easier to take a team of interviewers to the area to complete the large interviewing task required in Phase 1.

The plan for this stage of the study was to interview about two farmers and the keyman in each of about twenty villages spread all through each keyman's area. This would normally mean that virtually all villages under his care would be covered. The aim was to determine if distance or other factors which vary between villages appeared to be important in determining adoption rate, so that a decision could be made about the number of villages which needed to be studied in Phase 2. The aim was to reduce the number of people who had to be interviewed per area in Phase 2, without losing valuable information about factors influencing adoption of the program.

The areas chosen for investigation are shown in Table 3.1.

Assistance from the PLO in Mahasarakam and the DLOs was officially requested to make necessary arrangements prior to the actual survey activities. Details were given on how to arrange appointments in the villages. Field interviews were performed by two survey teams comprising two investigating officers from the NE-VRDC. Individual team members were familiar with the survey methodology. The target given for each interviewer to be achieved per day was to conduct interview with four farmers and two village headmen. Therefore, 24 interviews were performed by two survey teams per day. By that time, a Panacea[1] data file had been developed for entry and analysis of data gathered in the questionnaires.

Operation in Phase 2

In phase 2 which took place between May and July 1987, interviewing was extended to five additional provinces:

1. Surin, which had operated the program since 1984;

2. Khon Kaen and Loei, which entered the program in 1986;

3. Udornthanee and Kalasin, which were not yet in the program.

The field survey commenced about 2 weeks following the official arrangement with the PLOs of those provinces. A modified questionnaire, covering only those aspects which are relevant to farmers in the two provinces which have not yet joined the program, was developed from the standard questionnaire for use in Udornthanee and Kalasin. This made it possible to compare directly their knowledge and attitudes with those of farmers in the four participating provinces.

Two "high adoption" and two "low adoption" keyman areas were selected for study in each participating province. In the other two provinces (non-program provinces), four Tumbons were chosen randomly per province to participate in the study. Equivalent samples of

---

[1] Panacea Database Management System, Pan Livestock Ltd., 24 Albert Road, Caversham, Reading, U.K.

farmers and headmen were interviewed but, of course, no keymen could be included. All interviews during Phase 2 were performed by one interviewer.

In the three program provinces (Surin, Khon Kaen and Loei), interviews were conducted with the keyman, the village headman and two farmers from his own village. Interviews were also conducted with the headman and two farmers of two additional villages. Based on findings in Phase 1, it was considered that two additional villages was sufficient, and that distance from the keyman's village appeared to be the most important variable determining his effectiveness in a particular village. Therefore one of the villages was selected because it was located less than 2 km from the keyman's village, and the other because it was more than 2 km from the keyman's village. Although this division was arbitrary, it represented approximately the dividing line between "easy" travelling distance and a distance that would require either transport by vehicle or special effort for the keyman to extend his efforts that far. The distances between the keyman's village and the other studied villages in the program provinces was judged by the DLO following the recommendation of the interviewer, in order to select the villages for the study. It can be seen that the focal point represented by the keyman's village was used to select certain villages from those available for study (Appendix 4).

The design for Phase 2 meant that there were 10 interviews per keyman area (6 farmers, 3 village headmen and 1 keyman), 40 per program province (24 farmers, 12 village headmen and 4 keymen). Hence the total was 120 for the three program provinces studied in Phase 2 (72 farmers, 36 village headmen and 12 keymen).

In the two non-program provinces, a similar selection system was used, choosing four "focal" villages in each province as if they had a keyman and interviewing in two nearby villages chosen in the same way as for the program provinces. Since there were no keymen, there were 9 interviews per Tumbon, 36 per province, 72 in total. Altogether 192 interviews were conducted during this phase, compared with 244 in phase 1 and 436 interviews in total. Maps of the areas in which interviews were conducted in Phase 2 are shown in Appendix 4. The distribution of areas and farmers interviewed in phase 2 is shown in Table 3.2.

Table 3.2 Distribution of areas and farmers interviewed in phase 2

Province	Years in program	Adoption levels	Area interviewed	Number of F/VH/KM		
SR	3	High	Prasart	6	3	1
			Rattanaburee	6	3	1
		Low	Chompra	6	3	1
			Chumponburee	6	3	1
KK	1	High	Munjakeeree	6	3	1
			Pon	6	3	1
		Low	Phuphaman	6	3	1
			Nong song hong	6	3	1
LE	1	High	Wang sa pung	6	3	1
			Chieng kan	6	3	1
		Low	Maung	6	3	1
			Phuruoe	6	3	1
UD	0	-	Na klang	6	3	0
		-	Bandung	6	3	0
		-	Srithat	6	3	0
		-	Nong han	6	3	0
KS	0	-	Maung	6	3	0
		-	Kamalasai	6	3	0
		-	Yang ta lad	6	3	0
		-	Sahassakan	6	3	0
				120	60	12
			Total		192	

DATA ORGANIZATION AND ANALYSIS

The survey questionnaires contained a very large amount of data, which had to be prepared for analysis. All first-stage analysis and collation of results was carried out in the Panacea database management system. To make it easier to analyze the data entered into the Panacea datafile, most information was re-coded from the marked responses and Thai text notes made by the interviewers into numerical codes. The code descriptions used for farmer and keyman interviews are shown in Appendix 5. The area in which a particular interview took place is also represented by a numerical code to facilitate data entry for those items (Appendix 6).

The data obtained from the survey in questionnaire forms had been entered into Panacea in two datasets. The dataset for farmers and headmen was called **"FARMER"**, and comprised responses for 278 farmers and 142 village headmen. The dataset **"KEYMAN"** covered responses from the 16 keymen (Phases 1 and 2).

To avoid the analysis becoming too voluminous and confusing, all responses from Phases 1 and 2 were analyzed together. To make this possible, villages in Mahasarakam (Phase 1) were identified as either more or less than 2 kilometres from the keyman village, and then the data was analyzed as a single unit. No evidence was found that this created any problems with regard to analysis, but it is necessary to remember that there was a much larger sample of both farmers and headmen for Mahasarakam than for the other five provinces.

Before the data analysis, 50 (12%) randomly chosen questionnaire forms were checked to determine whether each of the 230 answers entered in Thai on the questionnaire form had been accurately transferred to English, and then to the numerical code which appears in the Panacea dataset. This was to confirm the validity and reliability of the information obtained. From 11500 question responses checked in the questionnaire form, only 7 (0.06%) questions were wrongly transcribed into the dataset. This error rate was considered to be very low, so data analysis commenced.

The statistical analysis was carried out in Panacea, using principally cross-tabulation, analysis of normal distribution statistics, and analysis of variance. The methods used have been described for each section of the results in Chapter 4. The economic analysis was carried out in the spreadsheet computer program, Quattro[2].

[2] Borland International. Scotts Valley, California

CHAPTER FOUR

SURVEY RESULTS

INTRODUCTION

The survey of farmers and keymen, carried out as described in the previous Chapter, was designed to provide detailed information on the understanding of parasitism and of major animal health issues in provinces with and without the farmer self-help program, linked to basic data about farming activity in each of the areas studied. The survey also provided essential data for the economic analysis which follows from the study of adoption patterns.

The general results will be described first for the farmers and then for the keymen, concentrating in the latter case on issues relating to their role as keymen rather than their farming activities. Finally, findings for farmers will be compared between keymen areas, contrasting the characteristics of farmers in high adoption and low adoption areas for the parasite control program.

Village headmen have been included in the analysis of farmers because they are all farmers and in most cases there was little point in treating them separately. In cases where the difference between headmen and other farmers was likely to be of interest, the results are reported in the section dealing with farmers, and the differences are pointed out.

FARMER SURVEY RESULTS

Farmer Characteristics and Farming Activities

Of the village farmers and headmen interviewed, 403 (96%) were males and 17 (4%) were females. The 17 females were all heads of households, and their farming activities were similar to those of the men interviewed. Because very few women were interviewed, and there were no grounds in the interview results for considering males and females separately in this study, further results reported here will combine the data for males and females.

The average age of farmers in the survey was 46 years, and their age distribution is shown in Table 4.1. It can be seen that the highest frequency was between 40 and 49 years (39.5%). The second largest group of farmers was between 50 and 59 years (31.6% of the total). The youngest farmers interviewed (between 20 and 29 years) comprised only 5.5% of the population studied.

Information was collected from headmen on the population of the villages in which the survey was carried out. The average human population of the study villages was 638, the buffalo population was 181, and the cattle population was 86. The mean number of families per village was 121, and the mean number of people in each family was 6.3. The family sizes in the six study provinces are shown in Table 4.2. The distribution of family sizes is shown in Table 4.3. Each family owned on average 5.6 hectares of land, 2.99 buffalo and 1.89 cattle. It can be seen from the Tables that variation among the provinces in mean values for these demographic indices was not large - the broad characteristics of the human and animal populations making up a single "typical" village and "typical" family unit do not differ greatly between one province and another within the region. However this similarity in mean values of course masks substantial variation between villages within each individual province. Nevertheless, it does mean that strategies for developing animal health services for the region can be built around a regional model of the type of village being served, which can be used for planning purposes as typical of the region, not just of a single province.

Table 4.1 Age distribution of 420 farmers

Province	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	>70 Total Years
MK	14 (3.3%)	41 (9.8%)	97 (23.0%)	78 (18.6%)	9 (2.1%)	1240 (0.2%)
SR	5 (1.2%)	7 (1.7%)	14 (3.3%)	9 (2.1%)	1 (0.2%)	-36 (0.0%)
KK	1 (0.2%)	10 (2.4%)	10 (2.4%)	14 (3.3%)	1 (0.2%)	-36 (0.0%)
LE	1 (0.2%)	8 (1.9%)	15 (3.6%)	9 (2.1%)	3 (0.7%)	-36 (0.00%)
UD	- (0.00%)	4 (0.9%)	20 (4.8%)	10 (2.4%)	1 (0.2%)	136 (0.2%)
KS	2 (0.5%)	7 (1.7%)	10 (2.4%)	13 (3.1%)	4 (0.9%)	-36 (0.00%)
Total	23 (5.5%)	77 (18.4%)	166 (39.5%)	133 (31.6%)	19 (4.3%)	2420 (0.4%)

Table 4.2 Family sizes in the six study provinces

Province	Number of villages interviewed	Number of families/village	Number of people / village	Number of people per interviewed family
MK	82	106	585	6.4
SU	12	100	543	6.3
KK	12	112	574	6.4
LE	12	169	873	6.0
UD	12	122	588	6.2
KS	12	117	667	6.6
Average		121	638	6.34

MK = Mahasarakam SR = Surin
KK = Khon Kaen LE = Loei
UD = Udornthanee KS = Kalasin

Table 4.3 Ownership of land and large ruminants by families

Province	Number of families interviewed	Area owned (hectares)	Buffalo owned	Cattle owned
MK	240	6.1	3.0	1.5
SR	36	4.5	2.8	1.0
KK	36	6.1	3.1	1.6
LE	36	4.5	2.2	3.8
UD	36	6.6	3.4	1.0
KS	36	5.6	3.5	2.6
Average		5.6	3.0	1.9

Table 4.4 Number of buffalo and cattle per village in 1985 and 1986.

Province	Number of buffalo 1985	Number of cattle 1985	Number of buffalo 1986	Number of cattle 1986
MK	186	90	181	89
SR	231	77	233	79
KK	155	47	156	50
LE	103	187	102	189
UD	206	37	211	44
KS	200	65	200	65
Average	180	84	181	86

The buffalo and cattle populations one year earlier (1985) were reported by village headmen to be 180 and 84 respectively (Table 4.4), so there had been little change in this number over the year prior to the survey. This may reflect either precise equilibrium between feed availability and the number of large ruminants, or else (if adequate feed supply for larger numbers is assumed) difficulty in expanding the animal population to meet the increasing demand as described in Chapter 1.

Cropping Activities

All except one of the farmers interviewed considered rice growing to be their most important farming activity, but 99% had other income-earning activities as well. Table 4.5 shows the extent to which various farming and off-farm activities are undertaken by the village farmers. Ninety four percent undertook animal raising, while 59% undertook cropping activities other than rice growing, and 5.2% were involved in off-farm activities.

The different types of cropping activities other than rice are shown in Table 4.6. The most important cropping activity was tapioca planting. Farmers in 5 of the 6 provinces studied had a large area of tapioca planted. Khon Kaen province was however the most important tapioca-planting area. From the results it can be seen that 72.2% of the cropping activities of farmers in Khon Kaen were tapioca. Kenaf was seen to be the second most important crop.

Kenaf was grown by farmers in all provinces other than Kalasin. Udorn was the only province where sugar cane was cultivated, and Mahasarakam was the sole area where tobacco was grown. Cropping activities represented 71.3% of total farmer income, as shown in Table 4.7.

Table 4.5 Percentage of farmers undertaking farming and other activities

Province	Animal raising	Rice planting	Cropping other than rice	Off-farm activities
MK	95	99.6	53.0	17.1
SR	97.2	100	31.0	-
KK	88.8	100	83	8.3
LE	86.1	100	100	5.6
UD	100	100	61	-
KS	97.2	100	64	-
Average	94.0	99.9%	59.3	5.2

Livestock activity

Income from animals comprised 4022.5 baht (US$ 160.9) from buffalo sales, 1910 baht (US$ 76.4) from cattle sales, and 787.5 baht (US$31.5) from sales of other livestock. Cash income from non-ruminant livestock comes principally from pigs and horses, since both of these species are actively traded. Poultry, which comprise a major part of the livestock activity of almost all village families, are used almost entirely for home consumption. Their significance is therefore greatly understated in data which deals only with cash income. However there are problems in easily estimating poultry consumption through a survey of this type, and other data would be needed for the purpose. Total income from animals in this study was 6720 baht (US$ 268.8), or 27% of the total income, and appears to represent a similar proportion of total income to the figure of 31% reported by Prapertchob et al (1983).

As far as costs of livestock management were concerned, direct costs were small. Across the 6 provinces, farmers in 1986 spent an average of 6 baht on artificial insemination, 41 baht on medicine, 11 baht on supplemental feeding and 52 baht on materials for animal handling, including rope and cattle yard repairs.

The other potential cost associated with livestock management was the expense of hiring buffalo for paddy preparation and other draught functions. Only 9% of farmers who were interviewed had hired buffaloes for working during the last year. Of this group, 45% hired buffaloes for 2 to 3 months, 53% hired them for six months, and the remaining 2% hired them for 9 months. Farmers hired working buffalo either because they had no buffalo (47%) or did not have enough buffalo for working (34%).

The average hiring cost in 1986 reported by respondents was 1,005 baht/3 months. (US$40). In comparison with income figures and the costs of managing buffalo, this is a very large amount for a farmer to pay. It demonstrates the vital importance of working animals to these farmers, and the value of protecting their buffalo from disease so that they do not have to hire replacement buffalo to meet their needs.

Total family income

The distribution of farming income per family derived from animals, crops and off-farm activities is shown in Table 4.7. Total annual family income reported by farmers was 24,762 baht (US$ 990.69). Of this, the income from crops was 17,655 baht (US$ 706.2), or 71.3% of total income which was similar to the figure of 69% reported by Prapertchob et al (1983).

Income from off-farm sources was relatively small, at 392.5 baht (US$ 15.7) which comprised 1.58% of total income.

Table 4.6 Types of cropping activities other than rice growing

Province	No. of families	Tapioca	Kenaf	Sugar cane	Tobacco	Other crops
MK	240	45%	7.9%	-	2.9%	5.8%
SR	36	-	25%	-	-	2.8%
KK	36	72.2%	16.7%	-	-	13.9%
LE	36	25%	2.8%	-	-	16.7%
UD	36	22.2%	19.4%	25%	-	-
KS	36	63.9	-	-	-	-

Table 4.7 Farmer income per family (US$) derived from animals, crops and off-farm sources

Province	Buffalo	Cattle	Crops	Other livestock	Off-farm income	Annual income
MK	183 (22.7%)	85 (10.5%)	390 (48.5%)	80 (10%)	66 (8.2%)	804.7 (100%)
SR	83 (12.6%)	24 (3.6%)	550 (83.6%)	1.12 (0.2%)	-	658.12 (100%)
KK	242 (21.5%)	135 (12%)	696 (61.9%)	47 (4.2%)	5 (0.4%)	1125 (100%)
LE	95.5 (10.4%)	167.4 (18.3%)	626 (68.4%)	3.4 (0.4%)	23 (2.5%)	915.3 (100%)
UD	140 (11%)	21 (1.6%)	1087 (84.7%)	35 (2.7%)	-	1283 (100%)
KS	221.7 (19.2%)	26 (2.2%)	888 (76.7%)	22 (1.9%)	-	1158 (100%)
Average	160.9 (16.2%)	76.4 (7.7%)	706.2 (71.3%)	31.5 (3.2%)	15.7 (1.6%)	990.69 (100%)

Crops = Rice, tapioca, kenaf, sugar cane, maize and other crops

Other livestock = Poultry, horses and pigs

Off-farm activities of farmers are shown in Table 4.8. Farmers in only three of six provinces (Mahasarakam, Khon Kaen and Loei) pursued off-farm activities, and only 46 heads of households were involved in off-farm activities. These comprised work as labourers (38%), as weavers producing local mattresses (30%), or as shopkeepers selling goods in their village (24%). Miscellaneous categories made up the remaining 8%.

Table 4.8 Off-farm employment of respondents

Province	Shopkeeper	Driver	Weaver	Carpenter
MK	9 (22.0%)	1 (2.4%)	10 (24.4%)	8 (19.5%)
KK	-	-	2 (66.7%)	-
LE	1 (50%)	-	-	-
Total	10 (24%)	1 (0.8%)	12 (30.5%)	8 (6.5%)

Classification of Farmers by Degree of Acceptance of the Parasite Control Program

Most of the information gathered in the survey relates in various ways to the animal health status of animals owned by the farmers, or to their views on a range of issues which reflect their overall attitudes to the farmer self-help worm control program. In order to assess factors influencing the adoption of the parasite control program in the keyman areas investigated, it is first necessary to have some measure of the extent to which each of the farmers interviewed has understood and adopted the principles and practice of parasite control promoted by the keymen in the 4 provinces involved in the program (Mahasarakam, Surin, Khon Kaen and Loei).

Within the questionnaire, farmers were asked in various ways about their awareness of the existence of the program and its function, and about whether or not they had purchased drugs from the keyman within the year prior to the administration of the questionnaire.

These two factors were used to develop a classification system which measured in a simple but objective way the extent to which the individual farmer had become aware of the program, and whether or not they were currently participating in it. Knowledge of the keyman and his role as a source of drugs for controlling animal parasites was considered as correct understanding of the program, even if the particular farmer did not comprehend the method of administration of the overall program which gave the keyman access to drugs.

Farmers were classified into three mutually exclusive categories:

1. High acceptance (had heard about the program, correctly understood its purpose, and had bought drugs within the last year),

2. Medium acceptance (had heard about and understood the program, but had not used the drugs in the program for at least a year), and

3. Low acceptance (unfamiliar with the program and its relevance to them, and had never used the drugs).

This classification is summarised in Table 4.9. From the answers given by each farmer to the questionnaire, he or she was retrospectively classified into one of the categories. In this way, farmers in the program provinces could be considered in an analysis by adoption area (high or low, determined by an assessment of the keyman) and by program acceptance (high, medium or low, determined by the response of the farmer to the work of the keyman).

Table 4.9 Farmer acceptance categories

Heard of parasite control program	Knew keyman and his role	Drug purchased from keyman in 1986	Degree of farmer acceptance
No	No	No	Low(1)
No	Yes	No	Medium(2)
Yes	Yes	No	Medium(2)
Yes	No	No	Medium(2)
Yes	Yes	Yes	High(3)
No	Yes	Yes	High(3)

Animal Health Problems

The animal health problem considered to be most important by veterinarians serving the villages, buffalo calf mortality due to internal parasitism, was very familiar to farmers interviewed. More than 65% reported as a major problem the large round worm (Toxocara vitulorum) obstructing the alimentary tract and causing death in calves under six months of age. Most calves affected by internal parasites suffered clinical signs of "white scours" or undiagnosed diarrhoea. Poor calf condition due to parasitism is exacerbated in some areas by inadequate nutrition. Furthermore, in the dry season calves suffer from skin disease caused by the sarcoptic mange mite, which probably contributes to the high calf mortality.

Farmers interviewed in the survey reported a fairly small list of diseases as causing non-fatal calf illness. When asked what made calves sick in their village, 37% listed internal parasites, 17% gave non-specific diarrhoea, 16% said malnutrition and 9% gave skin disease as an important problem. This result is shown in Figure 4.1.

The causes of fatal calf illness in village calves as reported by farmers in this study are shown in Figure 4.2. Of the farmers, 41% mentioned internal parasites as an important problem, 14% mentioned malnutrition, 12% mentioned diarrhoea without identifying a likely cause, and 33% mentioned various other causes. Internal parasites thus appear to be regarded by farmers as the major causative problem in buffalo calf mortality.

Farmers are at least moderately concerned about calf diseases, since 21% routinely take some form of preventive measures against them (Table 4.10). However whereas the percentage of farmers in program provinces who took measures against calf disease was in the range 22 to 31%, the percentage in non-program provinces was only 6 to 11%.

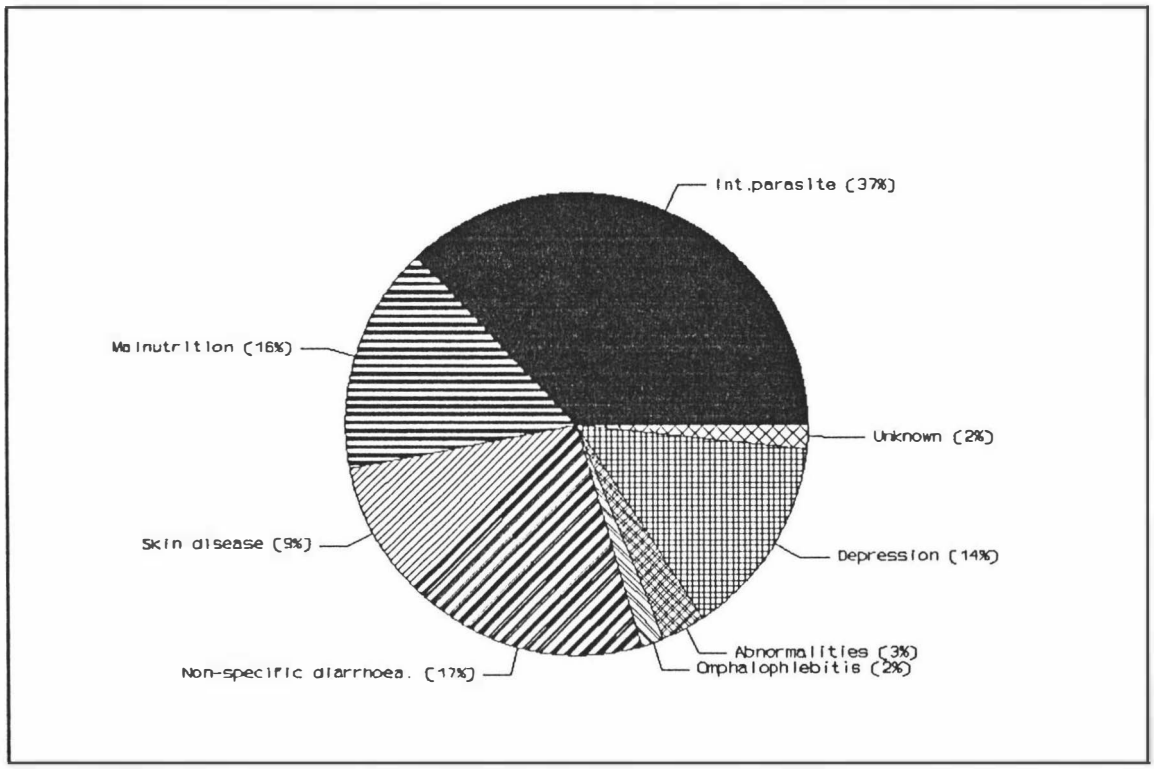


Figure 4.1 Causes of Non-Fatal Disease in Calves

Bhannasiri (1970) stated that the most common diseases causing buffalo mortality are haemorrhagic septicaemia in adults and gastrointestinal nematodes in calves. He expressed the view that internal parasites were the main reason for the 30-40% mortality rate in buffalo calves. Rufener (1971) stated that buffalo appeared to be more susceptible to some diseases and other sources of loss than cattle, such as calfhood illness and theft. He also believed that losses reported by village farmers understated the actual effects on herd productivity.

Table 4.10 Extent to which farmers carry out disease prevention in calves

Province	No	Yes	Total
Mahasarakam	69.2% 166	30.8% 74	100% 240
Surin	75% 27	25% 9	100% 36
Khon Kaen	78% 28	22% 8	100% 36
Loei	69% 25	31% 11	100% 36
Udorn	89% 32	11% 4	100% 36
Kalasin	94% 34	6% 2	100% 36
Total	79%	21%	240

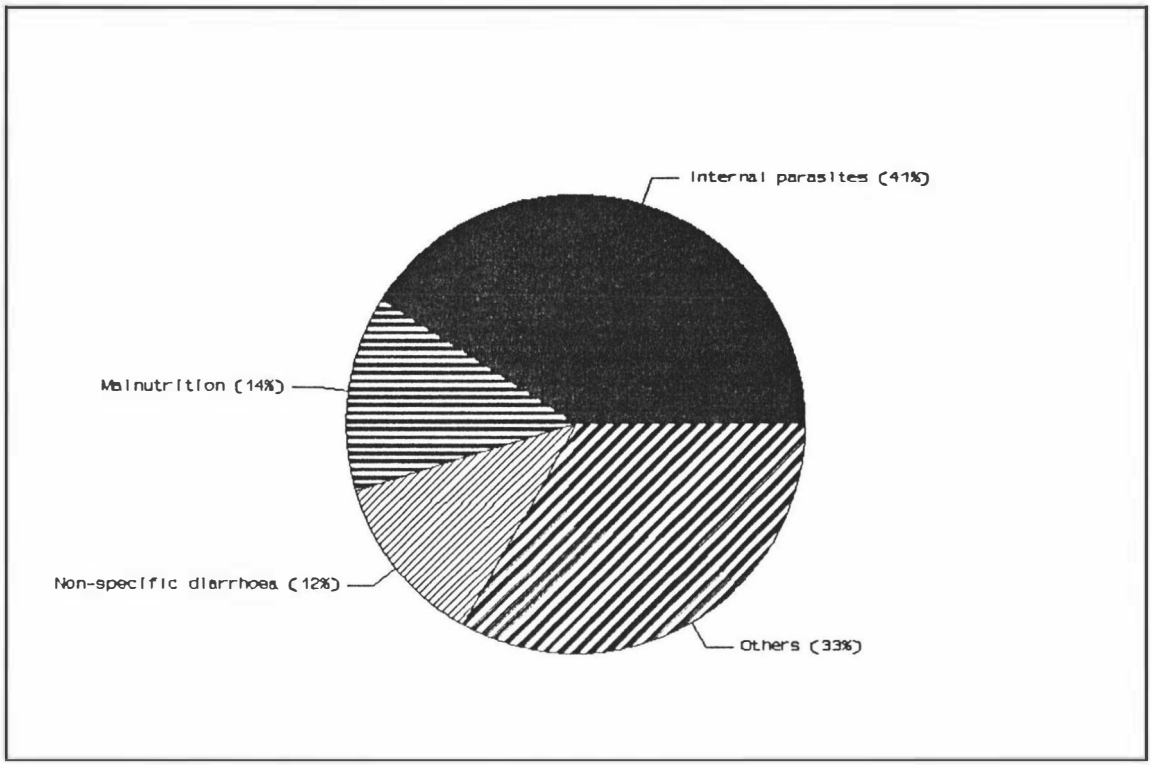


Figure 4.2 Causes of Death in Calves

Causes of death in adult animals

From the survey result, in 6 provinces in the area interviewed, 43% of farmers considered that there were important diseases which kill adult cattle or buffalo in their particular villages. The major diseases reported by farmers as contributing to adult mortality are shown in Figure 4.3. Fifty seven percent of farmers considered that hepatic cirrhosis, associated with liver fluke lesions in the liver, was a common fatal disease of buffalo and cattle. Sixteen percent of farmers identified as a common fatal disease problems associated with feeding of tapioca - either suffocation (from a form of tympany or bloat) or intoxication after animals ingested the leaves or roots of fresh tapioca. Four percent mentioned the "tetanoid syndrome" described earlier as an important cause of deaths in growing buffalo. Sixteen percent of farmers reported that adult animals died from acute tympany, 2% mentioned severe emaciation and 5% mentioned unexplained deaths.

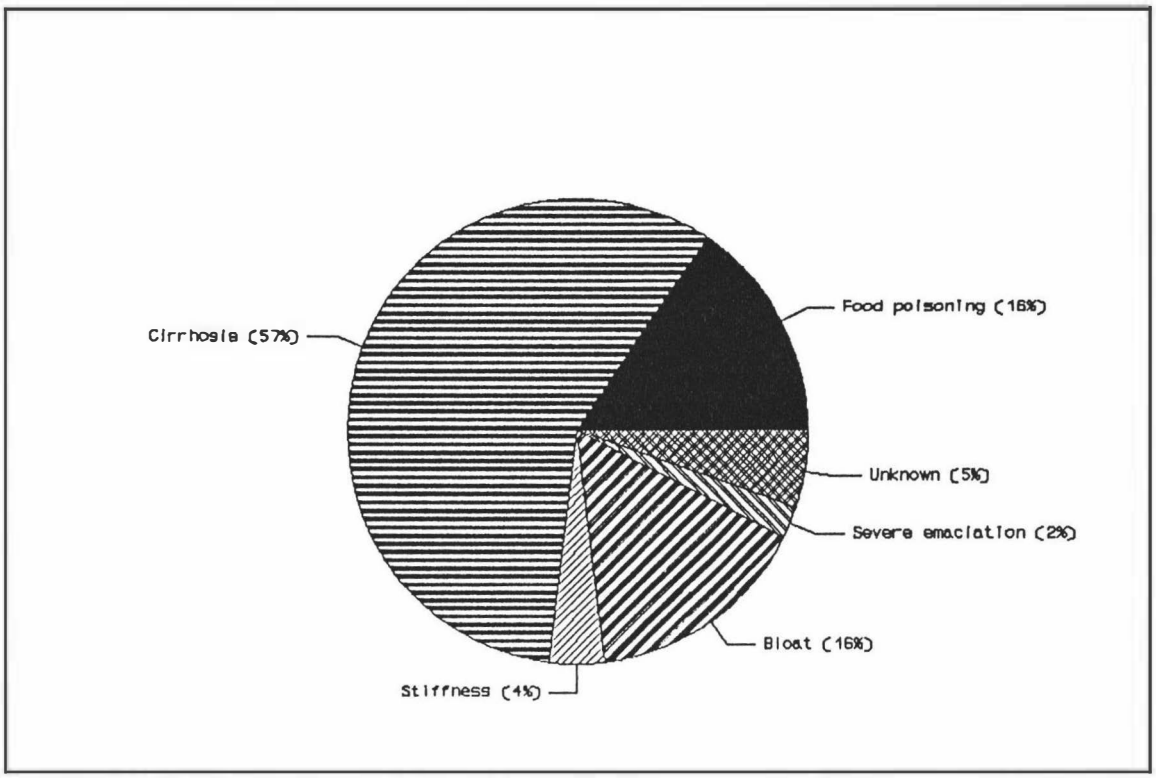


Figure 4.3 Causes of Death in Adult Animals

Therefore, liver fluke was seen by farmers to be the single most important cause of death in adult animals, and they could therefore be expected to be favourably inclined towards using control measures against the disease.

Causes of non-fatal disease in adult animals

Over all 6 provinces, 73% of farmers mentioned diseases in adult cattle or buffalo in their village which made them sick but did not normally kill them. Major diseases in adult animals are shown in Figure 4.4. Foot-and-mouth disease (FMD) is still widespread in the northern part of Thailand, and outbreaks occur sporadically throughout the North-east, especially at the beginning of the rainy season. The Department of Livestock Development aims to spend increased amounts on a vaccination campaign to eradicate this disease from the region and the whole country in the near future. From the survey results, in 1986 31% of farmers interviewed mentioned FMD as an important disease, 20% mentioned lameness, 20% mentioned "tetanoid syndrome", and 19% mentioned skin disease (which mainly occurs in the dry season). Ten percent of owners mentioned other miscellaneous diseases.

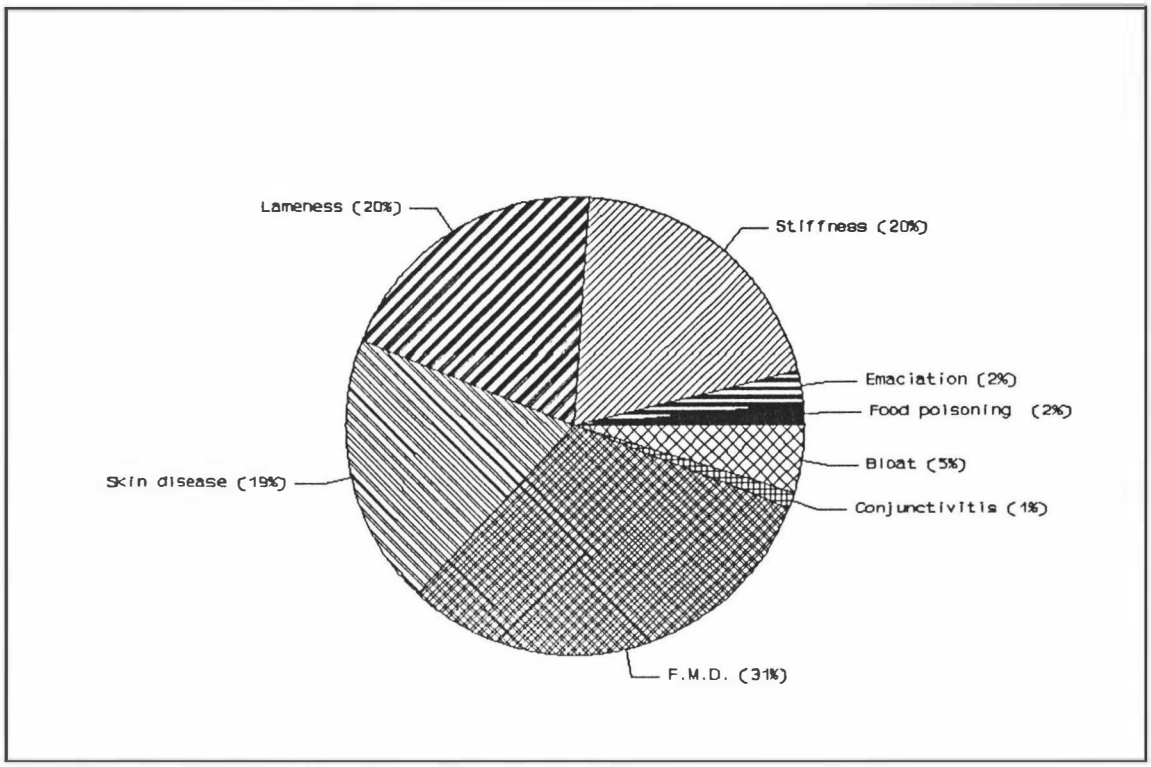


Figure 4.4 Causes of Non-Fatal Disease in Adults

Action taken when animals die

When buffalo calves died in the village, 44% of farmers stated that they divided the carcass among family and friends for consumption, 32% buried the whole carcass without examination, while 23% opened the carcass and then buried it. Ninety four percent of farmers in the 6 provinces have at some time investigated the cause of calf deaths by simple autopsies. From examination of these dead calves, 89% of examining farmers concluded that severe intestinal parasitic obstruction by Toxocara vitulorum was the cause of death. Thus it is clear that parasitism is a very common cause of calf death, although it has to be accepted that because of the ease of detecting impacted Toxocara it is likely that at least a few deaths due to other less easily diagnosed causes will be attributed to parasitism. However the nature of the survey made it impossible to make any judgment about the extent to which parasitic deaths might be over-reported.

Farmer Knowledge Concerning Parasitism

In order to make an assessment of the level of knowledge of farmers concerning the epidemiology of parasitism, they were asked a series of questions aimed at testing their understanding of parasitic disease caused by Toxocara vitulorum and Fasciola gigantica.

Knowledge of nematodes obtainable by observation

For Toxocara they were shown examples of the parasite and asked to identify it. They were then asked to explain where such a worm might be found. Finally they were asked to explain the transmission cycle of the parasite in simple terms. For Fasciola they were asked a similar series of questions, but as well as covering the parasite itself the questions also covered the intermediate host Lymnaea rubiginosa. These parasites were chosen both because they are the most important, and also because observant farmers could be expected to have some knowledge of their identification from past experience. However they would not know the epidemiology of the two parasites from experience, and questions on this subject would test whether they had received any specific education on this topic. Keymen had received basic training on this subject, and were taught to explain essential features of the epidemiology

of the parasites to village farmers as part of their extension efforts. Questions on these topics could therefore test whether farmers had received and retained this information.

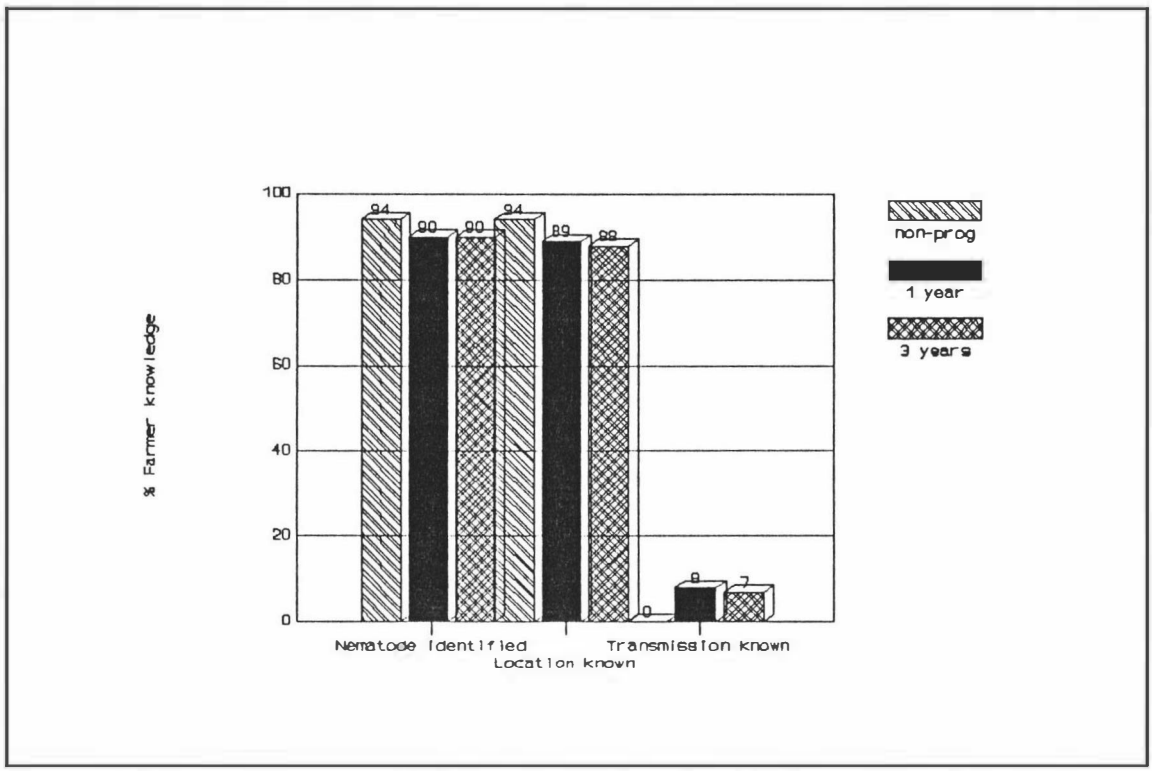


Figure 4.5 Farmer Knowledge of Nematode Parasitism in Program and Non-Program Province

Figure 4.5 shows that 90% of farmers in program and 94% in non-program provinces can identify Toxocara accurately, so the parasite is well-known to all the farming community from examination of dead animals. Similarly 89% (program) and 94% (non-program) of farmers could correctly identify where the parasite is found in the body. Figure 4.6 shows that within the program provinces farmers with a high acceptance level for the program showed slightly better knowledge of this information than those with lower acceptance level, but the difference is too small to be of significance. Thus awareness of Toxocara is high, and does not appear to depend on the operation of the parasite control program.

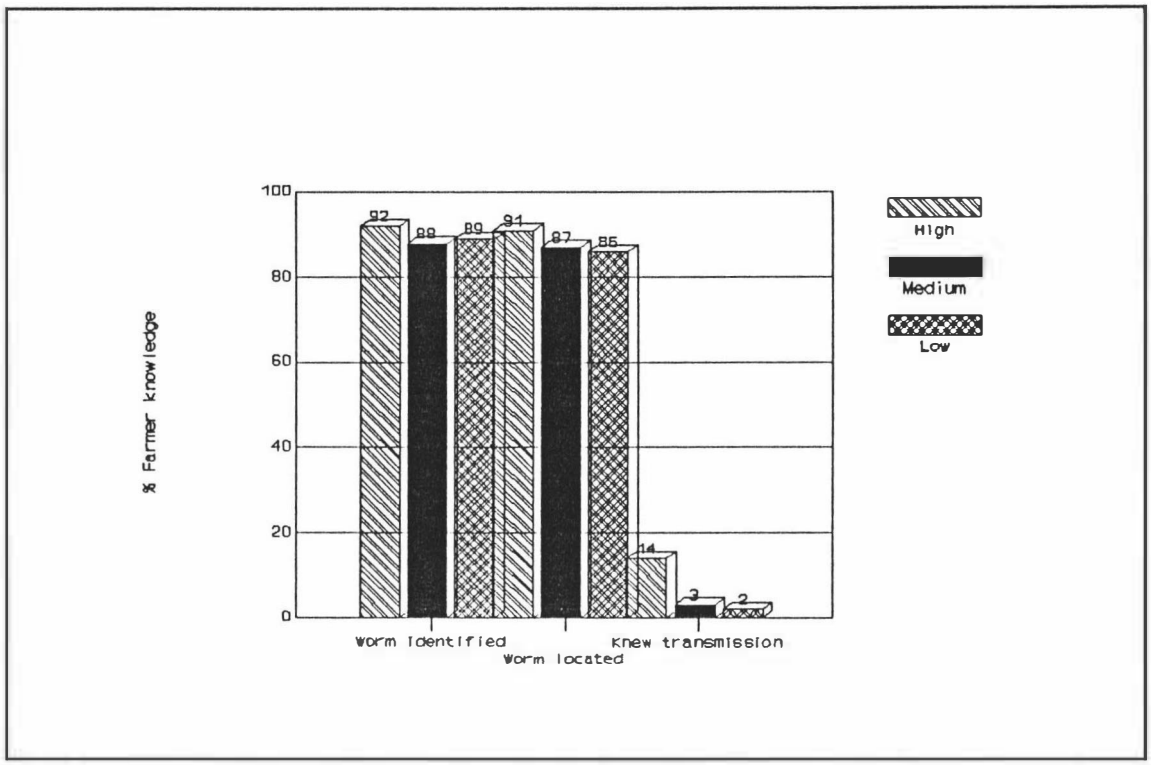


Figure 4.6 Farmer Knowledge of Nematode Parasitism By Program Acceptance Level

Knowledge of nematodes dependent on extension activity

However, knowledge of the transmission and epidemiology of Toxocara is much poorer, and demonstrates that keymen have not yet been very effective in making farmers aware of the way in which the parasite is transmitted. In non-program provinces, no farmers at all (0%) could provide a reasonable explanation of the transmission of the parasite, and only 8% and 7% of farmers in the one and three year program provinces could do so (Figure 4.5). It did appear that keymen had made some effort in this direction, however, since within the program provinces 14% of the high acceptance farmers could provide an adequate explanation, whereas only 3% and 2% could do the same in medium and low acceptance groups (Figure 4.6).

These results show that keyman training needs to be greatly strengthened in the area of communication and emphasis on their educational role. However it also shows that farmers will accept the advice and carry out the program on the basis of results achieved, rather than depending on understanding as a basis for action, since 86% of farmers who had treated their animals in the last year did so without even a rudimentary understanding of the life cycle of the parasite against which they were taking action. In Chapter 5 possible action to increase farmer understanding is considered.

Knowledge of trematodes obtainable by observation

Because the life cycle of Fasciola gigantica is more complex, farmers might be expected to have even lower knowledge levels concerning the transmission of this parasite. The majority of farmers recognized Lymnaea rubiginosa as a snail resident in dams and watercourses in their area, because they see them frequently. In non-program area 92% recognised the snail, and the same percentage could accurately identify its habitat. In three-year program provinces the figures were 64% for both snail and habitat identification, whereas in one-year program provinces they were 85% and 83% (Figure 4.7).

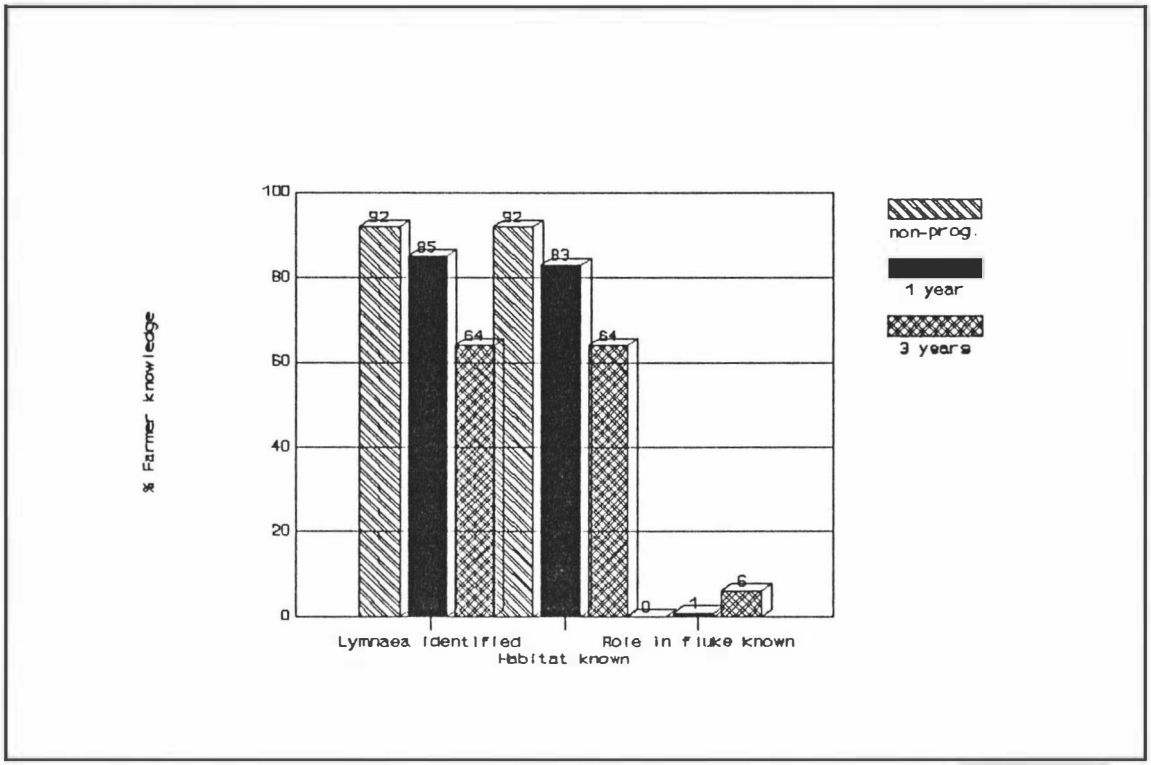


Figure 4.7 Farmer Knowledge Concerning The Intermediate Host of F.gigantica in Program and Non-Program Provinces

Within the program provinces, high acceptance farmers had the highest level of knowledge (73% correct on both issues) of Lymnaea and its habitat (Figure 4.8), but medium acceptance farmers had the lowest knowledge levels.

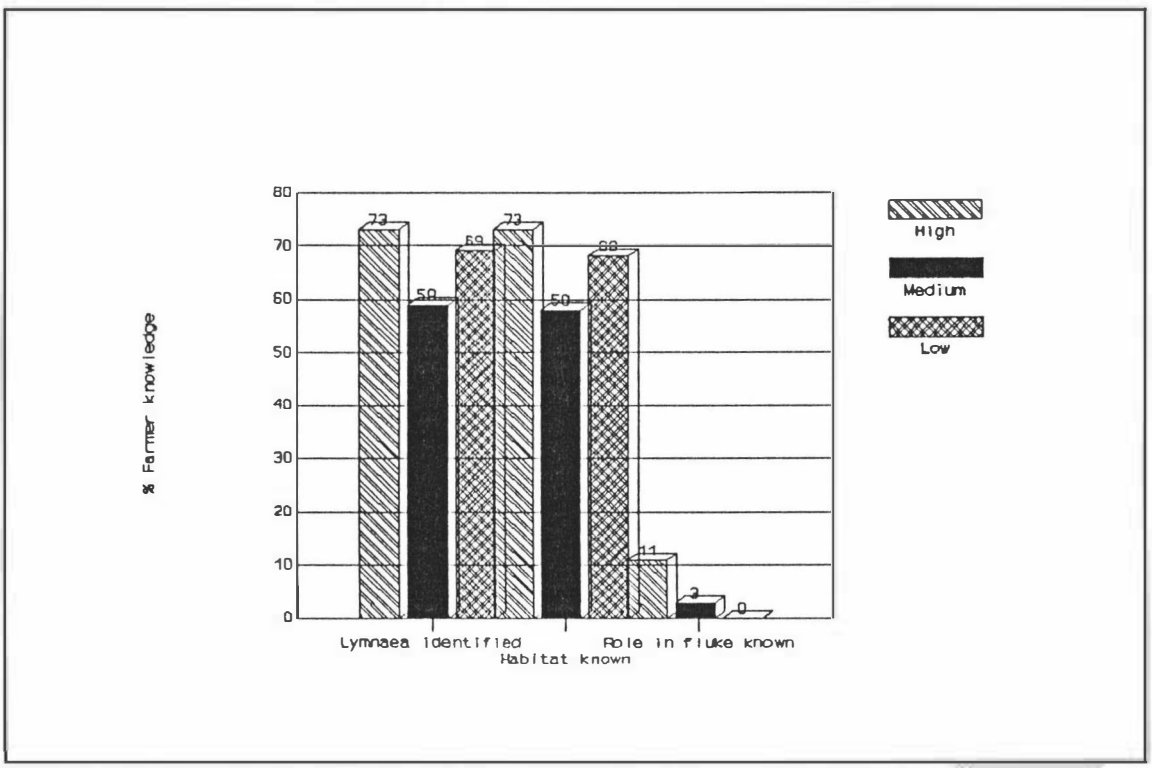


Figure 4.8 Farmer Knowledge Concerning The intermediate Host of F.gigantica by Program Acceptance Level

Comparing knowledge of farmers with respect to Fasciola between program and non-program provinces (Figure 4.9), it can be seen that farmers in non-program provinces had the highest recognition level for the parasite (78%) and awareness of where in the body it is located (78%). Farmers in one year program provinces had better knowledge (69% recognition and 71% knowledge of site) than did farmers in the three year program provinces (61% and 59% correct respectively). It is likely that these differences in knowledge levels with respect to both the snail and the parasite itself reflect mainly the differences in prevalence of suitable habitats for the snail (and hence the parasite) among the provinces and between the local areas chosen for study, since 78% of non-program farmers had seen flukes in dead animals, compared with 51% in one-year program provinces and 46% in three-year provinces. The physical geography of the provinces chosen for the study is such that habitats are more widespread in the non-program provinces than they are in the program provinces.

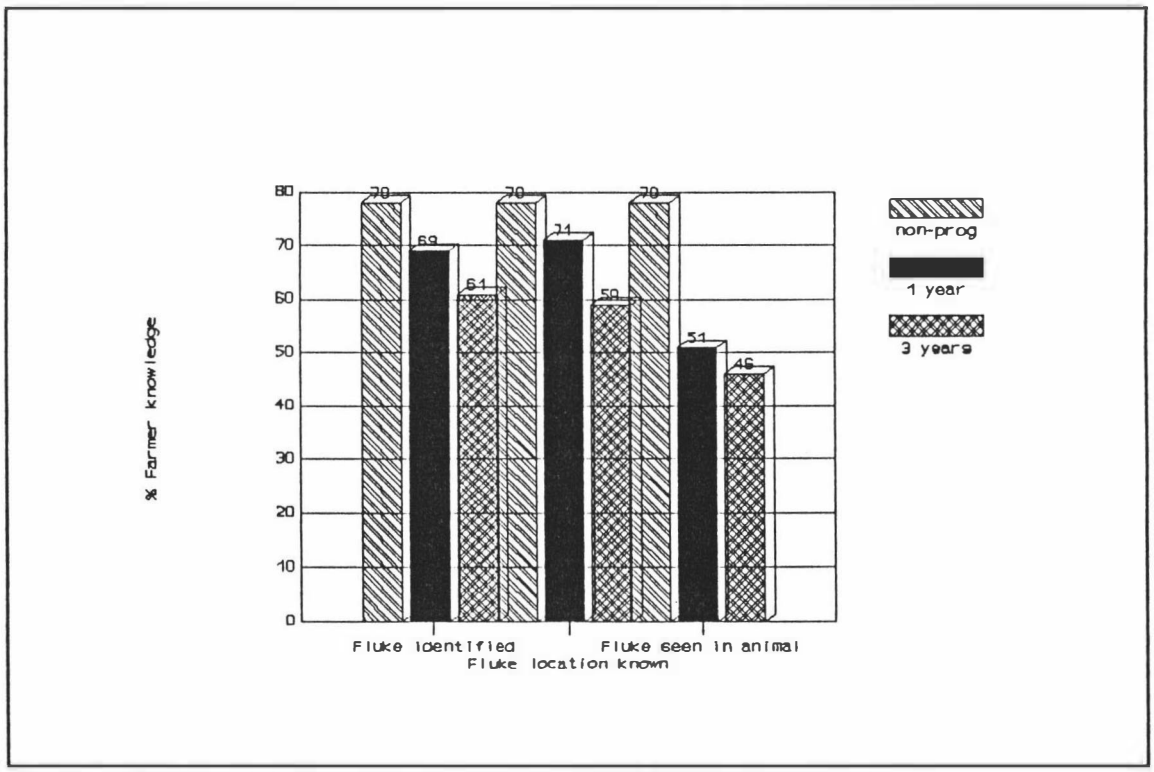


Figure 4.9 Farmer Awareness of Fasciola gigantica in Program and Non-Program Provinces

When considered in relation to program acceptance level within the program provinces, slightly over 60% of farmers at all acceptance levels could identify Fasciola and accurately explain its location in the body (Figure 4.10). Just under 50% in all groups had personally observed the flukes in dead animals (Figure 4.10).

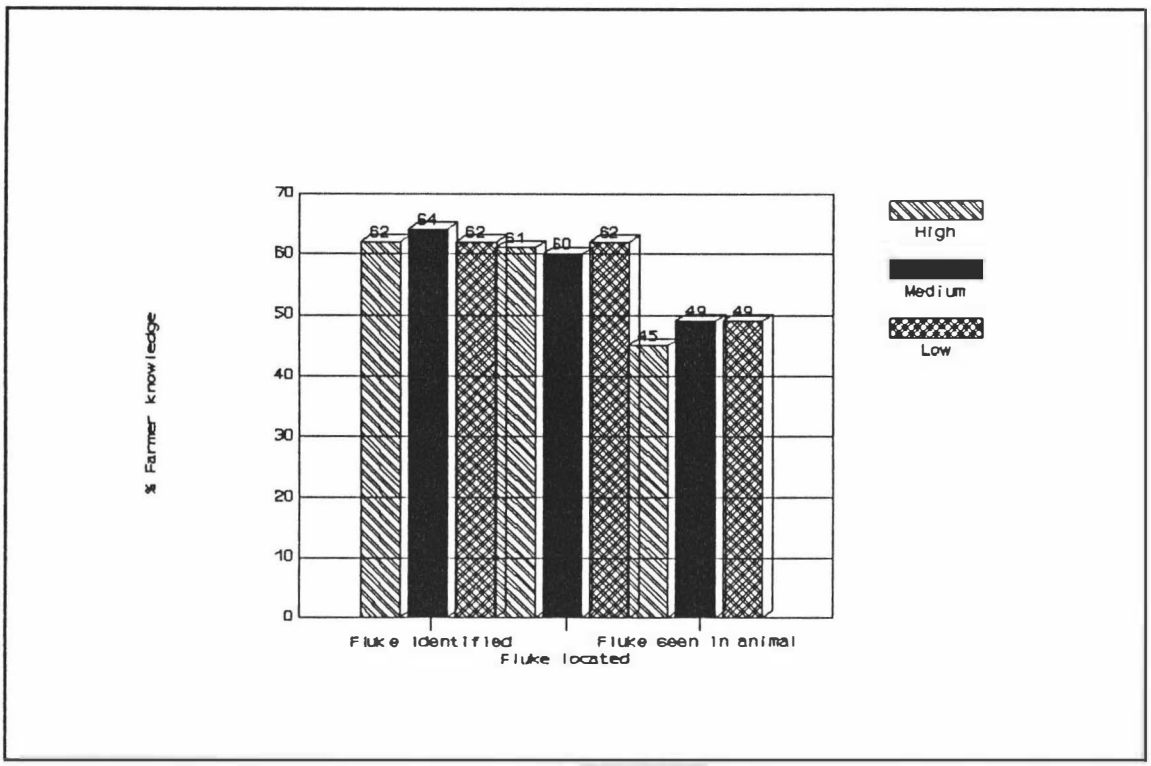


Figure 4.10 Farmer Awareness of Fasciola gigantica by Program Acceptance Level

Knowledge of trematode parasitism dependent on extension activity

The percentage of farmers in high, medium and low acceptance groups who could explain the role of the snail in fluke transmission was 11%, 3% and 0% respectively. As with the nematode, knowledge of the life cycle was related to degree of involvement in the program, but the proportion of farmers who had even an elementary understanding of the life cycle of Fasciola remained very low. These results are shown in Figure 4.8.

However no farmers at all in non-program provinces had knowledge of the role of Lymnaea rubiginosa in the epidemiology of liver fluke (0% correct answer), whereas 1% of farmers knew in one-year program provinces and 6% in three-year program provinces. The results are shown in Figure 4.7.

Farmer awareness of subclinical parasitism and its effects

The other area of farmer knowledge covered in the questionnaire was their awareness of the relationship between parasitism and adverse effects on animal performance, particularly at the subclinical level. This is a difficult area to evaluate because of the need to frame questions which do not lead the farmer to give the preferred answer by guessing, yet are specific enough to get at the matters of interest. Questions 66 to 73 in the farmer questionnaire (Appendix 2) were intended to investigate this general area.

Farmers were asked to describe the effects which worm infestation has on calves. Eighty nine percent of farmers in both one and three year program provinces could do so accurately, compared with 84% in non-program provinces. This difference was not statistically significant. When program province farmers were classified by acceptance level, 94% of high acceptance farmers understood the effects of worms, compared with 83% for medium and 87% for low acceptance farmers. This difference between categories is statistically significant. Ninety one percent of farmers in the 6 provinces believed they were able to identify calves with parasite burdens by the clinical signs they show, with non-significant differences between the three stages of program development. Within the

program provinces 92% believed they could distinguish calves affected by worms from those which were not, with no significant differences between acceptance levels. Sixty eight percent of farmers used loss of appetite and condition to detect parasitised calves, while scouring was the primary criterion used by 20%. Two percent used direct detection of worms passed in faeces, 4% used abdominal pain, 2% the occurrence of convulsions, and 3% used a combination of findings from those described. Farmers in the program provinces at different acceptance levels conformed closely to this overall pattern, with no marked differences between acceptance levels in the methods used to detect parasitism.

Farmers were also asked whether they thought most animals have worms in them, or only some. This question was intended to assess whether farmers recognised the possibility of subclinical parasitism, in that calves could have worms yet appear perfectly normal. Overall, 44% of farmers believe that most animals have parasites, whereas 56% believe that a smaller proportion have them. The three categories of province had similar results, and differences between them were not statistically significant. An unexpected finding was that only 35% of high acceptance farmers thought most animals were affected by worms, compared with 46% in medium acceptance and 55% in low acceptance groups. This difference was significant (Chi-squared = 11.4, $P<0.01$). In retrospect, the question may have been understood to relate to treatment, high acceptance farmers believing that their animals were not parasitised because they had been treated. If this is not the case, then low acceptance farmers are more aware of the nature of parasitic infestation than higher acceptance ones, and again the extension effort of keymen would have to be judged much less successful than their promotion of the use of anthelmintic. However if the question meant different things to farmers according to whether or not they used anthelmintic, then the answers are difficult to interpret. The findings for this question must therefore be interpreted with considerable caution.

Treatment and Prevention Practices for Parasitic and Other Diseases

As a further test of understanding of parasitism and its control, respondents were asked whether they take any measures to prevent calves becoming ill with worms. In non-program provinces 8% take measures, in one year program provinces 26% and in three year program provinces 30% take preventive action (Table 4.10). In program provinces, 50% of high acceptance farmers say they take preventive action, compared with 21% of medium and 12% of low acceptance farmers (Table 4.11).

Table 4.11 Calf parasite prevention practised by farmers at different acceptance levels

Acceptance of farmer	Yes	No	Number of observations	
High	50.4	49.6	139	(100%)
Medium	21	79	76	(100%)
Low	12	88	133	(100%)

If farmers stated that they took preventive measures, they were also asked what form these took. The results classified by acceptance level are shown in Table 4.12. Among high acceptance farmers, 53% stated that they treated calves preventively by dosing them with anthelmintic at recommended ages, rather than just when they appeared parasitised, and 39% said they dosed calves preventively in accordance with the recommendations of their keyman, which would amount to the same procedure. A further 3% dosed their calves preventively in accordance with the advice of the district livestock officer. Hence a total of 95% of high acceptance farmers followed the recommended program as a prevention

approach. The remaining 5% used herbal methods (3%) or magical[1] methods (1%) for prevention, and anthelmintic only for therapy of clinically parasitised calves.

In contrast, among the very small numbers who used any form of preventive measures, 37% of medium acceptance and 44% of low acceptance farmers chose herbal or magical approaches, and only 63% and 56% respectively of the two groups stated that they used the recommended anthelmintic dosing program or the advice of the keyman or DLO as their prevention method (Table 4.12). Moreover no farmers in these two groups had used anthelmintic on their calves in the previous year, so their statements were ones of principle rather than recent practice. The numbers are low because few farmers in these acceptance levels claimed to use prevention methods.

Table 4.12 Methods of farmer prevention for worm infection

Acceptance of farmer	Timed worming	DLO's suggestion	Keyman's suggestion	Herbal med.	Magic	Total
High	53% 37	3% 2	39% 27	3% 3	1.4% 1	100% 70
Medium	38% 6	19% 3	6% 1	31% 5	6% 1	100% 16
Low	44% 7	6% 1	6% 1	44% 7	-	100% 16

Farmers were also asked whether it is worthwhile giving anthelmintic to calves which have worms but appear healthy. In non-program provinces 6% said yes, compared with 22% in one-year and 33% in three-year program provinces. When acceptance level is considered, 51% of high acceptance farmers thought it would be worth treating such animals, compared with 16% of medium acceptance and 17% of low acceptance farmers (Table 4.13). Thus slightly over half of the farmers who have accepted the advice to treat their animals and have carried out treatment during the last year agree that it is worthwhile treating subclinically affected animals. Although this is a much higher proportion than for the lower acceptance levels, it shows that there is still considerable scope to reinforce with the farmers the

[1] Magical methods are defined for this purpose as those where the procedure followed does not involve the use of any ingredient which could be rationally expected to have a therapeutic effect, even one as yet unidentified. One common example in the study area is blowing steam generated from pouring water on to hot metal on to the part of the animal affected by a disease. Another is the use of a red cloth tied around the neck of a newborn calf to prevent disease from affecting it.

importance of subclinical parasitism to their animals. Traditional treatments[2] were widely used, even by the high acceptance farmers.

Table 4.13 Extent to which farmers use preventive treatment for parasites in buffalo calves, classified by length of time in program and acceptance levels

Duration of program	No	Yes	Total
One year	77.8%	22.2%	100% (72)
Three years	67.4%	32.6%	100% (276)
Acceptance levels	No	Yes	Total
High	49%	51%	100% (139)
Medium	84%	16%	100% (76)
Low	83%	17%	100% (133)

Farmer Action When a Calf Became Sick Prior to the Program

One of the points of interest in the study was to determine the extent of changes in the action taken by farmers when one of their animals became ill with a possible parasitic disease, as a result of introduction of the farmer self-help parasite control program.

Farmers were therefore asked what action they would take now, and what they would have done if faced with the same problem five years earlier. If they had changed their approach, they were asked the reason for the change.

Prior to the commencement of the program, 58% of farmers in the four provinces which subsequently joined the program used traditional village treatments, either herbal remedies or drugs such as antibiotics or vitamins obtained through local suppliers, 8% said they would have asked for advice from the DLO, 13% said they would go to a local chemist for a suitable drug, 4% would use magical methods, and the remaining 17% would use miscellaneous alternative methods. These results are summarised in Figure 4.11. When all six provinces are considered (Figure 4.12), the results are generally similar.

[2] Traditional treatments are those used by farmers themselves when animals were severely affected by diseases, including but not limited to parasites. Antibiotics and vitamin injections were the drugs most farmers used for treatment. Herbal remedies were also used by farmers in remote areas for animal treatment, and animal deaths may frequently occur from these treatments.

Farmer Action When Adult Animals Became Sick Prior to Commencement of the Program

Before the program commenced, when adults were sick, the percentage of farmers using traditional treatment across the 6 provinces was 53%, 17% bought drugs from the chemist, 12% sought help from the DLO, 5% used magical methods to solve their animal problems, and 13% gave miscellaneous responses. These findings are shown in Figure 4.13.

Figure 4.14 compares the sources of advice used by farmers at each of the three program acceptance levels in deciding on treatment of adult stock in the time before the program started.

Low acceptance farmers were more likely to have used a chemist or the DLO as their source of advice than the high or medium acceptance farmers, and hence were less likely

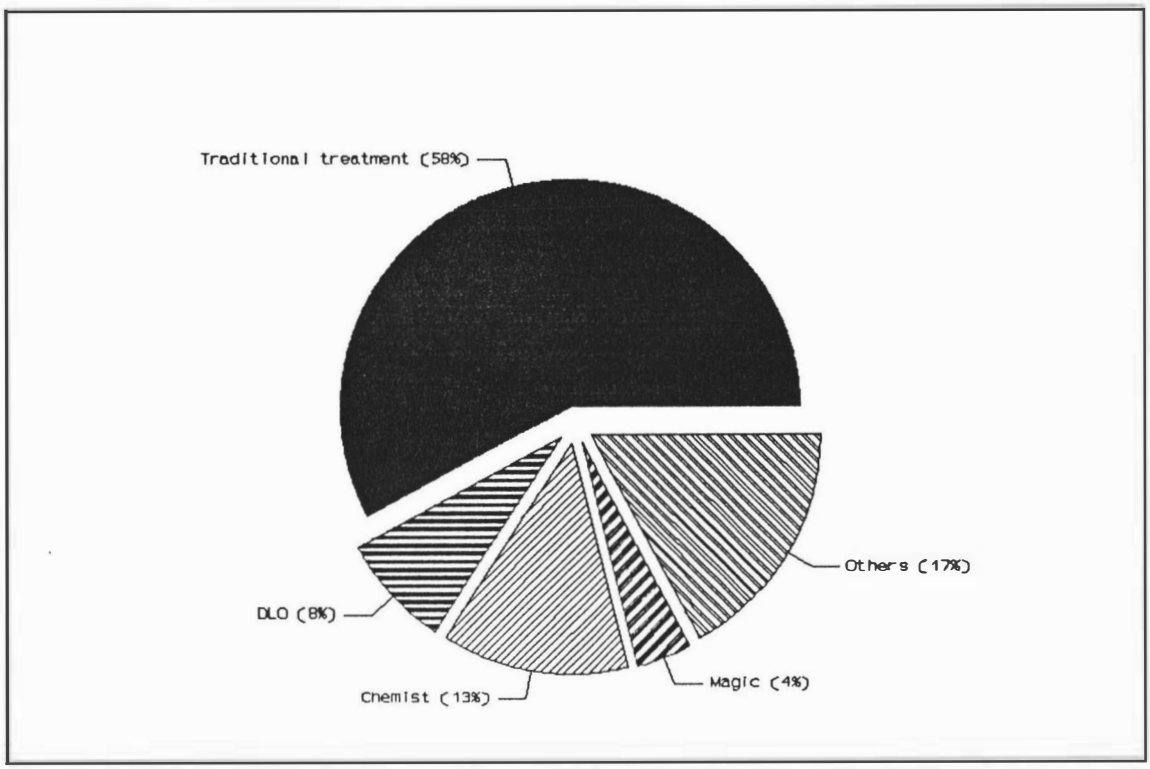


Figure 4.11 Sources of Treatments Used for Sick Calves Prior to the Program, for Provinces Which Subsequently Joined the Program

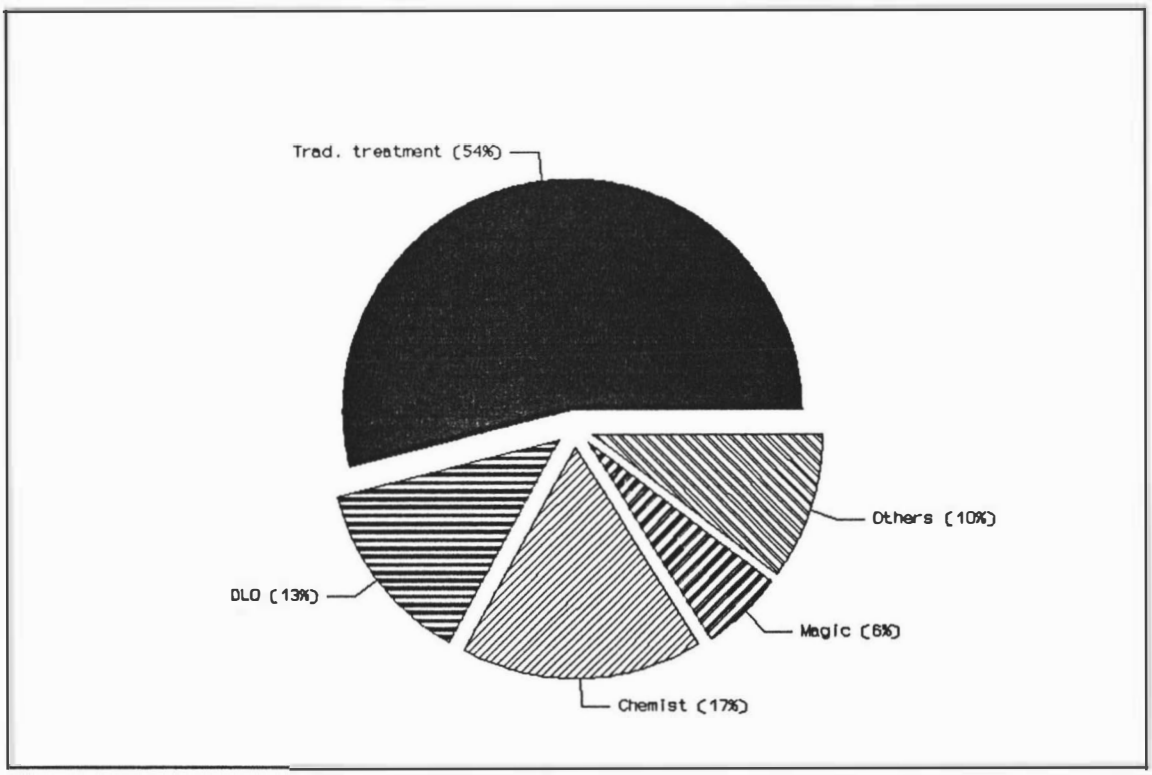


Figure 4.12 Sources of Treatment Used for Sick Calves Prior to the Program, for all Six Provinces

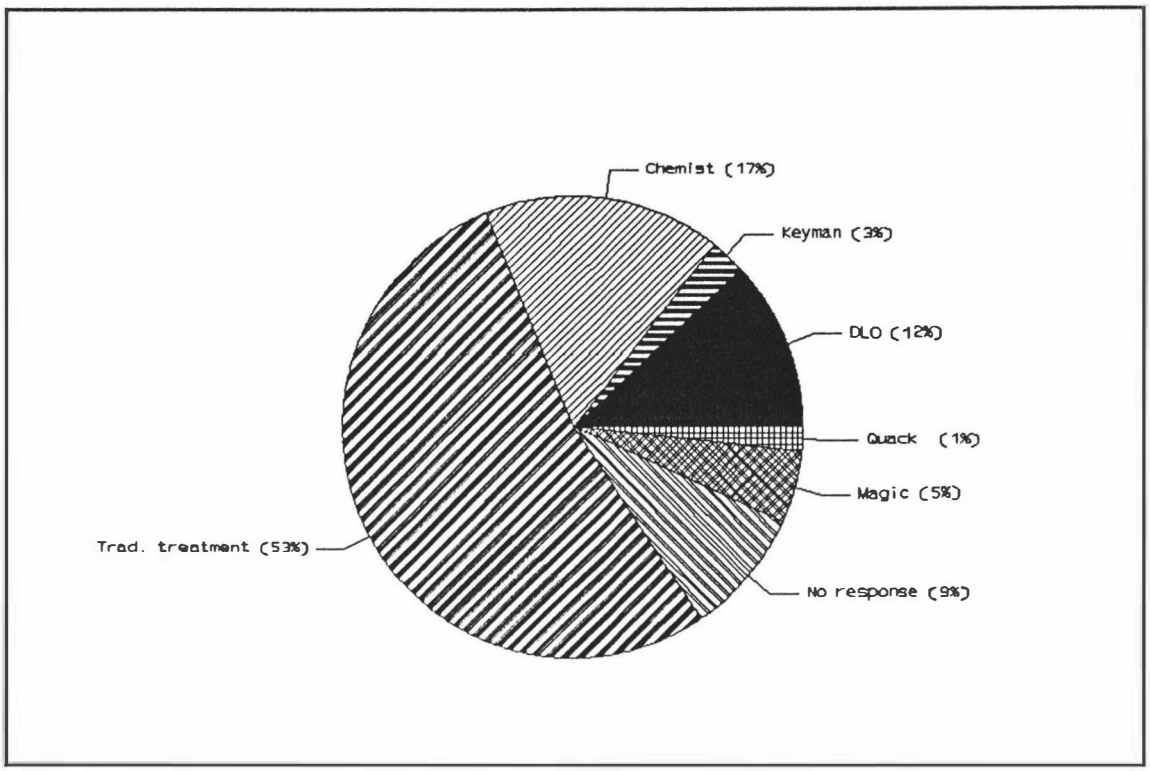


Figure 4.13 Sources of Treatment Used for Sick Adults Prior to the Program, for all Six Provinces

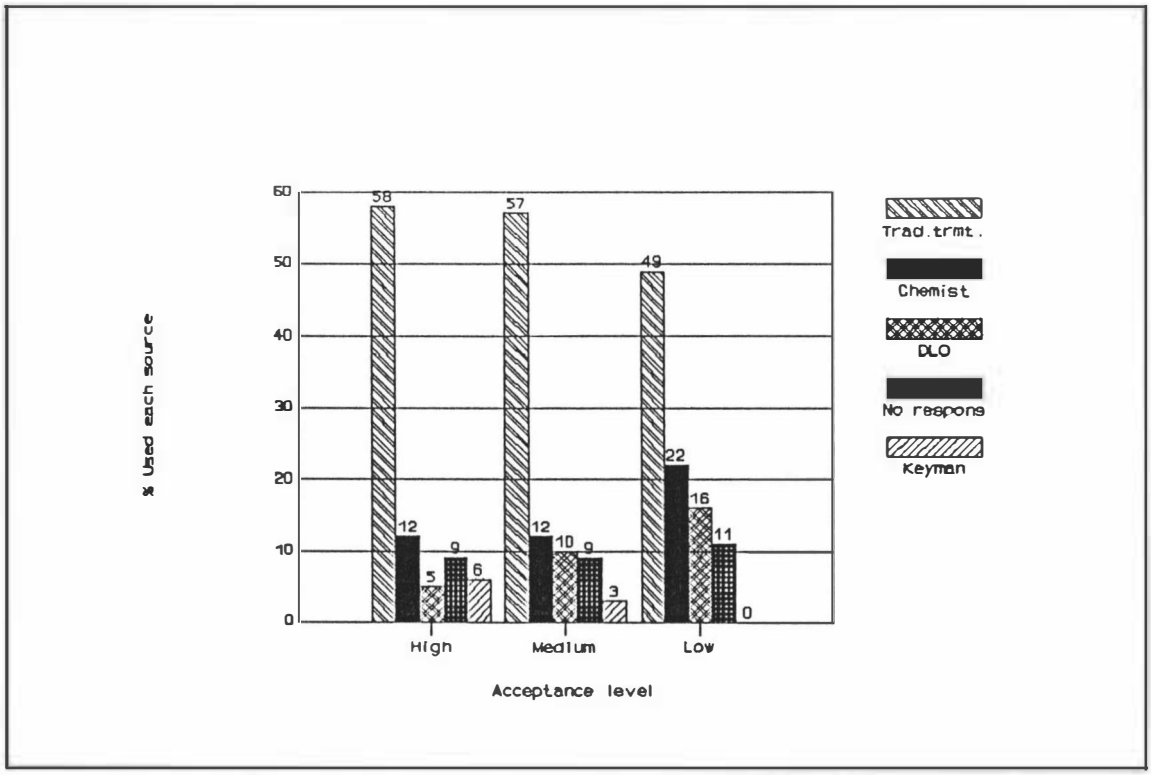


Figure 4.14 Sources of Treatment Used for Sick Animals Prior to Program Commencement, Classified by Subsequent Acceptance Level for Program

to rely on traditional treatment. A small number of farmers already used as a source of advice the farmer who later became the program keyman.

Current Sources of Advice to Farmers Concerning Treatment of Sick Animals

At the time of the survey sources of advice had changed substantially, as shown in Table 4.14. Forty percent of farmers now sought their advice from the keyman, and a further 30 to 40% from the DLO, who appears to have gained considerably in public recognition in comparison with the situation five years earlier. In the non-program provinces the chemist (28%) and the DLO (56%) account for most of the advice.

When program province farmers are considered by acceptance level (Table 4.15), the keyman has become clearly the dominant source of information for high acceptance level farmers, advising 78% of this group. Since a further 15% would go to the DLO, the official veterinary service would advise 93% compared with 5% five years earlier, leaving only 7% of high acceptance farmers who would now use alternative sources. Medium acceptance farmers would predominantly use the DLO (54%), with the keyman coming second (31%).

Thus the official veterinary service (taken to include the keyman as one of its components) is now acting as the source of advice for 85% of medium acceptance farmers, compared with 10% five years earlier (Table 4.15). Low acceptance farmers appear to rely more on other sources for their advice, but still 55% would now go to the DLO and 1.6% to the keyman, compared with 16% prior to the program. Low acceptance farmers appear to be people who make much greater use of the chemist - both now (19%) and five years ago (22%). Involvement of local chemists in the program in some form may provide a mechanism for getting sound advice to the farmers who have been relatively untouched by the program in its present form. Alternatively, continuing use by low acceptance farmers of the chemist may reflect simply their difficulties in using the keyman for one reason or another, and changes with respect to numbers and selection of keymen may result in these farmers becoming more involved in the program. At least they are predominantly using trained sources of advice, rather than people who lack any understanding of the epidemiology and control of parasitism.

Table 4.14 Sources of advice currently used by farmers for treatment of calves, classified by province group

Time in program	Don't need any advice	Keyman	Chemist	DLO	Herbs	Others	Total
One year	2.9%	40.5%	21.7%	30.4%	3%	1.5%	(100%) 69
Three years	5.3%	39.1%	8.4%	40.3%	1.1%	5.8%	(100%) 263
Non-program province	11.1%	-	27.8%	55.6%	-	5.6%	(100%) 72

Table 4.15 Sources of advice used by farmers to treat sick calves, classified by level of acceptance of the program

Acceptance of farmer	Don't need any advice	Keyman	Chemist	DLO	Herbs	Others	Total
High	0.7%	77.5%	4.4%	15.2%	0.7%	1.4%	(100%) 332
Medium	2.9%	31.4%	10%	54.3%	-	1.4%	(100%) 70
Low	10.5%	1.6%	19.4%	54.8%	3.2%	10.5%	(100%) 124

Farmer Knowledge and Attitudes Concerning Keymen

The source to which farmers in different province groups said they would go to buy drugs to treat a sick calf is shown in Table 4.16. It can be seen that the keyman provides drugs to about 40% of farmers, the DLO to about 30% and the chemist to about 25%.

Table 4.16 Sources of drugs for animal treatment used by farmers in program and non-program provinces

Time in Program	Village headman	Keyman	Chemist	DLO	Never administered	Total
One year	-	42.0%	26.0%	29.0%	3.0%	(100%) 69
Three years	0.8%	38.4%	24.3%	33.8%	2.7%	(100%) 263
Non-program province	1.4%	-	40.0%	58.0%	-	(100%) 72

When considered in relation to acceptance level, 76% of high acceptance farmers said they would go to the keyman to buy drugs to treat a sick calf, compared with 31% of the medium and 2% of the low acceptance farmers. This difference is significant ($P < 0.01$). This result is shown in Table 4.17. However those farmers who did not use the keyman went instead to either the DLO or the local chemist, so provided they both supply information which is similar to that provided by the keyman, the right information will get through to the farmer.

Table 4.17 Sources of drugs for farmers, classified by level of program acceptance

Acceptance of farmer	Village headman	Keyman	Chemist	DLO	Never administered	Total
High	-	76.1%	10.8%	13.0%	-	(100%) 138
Medium	1.4%	31.4%	17.1%	47.0%	3.1%	(100%) 70
Low	0.8%	2.4%	44.4%	46.8%	5.6%	(100%) 124

The opinion on a keyman's activity held by high and medium acceptance farmers can be

The opinion on a keyman's activity held by high and medium acceptance farmers can be seen in Table 4.18. Ninety nine percent of the high acceptance farmers had seen keymen visit their village, 96% had talked with the keyman about the program, and (by definition) all high acceptance farmers interviewed had bought drugs from the keyman, either a deworming drug for calves, or treatment for adult animals against liver fluke. Ninety percent of farmers knew that keymen talked to others as well about the program, 79% considered that their keyman gave correct advice concerning parasite control, and 84% followed the keyman's recommendation. It is notable that medium acceptance farmers had much lower opinions of the keyman's effectiveness in all respects. In part this will be because they were in different villages where the keymen had put less effort, but it probably also reflects a difference in attitude. Low acceptance farmers could not answer these questions since they did not know about the program.

Table 4.18 Farmer opinion on keyman's activity

Visited village	Talked on program	Sold drug to me	Talked to others	KM gave good advice	Followed KM advice	Total
High acceptance						
99.3%	96.4%	100%	89.9%	79.0%	84.2%	139
Medium acceptance						
84.7%	59.7%	0%	50.0%	13.9%	2.6%	76

Interaction of Village Headman with Keyman

In general it might be expected that the village headman and the DLO would be the people who most of the effective keymen would ask for help in arranging meetings in either their own or other villages. During the meeting, keymen would explain the program and answer questions from farmers about the parasite control program. This can help farmers understand the program. If the village headmen were instrumental in arranging meetings for keymen, it would be hoped that they would be more fully informed on the program than ordinary farmers. However that does not seem to have been the case with regard to aspects of the program investigated. Table 4.19 shows the acceptance levels for farmers and village headmen separately, and it can be seen that the percentage of headmen classified as high acceptance is equal to that for other farmers. However the percentage of medium acceptance headmen is 33%, compared with only 16% in this category for other farmers. As a result, the number of low acceptance headmen is much smaller than for other farmers. The reason for this appears to be that high acceptance is defined in terms of buying drug from the keyman. Yet 47% of headmen obtained their drug supplies direct from the DLO rather than from the keyman, presumably because they knew him personally and may have obtained their supplies on preferential terms, whereas only 26% of other farmers went direct to the DLO. This will distort the acceptance figures for the headmen, and give a false impression that they have an acceptance level no better than other farmers. It appears that they do use the program, but many obtain their supplies higher up the distribution chain. Thus the number of **true** "high acceptance" farmers would be substantially increased if this group was added in.

Table 4.19 Acceptance levels for village headmen and other farmers

Acceptance levels	Farmers	Village headmen	Total
Low	43.5% 100	28% 33	38% 133
Medium	16% 37	33% 39	22% 76
High	40.4% 93	39% 46	40% 139
Total	230	118	348

Reasons why farmers did not use the keyman

The reasons why farmers did not follow their keyman's recommendations is shown in Figure 4.15. It can be seen that 46% of them reported that they had not had sick animals, and as described above many of them did not consider it necessary to treat animals under these conditions. Twenty five percent of farmers were unaware of the program, 8% had no adult animals, 14% had no calves, 1% preferred traditional treatment, and 6% had other reasons.

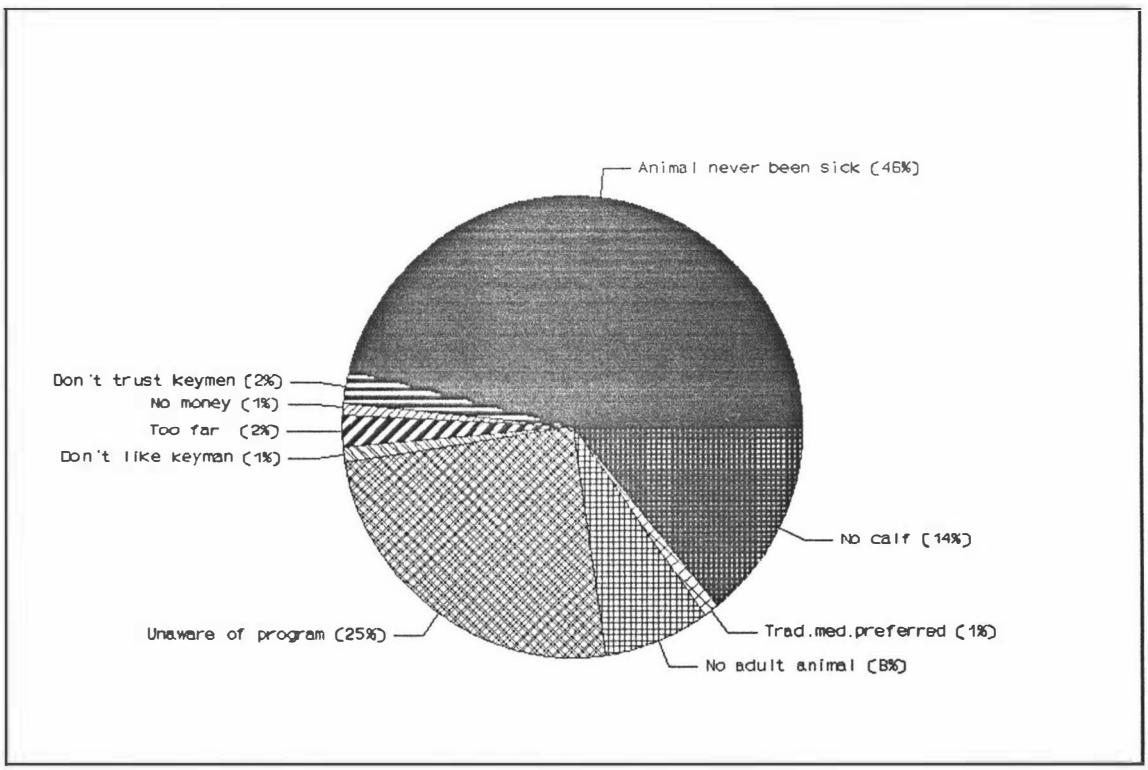


Figure 4.15 Reasons Why Farmers Did Not Use Keyman

Six percent of high and 44% of medium acceptance farmers mentioned that the keyman was so busy with other work that he did not have much time to work as a keyman. Ninety six percent and 33% of high and medium acceptance farmers believed what the keymen told them and used the drugs he provided. Those who believed the keymen but had no money to buy drugs were only 2% of high and 2% of medium acceptance farmers. Only 1% and 29% of high and medium acceptance farmers could not get drugs from the keyman. Those who thought no treatment was necessary comprised 18% and 53% of high and medium acceptance farmers. This result is shown in Table 4.20.

Table 4.20 Farmer opinion on their keymen (KM) by acceptance levels

Farmer acceptance	Too busy for KM work	Believed KM and used drug	Believed but no money	Can't get drug	No treatment needed	Total
High	6.5	96.4	2.2	1.4	18	139
Medium	44.4	33.3	2	29	53	72
						211

Farmers were asked about problems of obtaining drugs from the keyman. Forty four percent of high and 20% of medium acceptance farmers who reported difficulties in buying medicines for their animals said that they had not enough money to buy drugs; 12% and 30% mentioned that it was difficult to contact the keyman when they needed to buy drugs; 25% and 20% complained that the keyman's village was too far away to buy drugs. These findings are reported in Table 4.21. However it should be noted that relatively few farmers expressed concern about difficulties with drug supply.

Table 4.21 Difficulty in getting drugs from keyman

Farmer acceptance	No transportation	Drug supply limited	No money to buy drug	Difficult to find keyman	Too far away	Total
High	19	-	44	12	25	100 (16)
Medium	25	5	20	30	20	100 (20)
						(36)

Sources of Farmer Advice Who Convinced Farmers to Change Disease Control Methods

As seen in Figure 4.16, a high proportion of farmers had changed their practice concerning disease control methods in calves, compared with five years earlier. Among high acceptance farmers, 95% had changed their approach over that time, compared with 79% of

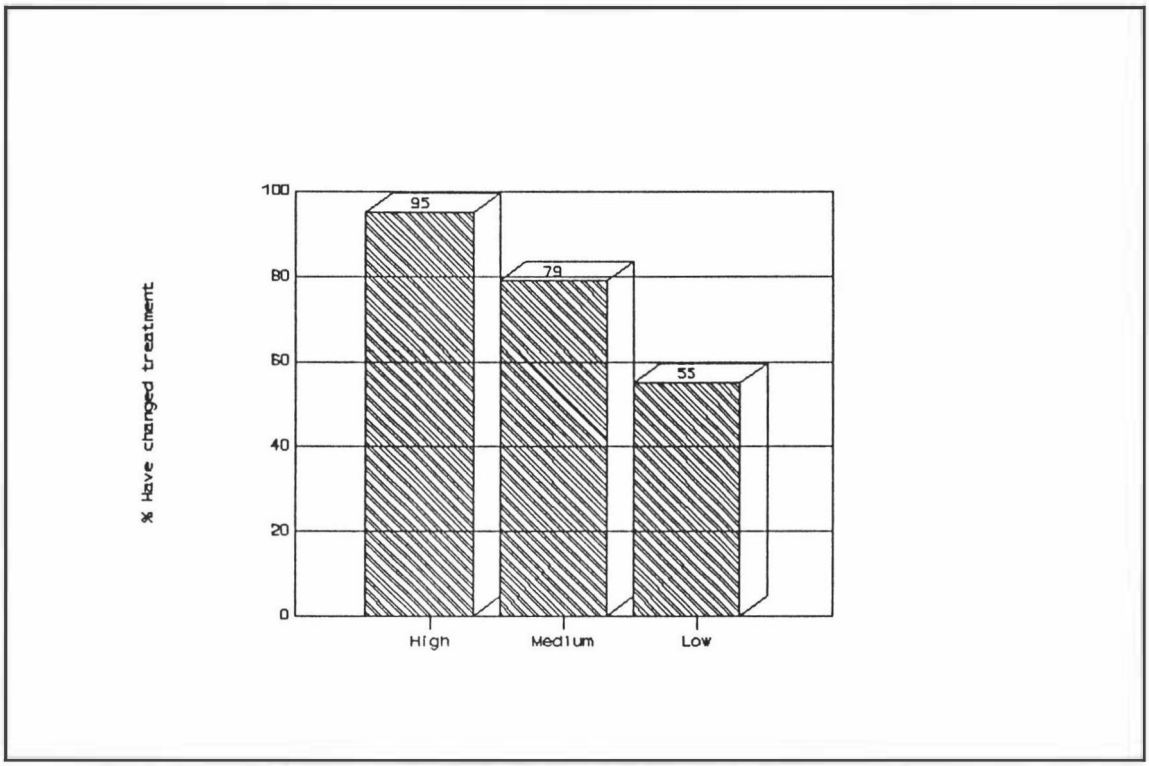


Figure 4.16 Extent of Change in Calf Disease Control Methods, by Acceptance Level

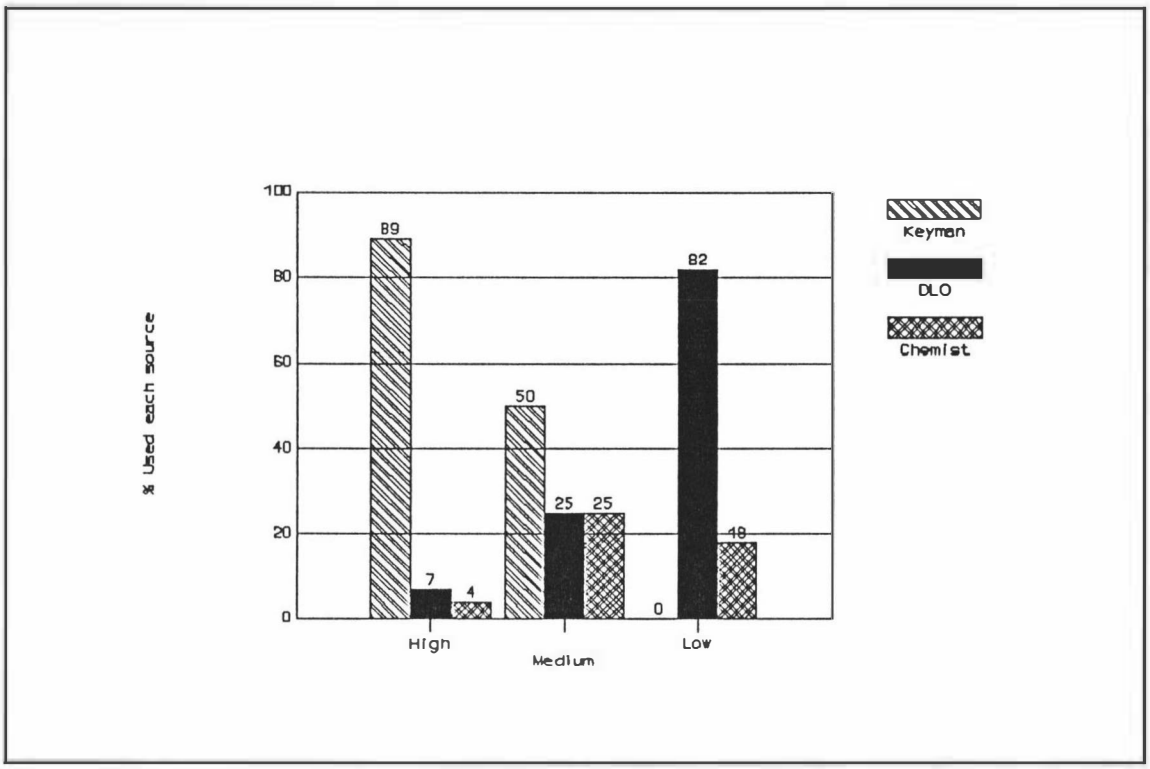


Figure 4.17 Sources of Advice Who Convinced Farmers to Change Disease Control Methods - One Year Provinces

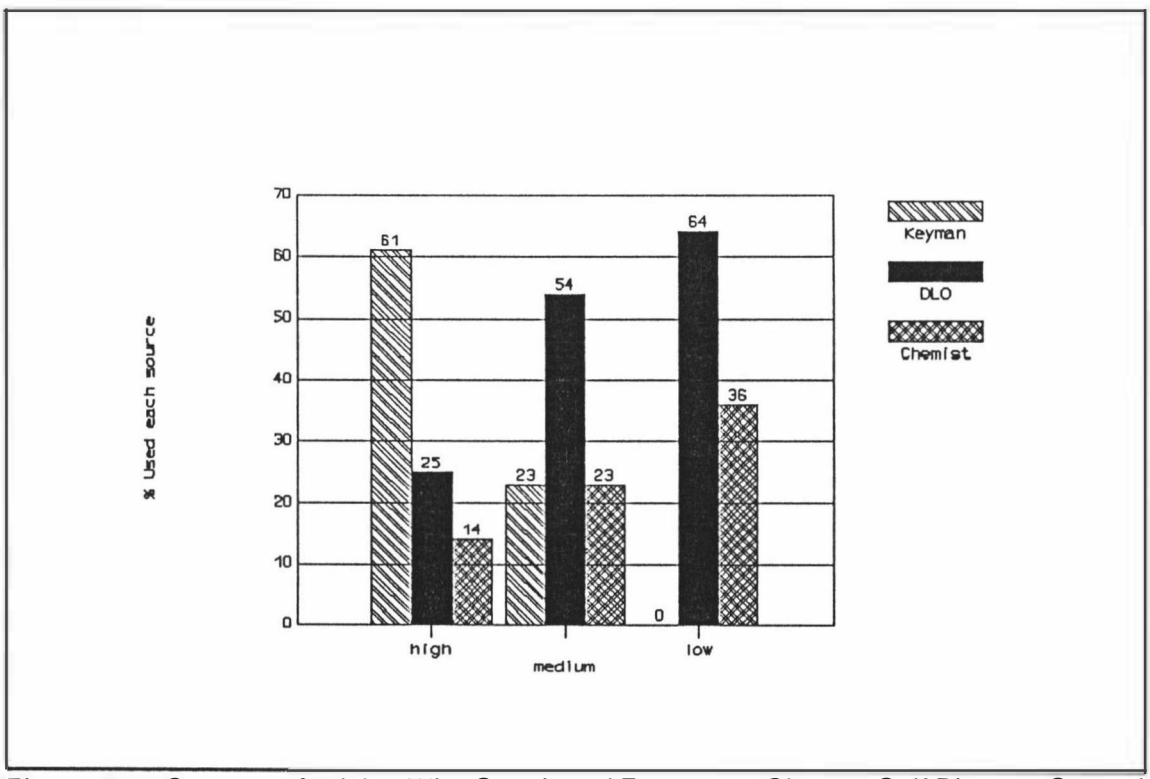


Figure 4.18 Sources of Advice Who Convinced Farmers to Change Calf Disease Control Methods - Three Year Program Provinces

medium acceptance and 55% of low acceptance farmers. This difference is statistically significant ($P < 0.01$). Thus the thinking of farmers has progressed from using traditional methods of treatment five years earlier, to reliance on trained sources of advice predominantly at the time of the survey.

For the farmers who had changed their disease control practices, a question was asked concerning the adviser who had convinced them to change. For both one year program provinces (Figure 4.17) and three year program provinces (Figure 4.18), the keyman was clearly the most influential in changing the high acceptance farmer's policy. Among the smaller number of medium acceptance farmers who changed, the keyman and the DLO were the most influential people. Among the 55% of low acceptance farmers who had changed their practices, the DLO was the most influential adviser and the keyman had no part in the change, since these farmers did not know of his existence.

The current source of drugs for treatment of calves is shown in Figure 4.19. The keyman was the main source for high acceptance farmers, and the DLO was the main source for medium and low acceptance farmers who wished to buy drugs.

Figures 4.20 and 4.21 show that the reasons for changing the method of treatment of adult animals were similar to those given by farmers for changing the method of treatment of calves, and that the pattern was broadly similar for one year and three year provinces. Most high acceptance farmers were influenced by the keyman, with the keyman having reduced influence at lower acceptance levels, and the DLO having proportionately more influence, bearing in mind that the number of owners involved becomes rapidly smaller at lower acceptance levels.

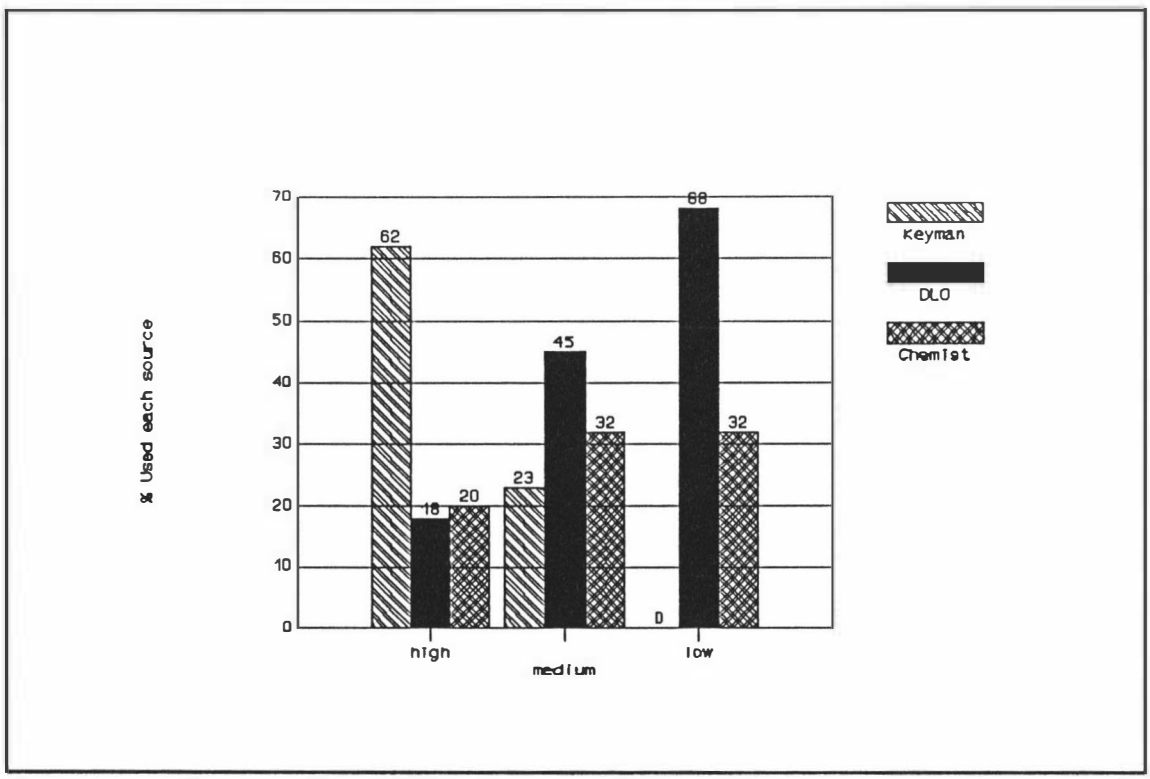


Figure 4.19 Sources from Which Drugs for Calves Were Obtained, by Acceptance Level

The extent of change in calf disease control methods by acceptance level is seen in Figure 4.16 and Table 4.22. Although high acceptance farmers have accepted the value of using the drugs and have switched to them, the timing of their treatment does not always agree with the recommended practice. As can be seen from Table 4.23, only 50% of farmers who used the recommended drugs did so exactly in accordance with program recommendations, and the rest deviated from the official guidelines to varying extents. In this respect they are not greatly different from farmers in the rest of the world, who frequently fail to follow label instructions in carrying out measures to control animal disease. However this reinforces the importance of intensifying keyman training and encouraging keymen to increase their extension efforts direct to farmers in the villages.

Table 4.22 Extent of change in calf disease control methods, by acceptance level

Acceptance of farmer	Change in calf disease control methods (%)
High	95
Medium	79
Low	55

Table 4.23 Extent to which farmers used drugs correctly

Acceptance of farmer	Correctly used	Not correctly used	Total
High	50% (57)	50% (57)	100% (114)

Farmer Views on Effect of Treatment on Calf Health and Wellbeing

Farmers who had used the drugs for calf treatment provided by the keyman almost all (98%) considered that the condition of their calves improved considerably, as shown in Table 4.24. Ninety percent of farmers believed that after treatment, the appetite and weight gain of the calves improved. Some were impressed by seeing worms passed in the faeces after treatment (10%), as shown in Table 4.25.

Table 4.24 Improvement in calf condition after treatment

Acceptance of farmer	No	Yes	Total
High	2% (2)	98% (112)	100% (114)

Table 4.25 Nature of improvements after calf treatment

Acceptance of farmer	Appetite improved and weight gained	Worm detected	Total
High	90% (100)	10% (11)	100% (111)

Farmer Views on Effect of Treatment on Health and Wellbeing of Adult Animals

After fluke treatment in adult animals, animal condition generally improved. It can be seen in the results from Table 4.26, that the percentage of owners who treated animals and thought they improved in appetite and weight gain was 82%, and in 18% of cases owners believed that work ability improved.

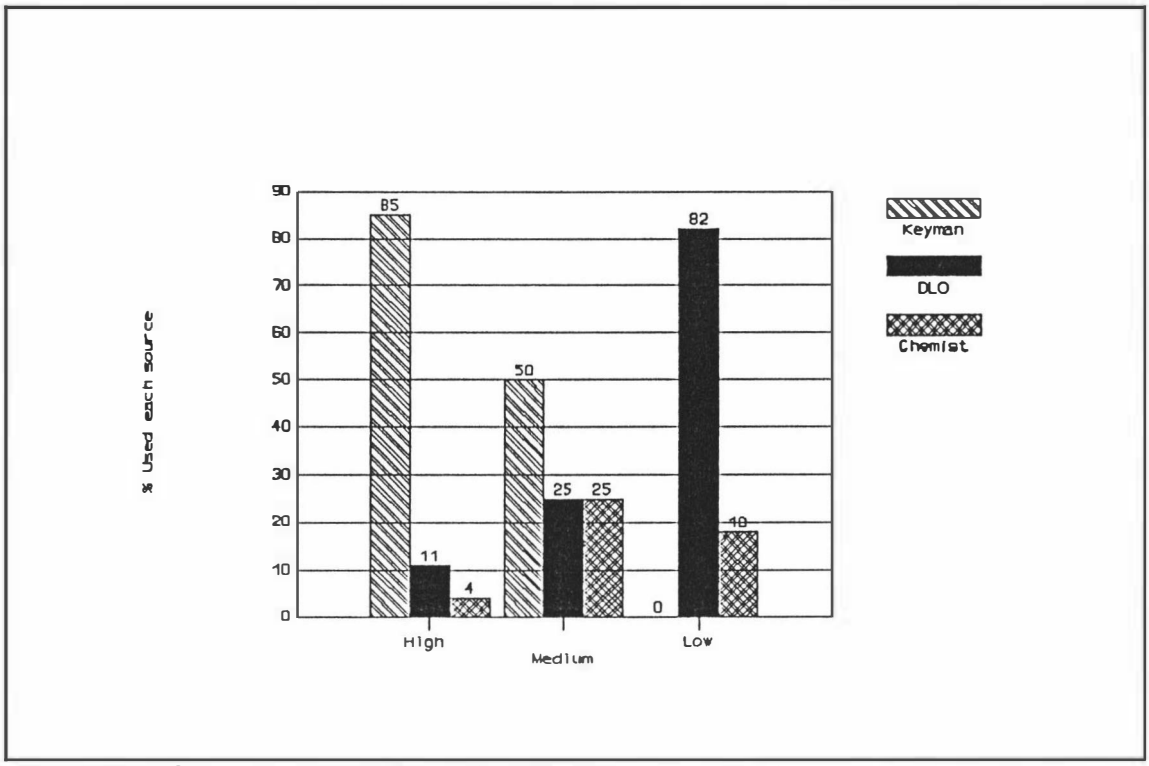


Figure 4.20 Source of Advice Who Convinced Farmers to Change Disease Treatments in Adult Animals - One Year Program Provinces

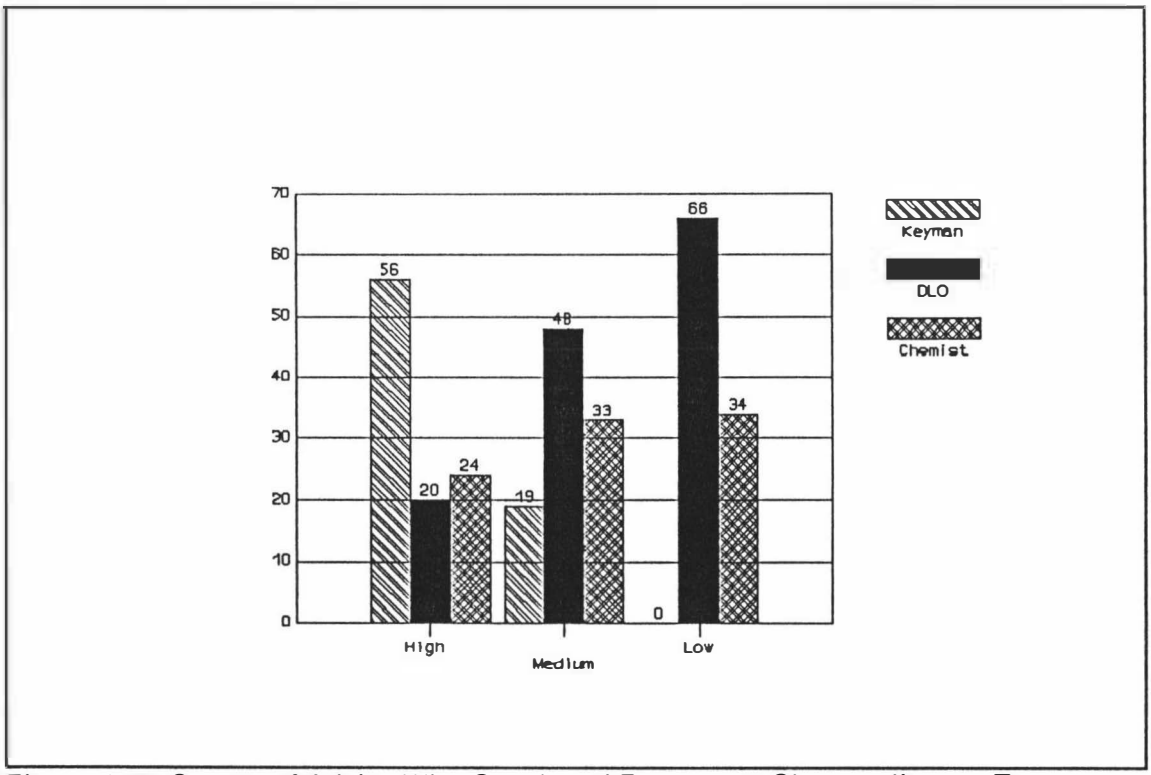


Figure 4.21 Source of Advice Who Convinced Farmers to Change disease Treatments in Adult Animals - Three Year Program Provinces

Table 4.26 Effects of fluke treatment on adult animals

Acceptance of farmer	Appetite improved and weight gained	Work ability improved	Total
High	82.0%	18.0%	100% (81)

Effect of Program on Reproduction and Calf Survival

When calf survival as reported by farmers was compared between acceptance levels, it was clear that the survival rate for both buffalo and cattle calves was considerably better for high acceptance farmers than low acceptance ones (Table 4.27 and Figure 4.22). The situation for medium acceptance farmers was intermediate in both cases, and is more difficult to interpret because these farmers understood the program, but many of them obtained drugs from sources other than the keyman, as mentioned earlier. Thus they represent a mixture of people who implicitly used the program although did not fit the "high acceptance" definition, and farmers who merely knew about the program but did not use the drugs.

If the comparison is restricted to high and low acceptance, the difference is quite striking, with a survival rate 12 percentage points higher in buffalo and 13 percentage points higher in cattle. The calving rate was also 15 percentage points higher in buffalo and 10 percentage points higher in cattle for high acceptance farmers than low acceptance ones (Table 4.27 and Figure 4.23). It is difficult to draw any conclusions from the data about whether this had any causal basis in the program, or was merely associated with it, for example because high acceptance farmers were better animal managers overall.

Table 4.27 Survival rate (%), Birth rate(%), and Mortality rate(%) in calves of farmers in acceptance

Accept-ance levels	Survival rate of buffalo calves	Survival rate of cattle calves	Birth rate of buffalo calves	Birth rate of cattle calves	Mortality rate of buffalo calves
Low	68.2%	81%	40.6%	51.5%	40.0%
Medium	80.0%	84.6%	65.4%	50.0%	25.5%
High	80.6%	92.0%	55.8%	61.0%	18.3%

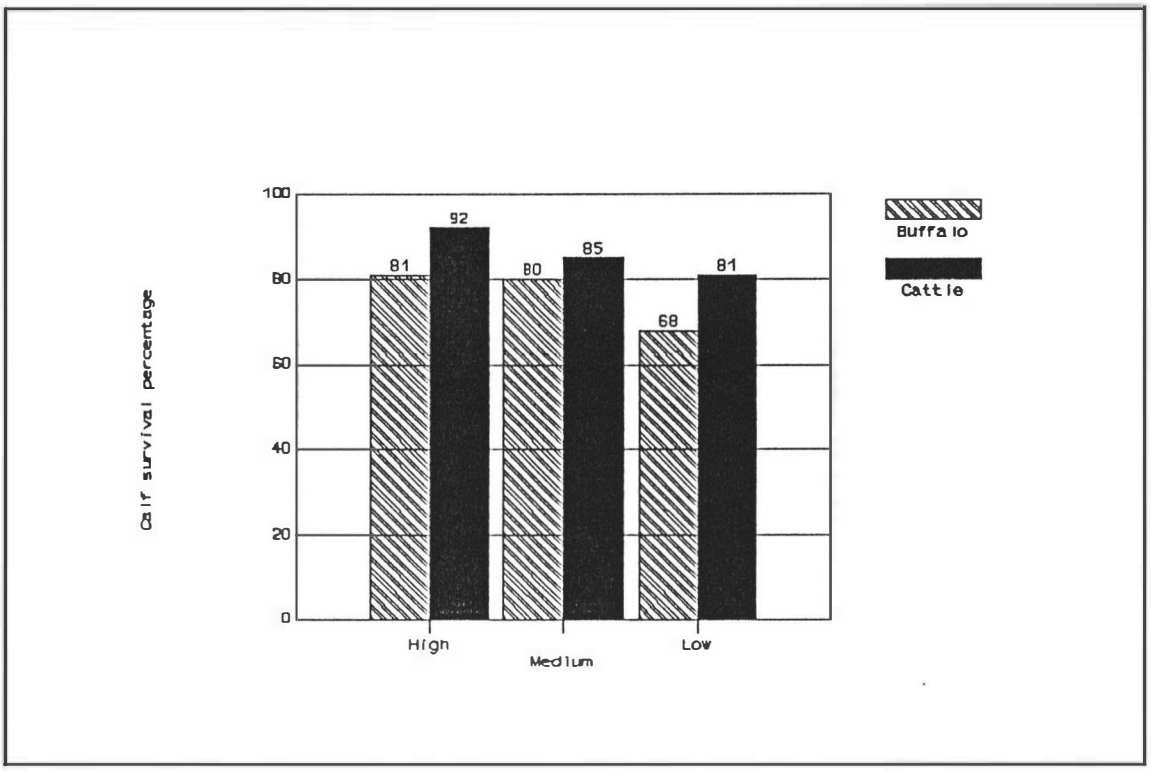


Figure 4.22 Survival Rates of Buffalo and Cattle Calves, by Acceptance Level

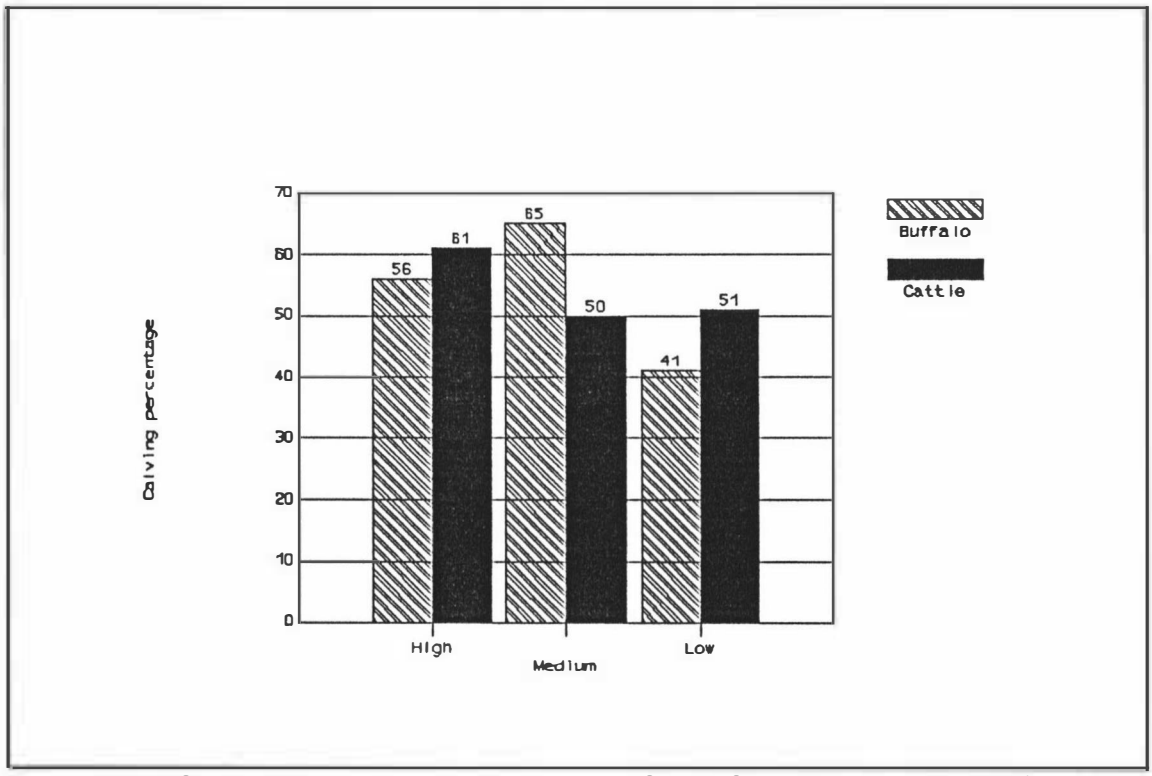


Figure 4.23 Calving Percentage of Buffalo and Cattle Cows, by Acceptance Level

Factors Influencing Farmer Acceptance of the Parasite Control Scheme

The results in Table 4.28 show the effects of keyman suggestion and other factors on farmer acceptance and treatment of their healthy animals. Some farmers themselves became aware of the need for prevention measures against worm infestation. Some owners after recognition of the severity of internal parasite infestation, become apprehensive concerning animal deaths. The high acceptance farmers treated their healthy animals due to a keyman's suggestion (41%), need to prevent worm infection (38%), afraid of animal deaths (17%) and followed the DLO's suggestion (4%)

Table 4.28 Reasons farmer treated healthy animals by acceptance level

Farmer acceptance	DLO's suggestion	Advice of keyman	Need to prevent worm infection	Owners afraid of animal deaths	Total
High	4%	41%	38%	17%	100% (71)
Medium	8.3%	8.4%	58.3%	25%	100% (12)
Low	4.3%	-	48%	47.7%	100% (23)

Table 4.29 shows another considerable difference between the different periods of program, the effects of keyman in one year program provinces caused farmers treated their healthy animal (44%), while only 26% in three year program province.

Table 4.29 Reasons farmer treated their animals in program provinces

Duration of program	DLO's suggestion	Advice of Keyman	Need to prevent worm infection	Owners afraid of animal deaths	Total
One year	12.5%	44%	12.5%	31%	100% (16)
Three years	3.3%	25.5%	47.8%	23.4%	100% (90)

Accessibility of Keyman

One important factor in determining program acceptance by the farmers in each area is the extent to which they are aware of the activities of the keyman, and the ease with which they can make contact with him. Two central points in determining this are the effectiveness of publicity which alerts them to the existence of the program, and the extent to which the keyman is active in publicising the program and his role in it.

The effectiveness of program publicity

The program has made extensive use of both general and local publicity methods in alerting farmers to the existence of the program, and the way in which they get access to the keyman and his services.

The following major components of the publicity effort have been implemented:

1. Use of videotapes, both locally and on national television, to publicise the nature of the program. Two separate videotape programs have been produced and widely used.

2. The use of posters which the keyman can display in prominent places around each of the villages which he serves, both outside his house and at the "sala klang ban", the village meeting hall. These explain the program, and direct farmers to their local keyman.

3. The use of leaflets which can be made available to farmers to read, and which describe the program in simple lay terms.

4. The holding of farmer meetings at which the program is explained and treatment procedures can be demonstrated.

Farmers were asked about their knowledge of this publicity effort, both in general and in relation to specific forms of publicity. Figure 4.25 shows the level of awareness of program publicity among farmers at different acceptance levels.

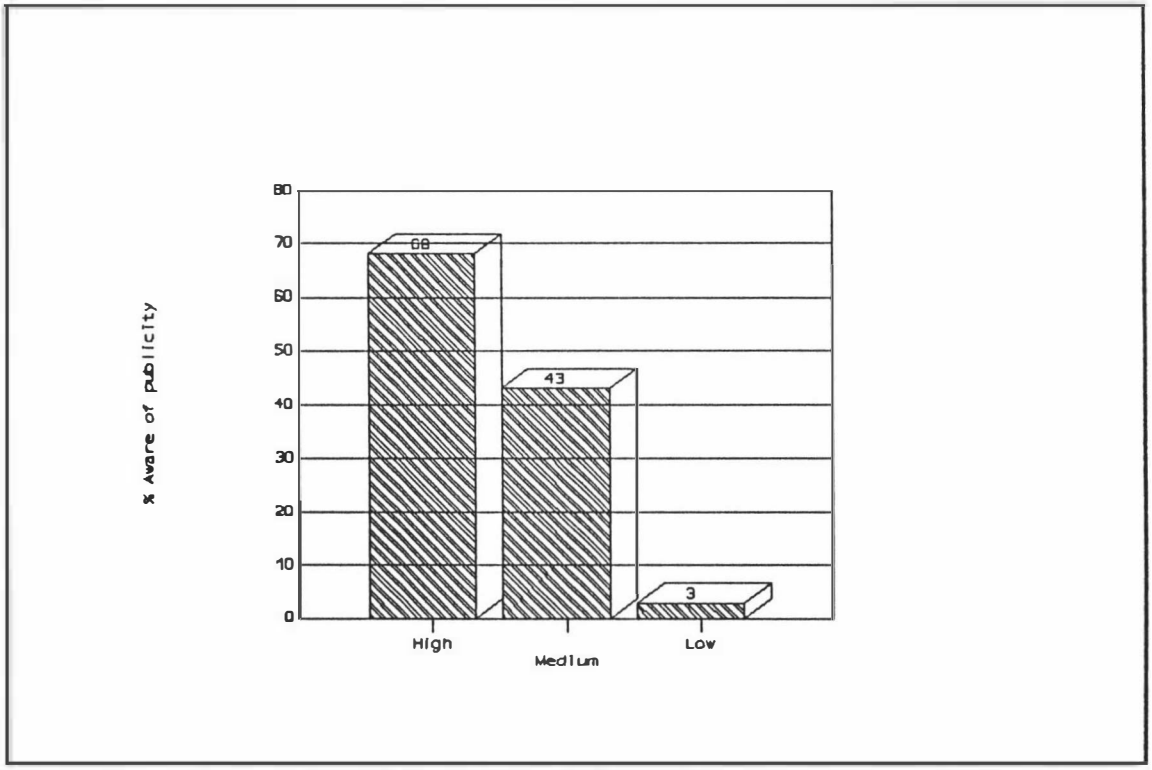


Figure 4.24 Extent to Which Farmers at Different Acceptance Levels Were Aware of Program Publicity

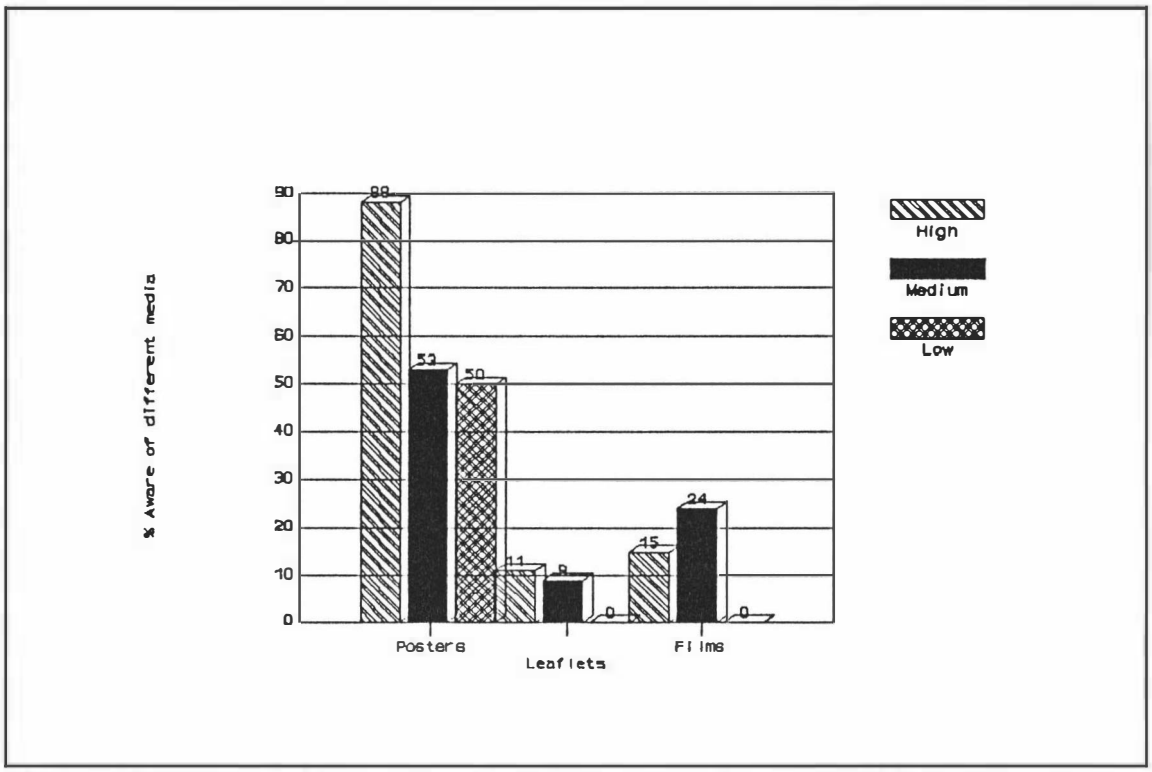


Figure 4.25 Degree of Farmer Awareness of Various Forms of Publicity, Classified by Acceptance Level

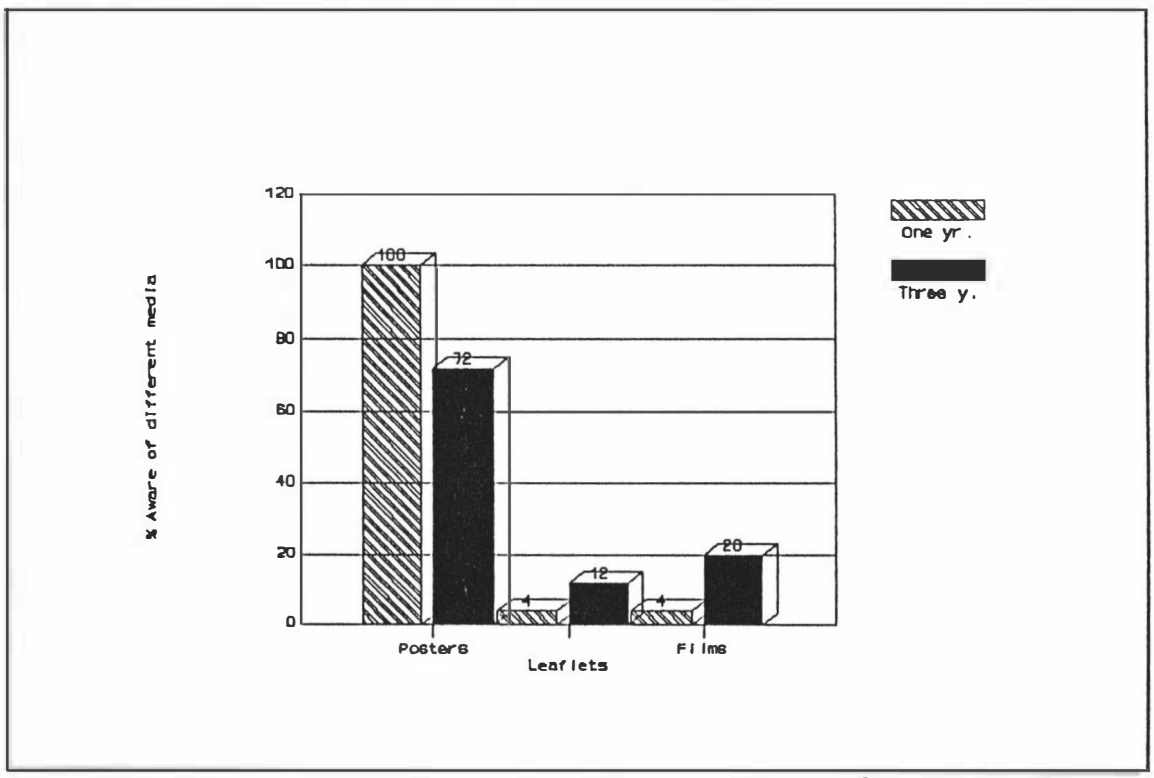


Figure 4.26 Degree of Farmer Awareness of Program Publicity, Classified by Duration of Program in Province

Figure 4.24 shows clearly that the publicity has not reached the low acceptance farmers, and their failure to adopt the program has been due at least in part to the fact that they were not adequately informed on the program, so could not make an informed decision not to participate. It is intriguing to speculate on the specific individual reasons for this lack of knowledge, since many of them lived in the same village as farmers who were well informed. The survey does not allow this deeper aspect of farmer knowledge to be explored, but later results will bring out some of the factors which can be influenced by the veterinary services, as distinct from those aspects which are related to farmer personality and contacts.

Figures 4.25 and 4.26 demonstrate which of the publicity methods used has been most widely recognized by farmers, and their effectiveness both for different acceptance levels and in the early and later stages of a program. Clearly the posters are the most widely known of the forms of publicity, especially in provinces where they had only appeared during the previous year. The figures include only those who agreed that they had been aware of publicity for the program, but even so 100% awareness of the posters in the one-year provinces is an excellent recognition level by any standards. Since posters are exceptionally cheap and durable, they represent an outstanding publicity investment. Judging by the result for three year provinces where recognition had dropped off, further distribution of posters and production of new poster designs from time to time would be a good investment.

Leaflets do not perform well, and although they are cheap to produce they clearly do not achieve much recognition among the farmers, presumably in part due to the fact that they do not receive a lot of information in this form.

The videotapes and slide shows used to publicise the program have a low but intermediate recognition level, better among the earlier provinces to join. The videotapes in particular were used in the early phase of the program, and probably deserve intensive use when the program is being established in an area, with follow-up by other methods. The fact that they were best known among medium acceptance farmers who knew about the program but had not used it in the last year would reinforce the value of the films as sensitising devices, which cannot be relied on to convince farmers to adopt the program. The pattern of usefulness of various publicity methods found in this study would agree generally with the recommendations for communications strategies for animal health programs put forward by Chain (1980).

Ease of Contact Between the Keyman and Individual Farmers

Clearly an important factor in acceptance of the program is how easy it is for the farmer to come in contact with the keyman, both to learn about the program, and to obtain drugs when he needs them. Farmers in north-east Thailand virtually all live in villages, and these villages are commonly 0.5 to 0.8 km apart. Thus the distance that a farmer lives from the keyman's village is likely to be important in influencing program effectiveness, since transport is very limited. Appendix 6 shows the location of villages in relation to the keyman's village.

Table 4.30 Percentage of farmers who have heard about the program

Location of village	Have heard of program	Have not heard of program	Total
In keyman's village	88%	12%	100% 73
<2km.from keyman's village	54%	46%	100% 134
>2km.from keyman's village	40%	60%	100% 141

Table 4.31 Percentage of farmers who know their keyman's name

Location of village	Know keyman	Do not know keyman	Total
In keyman's village	90%	10%	100% 73
<2km.from keyman's village	63%	34%	100% 134
>2km.from keyman's village	42%	58%	100% 141

Table 4.32 Percentage of farmers who have bought drugs from keymen

Location of village	Have bought drug	Never bought drug	Total
In keyman's village	67%	33%	100% 73
<2km.from keyman's village	44%	56%	100% 134
>2km.from keyman's village	23%	77%	100% 141

Tables 4.30 to 4.33 show that distance is an important factor in program effectiveness, and that in general the closer the farmer is to the keyman, the more likely it is that he has heard about the program, knows who is the keyman serving his area, and has purchased drugs from the keyman. It also Influences the opinion of farmers who do know the keyman on his effectiveness. Table 4.33 shows that hlgh acceptance farmers believe that most farmers believe the keyman and use the drugs he supplies, whereas medium acceptance farmers believe there are substantial difficulties, such as the keyman being too busy, or farmers lacking understanding. In particular, difficulty in getting drug from the keyman and lack of time for the keyman to carry out his functions are mentioned far more in distant villages than his own village. Therefore the Issue of the size of area which must be covered by a particular keyman is an important one in determining the extent of farmer acceptance of the program. This will be taken up again in a later section.

Table 4.33 Farmer opinion on their keymen in respect to acceptance levels and distance between villages

Distance between farmer and keyman's villages	Opinion of **medium** acceptance farmers						
	1	2	3	4	5	6	7
0 km	38.9%	22.2%	66.7%	5.6%	16.7%	16.7%	66.7%
<2 km	33.3%	42.3%	42.3%	3.9%	23.1%	19.2%	57.7%
>2 km	51.6%	32.1%	67.9%	3.6%	42.9%	10.7%	39.3%

Distance between farmer and keyman's villages	Opinion of **high** acceptance farmers						
	1	2	3	4	5	6	7
0 km	-	98%	2.1%	-	-	2.1%	12.5%
<2 km	13.6%	96.6%	6.8%	5.1%	3.4%	1.7%	20.3%
>2 km	3.1%	93.8%	-	-	-	3.1%	21.9%

Code description

1 = Keyman is very busy, no time as keyman
2 = Most farmers believed keyman and used drug
3 = Don't understand keyman's activity
4 = Believed but no money to buy drug
5 = Can't get drug from keyman
6 = Traditional treatment preferred
7 = No treatment needed

No opinion from farmers at low acceptance level, because they did not know about the keyman and his activities.

Extent of Livestock Ownership

There is considerable variation among farmers within each village in the scale of their animal ownership, and it may be that owners who have relatively large herds are more likely to be interested in the program than those who own only one or two animals. This may influence the acceptance rate of the program, and it may be difficult to interest those with smaller herds in the program.

Table 4.34 Distribution of acceptance levels by herd size

Acceptance levels	Buffalo owned	Cattle owned	Herd size (Farmers owned buffalo/cattle)				Total
			0	1-3	4-6	>6	
Low	2.9	1.2	12% (16)	42.1% (56)	28% (37)	18.1% (24)	133
Medium	2.3	2.0	14.5% (11)	44.7% (34)	18.4% (14)	22.4% (17)	76
High	3.1	2.0	3.6% (5)	41% (57)	31.7% (44)	23.7% (33)	139
			10% (32)	42.6% (147)	26% (95)	21.4% (74)	348

The distribution of acceptance level by herd size in program provinces is shown in Table 4.34. It can be seen that most farmers owned 1-3 animals (buffalo and cattle). There were 32 families of farmers who had no animals at all at the time of the survey. It is clear that the program does not only reach farmers at the high end of the herd size range, and that in fact the percentage of herd sizes in the high acceptance group is very close to the distribution for the population as a whole. Thus the program reaches the small farmer successfully, and factors other than wealth and scale of farming determine the penetration of the program. High acceptance farmers do own slightly more animals in total than the other two groups, but this should in part be a consequence of the program rather than a causal factor, since calf survival is much higher for herds which use the program. It also means that the proportion of animals which benefit from the program is a little higher than the proportion of farmers who participate.

Another matter of interest is whether there was any difference in farming income among the farmers at different acceptance levels. This information is shown in Table 4.35.

Total annual income of farmers in low acceptance level in 1986 was US$ 927, slightly higher than income of farmers in medium (US$ 724) and high acceptance levels (US$ 806). Interpretation of this data is complex, due to the fact that the income of farmers in low adoption level came from crops to a greater extent than the other acceptance levels. Farmers at the low acceptance level earned the highest income (US$ 196) from buffalo sales, higher than the income of farmers in high and medium acceptance levels (US$ 172 and US$ 120). Farmers in high acceptance earned the highest income from cattle sales (US$ 116), while farmers in medium and low acceptance earned US$ 79 and 76 respectively (Table 4.35). Since this data was obtained in isolation from wider details about each farmer's activities for the year, it is difficult to interpret with any confidence.

Table 4.35 Income (Baht/US$) of farmers in acceptance levels in 1986

Acceptance levels	Annual income	Income from buffalo	Income from cattle
Low	23166/926.6	4890/195.6	1900/76
Medium	18111/724.4	2996/119.8	1967/78.7
High	20137/805.5	4292/171.7	2905/116.2

KEYMAN SURVEY RESULTS

It is important to see the program from the viewpoint of the keyman as well as that of other farmers, and the following section presents the results of interviews with the keymen in the study areas, using the questionnaire described in Chapter 3.

Keymen Characteristics and their Farming activities

The sixteen keymen interviewed were all male, with an average age of 39 years. The average keyman had 5 people in his family, and owned an area of 29.3 rai (4.7 hectares), 2.8 buffalo and 1 cattle beast as shown in Table 4.36. Their main farming activity was rice growing, although 94% of keymen were involved in animal raising activities. It is notable that 15 out of 16 of them have other similar roles in the community as well. All 15 who have other community roles serve as keymen for the local Public Health Organization. In addition, 31% serve as keymen of the Interior Ministry and 13% as keymen of the Education Ministry.

Table 4.36 Family size and animal ownership

Province	Number of observations	People in family	Area owned (ha.)	Buffalo owned	Cattle owned
Mahasarakam	4	5	5.4	2.8	0.5
Surin	4	5	4.4	2	0.5
Khon Kaen	4	5	3.8	3.8	1
Loei	4	5.2	5.2	2.8	2
Average	4	5	4.7	2.8	1

Mahasarakam = MK
Surin = SR
Khon Kaen = KK
Loei = LE

The average keyman's annual income totalled 18,074 baht (US$ 723). This consisted of an average from buffalo sales of 2,831 baht (US$ 113), from cattle sales of 2,000 baht (US$ 80), from other livestock 106.25 baht (US$4.25), from crops 12,750 baht (US$ 510) and from being a keyman 387 baht (US$ 15). These results can be seen in Table 4.37.

Table 4.37 Incomes of keymen (US$) derived from buffalo, cattle, crops, other livestock and being keymen in 1986.

Province	Buffalo	Cattle	Crops	Other livestock	Being keyman	Annual income
MK	210	40	235	0	12	497
SR	140	0	570	6	34.3	750.3
KK	103	0	262	2	6.5	374
LE	0	280	973	9	9	1271
Average	113.3	80	510	4.3	15.5	723.1

Table 4.38 shows the average income of keymen, classified by province type and adoption area. In the high adoption areas, each keyman earned an average of 22,235 baht (US$

889.4) while keymen in low adoption areas earned only 13912.5 baht (US$ 556.5) on average. Reported income from keyman services was notable in that it made only a contribution of 2.1% of income. It is clear that income alone does not justify the large effort put into the program by many of the keymen.

In the one year program provinces, each keyman earned an average of 22,057 baht (US$ 882.3), while only 15,592.5 baht (US$ 623.7) on average was earned on average by the keymen in the three year program provinces. The average annual income in 1986 was 18,075 baht (US$ 723) as shown in Table 4.38.

Table 4.38 Keyman's annual income (US$) by adoption area and duration of program.

Adoption areas	Annual income
High	889.4
Low	556.4
Duration of program	
One year	822.3
Three years	623.7

Average annual income = US$ 723

In the high adoption areas, each keyman earned an average of 6,662.5 baht (US$ 266.5) from buffalo and cattle, whereas the figure was only 3,000 baht (US$ 120) on average in low adoption areas. The average keyman's income from buffalo and cattle in 1986 was 4,831.25 baht (US$ 193.25). These results are shown in Table 4.39.

Table 4.39 Keyman's income (US$) from buffalo and cattle in 1986

Adoption areas	Income of keyman
High	266.5
Low	120.0
Duration of program	
One year	192.0
Three years	195.0

Average income = US$ 193.25

In high adoption areas, a keyman earned on average 648 baht (US$ 26) from being a keyman, while a keyman in a low adoption area earned on average only 126 baht (US$ 5). In the three year program provinces, a keyman earned 579 baht (US$ 23.2) on average, while only an average of 194 baht (US$ 7.8) in one year program provinces. The average income from being a keyman in 1986 was 386.75 baht (US$ 15.5). This result is shown in Table 4.40.

Table 4.40 Income of keyman (US$) in 1986 by adoption area and program duration

Adoption areas	Income of keyman
High	26.0
Low	5.0
Duration of program	
One year	7.8
Three years	23.2

Average income = US$ 15.47

The average number of buffalo and cattle in a keyman's village were 164 and 125 respectively. The average number of buffalo and cattle in a keyman's Tumbon were reported by 16 keymen as 1,634 and 725 (2,359 animals) respectively, as shown in Table 4.41.

Table 4.41 Number of buffalo and cattle in Tumbons and villages in 1986

Province	Number of buffalo/ Tumbon	Number of cattle/ Tumbon	Number of buffalo /village	Number of cattle/ village	Number of obser-vations
MK	1481	455	225	114	4
SR	2260	621	170	22	4
KK	1843	593	149	54	4
LE	952	1229	112	311	4
Average	1634	725	164	125	4

Disease Problems in Buffalo and Cattle

Keymen were asked about the disease problems occurring in buffalo and cattle in the villages they serve. Their lists of common problems agreed very closely with those offered by

be reported further.

Before the program commenced, the keymen had followed the same practices as other farmers in mainly using traditional treatments when their calves were sick. In the high adoption areas, 38% (3) of the keymen had treated their sick calves with traditional medicines and the same percentage had commmonly bought additional drugs from the chemist, while 50% (4) of keymen in low adoption areas had treated their calves with traditional medicines and 25% (2) of them had commonly bought drugs from the chemist.

When considered by adoption areas, 100% (8) of high adoption keymen had changed their opinion on parasite control measures for calves from 5 years ago, while 88% (7) of keymen in low adoption areas had changed their opinion. In the one year program provinces, 100% (8) of keymen had changed their opinion from 5 years ago, while 88% (7) of keymen in the three year program provinces had changed. Overall, 87% (13) of all keymen now treated calves with modern drugs.

Before the program started, when adult buffalo and cattle were sick, 44% of the keymen had used traditional treatment, 31% had asked for veterinary services from DLD and 19% had bought drugs from the chemist. In high adoption areas, 38% had used traditional medicines and 25% had asked for veterinary services from DLD or bought drugs from the chemist. In low adoption areas, 50% had used traditional medicines, 38% had asked for veterinary services and 13% had bought drugs from the chemist.

KEYMAN ACTIVITIES IN THE SCHEME

For the survey, the 16 keymen in 4 program provinces were divided into 2 groups: 8 keymen in high adoption areas and 8 keymen in low adoption areas. As mentioned in Chapter 2, the majority of keymen had used various kind of drugs before they participated In the scheme. From the survey results, in the high adoption areas 63% of keymen used to inject animals before they became keymen, and the equivalent figure for keymen in low adoption areas was 37%, as shown in Table 4.42.

Table 4.42 The percentage of keyman with prior experience of injecting animals

Adoption areas	Yes	No	Total
High	63% 5	37% 3	100% 8
Low	37% 3	63% 5	100% 8

The number of keymen who had been involved in other community activities In the villages before they became keymen was 6. In 1986, the average number of villages in a keyman's Tumbon was 12, and because each keyman has responsibility for about a half of a Tumbon, a keyman was responsible for 6 villages on average as shown in Table 4.43.

Table 4.43 Number of villages in a keyman's area and number of keymen who were involved in other community activities.

Adoption areas	Average number of villages in keyman's Tumbon	Total number of keymen involved in other activities
High	12	6
Low	12	6
Duration of program		
One year	10	6
Three years	14	6

In high adoption areas, all keymen had visited other villages, while only 25% of keymen in low adoption areas had visited other villages, but there were no differences associated with program duration, the percentage of keymen visiting villages in one and three year provinces being 63%, as shown in Table 4.44. An average of five villages had been visited by each keyman since the program started. In high and low adoption areas, 8 and 1 villages were visited respectively. In one and three year program provinces, 4 and 6 villages were visited respectively. This can be seen in Table 4.45.

Table 4.44 Percentage of keymen who visited other villages

Adoption areas	% keyman visiting
High	100
Low	25
Duration of program	
One year	63
Three	63

Table 4.45 Number of villages visited since the program commenced

Adoption areas	Number of villages
High	8
Low	1
Duration of program	
One year	5
Three years	6

Average number of villages visited = 5 villages

The mean number of villages which visited by keymen during 1986 specifically is shown in Table 4.46. In high adoption areas, 8 villages were visited, whereas only 1 village was visited on average in low adoption areas. This shows the variation in the level of effort of keymen in high adoption areas compared with keymen in low adoption areas, and provides guidance on the criteria which should in future be used to select good keymen. Five and four villages were visited respectively by keymen in one and three year program provinces.

Table 4.46 Number of villages visited in 1986.

Adoption areas	Number of villages
High	8
Low	1
Duration of program	
One year	5
Three years	4

Table 4.47 Number of days keymen spent on promoting the scheme in 1986

Adoption areas	Days
High	38
Low	7
Duration of program	
One year	22
Three years	23

The number of days keymen spent promoting the scheme in 1986 is shown in Table 4.47. In high adoption areas each keyman had spent an average of 38 days on promoting the scheme, while the average was only 7 days for each keyman in low adoption areas. A keyman's work in high adoption areas was approximately 5 times more intensive than the keyman's effort in low adoption areas. But with regard to duration of the program, there was no difference in the number of days spent on promoting the scheme; 22 and 23 days a year respectively.

It was suggested that keymen should record drugs received and sold while they were performing their duties in the program. These records would not only assist the keymen to organise their job, and what they had done, but also sometimes may be checked by people who need to examine the progress of the program in that particular area. The survey findings with regard to keymen keeping drug receival and sale records is shown in Table 4.48.

Fifty percent of keymen in high adoption areas recorded drug receiving and selling, while only 13% of keymen in low adoption area had done any recording. The performance of keymen in one year program provinces was slightly better than the keymen in three year program provinces. Thirty eight percent of keymen in one year provinces had recorded drug receiving and selling, while only 25% of keymen had done so in three year provinces.

Table 4.48 Percentage of keymen keeping drug receiving and selling records

	Adoption areas		**Duration of program**	
	High	Low	1 year	3 years
Drug received records	50%	13%	38%	25%
Drug sold records	50%	13%	38%	25%

The number of packages of deworming drugs which keymen had obtained and sold during 1986 is shown in Table 4.49. It can be seen that keymen in the high adoption areas and those in the one year program provinces had obtained and sold a higher number of drugs than the keymen in the low adoption areas and three year program provinces respectively. The differences between the high adoption keymen and low adoption ones are striking, with high adoption keymen selling typically 4 to 10 times the volume of drugs sold by low adoption area keymen. While this is to be expected since the keyman areas were chosen on this criterion, the size of the difference is very large, and its uniformity across all drug

types is worth noting. Moreover, the high adoption keymen have a much smaller margin between drugs obtained and drugs sold, so they are turning over their stock much more effectively. Since the program depends on a revolving fund in which payment for drugs sold must provide the funds for new purchases at the central Government level, the low adoption keymen are not only far less effective in the field, they are also a serious liability to the revolving fund since they are holding about two thirds of the stock they have obtained as unsold material, thus draining the revolving fund of its reserves. There is clearly a need to make administrative modifications to overcome this problem.

Table 4.49 Number of containers of deworming drugs obtained and sold in 1986

	Adoption area		Duration of program	
	High	Low	1 year	3 years
Formula 1 (Packages)				
Drug obtained (Ave.77)	115	39	82	72
Drug sold (Ave.59)	105	14	60	59
Formula 2 (Packages)				
Drug obtained (Ave.68)	114	22	74	62
Drug Sold (Ave.54)	99	9	54	54
Niclofolan (bottles)				
Drug obtained (Ave.12)	20	4	9	15
Drug sold (Ave.10)	18	1	6	13

Table 4.50 Mean prices charged (in baht) for drugs by keymen

Adoption areas	Formula 1	Formula 2	Niclofolan	Total
High	7.8	10	10	8
Low	7.4	11	10	8
Mean	7.5 baht (US$0.3)	10.5 baht (US$0.42)	10 baht (US$0.4)	

The mean prices of drugs charged by keymen are shown in Table 4.50. The recommended prices for Formula 1 and 2 are 7 and 10 baht respectively. Some keymen have added a little to prices to compensate them for their efforts to sell the drugs, although the differences from the recommended prices are smaller than perhaps might have been

expected. Niclofolan (Bilevon) was priced at 10 baht (US$ 0.4) per dose. These price were set by the DLD and NE-VRDC.

Because of the distances between villages, the discomfort of travelling on foot in the heat, and the high cost of transport provided by others, the method of getting from village to village is an important issue for keymen if they are to do their job well. The majority of keymen in the program used motorcycles for transportation. This vehicle is practical to use in travelling among the various villages. The second most commonly used method was travel by bicycle (which were naturally cheaper than the motorcycles). The transportation keymen used in the program are shown as percentages in Table 4.51. It is shown that 50% of keymen used motorcycles, 31% used bicycles, 6.3% provided their services from village to village on foot, 6.3% used their own cars, and 6.3% of them only serviced their own village. There is no obvious difference between high and low adoption keymen with regard to access to transport, which would help account for the marked differences in the amount of visiting carried out. Thus again it would appear that the critical difference between keymen is in effort, rather than one group having disadvantages relative to the other.

Table 4.51 Methods of transport used by keymen in the program

Adoption areas	On foot	Bi-cycle	Motor cycle	Car	No visits	total
High	-	37.5% (3)	50% (4)	12.5% (1)	-	100% (8)
Low	12.5% (1)	25% (2)	50% (4)	-	12.5% (1)	100% (8)

Table 4.52 Knowledge retention of keymen concerning parasitism

	Adoption areas		**Duration of program**	
	High	Low	1 year	3 years
Knew worm transmission	100%	38%	50%	88%
Right recommendation	100%	38%	50%	88%
Knew fluke transmission	100%	50%	75%	75%
Right recommendation	100%	38%	75%	63%

During the survey, keymen were also questioned about parasitism in the same way described previously for farmers to assess their retention of knowledge from the training courses they had attended. The idea was to measure, how much of their initial knowledge had been retained, and if this knowledge was good enough to transfer to farmers. These results are shown in Table 4.52. It can be seen that all keymen (100%) in high adoption areas could explain the basic points correctly. But only 38%-50% of keymen in the low adoption areas could explain these points correctly. The results also show that keymen in the three years program provinces had generally slightly more basic knowledge than keymen in the one year program provinces. Follow-up training courses had been offered in the three

year program provinces, but it is disappointing that the less motivated keymen in one year provinces had already forgotten some of the information.

Involvement of Other People in the Program at Village Level

Another factor which might influence the effectiveness of the program in particular areas is the extent to which keymen drew on the support and assistance of other people to carry out their functions - either their families and neighbours to assist with practical management, or people respected by the villagers to lend authority to their efforts by taking part in farmer meetings, dealing with village headmen, or helping to sort out any problems. It might be expected that the more effective keymen would make greater use of the assistance of the village headmen to explain the program to farmers in their own and other villages, and to ask the DLO to speak at meetings and provide more comprehensive explanations of the program. The village headmen and the DLO are powerful persons in influencing the program, and farmers normally obey what they suggest.

If keymen keep in touch with these persons and ensure that they fulfil a supportive role in the program promotion, the program is more successful. From the survey result in Table 4.53, it can be seen that all keymen in high adoption areas obtained help from these people, whereas the keymen in low adoption areas involved village headmen to some extent, but barely went beyond that.

Table 4.53 Percentage of keymen who used assistance to carry out responsibilities

	Adoption areas	
	High	Low
Neighbours	50%	-
DLO	100%	-
Village headman	100%	63%
Wife	25%	13%
NE-VRDC	38%	-
Other members of family	13%	-

EFFECTS OF KEYMAN ON FARMER ACCEPTANCE OF THE SCHEME

The active and well known keymen usually spent considerable time and effort promoting the program to farmer meetings in their own and other villages, and explaining to farmers both at meetings and personally what they should do to control parasites in their animals.

The extent of the promotional activities of various keymen in their own and other villages can be seen in Table 4.54. It is clear from the table that keymen in high adoption areas were substantially more active in speaking at meetings, especially those in villages other than their own, and also made more extensive use of posters. Distribution of leaflets was quite limited, regardless of the adoption level or category of village, reinforcing the earlier finding that leaflets have been the least successful of the promotional measures for the program.

Interestingly, the three year program province keymen appear to have been more active than the one year province keymen in their use of most of the promotional methods. This is contrary to the general pattern of the results concerning the relative efforts of the one and three year province keymen, and may reflect the longer time that the three year people have had in which to carry out the various activities listed.

Table 4.54 Percentage of keymen promoted the program in own and other villages.

	Adoption areas		Duration of program	
	High	Low	1 year	3 years
Talked to farmers				
in own village	100%	87%	88%	100%
in other villages	100%	25%	63%	63%
Talked at village meeting				
in own village	100%	50%	75%	75%
in other villages	75%	13%	38%	50%
Leaflet shared				
in own village	13%	13%	-	25%
in other villages	13%	13%	-	25%
Put up posters				
in own village	75%	25%	63%	37%
in other villages	25%	-	-	25%

Keymen were asked about the nature of the response from farmers to their promotional efforts for the program, both in their own and other nearby villages which they served. The results can be seen in Table 4.55 and 4.56, and represent the percentage of keymen who believed that each of the listed statements was true of their own or other villages. Whereas there were various "problems" inhibiting the keyman's effectiveness in the low adoption areas, the only two problems in the high adoption areas were the expectation of farmers that drugs would be free, and the belief that animals were healthy and did not require treatment.

The expectation that the drugs carried by the keyman should be provided free because they came from the government arose from two factors. Firstly, most farmers were familiar with the DLO as a representative of the official veterinary services, who had in the past provided deworming drugs to them. Whenever the DLO came to carry out immunization of animals in the village, drugs were likely to be provided to owners without charge. In the keyman's own village, this traditional belief remained to some extent, especially since as a neighbour it was believed that the keyman should look after his friends. A second factor in some of the study provinces was that an aid program had operated before this project, in which free drugs had in fact been distributed widely to farmers, in order to increase the effectiveness of disease control. This project had not in general been considered a success,

because there was no supporting extension effort, and there was no incentive for farmers to use the drugs wisely since they were free. As a consequence, the particular project was expensive but not very effective, and was terminated. The "cargo cult" thinking that drugs should all come free carried over to the early stages of this program, and it took some time for farmers to realise that they would have to pay, but would receive advice on how and when to carry out treatment.

Table 4.55 Keyman's perception of attitudes of farmers in his own village

	Adoption areas	
	High	Low
Need drug free of charge	50%	63%
Believed in and used drugs	100%	13%
Ignored keyman's activity	-	50%
Believed in but had no money to buy drugs	-	-
Not interested in the program	-	50%
Traditional treatment preferred	-	25%
No treatment needed	25%	75%

Table 4.56 Keyman's perception of attitudes of farmers in other villages

	Adoption areas	
	High	Low
Needed drugs free of charge	13%	38%
Believed in and used drugs	100%	25%
Ignored keyman's activity	-	63%
Believed but had no money to buy drugs	-	-
Not interested in the program	-	13%
No treatment needed	25%	75%

Problems in Implementation of the Program - Adverse Drug Reactions

A problem that most of keymen faced from time to time was that some animals were already sick at the time of parasite treatment, and some died after administration of drugs in the program. These animals included both calves and adults. For keymen who had been trained in parasite control measures for only 1 day, it was difficult to give owners an adequate

explanation of the reasons for such post-treatment complications. Keymen were therefore asked whether or not they had faced such difficulties. The results are shown in Tables 4.57 and 4.58. Fifty percent of keymen in the high adoption areas reported that they had treated animals which became sick after dosing, while 38% of keymen in the low adoption areas gave similar reports. Twenty five percent of keymen in both high and low adoption areas reported that in some cases animals died after treatment. Keymen were also asked about the proportion of treated animals in which such adverse reactions occurred. The percentages are low, but still quite high enough to create concern in some areas, where farmers expected miracles from treatment. Although these problems were rarely if ever due to treatment itself, since only ultra-safe products were used in order to minimise the risk of genuine over-dosing, the occurrence of such deaths could create problems for keymen. Solutions to this issue will be considered in Chapter 8.

Table 4.57 Percentage of keymen reporting that animals had become sick after parasite treatment

	Adoption areas	
	High	Low
Animal sick	50%	38% (Ave.44%)
Calves sick	3.5%	0.3% (Ave.2.14%)
Adults sick	4%	1.3% (Ave.2.6%)

Table 4.58 Percentage of keymen reporting that animals had died after treatment

	Adoption areas	
	High	Low
Animals died	25%	25%
Calves died	0.6%	0.5% (Ave.3.2%)
Adults died	2%	1.5% (Ave.1.8%)

Effects of Publicity Support for the Program

The views of keymen concerning the effectiveness of posters, films, leaflets and video are shown in Table 4.59. It can be seen that all keymen, both in high and low adoption areas, mentioned that the video program and slide show are both very useful in promoting the program. These describe a keyman's activity, show a demonstration of drug administration, and give a simple explanation of the parasite control program.

Table 4.59 The effect of publicity methods, by adoption areas (%)

	Very useful	Some help	No help
Posters			
High	75%	25%	-
Low	62%	38%	-
Leaflet			
High	50%	25%	25%
Low	13%	75%	13%
Videotapes and slides			
High	100%	-	-
Low	100%	-	-

Posters had also been essential for program promotion in the villages. One poster illustrated a simple understanding of the worm's lifecycle, and preventive measures for worm infection. The other poster described details of drug use, with a list of names and addresses of keymen in particular areas, where farmers were able to find out more information, and ask for services.

A high percentage of keymen in both high and low adoption areas mentioned that posters were very useful, but it appeared that in general the farmers were not interested in the leaflet. Leaflets were shared among farmers for them to read, but keymen did not appear to make much use of them. Posters were mostly put up in the keyman's own village, and used to a lesser extent in other villages. It may be that posters are not very practical for keymen to carry from village to village. This problem needs to be solved since posters are seen to be very useful for program promotion. This point will be discussed again in Chapter 8.

Supply and Pricing of Drugs in the Program

With regard to obtaining a regular supply of drugs for the program, 75% of keymen in high adoption areas said that this was very convenient, and no problem to get the drugs from the DLO. Twelve percent said that the supply system for drugs was inadequate. None found that the DLO did not have a supply of drugs when they needed them. Thirteen percent of them wanted supplies of additional drugs, to cover the diseases other than internal parasites. For instance, they would like to have drugs for treatment of bloat (tympany) in adult animals, and mineral supplements for use in deficient areas.

For the low adoption areas, 62% of keymen mentioned that the drug supply was very convenient, 25% said they could not get drugs from the DLO when they need them, but none requested an expanded range of drugs. These results are shown in Table 4.60.

Table 4.60 Keymen comments on drug supply in the program

	Adoption areas	
	High	Low
Very convenient	75%	62%
Inadequate	13%	-
Unavailable drugs from DLO	-	25%
More drug needed	13%	-
No comments	-	13%

The majority of keymen in both high and low adoption areas agreed that the price of the drugs as recommended was reasonable, and that the drug range provided was adequate to control parasites. These findings are shown in Tables 4.61 and 4.62.

Table 4.61 Keyman comments on drug prices

	Adoption areas	
	High	Low
Too expensive	13%	25%
Too cheap	38%	38%
Reasonable price	50%	38%

Table 4.62 Keyman comments on drug range provided

	Adoption areas	
	High	Low
Inadequate	13%	13%
Suitable	88%	63%
No comments	-	25%

Table 4.63 Keymen comments on incentive payments and number of keymen in Tumbon

	Adoption areas	
	High	Low
Comments on 13% incentive payment		
Not enough	75%	50%
Enough	13%	50%
No comments	13%	-
Comments on 2 keymen/Tumbon		
About right	12.5%	12.5%
Too much work **(needed more KM)**	87.5%	87.5%

An assessment was also made of the extent to which keymen thought they received enough payment for their work (in the form of the 13% incentive), and whether the amount of work was too large for them to handle in their assigned area. These results are shown in Table 4.63.

The majority of keymen thought that the incentive payment was not adequate, especially in high adoption areas where the keymen make greater efforts. Although the view that payment was inadequate could be expected as an instinctive reaction to such a question, it does appear from earlier results that the keymen in high adoption areas are working very hard for a surprisingly small income from their work, and this issue deserves further consideration.

The number of animals under the care of each keyman also deserves attention. In each Sub-district (Tumbon) two farmers were selected and trained to become keymen. It was planned that each of them would be responsible for half of a Tumbon, comprising 6 villages with 800-1200 buffalo and cattle on average. It can be seen from Table 4.64 that the number of animals per keyman is at the low end of this range. However from Table 4.63, it can be seen that the great majority of keymen in both high and low adoption areas nevertheless considered that they had too much work to do and needed additional keymen to help them. At the time the project was planned there was little to go on in deciding on the density of keymen, and it does appear that there would be considerable advantage in increasing their density so that there is one for every two to four villages. An increase in the number of keymen has already been made in Surin, where the PLO realised that the number of keymen per Tumbon was inadequate to provide a complete service.

Table 4.64 Ratio of animals to keymen in 4 program provinces

Province	Buffalo	Cattle	Keymen	Animals/KM
MK	178068	56599	218	1076
SR	287674	74746	622	583
KK	281249	91243	312	1194
LE	48914	36454	156	547
Total	795905	259042	1308	850

COMPARISON BETWEEN HIGH AND LOW ADOPTION AREAS

Farmer Characteristics and Farming Activities

The data obtained in the field survey has already been analysed by province and by acceptance level of the farmers for the parasite control program. The viewpoints of both farmers and keymen have been considered. The final major component of the analysis is a comparison of farmers between high and low adoption areas for the program. This will investigate whether there are any major differences between farmers in the two types of areas which could account for the widely different levels of program acceptance, and also whether there are any differences which could be considered as a consequence of the program. In this study, 177 farmers were in low adoption areas, and 171 farmers were in high adoption areas.

As well as a general comparison between high and low adoption areas, the issue of distance from the keyman's village as a factor influencing penetration of the program will be considered in more detail. It was shown earlier that this influences the success of the program overall, and the extent to which it interacts with the apparent effectiveness of the keyman will be analysed. For this purpose farmers will be grouped into those who lived less than 2 km from the keyman's village and those who lived more than 2 km away, as designed into the study in the way described in Chapter 3.

The average age of farmers in low and high adoption areas was between 45 and 46 years, with no significant difference between the two groups. The mean number of people in each family was 6.5 and 6.2. Table 4.65 provides a comparison of the details concerning animal ownership and training between high and low adoption areas. Farmers in high adoption areas owned one hectare more land than low adoption area farmers, and slightly more buffalo and cattle. Farmers in low adoption areas undertook more off-farm work than farmers in high adoption areas (19.2% and 7% respectively).

Table 4.66 shows types of cropping activities other than rice undertaken by the village farmers in low and high adoption areas. The most important such cropping activity was tapioca planting. The proportion of farmers interviewed in low adoption areas who planted tapioca was nearly double the proportion for high adoption farmers.

Table 4.65 Distribution of family livestock activity by adoption area

Adoption area	Area owned	Buffalo owned	Cattle owned	Buffalo bought	Cattle bought	Buffalo sold	Cattle sold
Low	5.4	2.8	1.3	1.2	1.3	1.6	0.5
High	6.4	2.9	2.0	0.4	0.2	0.9	0.5

Table 4.66 Percentage of farmers undertaking various cropping activities other than rice growing

Adoption areas	Tapioca	Kenaf	Maize	Other crops	Total
Low	53.7%	1.1%	13.6%	5.1%	73.5%
High	28%	19.3%	7.0%	9.4%	63.7%

Table 4.67 Income of village farmers (US$)derived from animals, crops and off-farm work

Adoption areas	Buffalo	Cattle	Crops	Other live-stock	Off-farm	Annual inc-ome
Low	184 18%	96 9.4%	563.7 55%	93.6 9%	88.5 8.6%	1025.8 (100%)
High	154.5 24.3%	89.3 14.1%	358.2 56.4%	26.6 4.2%	7 0.1%	635.6 (100%)
Average	169.3 21.5%	92.7 11.8%	461 55.7%	60.1 6.6%	47.8 4.4%	830.7 (100%)

Crops = rice, tapioca, kenaf, maize, and other crops
Other livestock = poultry, horses and pigs

Table 4.67 shows that the total family income was substantially higher in low adoption areas than high adoption areas, all individual components being higher as well. In percentage terms, the high adoption area farmers make a higher proportion of their income from buffalo and cattle, and a lower proportion from other livestock and off-farm sources. The major explanation for these differences is probably the extent of tapioca growing in the two areas. Tapioca can only be grown on elevated land, and is a very profitable crop. It would appear that in the selection process the low adoption areas chosen were concentrated on higher land, so that 53% of these farmers grew tapioca, whereas the high adoption areas

were on less favourable land for tapioca. This difference would tend to carry through to other aspects of farm income, since for example a successful tapioca grower would have more money available to buy livestock.

Actions of Farmers in Relation to Disease Control

The next aspect to be examined is differences between high and low adoption areas with respect to their knowledge concerning diseases and their control.

Table 4.68 Sources of information for farmers about treatment of sick calves in relation to distance from the keyman's village

Distance from keyman's village	**Low adoption areas**			**High adoption areas**		
	KM	DLO	Chemist	KM	DLO	Chemist
0 km	24.2%	54.6%	12.1%	81.6%	10.5%	5.3%
<2 km	17.2%	53.5%	10.3%	59.5%	25.7%	9.5%
>2km	5.3%5	7.3%	16.0%	63.0%	22.2%	11.1%

When farmers had a sick calf, it was shown earlier that they used three main sources of information for treatment - the keyman, the DLO and the chemist. Table 4.68 shows that in high adoption areas the keyman was by far the most important source of advice, and was used by at least 60% of farmers even in distant villages. In low adoption areas far fewer farmers would plan to ask the keyman concerning treatment of sick calves, and moreover the percentage who would do so falls off very rapidly with increasing distance from the keyman's own village. Thus whereas the highly effective keymen have achieved wide recognition for their role throughout the area they serve, the less effective keymen have achieved only limited recognition, even within their own village. This fits in with the figures on the scale of their work described earlier.

The extent of farmer knowledge about parasites is shown in Table 4.69. As was found for different acceptance levels, those aspects of parasitism which can be learned by direct observation was equally well known by a high proportion of farmers in both areas. However information which depended on extension activities for its dissemination was not equally well known. In low adoption areas, only 1.7% of farmers (3 out of 177) could provide a reasonable explanation of the transmission of the parasite, while 12.3% of farmers (21 out of 171) in high adoption areas could do so. This difference was highly significant (Chi-square = 13.6, P<-0.001). However, it must be recognized that knowledge of the transmission and epidemiology of Toxocara is still quite limited in extent. This means that the educational efforts of keymen has not yet been very effective, even in high adoption areas, in making farmers aware of how the parasite is transmitted.

Table 4.69 Farmer knowledge of nematode parasitism by adoption area

Adoption areas	Nematode identified	Knew location of worm	Knew transmission	Knew effects of worms	Able to pick wormy animal
Low	92%	91%	1.7%	89%	93.2%
High	88%	86%	12.3%	88%	90%

With respect to the epidemiology of Fasciola gigantica, Table 4.70 shows that farmers in both areas know the intermediate host snail and its habitat, but the level of knowledge about its role In the epidemiology of F. gigantica is low. Moreoever this knowledge, which could virtually only come from the keyman or another representative of the DLD, is strongly associated with proximity to the keyman. It would appear that the high adoption area keymen are achieving at least some success in passing on this information to farmers with whom they deal, but the low adoption keymen have achieved almost nothing in this educational role. With respect to farmer recognition of the parasite itself and its location in the body, the level of knowledge was similar in both adoption areas, and showed no effect of distance from the keyman's village. Again this supports the case that these farmers are careful observers, and know of the parasites and the problems they cause, but need an active keyman to inform them about important epidemiological facts which they cannot obtain just by observation.

Table 4.70 Farmer knowledge on Fasciola epidemiology, classified by adoption areas

Distance from keyman's village	Low adoption areas		
	Lymnaea identified	Habitat known	Knew role in fluke
0 km	80%	77%	29%
<2 km	61.7%	61.7%	-
>2 km	79.3%	79.3%	-
	High adoption areas		
	Lymnaea identified	Habitat known	Knew role in fluke
0 km	68.4%	68.4%	13.2%
<2 km	58%	58%	9.5%
>2 km	66%	64.4%	6.8%

Farmers were asked whether they had practised prevention measures on their animals and whether they treated apparently healthy animals to control parasitism in them. Table 4.71 clearly shows that a higher proportion of farmers in high adoption areas had a preventive approach to parasitic disease than did farmers in low adoption areas.

Table 4.71 Extent to which farmers practised prevention, by adoption areas

Adoption areas	Practised prevention	Treated healthy animals
Low	19.8%	24.9%
High	39.2%	36.3%

Farmer Attitudes to the Parasite Control Program and the Keyman

The principal test of the difference between high adoption and low adoption areas is the difference in acceptance levels for the program between the two groups of keyman areas. Figure 4.27 shows the percentage of farmers in each of the three acceptance levels, classified by adoption area.

The graph shows almost symmetrical but opposite patterns for the two adoption areas, with 64% of farmers in high adoption areas falling into the high acceptance group compared with 16% for the low adoption group, whereas the low adoption areas had 63 % in the low acceptance level, compared with 12% for the high adoption areas. Medium acceptance farmers were almost equally distributed between the two areas.

Thus the high and low adoption areas were chosen well, in that on the criterion of knowledge and use of the control program, high adoption areas have excellent acceptance but low adoption areas have very low acceptance of the program so far.

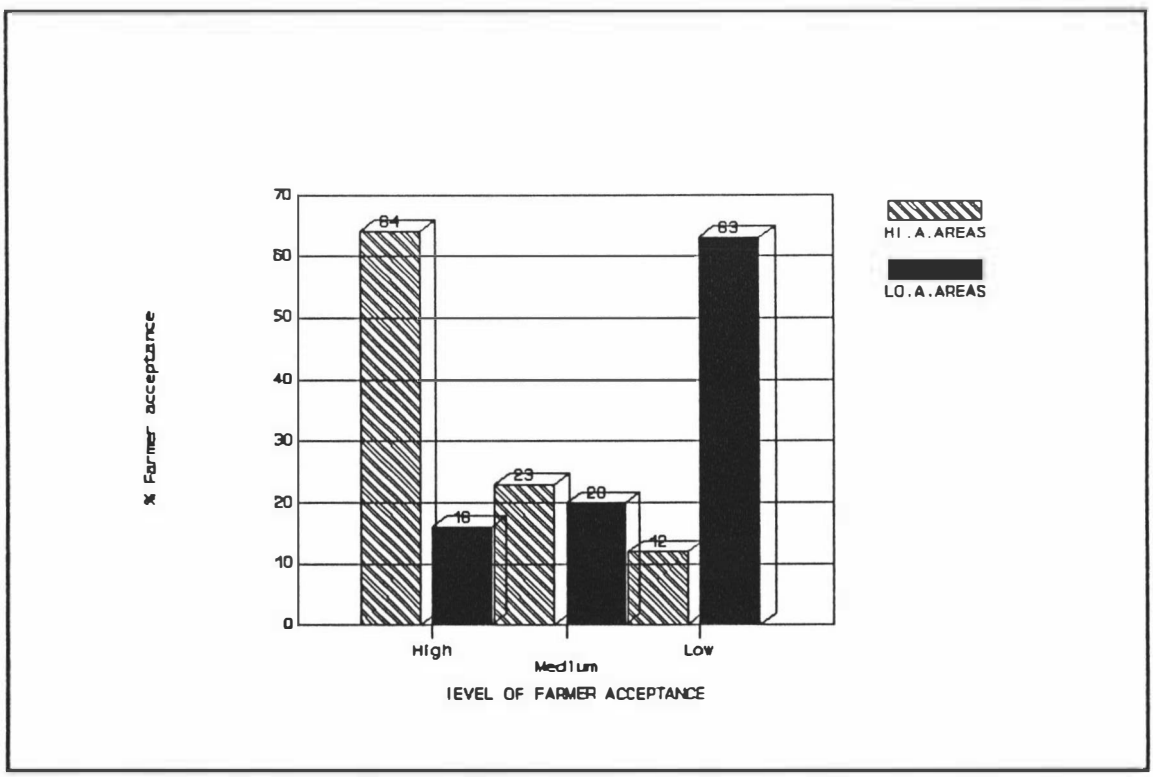


Figure 4.27 Distribution of Farmer Acceptance Levels for the Program in High Adoption Areas (HI.A.AR) and Low Adoption Areas (LO.A.AR)

This evidence concerning acceptance of the program is supported by other questions relating to the knowledge of farmers in the two different types of areas concerning the program. As shown in Table 4.72, a high proportion of farmers in high adoption areas are familiar with the program, understand it accurately, and can correctly name the keyman who is responsible for their area. In each of these aspects, there is only a slight fall in the percentage in villages increasingly distant from the keyman's own village. In contrast, knowledge is quite a bit lower for the low adoption areas, even within the keyman's own village, and falls off dramatically in villages at increasing distance from the keyman's village. Thus the earlier finding - that high adoption area keymen had travelled extensively to other villages whereas the low adoption ones had not - fits well with this result that the low adoption keymen had achieved very little recognition of the program beyond their own village whereas the high adoption ones had acheived widespread awareness of the program and its nature.

Table 4.72 Farmer knowledge concerning the scheme

Distance from keyman's village	**Low adoption areas**		
	Heard of program	Well described	knew of keyman
0 km	77%	48.6%	82.9%
<2 km	26.7%	11.7%	31.7%
>2 km	18.3%	9.8%	17.1%
	High adoption areas		
	Heard of program	Well described	Knew of keyman
0 km	97.4%	86.9%	97.4%
<2 km	77.0%	52.7%	89.2%
>2 km	69.5%	59.3%	76.3%

Since there were clear differences between the adoption areas with regard to knowledge concerning the program, the next step was to determine how active the keymen in the different areas had been, in the eyes of the farmers. Questions 80 to 85 in the farmer questionnaire investigated various aspects of keyman activity, and Table 4.73 summarises the findings.

Whereas 84% of farmers in high adoption areas had seen the keyman responsible for their village during the year, this was true for only 32% of farmers in low adoption areas. The ratio was similar with respect to whether or not the keyman spoke to the respondent about the parasite control program, and also whether or not he was known to have spoken to others in the same village about the program. Keymen in high adoption areas had sold anthelmintic to 64% of the respondents, whereas those in low adoption areas had sold drug to only 16% of respondents. When farmers were asked about the advice on parasite control that had been given to them by the keyman, 65% in the high adoption areas gave the answer which the keyman had been originally taught, compared with 37% of the farmers in low adoption areas. In the high adoption areas 56% had followed the recommendations of the keyman, whereas only 14% had done so in the low adoption areas.

Table 4.73 Farmer's opinion of activities of keymen by adoption areas

	Low adoption areas		High adoption areas	
	Unknown	Yes	Unknown	Yes
Visited village	65%	31.6%	12.9%	83.6%
Talked to respondent about program	65%	25.4%	12.9%	71.2%
Sold drugs to respondent	-	16.4%	-	64.3%
Talked to others	65%	20%	12.9%	73.7%
Keyman's advice correct	-	37%	-	65%
Followed his recommendation	-	14.2%	-	56.3%

Table 4.74 Reasons farmers in adoption areas ignored keyman's recommendation

Adoption areas	No sick animal	Insufficient information	No adult animal	No calf	Other reasons	Total
Low	32.4%	46%	2.7%	10.8%	8.1%	100%
High	54.3%	11%	11%	16.4%	7.3%	100%

For those farmers who did not follow the recommendations on treatment given to them by the keyman, the reasons they gave are summarised in Table 4.74. The notable finding in this Table is that 46% of low adoption area farmers said that they did not have enough information to make a decision to treat their animals, whereas this was true for only 11% in the high adoption areas.

Table 4.75 shows that farmers in high adoption areas who lived in the same village as the keyman had no problems in getting drugs from keymen, and less than 20 % of farmers reported having any difficulties in getting drugs even in the most distant villages. In contrast, in low adoption areas some farmers had difficulty in getting drugs even when they lived in the same village, and 50% of those who lived more than 2 km away had difficulty.

Table 4.75 Difficulty in getting drugs from keymen

Distance from keyman's village	Low adoption areas	High adoption areas
0 km	7.0%	-
<2 km	36.8%	18%
>2 km	50%	16.7%

Table 4.76 Nature of problems in getting drugs from keymen

Distance from keyman's village	Low adoption areas				
	1	2	3	4	5
0 km	-	-	50%	50%	-
<2 km	-	-	57%	29%	14%
>2 km	14%	14%	-	43%	26%

	High adoption areas				
	1	2	3	4	5
0 km	-	-	-	-	-
<2 km	42%	-	25%	8%	25%
>2 km	25%	-	38%	13%	25%

Code description

1 = No transportation
2 = Keyman did not have drug supplies
3 = No money to buy drug
4 = Difficult to see keyman
5 = Keyman's village is too far

In table 4.76 the nature of any difficulty which farmers faced in obtaining drug supplies is summarised, for those who reported some difficulty. No farmer in the same village as a high adoption keyman reported any difficulty, whereas half of those in the same village as a low adoption keyman who reported a difficulty said that it was because it was difficult to see the keyman. The pattern of difficulty of access to the keyman is repeated more strongly for more distant villages, especially in the low adoption areas.

Table 4.77 Percentage of farmers who bought drug for calf treatment in relation to distance from keyman's village

Distance from keyman's village	Adoption areas	
	Low	High
0 km	41.4%	75.7%
<2 km	52.6%	57.6%
>2 km	14.3%	53.3%

Table 4.77 shows the percentage of farmers at different distances from the keyman's village who had purchased drugs to treat their calves, and it can be seen that the percentage of farmers who purchased drugs was lower for low adoption areas in the keyman's own village and fell off faster as well, with increasing distance from the keyman's village.

As well as the problem of purchase of drugs, some animal owners had no experience on how to administer them. In some cases they ask the keyman to drench the deworming drug for their calves. Some farmers are still using "Bung Mai Phi"[1] a piece of bamboo stem, slightly cut at one end. This is about 30-40 cm long. Farmers used it as a drug container for drenching their calves. This primitive container is available in villages, but some farmers now use a 750 ml bottle as drencher. It is vital that whichever method is used, the calf get an accurate dose.

Farmers were questioned on how accurately they used the drugs - whether they used them as per the prescription on the package of anthelmintics, and whether they used them at the times recommended. Table 4.78 shows the different percentages of accurate drug usage reported, depending on distance from the keyman's village. It can be seen that farmers who lived in the same village as the keyman and dosed their animals had similar accuracy, but the accuracy of dosing fell off seriously in more distant villages in the low adoption areas.

Table 4.78 Effects of distance on how accurately farmers used the drugs.

Distance from keyman's village	Adoption areas	
	Low	High
0 km	66.7%	57%
<2 km	30%	39%
>2 km	-	62.5%

Benefits of Treatment of Animals for Parasitism

Almost all farmers who had treated their animals in both high and low adoption areas reported that calf condition improved after treatment (Table 4.79). A high proportion of these farmers reported that calves had improved both in condition and in appetite within a week after treatment, and 8-10 % of farmer had detected dead worms in calf faeces the day after administration.

[1] Bung = container, Mai Phi = bamboo

The percentage of farmers in low adoption areas who still preferred to use traditional treatment in preference to the drugs offered by the program was 12%, while only 1% preferred traditional treatment in the high adoption areas (Chi-square = 3.82, P<0.05). This result is shown in Table 4.79.

Table 4.79 Farmer opinion on traditional versus modern treatment, and the improvement achieved after program treatment

Adoption areas	Traditional treatment preferred	Calf condition improved	Nature of improvement	
			Good appetite	Worm detected
Low	11.5%	95.8%	91.3%	8.7%
High	1.1%	99.0%	90.0%	10.2%

Table 4.80 Farmer opinion on benefits of fluke treatment in adoption areas, by adoption areas

Adoption areas	Number of improved animals	Number of animals not improved	Effect of fluke treatment	
			Condition improved	Work ability improved
Low	100% (18)	-	78% (14)	22% (4)
High	98% (63)	2% (1)	83% (52)	17% (11)

In the high adoption areas interviewed, farmers owned 63 adult animals which were treated against liver fluke by keymen, and these farmers reported that 98% (62) of the animals improved in health and physical state by 2-3 months after treatment, and only 2% (1) of them had not improved. This single case was due to the fact that the animal was severely emaciated. Farmers in low adoption areas who had animals treated reported that all animals treated (18) had improved. The percentages of animal condition improvement and weight gain reported by farmers in the low and high adoption areas were 78% and 83% respectively. Large ruminants, especially buffalo, are essential for crop preparation work such as ploughing in the paddy field and working of tapioca planting areas. Once animals become emaciated with a heavy infestation of liver fluke they cannot provide power for this work. The farmers appreciate the improvement in physical energy and condition of buffalo achieved by fluke treatment, but Table 4.80 shows that only about 20% of farmers detected an improvement in working ability of their buffalo following fluke treatment.

Farmers are also very interested in the improvement which can be achieved in animal condition after treatment. Large ruminants are their financial reserve as well as energy source, and they buy and sell animals quite frequently as a way of making a profit.

Farmers were therefore asked whether they sold treated animals, and if so how much benefit they gained from previously treating their animals. From the results in Table 4.81, it can be seen that all treated animal (81) were sold, and farmers in the low and high adoption areas reported the extra value gained as a result of treatment was 1811 Baht (US$ 72.4) and 1112 Baht (US$ 44.5) respectively. This benefit was assessed as the extra return farmers obtained on top of the normal price they would have expected to receive for their animals had they remained untreated. Village farmers monitor prices closely, and these assessments would be quite accurate. The extent of agreement between different farmers about the size of the increase over a sample of 81 animals also gives confidence in its accuracy.

Table 4.81 Effects of treatment on the value of adult animals by adoption areas

Adoption areas	Number of treated animals sold	Effect of treatment on value per animal
Low	22% (18)	1811 baht (US$ 72.4)
High	78% (63)	1112 baht (US$ 44.5)

Effectiveness of Various Publicity Mechanisms in High and Low Adoption Areas

Table 4.82 shows that posters were the most widely remembered form of publicity offered by the program, and that in high adoption areas most farmers knew of them. Knowledge only fell off slightly with increasing distance from the keyman's village. In low adoption areas they were known by all respondents in the keyman's own village, but by very few in distant villages.

The films used to promote the program were moderately effective, as judged by the recollection of respondents of having seen them. The proportion who remembered them was not related to distance from the keyman's village, in part at least because they were shown on television. The films therefore provide a way of drawing the program to the attention of farmers who might not otherwise know of its existence, and can be useful provided that other efforts build on it. It should however be noted that the videotapes on the activities of the program had been shown at the beginning of the program in some selected villages in Mahasarakam province. These were where DLOs reported that keymen in those areas had a poor level of activity in program promotion, and required more assistance from the NE-VDRC staff. Those areas in fact were mostly those that have subsequently become low adoption areas in this study. This was therefore a special factor in the interpretation of the data on the videotape, since they were used more in low adoption areas for the study than high adoption ones, and this difference appears to be reflected in the findings.

Leaflets are again seen as the least effective of the three main publicity methods used so far.

In general farmers would prefer to have the keyman explain the program to them rather than to read material themselves. There is however one effective method to provide leaflets as a valuable source of knowledge about parasite control in the village. Leaflets or similar publicity may be officially given either to village headmen or Tumbon councils. These leaflets will be displayed in the village library[2] and every farmer will have an good opportunity to read them.

[2] The village library is the special place in most villages which has been built by farmers under supervision by the village headman or Gumnun in that community. There are daily newspapers and books available for farmers who are interested in reading. It is an equally good place in the village as the Sala klang ban to display posters.

Overall, however, it is clear that posters and direct contact between the keymen and farmers provides the best publicity, and that this system works much better in high adoption areas than low adoption ones.

Table 4.82 Effects of various media in each type of adoption area, classified by distance of villages

Distance from keyman's village	Low adoption areas		
	Posters	film	leaflet
0 km	100%	16.7%	8.3%
<2 km	63.6%	27.3%	27.2%
>2 km	16.7%	50%-	
	High adoption areas		
	Posters	film	leaflet
0 km	84.8%	21.2%	9.1%
<2 km	80.7%	6.5%	6.5%
>2 km	65.4%	11.5%	11.5%

CONCLUSION

The analysis of results of the survey has identified a number of factors which influence the effectiveness of the parasite control program, judged by a comparison of areas with different levels of adoption of the program. In Chapter 5 the findings described in this Chapter will be combined with field experience of the operation of the program to propose various ways in which the program could be further enhanced.

This will lead on to an economic analysis of various possible improvements to the program in Chapters 6 and 7. A full discussion of the significance of the findings reported in this Chapter will therefore appear in Chapter 8, where the field findings can be integrated with the results of the economic analyses.

CHAPTER FIVE

POSSIBLE WAYS FOR FURTHER DEVELOPMENT OF THE PROGRAM

INTRODUCTION

This Chapter discusses weak points of the program as currently operated, opportunities for expansion of its scope, and methods by which improvements could be achieved under the specific conditions in north-east Thailand.

The original aims of the program are being achieved in many respects, but further development is needed to meet the growing needs of the region for livestock in the future. Possible avenues for development of the program will be described in this chapter, then some of the major alternatives will be considered in the economic analysis in Chapters 6 and 7.

The main directions in which expansion could take place are:

1. Increase the density of keymen in existing program provinces, and enhance their training.

2. Increase the motivation of keymen to promote the program, especially those who are at present of relatively low effectiveness.

3. Promote the scheme more widely and effectively through keymen to farmers in existing program provinces.

4. Promote the program more strongly through mechanisms which do not directly involve the keymen.

5. Persuade farmers who already participate in the program to treat a higher proportion of the animals they own than they do at present, since few if any farmers treat all of their animals.

6. Expand the program to additional provinces, with features according to those decided upon for the existing provinces.

7. Expand the scope of the program to cover additional products for diseases other than parasitism, and possibly additional functions beyond the prevention and control of disease in large ruminants.

8. Modify the pricing of drugs, the funding of keymen and the administration of the program to make it more effective.

9. Expand the range of people involved in the program by including other categories of advisers to farmers, such as local chemists.

10. Regularly review the program to make technical improvements.

INCREASE DENSITY AND TRAINING OF KEYMEN

From Chapter 4, it is clear that increasing the number of keymen per Tumbon would enable each keyman to better serve the farmers in his immediate area. Even the highly effective keymen are severely stretched to cover their existing areas, and less effective keymen do not even attempt to do so. Increased density of keymen should be designed to reduce the number of villages per keyman from an average of 6 in the sample used for the study to an

average of 4 or even 2 villages per keyman. The decision on how dense the keymen should become should be influenced by livestock numbers as well as the numbers of villages and farmers, and should not be strictly based on a number per Tumbon as at present. Villages should also not be exclusively served by one keyman, although there should be some degree of allocation. If keymen are more numerous, then good ones will tend to serve the area of less active ones, thus reducing the direct effect of the effort of each keyman on an entire group of villages. They will probably also provide better extension services in combination than they can do if each works in isolation, since what one fails to do another may achieve.

It is also clear that keymen are being more effective in persuading farmers to use the drugs than they are in educating the farmers about the nature of parasitism. This is not surprising, but in the next phase keymen should be strongly encouraged and assisted to raise the standards of their extension work. This will require increased training effort in which keymen will participate for longer periods in single training programs, and may have additional training every six months or so.

In some areas close to cities, farmers were not as interested in the program as those in remote areas. This was due to the fact they could buy drugs from the chemist and veterinary advice was more readily accessible. In those areas, the number of keymen selected should be less than in remote areas where farmers own a number of animals and really need the program.

One practical problem which has arisen is that some keymen moved to other areas and the DLO and Tumbon council had to find and train new keymen to replace them. This requires continuing attention to ensure that the number of keymen remains up to the desired strength.

INCREASE THE MOTIVATION OF KEYMEN

As can be seen from the data, many keymen are already highly motivated, even though the return they get for their efforts is very small. However there is scope to either replace ineffective keymen, and in some cases to provide mechanisms to stimulate the level of activity of those who are of marginal value at present. Motivation can be improved by providing various incentives, such as special payments for every 50 drug packages sold or prizes to keymen who sell the most drug, or other forms of reward for extra effort. A variety of non-financial forms of motivating activity could also be undertaken, such as holding meetings to review achievements, providing other tasks which will expand the scope and rewards of the system, or providing competition for existing keymen from newly appointed ones. Another motivating factor would be to modify the administration of the program so that it is as easy as possible for keymen to use - for example by making all drug charges in full baht, rather than half baht, which are difficult coins to obtain.

Additional training programs would also be an important motivating factor, and the results of this study could be used to motivate keymen to be "high adoption" keymen. The content of the training program should be developed and improved to facilitate keyman comprehension. Media and materials used in training should be effectively designed for farmer comprehension.
The acquisition of communication skills should be emphasised in keyman training, together with the importance of utilising these skills to convince farmers that preventive measures against animal diseases are of paramount importance. This intensive training specifically requires experienced trainers who are involved with farmers, in order to create and encourage keyman confidence, so that keymen can fully explain the program to farmers.

PROMOTE THE PROGRAM THROUGH KEYMEN

Additional effort could be put into promoting the program to farmers by using the keymen more extensively for this purpose. For example, a wider range of posters could be provided to keymen, alternative methods of local promotion could be explored, or standard commercial practices for increasing the market size for a product could be attempted. As one example, numbered tickets could be put in each packet of drug, and small prizes awarded to those who get "lucky" numbers, with a prize to the keyman who sells the lucky packet. Village

farmers enjoy such activities and this would stimulate interest in drug sales.

The use of village meetings is a vital part of the promotion effort, and assistance could be provided to make these as attractive as possible for farmers to attend. These meetings are usually held in the late evening when most farmers are free from their work. A keyman can explain to farmers the details of the program, convince them to practise prevention rather than symptomatic treatment, and suggest the use of correct anthelmintics. The next morning, the keyman can start to treat animals with drugs provided by the program. In this way farmers will see the results of treatment quite soon after the meeting.

Keymen have already been advised to prepare an advertising sign using a piece of wood or metal which displays a simple, short description of their activities, and to fix this sign in front of their houses. These advertisements are very useful for program promotion, and more than 1000 keyman have adopted this advice. Signs could be provided to help the keymen in this way.

PROMOTE THE PROGRAM BY REGIONAL PUBLICITY

It is vital to the effort of keymen that they be seen to be part of a larger program, so that farmers will recognize that the keyman is there to help him, and has been trained to do so. Broad promotional efforts such as television promotion and special activities involving notable people at the provincial and regional levels all help to identify the local keyman and his work as something of importance, stimulating both the farmers and the keymen. Use has already been made of a videotape and a radio program. Video films on the parasite control program and keyman activities, including demonstrations of drug administration, were shown in the late evening to farmers in more than 90 keyman areas (10 districts in Mahasarakam province) by a mobile unit from the NE-VRDC in 1985. This stimulated farmer interest in the program. More than 20 copies of the film were provided following farmer and keyman requests. This activity was very effective for the promotion of the program, and despite considerable financial outlay it was well worthwhile.

A television program on parasite control activities has been broadcast twice in the Northeast and once nation-wide since the program began. Radio programs on these activities have occasionally been broadcast from Khon Kaen radio station with other documentaries on animal disease control. These promotions were organized and fully supported by the NE-VRDC. It is clear from this experience that a regular and systematic contribution from the Department of Livestock Development through the NE-VRDC and other parts of the Department are vital to program success.

Special activities involving people other than farmers may also be useful, such as projects for school children to help them understand the purpose of the program, offering prizes for the best projects. The children would become more knowledgeable on the subject, and would also discuss the topic with their parents. This in turn would draw the program to the attention of their parents.

To promote program and assist keymen, the PLO may arrange "a week of worm eradication", to reduce the parasite problem in particular areas where animals are reported to be sick or dying from internal parasites. For instance, liver fluke was confirmed as the cause of deaths in adult buffalo and cattle in villages surrounding a large dam in Sakonakorn province.

The "week of worm eradication" program was first implemented in that area during September 1986 and resulted in a decrease in the prevalence of parasitic disease within a few months of initial drug administration. This activity has been repeated in the same province twice a year thereafter. All animals were treated by keymen, using drugs under the supervision of veterinary field staff.

The three most important recommendations to arise from this campaign were:

1. Use the correct anthelmintic.
2. Treat all calves twice at 3 and 6 weeks of age.
3. Treat all adult animals at least once a year at the beginning of September for liver fluke.

Program commencement should be fixed in January each year to correspond with peak calving period. In this way it can quickly be shown that effective anthelmintic drugs in the program reduce calf mortality rate from internal parasites. This method will encourage the farmers' interest in further information on the program, including the use of other drugs.

PERSUADE USERS TO TREAT MORE ANIMALS

At present few high acceptance farmers treat anywhere near all their animals. Since these farmers are already convinced to use the program, it should be easier to convince them to treat most or all of their animals in accordance with recommendations, than to recruit more farmers into the high acceptance category. This aspect should therefore not be neglected in favour of efforts directed solely at bringing more farmers into the high acceptance category.

EXPAND THE PROGRAM TO ADDITIONAL PROVINCES

This is an obvious method, but it requires that considerable effort be put into starting the program and recruiting the keymen. It should probably only be done gradually, once existing provincial programs are operating as well as possible.

EXPAND THE PROGRAM TO COVER ADDITIONAL PRODUCTS

Animal diseases are caused not only by parasitic problems, but also by many other agents. For example, mineral deficiencies are widespread in some areas, causing lower productivity. A mineral mix containing selenium and vitamin E is prepared for distribution to keymen for use in the program to reduce the problem of "tetanoid syndrome". Other simple drugs are progressively being added to the program to help keymen treat common and easily recognizable conditions. Farmers appreciate this additional help, and it all helps to increase recognition of the program.

MODIFY ADMINISTRATIVE AND FUNDING ASPECTS OF THE PROGRAM

A number of improvements could be made with respect to charging for drugs, drug supply, funding support for keymen and the administration of the program. Some suggestions are as follows:

1. Improvement in quality of material supplied to keymen, eg. drug containers, and description of drugs. This should be simple and practical for both keymen and farmers. Spare parts for plastic syringes, an important piece of equipment for keymen, should be readily available.

2. Drug storage arrangements in each province need to be reconsidered because drug life is limited, especially injectable drugs. In some PLO or DLO offices, there was not enough room to store drugs, and appropriate storage space is required. Finance for these facilities could be provided by the revolving fund.

3. Drug movement between the PLOs, DLOs and keymen in some areas is irregular due to problems of transportation. Reduction of these problems could be achieved if drugs and materials were purchased by the Regional Veterinary offices instead of the Department of Livestock Development in Bangkok, which is a considerable distance from the Northeastern provinces. This would facilitate delivery to PLOs and alleviate the problem of drug supply between DLOs and keymen.

4. The 13% incentive payment is not considered enough by most keymen, compared to the efforts expended. The amounts received even by good keymen over a year are very small, and something must be done about this if the program is to continue to be a success. Serious consideration should be given to using the keymen for other functions, so that their income from the work is enough to justify them continuing. One possibility is to expand their work to include poultry, since there is a need for a poultry health service and a study is currently being conducted at NE-VRDC to

develop a disease control program for village poultry based on a study of health and productivity of village chickens. Such a program could be integrated with the existing ruminant program. A second possibility is to use the keymen in a simple disease reporting role, and to reward them for this work. It would help give them a reason for visiting villages, and would fit in well with their present role.

5. To improve incentive payment for keymen there are two possibilities, with money or without additional money. Incentive payment without additional money means keymen may be provided extra drugs in return for their previous payment, according to how many animals each owns. Keymen may use these drugs to treat their own animals, instead of buying from their own stock as is usual.

6. A group of selected keymen who achieve good performance in keyman activity could be rewarded. For example a special trip could be arranged for them to visit areas where animal production is increasing, eg. private or commercial livestock farms, or the livestock breeding station.

7. Following animal deaths which occurred shortly after drug administration, some keymen could not continue their activities in those areas. Farmers did not trust them any more, unless the animal owners clearly understood that the deaths did not result from the keyman's drugs. This meant that keymen had to be able to clearly explain to the owners how such deaths could happen. Some animal owners requested money as compensation from keymen. These problems occasionally occurred in the program provinces, working with nearly 2000 keymen, and had been not been effectively dealt with by the DLD. A solution must be found to this problem, and one possibility is to authorise expenditure from the revolving fund as compensation in the case of an animal death. Animal owners could get about 75% of the market value, following diagnosis by the NE-VRDC, confirming that the cause of death was drug administration by keymen. This solution has not been officially explored since the program started.

8. At the provincial level, the program should be operated and continuously monitored under the supervision of the Provincial Veterinary Officer (PVO), as standard policy. The PVOs of 17 Northeastern provinces are responsible for disease eradication in province areas, under the control of the Provincial Livestock Officers (PLOs), and are the link between the NE-VRDC and the provincial level. The PVOs are the appropriate field staff who can oversee the program and provide technical advice directly to DLOs and keymen in their provincial areas.

9. The price of drugs recommended for farmers in the program was quite reasonable for farmers and keymen. Pricing of drugs should be closely monitored to ensure that they remain within the capacity of farmers to pay, but that the keyman receive an adequate payment and the revolving fund does not lose money over time. The revolving fund should be authorised to provide replacement drug stocks promptly so that farmers can always obtain treatment when they need it. Some keymen kept money from drug sales for too long, causing financial difficulties in management of the revolving fund. The DLOs who are responsible for these keymen should find an appropriate solution to the problem and replace the keymen if necessary.

10. Random testing of program results in some areas should be implemented and methods of further improvement investigated.

INVOLVE OTHER ADVISERS

The local chemist is clearly a significant adviser to farmers on animal health matters, especially for those farmers who have not yet participated in the program. Use could perhaps be made of them either as participants, or as people who are used to direct farmers to the keyman for their area. The chemists would have to be trained in the same way as keymen so that they could carry out this work.

REGULARLY REVIEW TECHNICAL ASPECTS OF THE PROGRAM

Reviews such as the one described in this thesis are vital to find out how the organization of the program can be improved. Such assessments should be conducted periodically. Specific technical aspects of the program should also be re-examined regularly, to take account of new scientific findings, changes in the pricing and availability of drugs which could lead to a change in the recommendation on treatment, and the release of new improved drugs on to the market in Thailand, which might result in changed recommendations.

Some of the major options for improving the program will be considered in more detail in the next two chapters.

CHAPTER SIX

ECONOMIC EVALUATION OF THE BENEFIT OF THE SCHEME FOR INDIVIDUAL FARMERS

INTRODUCTION

In evaluating the economic benefit of disease control, it is necessary to consider the difference in productivity between diseased and disease-free animals, and also the changes in productivity which follow elimination of a disease from an affected animal (Morris,1986b). The effects of disease and the need for disease control have to be considered as part of the overall economic assessment of methods of improving the income and wellbeing of farmers and their families. This will be true regardless of whether the issue is being looked at from an individual, regional or national level. This aspect of assessment is closely allied to epidemiological studies of possible methods for achieving better control of disease in animals.

A basic knowledge of economic techniques provides a necessary perspective to the veterinarian's activities in large animal practice (Thrusfield,1986). Morris (1979a) pointed out that the animal health services of each country are competing with many other parts of the economy for strictly limited resources. Therefore although improvement of animal health may deserve high priority in national development, it is unlikely to be achieved unless well-documented cases can be presented when decisions on economic planning are being made. This same information will be valuable in making livestock owners more aware of the problems caused by animal disease, and will be essential as a basis for internal decisions by the animal health service.

Ellis et al (1979a), describing the changing character of animal health problems write that in the past, decisions on the control of animal diseases could be made without a formal economic analysis, because the losses due to the disease were obviously outweighing the costs of control. In recent years, however, the situation has become more complex because the diseases with which veterinarians must deal are multi-factorial and the non-technical factors which must be taken into account in decisions have become more numerous. The general epidemiological picture has changed too, as a result of changes in the structure of livestock populations, and in herd and flock management. Moreover, as traditional management systems are modified by development schemes and the pressures of national development, new (and newly appreciated) animal health problems may become evident.

Morris (1979a) mentioned that the use of modern epidemiological and economic methods can be a very valuable tool in the hands of a veterinary administrator, and will give field veterinary staff the techniques they require to balance the increasing technical sophistication of laboratory staff. The approach will assist veterinary administrators to make more soundly based decisions on complex problems, and to convince economic planners that their recommendations are well supported and justify funding.

ECONOMIC BENEFITS FROM A DISEASE CONTROL PROGRAM

Ellis et al (1979a) explained in the measurement of benefits that,although the benefits of animal health programs usually take the form of an improvement in the efficiency of production, the extent of improvement is most easily estimated in terms of increased production per animal. Thus it is necessary to find the effect of the disease on production in order to estimate the benefits of the program. Farmers seldom count the costs of individual animal treatment and tend to regard them as an unavoidable expenditure, because even the best managed herds and flocks are accustomed to experiencing a certain number of health problems and accidents (Ellis et al, 1979b).

Morris et al (1980) mentioned in the measurement and evaluation of the economic effects of parasite disease that economic analysis provides a method for undertaking comparisons of parasite control strategies when the motive for action is a financial one. Economic studies should be designed so that as many strategies as possible can be compared within the experimental design, as this assists in interpretation. In conducting such experiments careful physical measurement of the consequences of the disease, and of actions taken against it, comprise the major part of the work. The principle value of economic analysis of parasite control strategies is that it provides a basis for making logical decisions on the optimal action which should be taken under various sets of circumstances.

If a control program involves substantial initial investment and the benefits gradually accumulate, it is necessary to weight annual costs and benefits by a factor which makes immediate costs and benefits more valuable than those which occur in the future. This procedure, which is known as "discounting of future cash flows", is simply the reverse of compound interest calculation. Its principal application is in the assessment of public disease control programs,where the government will contribute to a large-scale program.Analyses of this type are termed "benefit-cost analysis" when only measurable economic costs and benefits are considered (Morris et al 1980).

TECHNIQUES FOR ECONOMIC ANALYSIS

The precise approach used to collect, handle and interpret information must be chosen in the light of national circumstances. Many of these costs and benefits can be valued in simple monetary terms and the techniques involved fall under the general heading of "economic analysis" (Ellis et al, 1979a). Economic techniques have a place as one tool which can be used by epidemiologists in evaluating the practical value of their research findings to livestock producers.

Economic studies are intended to provide information for decision-making, so it is essential that studies be undertaken under circumstances which replicate field conditions as closely as possible.

The field information must then be summarised in the form of an economic analysis which shows farmers and decision-makers in the veterinary service the consequences of each of the possible decisions which they could make. The techniques of economic analysis which are useful in veterinary economics have been described by Morris (1969) and Morris and Meek (1980).

Of the techniques which they describe, those which are useful to this particular study are:

1. **Partial budgeting**. In this technique, which is normally used at farm level, the items of farm income and expenditure which change as a result of the disease control program are built into a budgeted comparison of the situation with and without the control program. All items which are not affected by the decision under consideration are excluded from the analysis, so that the evaluation is clear-cut and straightforward to undertake. In this study, the evaluation of the economic benefit to individual farmers has been carried out by partial budgeting.

2. **Benefit-cost analysis**. This is used to evaluate major decisions, commonly those which involve substantial Government spending on the program. Results are usually calculated over a period of years, with the results discounted back to a defined date, normally the starting date of the project. Benefit-cost analysis will be used in this study, but because the costs are very small and do not change greatly over time, an annual return figure has been calculated rather than the more usual "net present value". The results presented here in the form of a benefit-cost analysis will be an evaluation of the return on Government and aid funds invested in the parasite control program.

2. **Modelling of the biological system.** To give a comprehensive assessment of the biological and economic effects of a disease control program, a model can be developed to run on a computer and evaluate the full effects of the disease control program. These models can range from very simple ones built within an electronic spreadsheet, up to very comprehensive models of an entire animal production system. In this study a simple spreadsheet model has been constructed within the program Quattro, described in Chapter

3. This model enables values for each of the variables to be entered, and then the effects for the "typical" farmer will be calculated. These results will then be carried into a second stage of the model which calculates the annual costs and benefits of the program for each of the six provinces included in the study, then for the group of provinces as a whole. This method of laying out the analysis makes it quite easy to test the effect of changing any of the data which was used to build the analytical model, since a change in any factor will immediately cause the spreadsheet to recalculate all values in the results table. A series of analyses can therefore be conducted much more quickly and easily than would be the case if all figures had to be recalculated by hand every time one of the pieces of data in the analysis was altered.

In the last few years the application of economic techniques in parasite control has been demonstrated by a number of workers and the procedures which are now available permit comprehensive and reliable economic studies to be undertaken by individuals who do not have extensive knowledge in economic theory. With the development and intensification of livestock industry formerly insignificant diseases become important and epidemiology and economics are the most effective methods of study with regard to the health of animal populations (Morris, 1979b). If the effects of the disease have been estimated in physical terms as a loss of production due to disease, this loss must then be put into valid economic terms by assessing the expected benefit of controlling the disease, so that it can be directly compared with the cost of control strategies (James et al, 1979). It is very rare to be able to achieve complete control of a disease, so the analysis should normally be carried out by comparing the production losses due to disease between groups of animals in which the disease has been controlled and those in which it has not, in order to calculate the net benefit of the control measures.

BENEFITS OF PARASITE CONTROL TO THE VILLAGE FARMER

The analytical procedure which has been used in this part of the study is partial budgeting. The aim of this procedure is to select those components of enterprise income and costs which are likely to be influenced by the intended disease control procedure, and only these items are considered in the analysis. Each item in the physical measurement process is multiplied by its market value, and this financial estimate is included in the budget (Morris and Meek, 1980).

In this case, the expected benefits farmers receive when they adopt the parasite control program are categorised as follows:

1. Additional monetary returns received (or increased inventory value of capital assets) from calves, due to the calf survival rate being increased by control of internal paraistes. The high acceptance farmers gained benefits from the value of additional calves which survived to one year old, due to parasite control procedures.

2. The additional inventory value of growing and adult animals which survived because of the parasite control program.

3. Additional market value, due to improved body condition, of animals which have been treated for parasitism.

4. Reduced need to rent buffalo for working the rice paddy field because the farmer's own animals are stronger following treatment for liver fluke.

5. Additional value of manure produced.

6. Improved reproductive potential of animals, due to improved body weight and state of health, leading possibly to higher birth rates and therefore to growth of the animal population.

7. Possibly increased length of life as a result of parasite control, so that breeding animals which have been regularly treated can produce more calves, and have a prolonged working life.

In this study the first three categories listed above were considered as the major measurable benefits which farmers would be likely to receive if they adopted the parasite control scheme. The other benefits were considered as probable gains due to the program, but as being much more difficult to demonstrate within the study which was undertaken. It was therefore decided to limit the economic assessment to those three items for which adequate data could be derived from the field study, and to consider the other items as unmeasurable benefits, which would almost certainly make the true gain to the farmer larger than the figures provided in this analysis.

The costs of the program have been subtracted from the gross benefit caculated as above, to produce the net return or net benefit. This net return is estimated as additional income or gain in livestock value which farmers will achieve from adopting the parasite control procedures, and will be expressed in relation to an enterprise of standardized size as net benefit per farm.

Data related to the number of buffalo and cattle which a typical farmer owned, number of calves and adult animals treated, and the values of animals of the high and low acceptance farmers were analyzed using analysis of variance. The results are shown in Appendix 7. These results plus figures presented in the various Tables and Figures in Chapter 4 provide the base data used in the economic analysis tables. To present the difference between the livestock income of the high and low acceptance farmers, the following economic analysis for a single village farmer (household) was formulated in one section of a spreadsheet as shown in Table 6.1.

For the purposes of the analysis, an increase in inventory (the number of animals owned by the farmer, multiplied by their individual values) was treated as being exactly the same as livestock income, because a farmer who obtained a benefit from the parasite control program in the form of owning more animals, and having animals of higher market value, might either choose to sell the animals and use the cash, or keep the animals and build up his capital in the form of an "animal bank", which is common practice in the region. The economic effect is the same, although account must be taken in looking at the issue for the region, as distinct from the individual farmer, that if all farmers choose to keep the extra animals, then there may be feed supply problems in the medium term.

MEASUREMENT OF COST

The total cost of the progam comprises two components. One is the individual treatment cost incurred by each farmer. The other component is the cost incurred by the community through training of keymen and supplying them with promotional material. This second cost is only relevant to the benefit-cost analysis, and will be considered in Chapter 7.

The cost of treatment is the amount charged by the keyman for supplies of the various drugs, and has been taken for this analysis as US$ 0.3 for one calf treatment dose and US$ 0.4 for one adult treatment dose.

The cost for training of the keymen and supplying them with promotion material is about US $ 15 per keyman. This was calculated directly from data for the costs of training the number of keymen who are already in the program, and the cost of training additional keymen should certainly be no higher.

ANALYSIS OF THE BENEFIT TO THE INDIVIDUAL FARMER

Table 6.1 shows the method of calculation used to assess each of the components of the economic analysis.

Table 6.1 Formulae used in the economic analysis at farmer level

Birth rate/year	= No.calves born / No.females >4 yrs. = (No.calves present + No.calves died) / No.females >4 yrs.
Survival rate	= (No.calves present + No.calves sold) / No.calves born = (No.calves present + No.calves sold) / (No.calves present + No.calves sold + No.calves died)
Survival rate of treated calves	= No.treated calves * Survival rate of treated calves
Survival rate of untreated calves	= No.untreated calves * survival rate of untreated calves
Total value of calves at 12 months	= (No.treated calves + No.untreated calves) * Calf value at 12 months
Value of treated adult animals	= Standard market value adult animal + Additional value due to treatment

Since no evidence was obtained for the death of adult animals in the study population due to liver fluke, it has been conservatively estimated that the survival rate of both treated and untreated adult animals = 100%.

Total value of adult animals at the beginning of year	= (No.treated adult animals + No.untreated adultanimals) * Value of untreated animals = A
Total value of adult animals at the at the end of year value)	= (No.of treated animals at end of year * Value of treated animals) + (No.untreated animals at the end of year * Standard market = B
Change in value of adult animals over one year	= B - A
Total value of herd at end of year	= Total value of calves at 12 mths. +(B - A)

Drug cost per calf dose	=	US$ 0.3 (7.5 baht)
Drug cost per adult dose	=	US$ 0.4 (10 baht)
Total cost of calf treatment	=	No.calves treated * US$ 0.3
Total cost of adult treatment	=	No.adults treated * US$ 0.4
Total treatment cost	=	Total cost of calf treatment + Total cost of adult treatment = C

Total income from herd of high acceptance farmer = Total value of herd at end of year - C
= D

Total income from herd of low acceptance farmer = Total value of herd at end of year
= E

Net benefit due to being a "high acceptance" farmer = D - E

Tables 6.2 and 6.3 show the economic calculations in the Quattro spreadsheet using these formulae, when the actual data obtained from the farmers is used in the analysis. In other words, what is being measured is the difference in net livestock income between high and low acceptance farmers, based on the data they supplied in the survey.

All of the figures in the analysis have been calculated in US dollars, principally so that they could easily be interpreted by readers from a range of countries. For the analysis, US$1 has been taken as equivalent to 25 baht.

Table 6.2 Estimation of increased buffalo value per farm at end of year by acceptance level, for those farmers who own buffalo, using actual survey data

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	2.96	3.17
Number of female animals >4 yrs.owned	0.92	0.95
Birth rate(%) of calves	55.8	40.6
Number of calves born	0.51336	0.3857
Survival rate treated calves	81	0
Survival rate untreated calves	68	68
Number of calves treated	0.48	0
Number of calves not treated	0.03336	0.3857
No. treated calves surviving to 12 months	0.3888	0
No. untreated calves surviving to 12 months	0.022685	0.262276
Value per calf at 12 months	89.1	89.1
Total value of calves at 12months	36.6633	23.36879
Number of treated adults >12 months	1.5688	0
Number of untreated adults >12 months	1.3912	3.17
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	270.82	0
Value of untreated adult animals	182.21	182.21
Number treated adults at end of year	1.5688	0
Number untreated adults at end of year	1.3912	3.17
Total value of adults at start of year	539.3416	577.6057
Total value of adults at end of year	678.353	577.6057
Change in value of adults over year	139.0114	0
Total increase in value of herd at end of year	175.6747	23.36879

Table 6.3 Estimation of Cattle Value Per Farm at End of Year by Acceptance Level, for Those Farmers Who Own Cattle, Using Actual Survey Data

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	3.81	3.81
Number of female animals >4 yrs.owned	1.481	1.515
Birth rate(%) of calves	61	51.5
Number of calves born	0.90341	0.780225
Survival rate treated calves	93	0
Survival rate untreated calves	81	81
Number of calves treated	0.08	0
Number of calves not treated	0.82341	0.7828
No. treated calves surviving to 12 months	0.0744	0
No. untreated calves surviving to 12 months	0.666962	0.634068
Value per calf at 12 months	110.65	110.65
Total value of calves at 12months	82.03172	70.15962
Number of treated adults >12 months	1.2573	0
Number of untreated adults >12 months	2.5527	3.81
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	325.46	0
Value of untreated adult animals	214.35	214.35
Number treated adults at end of year	1.2573	0
Number untreated adults at end of year	2.5527	3.81
Total value of adults at start of year	816.6735	816.6735
Total value of adults at end of year	956.3721	816.6735
Change in value of adults over year	139.6986	0
Total increase in value of herd at end of year	221.7303	70.15962

Table 6.4 Costs and Net Benefits of Parasite Control Program - Actual Data

Cost of treatment	Buffalo	Cattle
Cost per dose of drug/calf	0.3	0.3
Cost of calf treatment	0.144	0.024
Cost per dose of drug/adult	0.4	0.4
Cost of adult treatment	0.62752	0.50292
Net benefit of program		
Value of animals in high acceptance level	175.6747	221.7303
Value of animals in low acceptance level	23.36879	70.15962
Total cost of treatment	0.77152	0.52692
Net benefit/farmer	151.5344	151.0438

Table 6.4 shows that the net benefit calculated in this way for a farmer who keeps buffalo was US$151.5, and the net benefit for a farmer who keeps cattle was $151.0. A farmer who keeps both would on average receive the combined benefit. However since about 88% of farmers in the study keep buffalo and about 30% keep cattle, the "average farmer" will receive a benefit of about $170 after adjusting for the likelihood that he will keep each of the two species.

Because the cost of the program is so low, there is little point in undertaking a sensitivity analysis since all of the factors in the analysis would have to be taken to extreme and most improbable values before the benefit was reduced to zero.

However this first analysis is based on the assumption that all of the difference in calculated net income between high and low acceptance farmers is due to the parasite control program, at least as far as the factors used in the analysis are concerned.

Within the limits of the survey method on which the analysis was based, this is a reasonable conclusion for the calf mortality data and the increase in value after treatment of adult animals, the two factors which make up most of the benefit. There is independent evidence, as mentioned in Chapter 1, that differences in calf mortality of at least this size can be produced by anthelmintic treatment of calves, and the data on adults was based on actual sale data in the region, since 81 treated animals were sold by respondents and they provided data on what they believed to be the difference in value between treated and untreated animals. They are very aware of prices of animals, and the mean value from their estimates should be an accurate estimate of the true value, especially since the variability among respondents in the figure they quoted was quite small.

However the difference in calving rate between the two groups, while it may be due at least in part to treatment of adult animals, is difficult to ascribe totally to this cause since most of the cows which produced these calves would probably have been untreated animals. A further analysis has therefore been conducted in which the calving rate for both high and low acceptance groups has been standardised to the mean over all animals in the study. In addition, the number of animals in the base population has been adjusted to the mean value across the entire population in the survey group, to remove effects due to the difference in starting herd size. In this way the data should represent as close as can be achieved to an assessment free of complications due to inherent differences between the high and low acceptance farmers, unrelated to their involvement in the parasite control program.

In addition, the figures are based on the actual number of each species owned by a high acceptance farmer and a low acceptance one. Since they owned slightly different numbers of animals, the results are influenced by this difference in herd size. Whether this difference is at all related to acceptance level is something which cannot be assessed with this data.

Thus the calculated figures in Table 6.4 represent just the difference in actual and potential income between high and low acceptance farmers, which may be due to a variety of factors in addition to whether or not they use the program. For example, high acceptance farmers may be those people who are likely to accept advice on matters other than parasite control, and therefore may do a number of things differently from low acceptance farmers. It is impossible within the design used for the study to totally remove this factor. However in order to reduce it to a minimum, various adjustments will be made to the data to standardise it and remove possible confounding factors which might make the results look too good.

Adjusted Base Analysis

Tables 6.5, 6.6 and 6.7 show the results of this adjusted analysis for an "average farmer" who owns the mean number of animals as determined across the entire survey population for farmers who own the particular species.

Table 6.5 Estimation of buffalo value per farm at end of year by acceptance level, for those farmers who own buffalo, adjusted to equate animals owned and birth rates

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	2.97	2.97
Number of female animals >4 yrs.owned	0.86	0.86
Birth rate(%) of calves	51	51
Number of calves born	0.4386	0.4386
Survival rate treated calves	81	0
Survival rate untreated calves	68	68
Number of calves treated	0.412284	0
Number of calves not treated	0.026316	0.4386
No. treated calves surviving to 12 months	0.33395	0
No. untreated calves surviving to 12 months	0.017895	0.298248
Value per calf at 12 months	89.1	89.1
Total value of calves at 12months	31.34938	26.5739
Number of treated adults >12 months	1.5741	0
Number of untreated adults >12 months	1.3959	2.97
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	270.82	0
Value of untreated adult animals	182.21	182.21
Number treated adults at end of year	1.5741	0
Number untreated adults at end of year	1.3959	2.97
Total value of adults at start of year	541.1637	541.1637
Total value of adults at end of year	680.6447	541.1637
Change in value of adults over year	139.481	0
Total increase in value of herd at end of year	170.8304	26.5739

Table 6.6 Estimation of cattle value per farm at end of year by acceptance level for those farmers who own cattle, adjusted to equate animals owned and birth rates

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	3.94	3.94
Number of female animals >4 yrs.owned	1.45	1.45
Birth rate(%) of calves	56	56
Number of calves born	0.812	0.812
Survival rate treated calves	93	0
Survival rate untreated calves	81	81
Number of calves treated	0.07308	0
Number of calves not treated	0.73892	0.812
No. treated calves surviving to 12 months	0.067964	0
No. untreated calves surviving to 12 months	0.598525	0.65772
Value per calf at 12 months	110.65	110.65
Total value of calves at 12months	73.74707	72.77627
Number of treated adults >12 months	1.3002	0
Number of untreated adults >12 months	2.6398	3.94
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	325.46	0
Value of untreated adult animals	214.35	214.35
Number treated adults at end of year	1.3002	0
Number untreated adults at end of year	2.6398	3.94
Total value of adults at start of year	844.539	844.539
Total value of adults at end of year	989.0042	844.539
Change in value of adults over year	144.4652	0
Total increase in value of herd at end of year	218.2123	72.77672

Table 6.7 Costs and net benefit of program for buffalo and cattle owners, adjusted for herd size and birth rate

Cost of treatment	Buffalo	Cattle
Cost per dose of drug/calf	0.3	0.3
Cost of calf treatment	0.123685	0.021924
Cost per dose of drug/adult	0.4	0.4
Cost of adult treatment	0.062964	0.52008
Net benefit of program		
Value of animals in high acceptance level	170.8304	218.2123
Value of animals in low acceptance level	26.5739	72.77672
Total cost of treatment	0.753325	0.542004
Net benefit/farmer	143.5032	144.8936

In fact the difference from the earlier unadjusted analysis is only slight, because there are various counterbalancing differences between the two groups whi ch mean that the original unadjusted figures come out very close to these adjusted ones. In this case the net

benefit for a buffalo owning farmer is $143.5, while the net benefit for a cattle owning farmer is $144.9. After adjustment for the proportion of farmers who own each species, the net benefit to the "average farmer" would be again approximately $170.

Analysis Adjusted to Represent the Average Farmer

The figures so far have been concerned with farmers who own the particular species for which the calculation is being made. Since, as pointed out earlier, a much lower proportion of farmers own cattle than buffalo, if the analysis is to represent the situation for the average farmer for the region, then it should be based on the mean number of animals of each species owned by a farmer, including those farmers who own no animals of one or both species. Tables 6.8 to 6.10 show the results for this farmer.

He owns the mean number of buffalo (2.13) and the mean number of cattle (1.1), noticeably lower than the mean for cattle-owning farmers. This farmer's herd also has a calving rate equal to the mean for the entire population, calculated separately for buffalo and cattle. The net benefit is $102.9 from his buffalo, and $40.4 from his cattle, allowing for the differing proportion of farmers who own each species. The total benefit to the average farmer is $143.3. Thus it is smaller than the unadjusted figure, but is still a remarkably large benefit considering that the investment required to obtain it is US$0.69. Again sensitivity analysis shows that the net benefit will exceed the breakeven point for virtually all values of the major variables.

Table 6.8 Estimation of Buffalo Value Per Farm at End of Year by Acceptance Level, adjusted to represent the average farmer

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	2.13	2.13
Number of female animals >4 yrs.owned	0.61	0.61
Birth rate(%) of calves	51	51
Number of calves born	0.3111	0.3111
Survival rate treated calves	81	0
Survival rate untreated calves	68	68
Percentage of calves treated	0.94	0
Number of calves treated	0.292434	0
Number of calves not treated	0.018666	0.3111
No. treated calves surviving to 12 months	0.236872	0
No. untreated calves surviving to 12 months	0.012693	0.211548
Value per calf at 12 months	89.1	89.1
Total value of calves at 12months	22.23619	18.84893
Percentage of adult treated	0.53	0
Number of treated adults >12 months	1.1289	0
Number of untreated adults >12 months	1.0011	2.13
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	270.82	0
Value of untreated adult animals	182.21	182.21
Number treated adults at end of year	1.1289	0
Number untreated adults at end of year	1.0011	2.13
Total value of adults at start of year	388.1073	388.1073
Total value of adults at end of year	488.1391	388.1073
Change in value of adults over year	100.0318	0
Total increase in value of herd at end of year	122.268	18.84893

Table 6.9 Estimation of Cattle Value Per Farm at End of Year by Acceptance Level, adjusted to represent average farmer

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	1.1	1.1
Number of female animals >4 yrs.owned	0.4	0.4
Birth rate(%) of calves	56	56
Number of calves born	0.224	0.224
Survival rate treated calves	93	0
Survival rate untreated calves	81	81
Percentage of calves treated	0.09	0
Number of calves treated	0.02016	0
Number of calves not treated	0.20384	0.224
No. treated calves surviving to 12 months	0.018749	0
No. untreated calves surviving to 12 months	0.16511	0.18144
Value per calf at 12 months	110.65	110.65
Total value of calves at 12months	20.34402	20.07634
Percentage of adult treated	0.33	0
Number of treated adults >12 months	0.363	0
Number of untreated adults >12 months	0.737	1.1
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	325.46	0
Value of untreated adult animals	214.35	214.35
Number treated adults at end of year	0.363	0
Number untreated adults at end of year	0.737	1.1
Total value of adults at start of year	235.785	235.785
Total value of adults at end of year	276.1179	235.785
Change in value of adults over year	40.33293	0
Total increase in value of herd at end of year	60.67695	20.07634

Table 6.10 Costs and net benefit of the program, adjusted to represent the average farmer

Cost of treatment	Buffalo	Cattle
Cost per dose of drug/calf	0.3	0.3
Cost of calf treatment	0.08773	0.006048
Cost per dose of drug/adult	0.4	0.4
Cost of adult treatment	0.45156	0.1452
Net benefit of program		
Value of animals in high acceptance level	122.268	60.67695
Value of animals in low acceptance level	18.84893	20.07634
Total cost of treatment	0.53929	0.151248
Net benefit/farmer	102.8798	40.44937

Increased Use of the Program

Farmers in the study only treated a proportion of each age group of both buffalo and cattle, as shown in Tables 6.8 and 6.9 for the adjusted average farmer. An analysis was therefore conducted to assess the effects of increasing the proportion of animals treated per farmer, to determine the effect on the economic benefit received.

It is difficult to show the full range of possible increases adequately, because the percentage of animals actually treated is different for buffalo and cattle, and for calves and adults within each species. The analysis has therefore been done by taking the base analysis as already described, first by reworking the calculations for the situation where all animals belonging to the "typical farmer" are treated. Then for each species and age group, a figure for "50% improvement" is calculated by taking an intermediate situation where the number of animals treated in each of the four sub-groups in the analysis (adults and calves, buffalo and cattle) is halfway between the number actually treated and the number which could possibly have been treated. Tables 6.11 to 6.13 show the situation in which all eligible animals are treated, and Tables 6.14 to 6.16 show the situation where 50% of the currently untreated animals are now treated.

If all animals are treated, the net benefit rises to $191.4 for buffalo (Table 6.11), $124.7 for cattle (Table 6.12), a large increase since fewer of the available cattle are currently treated, making a total benefit of $316.1 (Table 6.13). If the intermediate value is taken, as in Table 6.14 to 6.16, the benefit is $146.2 for buffalo and $81.9 for cattle, making a total of $228.1.

Table 6.11 Estimation of Buffalo Value Per Farm at End of Year by Acceptance Level, if all eligible animals are treated

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	2.13	2.13
Number of female animals >4 yrs.owned	0.61	0.61
Birth rate(%) of calves	51	51
Number of calves born	0.3111	0.3111
Survival rate treated calves	81	0
Survival rate untreated calves	68	68
Percentage of calves treated	1	0
Number of calves treated	0.3111	0
Number of calves not treated	0	0.3111
No. treated calves surviving to 12 months	0.251991	0
No. untreated calves surviving to 12 months	0	0.251548
Value per calf at 12 months	89.1	89.1
Total value of calves at 12months	22.4524	18.84893
Percentage of adult treated	1	0
Number of treated adults >12 months	2.13	0
Number of untreated adults >12 months	0	2.13
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	207.82	0
Value of untreated adult animals	182.21	182.21
Number treated adults at end of year	2.13	0
Number untreated adults at end of year	0	2.13
Total value of adults at start of year	388.1073	388.1073
Total value of adults at end of year	576.8476	388.1073
Change in value of adults over year	188.7393	0
Total increase in value of herd at end of year	211.1917	18.84893

Table 6.12 Estimation of Cattle Value Per Farm at End of Year by Acceptance Level, if all eligible animals are treated

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	1.1	1.1
Number of female animals >4 yrs.owned	0.4	0.4
Birth rate(%) of calves	56	56
Number of calves born	0.224	0.224
Survival rate treated calves	93	0
Survival rate untreated calves	81	81
Percentage of calves treated	1	0
Number of calves treated	0.224	0
Number of calves not treated	0	0.224
No. treated calves surviving to 12 months	0.20832	0
No. untreated calves surviving to 12 months	0	0.18144
Value per calf at 12 months	110.65	110.65
Total value of calves at 12months	23.05061	20.07634
Percentage of adult treated	1	0
Number of treated adults >12 months	1.1	0
Number of untreated adults >12 months	0	1.1
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	325.46	0
Value of untreated adult animals	214.35	214.35
Number treated adults at end of year	1.1	0
Number untreated adults at end of year	0	1.1
Total value of adults at start of year	235.785	235.785
Total value of adults at end of year	358.006	235.785
Change in value of adults over year	122.221	0
Total increase in value of herd at end of year	145.2716	20.07634

Table 6.13 Costs and benefits of control program for average farmer, if all eligible animals are treated

Cost of treatment	Buffalo	Cattle
Cost per dose of drug/calf	0.3	0.3
Cost of calf treatment	0.09333	0.0672
Cost per dose of drug/adult	0.4	0.4
Cost of adult treatment	0.852	0.44
Net benefit of program		
Value of animals in high acceptance level	211.1917	145.2716
Value of animals in low acceptance level	18.84893	20.07634
Total cost of treatment	0.94533	0.5072
Net benefit/farmer	191.3974	124.6881

Table 6.14 Estimation of Buffalo Value Per Farm at End of Year by Acceptance Level, if 50% of animals at present left untreated receive treatment

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	2.13	2.13
Number of female animals >4 yrs.owned	0.61	0.61
Birth rate(%) of calves	51	51
Number of calves born	0.3111	0.3111
Survival rate treated calves	81	0
Survival rate untreated calves	68	68
Percentage of calves treated	0.97	0
Number of calves treated	0.301767	0
Number of calves not treated	0.009333	0.311
No. treated calves surviving to 12 months	0.244431	0
No. untreated calves surviving to 12 months	0.006346	0.211548
Value per calf at 12 months	89.1	89.1
Total value of calves at 12 months	22.34429	18.84893
Percentage of adult treated	0.76	0
Number of treated adults >12 months	1.6188	0
Number of untreated adults >12 months	0.5122	2.13
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	207.82	0
Value of untreated adult animals	182.21	182.21
Number treated adults at end of year	1.6188	0
Number untreated adults at end of year	0.5112	2.13
Total value of adults at start of year	388.1073	388.1073
Total value of adults at end of year	531.5492	388.1073
Change in value of adults over year	143.4419	0
Total increase in value of herd at end of year	165.7862	18.84893

Table 6.15 Estimation of Cattle Value Per Farm at End of Year by Acceptance Level, if 50% of animals currently left untreated receive treatment

Variable	High acceptance level	Low acceptance level
Number of adult animals owned	1.1	1.1
Number of female animals >4 yrs.owned	0.4	0.4
Birth rate(%) of calves	56	56
Number of calves born	0.224	0.224
Survival rate treated calves	93	0
Survival rate untreated calves	81	81
Percentage of calves treated	0.54	0
Number of calves treated	0.112096	0
Number of calves not treated	0.10304	0.224
No. treated calves surviving to 12 months	0.112493	0
No. untreated calves surviving to 12 months	0.083462	0.18144
Value per calf at 12 months	110.65	110.65
Total value of calves at 12months	21.68244	20.07634
Percentage of adult treated	0.66	0
Number of treated adults >12 months	0.726	0
Number of untreated adults >12 months	0.374	1.1
Survival rate (%) of treated adults	100	100
Survival rate (%) of untreated adults	100	100
Value of treated adult animals	325.46	0
Value of untreated adult animals	214.35	214.35
Number treated adults at end of year	0.726	0
Number untreated adults at end of year	0.374	1.1
Total value of adults at start of year	235.785	235.785
Total value of adults at end of year	316.4509	235.785
Change in value of adults over year	80.66586	0
Total increase in value of herd at end of year	102.3483	20.07634

Table 6.16 Costs and net benefit of control program, if 50% of animals at present left untreated receive treatment

Cost of treatment	Buffalo	Cattle
Cost per dose of drug/calf	0.3	0.3
Cost of calf treatment	0.09053	0.036288
Cost per dose of drug/adult	0.4	0.4
Cost of adult treatment	0.64752	0.2904
Net benefit of program		
Value of animals in high acceptance level	165.7862	102.3483
Value of animals in low acceptance level	18.84893	20.07634
Total cost treatment	0.73805	0.326688
Net benefit/farmer	146.1992	81.94528

Thus there is a considerable opportunity for improving the value of the program to individual farmers by raising the percentage of animals they treat.

CONCLUSION

The control program Is a very cheap one for the farmer to carry out, and yields a very large benefit from his investment. It deserves much wider adoption, especially since the benfits accrue to all farmers, largely regardless of their herd size. Even making the very conservative assumptions of this analysis, the economic gain per farmer would be large enough to justify all farmers treating all of their animals. At present most cooperating farmers treat only a proportion of their animals, and they should be encouraged to treat all of them, since the gain to them is then greatly increased.

CHAPTER SEVEN

COST BENEFIT ANALYSIS OF THE PARASITE CONTROL PROGRAM

It has already been shown in Chapter Six that the benefit to the individual farmer from the program is large, and provides an excellent return for his investment. It is however necessary to look also at the costs and benefits to the community from providing this program, since there are community resources involved as well as those of individuals, mainly in the form of training costs for keymen and and promotion costs both to support the individual keymen and for the overall program.

In order to evaluate the wider aspects and to make an estimate of the benefit accruing to the community from providing this program, a benefit-cost analysis has been conducted for the six provinces which took part in the survey, since adequate data was available only for these provinces. The analysis could be extended without difficulty to the remaining provinces in the region, but conclusions about the profitability of the program can be drawn clearly from these six, since they include four in which the program is in operation and two in which it is not yet functional.

METHOD OF COST-BENEFIT CALCULATION

The cost benefit analysis was done using the data in Tables 6.8 to 6.10, which represent the situation for an average farmer from the survey group, owning the mean number of buffalo and cattle across the entire sample of farmers interviewed. All assumptions for the analysis have been standardised to remove differences between high and low acceptance farmers which could perhaps be due to differences other than their use of the control program. This is a very conservative approach, since it probably removes some differences that are partly or wholly due to the program, but it ensures that the figures given are minimum ones. In addition only 3 of the 7 categories of benefit from the program have been included, because accurate estimates could not be made for the other four.

It is therefore clear that the analysis is deliberately as conservative as possible, to ensure that it cannot be criticised as over-stating the gains to the community.

Statistics on the population of farmers who own buffalo in the six study provinces are difficult to obtain with any confidence. The number of farmers in each of the study provinces has therefore been calculated from the data in Appendix 1. For each province, the total number of buffalo has been divided by the mean number of buffalo per farmer in the survey, to estimate the number of farmers keeping buffalo in the province.

This has been used to estimate the number of farmers who would benefit from the program, and the expected benefit per farmer from Chapter 6 has then been multiplied by the number of farmers using the program in any particular analysis, to estimate the gross benefit of the program at provincial level, and across the six study provinces. It was assumed that the program currently has been accepted by about 50% of the farmers, based on the survey data which showed that 40% of the entire study population were in the "high acceptance" category, and also showed that some farmers carry out the program without qualifying for the "high acceptance" category since they buy the drug from the DLO rather than the keyman. It has therefore been assumed that continuation of the program much as at present can achieve a result where about 50% of farmers treat a high proportion of their buffalo calves (94%) but a low proportion of their cattle calves (9%). They also treat 53% of their adult buffalo and 33% of their adult cattle.

A calculation has then been made of the benefits of increasing this level of use of the program, considering two possible alternatives. The first is to intensify the program by training additional keymen and expanding the promotional effort, so that additional farmers begin to use the program. It is of course difficult to estimate the costs of achieving this, but it has been assumed that doubling the expenditure on keyman training and support in order to increase the number of keymen and their visibility in the community could raise the use

of the program to 60% of farmers. Doubling expenditure again could raise the level of use to 65%, because the principle of diminishing returns will begin to affect progress. It is however clear that at least 65% of farmers can be brought into the high acceptance category since that is the level (64%) in the high adoption areas, and it should be possible to raise all areas to the high adoption level of program acceptance simply by ensuring that all farmers have access to the equivalent of a "high adoption" keyman by increasing their numbers so that none have to serve more than 2 or 3 villages. All of these figures represent an estimate at the very high end of the range to achieve the particular objectives, but in the absence of specific evidence have been set at these levels to ensure that the true costs will almost certainly be lower, which will make the benefit to the community even higher than calculated.

The benefit for the community was calculated by taking into account the costs for training of the keymen and of supplying them with promotion material. The training cost for the period was US$2869 for initial training, plus $8092 for refresher training. Promotion costs were $8671, covering publicity media and associated expenses. The number of keymen covered by this expenditure was 1308, so the total cost was US $ 15 per keyman. They were multiplied by the number of keymen so far trained in each province. For Udorn Thani it was estimated from livestock numbers that 500 keymen would be required, and for Kalasin the estimate was 220 keymen. It has been assumed that similar costs would be incurred each year for additional publicity efforts plus refresher training of existing keymen. Each additional keyman would also cost $15. If anything, this figure is at the high end of the range, but can be taken as a maximum expected cost.

These calculations were done for the 6 provinces. The training and promotion costs would increase from currently totalling US $ 19620 to US $ 39240 for 60%, US $ 78480 for 70% and US $784,800 for an acceptance of 80%.

ECONOMIC BENEFIT OF THE PROGRAM FOR THE COMMUNITY

Table 7.1 shows the expected economic benefit of the program as it operates at present. This is taken to be an acceptance level of 50%, which yields a net benefit to the community of US$33.64 million. This is based on an estimate for a standard farmer, whose herd details are average for the study group. High acceptance farmers who adopt the program treat the percentage of their animals actually found in the field study. The base acceptance level of 50% is taken by counting all high acceptance farmers in the population (40%) and adding 10% adjustment. This takes account of the fact that some farmers and especially village headmen followed the recommended program but purchased their drugs from other sources, such as the DLO. It also adjusts for the fact that the study group was not a random sample of the population, but a selected sample of high and low adoption areas. Assuming that the mean acceptance level for the program across all keymen is likely to be better than midway between low and high adoption, it was considered that 50% acceptance was probably a balanced assessment of the current level of use of the program in the six provinces. However even if the true acceptance level is only 40%, the net benefit of the program across the six provinces is still $26.91 million, so the difference makes no difference to the overall assessment of the program. It is clearly a highly beneficial program for participating farmers, and for the community in the provinces as a whole, especially since the cost is extremely low.

Possible economic benefits of the program for the community by increasing the percentage of farmers who use the program

The analysis was carried out for the six study provinces, to extend the baseline result for the current level of use of the program to estimate the benefit of an increase in the percentage of farmers in the provinces who use the program, assuming new participants would treat the same proportion of their animals as existing users. The net benefit for the community of the six provinces would increase from US $33.64 m. to $40.35 m. for 60% using the program, $43.68 m. for 65% use (all areas using it at the present high adoption level), and $53.07 m. if 80% acceptance is achieved. Table 7.1 shows the costs and benefits of the program under these various assumptions.

Table 7.1 Benefit of The Base Program and Raised Farmer Acceptance

Gross Benefits	**Percentage acceptance by farmers**				**No. of farms**
	50%	**60%**	**65%**	**80%**	
Mahasarakam	4813280	5775936	6257274	7701248	67164
Surin	7573442	9088130	9845474	12117507	105679
Khon Kaen	7802410	9362892	10143133	12483856	108874
Loei	2907432	3488919	3779662	4651891	40570
Udorn	6600022	7920026	8580028	10560034	92096
Kalasin	3965201	4758242	5154762	6344322	55330
Total	33661787	40394144	43760323	53858859	469713
Cost of program					
Cost per keyman	(Training and promotion)			US$ 15	
MK	3270	6540	13080	130800	
SR	9330	18660	37320	373200	
KK	4680	9360	18720	187200	
LE	2340	4680	9360	93600	
UD	7500	15000	30000	300000	
KS	3300	6600	13200	132000	
Total	19620	39240	78480	784800	
Net benefit					
MK	4810010	5769396	6244184	7570448	
SR	7564112	9069470	9808154	11744307	
KK	7797730	935352	10124413	12296656	
LE	2905092	3484239	3770302	4558291	
UD	6592522	7905026	8550028	10260034	
KS	3961901	4751642	5141562	6212322	
Total	33642167	40354904	43681843	53074059	

Benefit of the Program If Participating Farmers Treat More of Their Animals

An analysis was also conducted to consider the implications across the six provinces if individual farmers treated a higher proportion of their animals, rather than the simple assumption that the level of use of the program by individuals cannot be altered, and that the only road to expansion is by increasing the number of farmers who participate.

Table 7.2 shows the situation when all animals owned by a participating famer are treated, and Table 7.3 shows the situation when 50% of those at present left untreated are treated. The proportion of animals previously untreated varies greatly between buffalo and cattle, and between calves and adults in each species, so for each of these categories the number treated for Table 7.3 is the mid-point between the number currently treated and the number owned.

Table 7.2. Benefit of the Program if All Eligible Animals are Treated

Gross Benefits	**Percentage acceptance by farmers**				**No. of farms**
	50%	**60%**	**65%**	**80%**	
Mahasarakam	10614784	12737740	13799219	16983654	67164
Surin	16701800	20042161	21712341	26722881	105679
Khon Kaen	17206747	20648097	22368771	27530795	198874
Loei	6411795	7694154	8335333	10258871	40570
Udorn	14555106	17466127	18921637	23288169	92096
Kalasin	8744506	10493407	11367857	13991209	55330
Total	74234737	89081685	96505159	119000000	469713
Cost of program					
Cost per keyman	(Training and promotion)			US$ 15	
MK	3270	6540	13080	130800	
SR	9330	18660	37320	373200	
KK	4680	9360	18720	187200	
LE	2340	4680	9360	93600	
UD	7500	1500	30000	300000	
Total	19620	329240	78480	784800	
Net benefit					
MK	10611514	12731200	13786139	16852854	
SR	16692470	20023501	21675021	26349681	
KK	17202067	20638737	22350051	27343595	
LE	6409455	7689474	8325973	10165271	
UD	14547606	17451127	18891637	22988169	
KS	8741206	10486807	11354657	13859209	
Total	74215117	89042445	96426679	118000000	

Table 7.3 Benefit of the Program If 50% More Eligible Animals Treated

Gross Benefits	Percentage acceptance by farmers				No. of farms
	50%	60%	65%	80%	
Mahasarakam	7661547	9193857	9960012	12258476	67164
Surin	12055039	14466047	15671551	19288063	105679
Khon Kaen	12419500	14903400	16145350	19871200	108874
Loei	4627910	5553493	6016284	7404657	40570
Udorn	10505596	12606716	13657275	16808954	92096
Kalasin	6311617	7573940	8205102	10098587	55330
Total	53581210	64297452	69655573	85729936	469713
Cost of program					
Cost per keyman	(Training and promotion)			US$ 15	
MK	3270	6540	13080	130800	
SR	9300	18661	37320	373200	
KK	4680	9360	18720	197200	
LE	2340	4680	9360	93600	
UD	7500	15000	30000	300000	
KS	3300	6600	13200	132000	
Total	19620	39240	78480	784800	
Net benefit					
MK	7658277	9187317	9946932	12127676	
SR	12045709	14447387	15634231	18914863	
KK	12414820	14894040	16126630	19684000	
LE	4625570	5548813	6006924	7311057	
UD	10498096	12591716	13627275	16508954	
KS	6308317	7567340	8191902	9966587	
Total	53561590	64258212	69577093	84945136	

It is notable from Tables 7.2 and 7.3 that the benefit to the community from increasing the percentage of animals treated by each current "high acceptance" farmer is greater than the benefit from increasing participation rate, although both are highly profitable. This assumes that there is no direct cost involved for additional promotion, since these farmers already use the program, but even if some costs are involved for the Government, it is still very worthwhile to increase drug useage by current high acceptance farmers. For example, the benefit in Table 7.2 and in Table 7.3 at 50% acceptance is larger than the benefit in Table 7.1 at 80% acceptance, with only the current number of animals treated per high acceptance farmer.

Table 7.4 Benefit of Program for Province

Gross Benefits	Percentage acceptance by farmers				No. of farms
	50%	60%	65%	80%	
Mahasarakam	7216132	8659358	9380971	11545810	67164
Surin	13055194	15666233	16971752	20888310	105679
Khon Kaen	10823538	12988245	14070599	17317661	108874
Loei	2324887	2789865	3022353	3719820	40570
Udorn	10955213	13146256	14241777	17528342	92096
Kalasin	5114371	6137245	6648682	8182993	55330
Total	49489335	59387202	64336135	79182936	469713
Cost of program					
Cost per keyman	(Training and promotion)			US$ 15	
MK	3270	6540	13080	130800	
SR	9330	18660	37320	373200	
KK	4680	9360	18720	187200	
LE	2340	4680	9360	93600	
UD	7500	15000	30000	300000	
KS	3300	6600	13200	132000	
Total	19620	39240	78480	784800	
Net benefit					
MK	7212862	8652818	9367891	11415010	
SR	13045864	15647573	16934432	20515110	
KK	15818858	12978885	14051879	17130461	
LE	2322547	2785185	3012993	3626220	
UD	10947713	13131256	14211777	17228342	
KS	5111071	6130645	6635482	8050993	
Total	49469715	59347962	64257655	78398136	

Table 7.4 shows the results for the special case where the data used for the analysis is that for the difference between actual high acceptance and low acceptance farmers in the field study. In other words, it calculates the benefit of additional farmers becoming high acceptance farmers, with the exact production results achieved by each acceptance group, before any corrections were made to them in Chapter 6 for the analysis described in Tables 7.1 to 7.3. As explained in Chapter 6, in order to avoid gving credit to the parasite control program for differences which were really differences between farmers rather than the effect of the program, the field results have been adjusted. However the figures in Table 7.4 are of some interest as an indication of overall differences in productivity between the two groups of farmers. They must not however be used to represent the specific benefits due to the program.

CHAPTER EIGHT

GENERAL DISCUSSION

INTRODUCTION

There have been very few previous studies of the adoption of animal health programs by Asian village farmers and the author is unaware of any previous published work which can be compared with this study. The discussion will therefore draw general conclusions concerning the effectiveness of the program and guidance for those who may wish to undertake similar work in the future. Where appropriate, comparisons will be made with other work in the published literature.

STUDY DESIGN

There are few precedents on how to evaluate the attitudes of village farmers to disease control programs. It was known from drug sale data that there was marked variation among keymen in the level of drug sales that they had achieved, but at the time this study commenced any views on the reason for this variation was purely conjecture. The study was therefore designed to evaluate these factors within a design which was feasible to carry out under Thai conditions. The practical problems of travel costs and difficulty of establishing a sampling frame dictated that a statistically valid sample of an entire province was not practical to achieve, and that it would be necessary to adopt a cluster sampling approach to make it feasible to complete successfully the three stages of sample selection, identification of members of the sample, and interviewing of these people.

It was therefore decided to forego the ability to directly extrapolate from the sample to the entire population and to concentrate on identifying the factors which determine the extent of use of the program by farmers. This could be achieved by doing a comparative study of farmers in areas served by keymen with high levels of drug sales (termed "high adoption areas") and areas served by keymen with low levels of drug sales (termed "low adoption areas"). The keyman areas were selected in cooperation with provincial staff who had sales data on program drugs and could identify keymen at the top and bottom ends of the sales range. As far as possible keymen were selected randomly from among those who met the selection criteria in the province. Within each selected keyman's area a sample group of farmers and village headmen were then chosen for interview. When the study was being designed it was not possible to state with any confidence whether the variation in program use within a keyman area would turn out to be completely random, or patchy depending on social linkages, or linearly dependent on distance from the keyman, which would imply that effort expended and travel difficulty were the dominant factors influencing the effectiveness of each keyman.

In order to avoid jumping to unsupported conclusions on this issue, in Phase 1 intensive sampling of 82 villages was undertaken in four keyman areas in Mahasarakam province, as described in Chapter 3 and Appendix 4. The results from this investigation showed that distance from the keyman's village was apparently the most important factor influencing program use, and that there was no strong evidence of patchy variation in distribution of program use or awareness. In view of this, the design was simplified for Phase 2 so that 2 farmers and a village headman were interviewed in each study village, and 3 villages were chosen for study per keyman area. These were the keyman's own village, a village less than 2 km from the keyman's village, and a village more than 2 km away. These locations were chosen in the light of Phase 1 findings, on the grounds that 2 km was beyond what could be considered easy travelling distance for the keyman under local conditions, and would require a special effort by the keyman if he were to reach a reasonable audience within such a distant village.

This geographical sampling plan was a simple one, but proved very informative, in that distance from his home village was clearly shown to be a major factor influencing the effectiveness

of keymen, as discussed below. Moreover there was evidence to confirm that the distance effect was real - for example it did not exist for knowledge of the video program, something which depended primarily on access to a television set rather than distance from the keyman. Thus it would appear that the technique of using a small sample of interviewees located at increasing distances from the source of animal health advice is quite adequate to determine the distance over which various types of information penetrates.

Within each village two farmers and the headman were interviewed. This is a small sample, but it was considered preferable to replicate the sampling over more areas rather than to increase the sample size within each village, since it was unnecessary to draw any conclusions about a village, but merely about a category of village, e.g. low adoption areas, more than 2 km from keyman village. The study results give no reason to think that this small sample rendered the findings unsatisfactory for achieving the study objective.

There was also some concern that headmen and DLOs who arranged the selection of farmers might consciously or unconsciously bias the sampling to include only farmers they knew to have been involved in the program. Information about the purpose for which interviews were to be conducted was kept deliberately vague so that headmen choosing farmers would not easily be able to choose sample members in any biased way, and instructions were issued to DLOs to sample randomly and to follow proper sampling procedure, but with such a small sample the risk of this occurring remained. However such biases should have shown up in the data as unexplained similarities - such as all chosen farmers in high adoption areas being users of the program. There were no results obtained in the study which support the existence of bias in the selection of sample members at the local level.

Another issue which was seen as a danger in the interviews was that farmers and particularly keymen might give answers that they thought would please the interviewer, rather than accurate answers. This problem occurs in all interview studies, but it was considered especially likely in this case because such surveys and contacts with Government officers are infrequent and therefore notable events, and because in Thai society it is important to provide a polite and satisfying answer to any questioner. Moreover, some questions concerned income, and there was some doubt about whether farmers would answer such questions honestly, in case the information might be used by the Government for tax purposes. Although it is not possible to rule out such factors influencing responses, in no case could evidence to support this be found. Further, wherever answers to different questions provided opportunities for cross-checking, results were consistent. The financial data was consistent both within the answers provided by single farmers, and across groups of similar individuals. As one simple example, it was expected that keymen would probably understate their income from working as a keyman, since they might feel that the survey provided an opportunity to increase payments. Questions were therefore asked which could permit cross-checking of this data, and it was in fact found that the keymen had overall mildly overstated their income from this source.

The final matter which took considerable time in the study was the design of the questionnaire itself. The questionnaire was designed and extensively refined in English, then had to be translated into Thai in a form which ensured that farmers would be providing exactly the information expected by the original question. This was checked as far as possible by having it reviewed by a group of people who speak both English and Thai, and then carrying out a pre-test of the Thai version in villages. After the first phase the questionnaire was again reviewed, to ensure that all questions would be asked in the most appropriate way to obtain valid answers. Answers obtained from farmers were recorded in Thai, then translated back into English for entry into the database program used for analysis. To simplify this process, much of the data was entered into the database in numerical form.

Questionnaire design is a difficult process under normal circumstances, and these added stages made it more of a challenge. However only one question was found where farmers appeared to have varied in their interpretation, and this related to their views being influenced by whether or not they used the parasite control program, not a difficulty with the wording of the questionnaire. Thus the design process for the questionnaire appears to have operated quite satisfactorily.

The other issue in questionnaire design was how to obtain information from farmers, many of whom have limited reading ability, about their level of knowledge concerning parasites, their epidemiology and control. The approach chosen was to take examples of the parasites and of the intermediate host snail to the interview, ask them to identify what the item was, and then to follow up with additional questions concerning the significance of the particular parasite. This group of

questions created no difficulty, and the answers produced consistent and sensible results when collated over the whole sample. Even more difficult was to find out from farmers whether they understood the concept of subclinical parasitism and the nature of subclinical disease on growth and production by their animals, plus the resultant need to treat animals for parasitism in the absence of clinical signs. These questions (principally 66 to 73) produced some inconsistency in results due to farmers not understanding the purpose of the question, but the results were more interpretable than might have been expected. It can be concluded that it is quite practical to carry out this kind of survey in a village population provided the questions are very carefully thought out first and pre-tested. However limits are reached where the interviewee has no concept of the point being sought by the questioner, and may give an answer which leaves uncertainty about the person's level of knowledge. Nevertheless, answers to even the most difficult sections of the questionnaire could be interpreted to give useful practical conclusions.

It is concluded therefore that the survey procedure was very successful in identifying factors influencing the success of the program, and that the technique justifies further use to investigate adoption of animal health programs in village agriculture.

FARMING ACTIVITIES

The "average" farming family studied in the villages comprised a head of household (male in 96% of cases) aged 46 years, with a family of 5.3 additional people. The family owned 5.6 hectares of land, 2.13 buffalo and 1.1 cattle, taking into account families who are involved in farming but do not own the particular species. Considering only families who actually own animals of a particular species, the number of buffalo owned by such a family is 3.0, and the number of cattle owned is 3.9. However 88% of farmers own buffalo and 30% own cattle, so the mean over the whole farming population is considerably lower. If worked out per family from the data supplied by the village headman, the mean number of buffalo per family is only 1.5, and the number of cattle is 0.7. This presumably reflects either the presence in the village of families who are not engaged in farming at all, or the fact that the farmers studied owned more than the average number of animals, or more likely a combination of the two.

There was a mean of 121 families per village in those studied. The average village contained 638 people, 181 buffalo and 86 cattle. The village population of both buffalo and cattle had remained virtually static from a year earlier, both across the entire sample and within each province studied.

Virtually all farmers in the sample considered rice-growing to be their principal activity, supplemented by growing other crops and raising livestock. Overall, cropping produced 71.3% of farm income, livestock raising produced 27% and off-farm work produced 1.6%. Total family income was 24,762 baht, equivalent to US$991. This represents a 48% increase in family income from the figure provided by Prapertchob et al (1983), without any adjustment for inflation. Interestingly, however, the proportion obtained from cropping and livestock have remained almost constant, since Prapertchob et al (1983) found that 69% of agricultural income came from crops and 31% from animals. This income data excludes food produced purely for family consumption. Rice is produced principally for home consumption, with only the surplus beyond family needs being sold. Some families also support relatives by providing rice without payment, so the bulk of rice production and consumption is outside the cash economy. However 59% of farmers produce other crops, almost all for cash income. Of these, tapioca and kenaf are by far the most widely grown. Very few farmers in the study (5%) have other jobs in addition to farming, and off-farm income amounts to only 1.6% of family income. Thus any improvement in the welfare of these farmers is more likely to come through improvement in farm income in the short term, rather than through substitution of off-farm employment. Opportunities for such employment are as limited in reality as they appear to the outsider to be. This is in contrast to most developed countries, where a rapidly growing proportion of farmers gain part of their incomes from off-farm employment.

Ninety four percent of farmers raise livestock for income. Within the livestock component of income (6720 baht, US$269), 60% came from buffalo trading, 28% from cattle trading, and 12% from trading in other livestock. This last item comprises mainly pigs and horses, since although almost every family owns poultry, birds are used solely for home consumption, and almost no trading takes place. Therefore income data underestimates the contribution of poultry to family welfare in comparison with that of buffalo and cattle. Cash costs of livestock production are small, the most important single expenditure being rope for nose ropes to lead buffalo to grazing areas and tie them

up when restraint is required. Total annual expenditure on buffalo and cattle for the study year was 110 baht (US$4.4), so it should be noted that even at a minimal cost of 7 to 11 baht per dose, a farmer could very easily double his total expenditure on animal care by following the recommendations of the parasite control program. Although the costs would still be very low, they do represent a major change in thinking by the farmer, to begin to think in terms of investing in animal care, rather than simply managing the animals within existing resources.

One of the potential benefits of the parasite control program is that it reduces deaths and makes adult buffalo fitter for work by reducing their liver fluke burden. Farmers cannot work their rice paddies without buffalo (or the much more expensive hand tractor known as an iron buffalo). Hence a farmer who does not have adult buffalo in a fit state to work land must rent them from others. Among the study farmers, 9% had hired buffalo in the last year -mostly either because they owned no buffalo (47%) or did not have enough buffalo capable of working (34%). Buffalo were usually hired for 2 to 6 months, and hiring cost for 3 months was reported by those who hired buffalo to average 1,005 baht (US$40). This is a very high cost, half the price of buying a buffalo at 12 months of age. Thus the parasite control program has a valuable role to play in protecting the poorest farmers from losing animals due to parasitism, so that they do not get caught without animals and have to pay high rental charges.

HEALTH PROBLEMS IN BUFFALO AND CATTLE

There was good agreement between farmers and keymen about the health problems of greatest importance in their animals. In calves, the most important disease in the eyes of the farmers was internal parasitism, both as a cause of death and as a cause of non-fatal disease. Malnutrition was second in both categories of disease, and non-specific diarrhoea was third. Some of this diarrhoea may be due to parasitism, but the remainder is presumably mainly due to bacterial, viral and protozoal diseases. The causes of these diarrhoeas deserves further investigation, since simple treatments may well reduce the syndrome considerably. Farmers provided a number of other diseases as causes of death, but no other single disease was mentioned commonly. Among non-fatal diseases, depression due to unidentified cause and skin disease were the other conditions mentioned commonly.

Thus farmers agree with the veterinary service (Bhannasiri, 1970; Rufener, 1971) that parasitism is the single most important disease of calves. Malnutrition is also very important, and is probably linked in some cases to parasitism. Non-specific diarrhoea and skin disease justify further investigation as conditions considered to be important by farmers, and for which simple cheap treatments could probably be provided.

In adult animals, hepatic damage (principally due to liver fluke) was mentioned by 57% of farmers as an important cause of death in adults, with bloat (due to ingestion of tapioca) and food poisoning ranked equal second. Foot-and-mouth disease was the most commonly mentioned non-fatal disease of adults, followed by stiffness (nutritional myopathy) and lameness equal second. Skin disease was the other widely mentioned condition of adults.

Therefore farmers also agree with the veterinary service that liver fluke is a very important disease of adult animals. The other diseases mentioned are all ones for which some form of treatment or prevention could be provided either through the keyman or in conjunction with him, so there is scope for expansion of the Basic Animal Health Service into other diseases, and farmers would support the need for measures against the ones listed. The views of farmers on the relative importance of various diseases is not guesswork, since they take considerable interest in the subject, and 94% have opened animals which died to investigate the cause of death.

FARMER ACCEPTANCE OF THE PARASITE CONTROL PROGRAM

The central objective of the study was to determine the extent to which farmers in the villages had become aware of the program, understood how to take advantage of it, and in practice did follow its recommendations. This could of course not be asked directly, so a series of questions was asked to clarify these points for each farmer. The information obtained was then combined into a measure called "program acceptance". Low acceptance farmers did not know about or understand the program, and did not know of the keyman or his role. Medium acceptance farmers understood either

the program and its relevance to their animals, or the keyman and the fact that he could supply drugs for parasite control to them. However they had not treated any animals with drugs supplied by the keyman during the year prior to the interview. High acceptance farmers both understood the program and had bought drugs from the keyman during the previous year. Over the whole farmer sample, 40% were classified as high acceptance farmers. However this differed greatly between high and low adoption areas, with 64% of farmers in high adoption areas being in this category but only 16% of those in low adoption areas. From the analysis of other questions it would also appear that the criterion used, while appropriate to the purpose of the study, underestimated the percentage of farmers who use the parasite control system as distinct from the services of the keyman. It would appear that a significant proportion of interviewees treated their animals with effective drugs, but obtained them either from the DLO or from a local chemist rather than from the keyman.

Given that the program has only been in operation for either one or three years in the areas studied, the levels of use of the control procedures must be regarded as quite exceptional. It would normally be expected in a developed country that adoption of any innovation similar in nature to the parasite control program would occur gradually over about ten years, with quite slow acceptance over the first three years and rapid growth from about years three to eight (Rogers and Shoemaker, 1971). In these villages the barriers to adoption which exist in a developed country will all be present, presumably to at least as great an extent. In addition there are problems of lower literacy and education levels among farmers, communication and transport difficulties, lower levels of official veterinary services to support the village programs, and very small incentives for the keymen to carry out their duties. Viewed against any standard for adoption of a technical innovation, the results achieved so far by the program are very good, and demonstrate that farmers in the area understand that they have a problem with their animals and are very responsive to efforts to help them.

FARMER KNOWLEDGE CONCERNING PARASITISM

Despite the difficulties involved in formulating suitable questions on this issue, the responses from farmers were very informative. It is clear that the farmers are very careful observers and are well aware of matters where observation alone can provide the necessary information. Thus a high proportion of farmers recognized Toxocara vitulorum and Fasciola gigantica, plus the intermediate host snail for the liver fluke. Most also knew where each of the three was located. This knowledge was not influenced noticeably by the operation of the parasite control program (knowledge levels were in fact highest in non-program provinces), but appeared to be determined principally by whether or not the animal being shown to them occurred in their immediate environment.

In sharp contrast, basic knowledge of the epidemiology of the parasites was very limited - clearly because this information could not be gained by observation alone, and depended on educational activities offered by people with training and some degree of scientific understanding. In the non-program provinces not one farmer understood either the transmission of Toxocara or the role of the snail in the epidemiology of liver fluke. The level of knowledge was higher in program provinces, but still less than 10% could accurately answer this question. The level of knowledge of farmers appears to be dependent on the effectiveness of the keyman and extension efforts associated with his work, since knowledge of transmission of Toxocara, for example, was 12.3% for farmers in high adoption keyman areas, and only 1.7% in low adoption areas. Moreover level of knowledge depended heavily on distance from the keyman's village, and the fall-off in percent of farmers able to explain epidemiological points with distance from the keyman's village was much more marked for low adoption areas than high adoption ones. Thus it appears that the farmer self-help worm control program is the factor which has raised the level of knowledge on these points, but that lack of this knowledge has not prevented farmers from accepting and using the program.

The other major area of farmer knowledge investigated was their understanding of the effects of parasitism on animals. Close to 90% of all farmers interviewed could accurately describe the effects of parasitism on calves, with a slightly higher percentage of high acceptance farmers accurately describing the effects than medium and low acceptance farmers. Ninety one percent of farmers believed that they could recognize parasitised animals by their clinical signs. They were then asked if most animals have worms in them, or only some. This question was intended to clarify whether the farmers recognize the existence of subclinical parasitism, without leading them to the "right" answer. However it produced a surprising response, in that far fewer (35%) high acceptance farmers believed that all animals were parasitised than did medium (46%) or low (55%) acceptance farmers, and the differences were statistically significant. At first sight it might appear that high acceptance farmers had

the poorest comprehension of subclinical parasitism. This may be true, but on re-evaluating the question another interpretation which would be more consistent with other responses is that high acceptance farmers believe their animals are not parasitised because they have treated them and consider they have removed the parasites, whereas the other farmers recognize that parasitism is widespread in their animals because in many cases they have not treated them. The question may not have therefore produced the desired information, and probably cannot be interpreted reliably.

High acceptance farmers certainly appeared more likely to believe that preventive methods were necessary for parasitism, because 50% of them routinely take preventive measures to prevent their calves becoming ill with worms, whereas the levels were much lower for medium (21%) and low (12%) acceptance farmers. Of the high acceptance farmers who took preventive measures, 95% followed the recommended program as a preventive approach. Farmers were also asked if they considered it worthwhile to give anthelmintic to calves which have worms but appear healthy. Fifty one percent of high acceptance farmers would treat such an animal, compared with 16% of medium acceptance and 17% of low acceptance farmers.

Overall it would appear that understanding of the epidemiology of parasitism and of the universal distribution of parasites is still limited among farmers in the study area, but that high acceptance farmers have a rather higher level of understanding than the others. This level of knowledge is clearly derived principally from their contacts with their keyman, although many of the farmers who use the program do so without understanding the epidemiological principles involved. There remains a substantial task for the keymen and staff of the DLD to increase the extension effort. However at least progress is being made in the program provinces, whereas in provinces not yet reached by the program existing extension services have not succeeded in establishing understanding of parasitism, which farmers agree is the most important disease problem affecting their animals.

SOURCES OF ADVICE ON DISEASE TREATMENT

Enquiries were also made on the action which farmers would have taken five years earlier if one of their animals had become ill, and the action they would take now. If their stated approach had changed, they were asked the reason for the change. Before the parasite control program commenced, the majority of farmers used "traditional" treatments for sick animals, which were those commonly recommended in the village, not those recommended by the veterinary service. They might be herbal remedies, antibiotic or vitamin injections obtained from unofficial sources, or various "popular" forms of treatment - but excluding the products recommended for treatment of the particular disease by the veterinary service. Only 20 to 30% of farmers, depending on the sub-group among interviewees and the nature of the problem, would have gone to a technically knowledgeable source for assistance, such as the DLO or the chemist.

When farmers were asked what source of advice they would now use, 40% of farmers in program provinces would now go to the keyman, 30 to 40% to the DLO, and 8 to 22% to the chemist, depending on the duration of the program. Thus about 90% overall would now go to a technically knowledgeable source, compared with less than 30% previously. Even in non-program provinces about 80% of farmers said they would go to one of the technically knowledgeable sources, in this case the DLO or the chemist. The DLO appears to have gained recognition among farmers over recent years, if these figures are valid. It is always difficult to ask someone what they "would have done five years ago" if faced with a particular problem, but their answers seem broadly reasonable.

When looked at by current acceptance level for the program, 93% of high acceptance farmers would now use the keyman or another representative of the official veterinary service, compared with 5% five years ago. For medium acceptance farmers, the figure has risen from 10% to 85%, while for low acceptance farmers it has gone from 16% to 56%. Low acceptance farmers were more likely to go to a chemist for advice both five years ago (22%) and now (19%), and this may account for some of the low acceptance farmers not making use of the keyman. However most of these farmers simply do not take measures to deal with parasitism.

Overall, farmers views as expressed to the interviewer show a marked change over five years - from predominant use of traditional treatment methods based on information obtained within the village to predominant use of advice from the official veterinary service, including its village representative, the keyman. There is now a much better foundation to build animal health programs

in the village, using the parasite control program as a starting point. Farmers are more aware of sources of trained advice, and if they have an effective keyman a substantial proportion of farmers adopt the program. The DLO is seen by farmers as a source of advice, but in general appears not to have been effective as a source of information about parasite control to farmers. The keyman has been more effective in this role.

It would seem worthwhile to encourage DLO's to work in close cooperation with keymen in providing extension services to farmers, and to put maximum effort into training enough keymen rather than attempting single-handed to undertake direct extension efforts with the villagers. This will be a much more effective use of their time and will provide a greater benefit to the village farmers. Consideration should also be given to involving local chemists in disease control by providing training to them in the epidemiology and control of parasitism, if possible through the DLO's. Since they are a significant source of advice, particularly to farmers who do not make use of the keyman, it would be valuable to ensure that they are giving accurate advice. Consideration should also be given to the role of the village headman. At present most headmen know about the program, but 47% of headmen obtain drugs to treat parasitism direct from the DLO, whereas only 26% of other farmers go direct to the DLO. This probably reflects the fact that the headman is more likely to know the DLO, and also the fact that drugs may be available from him on better terms than they are from the keyman. It may be desirable to strengthen the links between the headman and the keyman, so that the headman can be fully supportive of the work of the keyman. This issue requires investigation as part of the review of the administration of the program.

Another side-effect of the fact that headmen buy their drugs higher up the marketing chain is that they do not meet the definition of a "high acceptance" farmer, which required purchase of drugs from the keyman. Since headmen were over-represented in the sample of farmers because of the sampling plan chosen, the figures for "high acceptance" farmers are biased low by the headmen bypassing the keyman in obtaining their drugs. Program adoption is therefore higher in reality than the figure calculated by the method used.

EFFECTIVENESS OF KEYMEN

Farmers were asked questions to determine their views on the effectiveness of the keyman serving their area in fulfilling his responsibilities. High acceptance farmers were clearly much more aware of the keyman's activities than were medium acceptance farmers, even though they both lived in the same village. For example, 90% of high acceptance farmers said the keyman had talked to other people in their village about the program, whereas the figure for medium acceptance farmers was only 50%. Among high acceptance farmers 79% believed the keyman gave good advice and 84% followed his advice, but the figures for medium acceptance farmers were 14% and 3% respectively. Low acceptance farmers, of course, were unaware of the keyman's activity entirely. Farmers who had not used the keyman were asked for reasons, and these almost all related to the fact that they had not seen a need to do so, because they did not own any animals which would require treatment, or did not consider their animals needed treatment because they had not been ill. Reluctance in principle to use the keyman or to participate in a program of this type was rare. The cost of purchasing drugs was also not seen as a factor reducing useage of the program (although farmers quite commonly pay for drugs with rice or similar bartered goods rather than cash). Medium acceptance farmers were much more likely than high acceptance farmers to consider the keyman too busy with other activities to carry out his functions as a keyman. Only a small proportion of farmers considered that there were problems in obtaining drug supplies. Among these, difficulty of contact between the farmer and the keyman (due mainly to distance) was the most important factor involved.

When the issue of keyman effectiveness was examined separately for high and low adoption areas, the main factors determining keyman effectiveness became clear. Seventy percent or more of farmers in high adoption areas knew about the program regardless of whether they lived in the same village as the keyman or more than 2 km away, and there was only a moderate reduction in the percentage of farmers aware of the program as distance from the keyman increased. In contrast, whereas 77% of farmers living in the same village as a low adoption keyman knew about the program and 83% knew of the keyman as the local representative of the program, the figures dropped dramatically as distance from the keyman's village increased. Less than 20% of farmers in villages more than 2 km from a low adoption keyman knew about the program or about the keyman and his role. Whereas 84% of farmers in high adoption areas had seen the keyman visiting their village to carry out his functions during the previous year, only 32% of farmers in low adoption areas had seen

their keyman. The ratio was similar for other measures of keyman activity.

With regard to drug purchases, the high adoption keymen had sold drugs to 64% of respondents in their areas, compared with 16% for farmers in low adoption areas. When farmers were asked to describe the advice on parasite control which the keyman had given them, 65% of farmers in high adoption areas were able to restate the same instructions originally given to the keymen at their training session, whereas only 37% of farmers in low adoption areas could do so. In high adoption areas 56% had followed the recommendations of the keyman, whereas only 14% had done so in low adoption areas. Of those who had not done so, 46% of the farmers in low adoption areas had not taken action because of insufficient information, whereas this explanation accounted for only 11% of farmers in high adoption areas who had not taken the advice. In relation to ease of obtaining drug supplies, in high adoption areas no farmers living in the same village as a keyman had any difficulty and less than 20% of more distant farmers reported any problem, whereas over double the percentage of farmers in low adoption areas at each distance from the keyman's village reported problems in obtaining supplies compared with their counterparts in high adoption areas. The accuracy with which the program recommendations concerning time of administration and dose rates of drugs were followed by farmers in the two types of areas was also analysed, for those farmers who had treated animals during the previous year. Accuracy was similar between high and low adoption areas for farmers in the same village as the keyman, but fell off rapidly with increasing distance from the keyman's village in low adoption areas. In high adoption areas there was no clear trend to lower accuracy in more distant villages.

The explanation of these marked differences in the effectiveness of the different keymen was largely given by the keymen themselves in their interviews. Whereas 100% of high adoption keymen reported visiting other villages and had visited an average of 8 villages during the previous year, only 25% of low adoption keymen had visited other villages and the mean number of villages visited was one. Similarly, high adoption keymen had spent an average of 38 days promoting the program during the previous year, compared with 7 days for low adoption keymen.

The high adoption keymen had put most of this extra effort into speaking at village meetings and directly with individual farmers, especially in the more distant villages of their area, although they had also made more use of posters to promote the program.

High adoption keymen were also more likely to have kept program records as requested, and (as expected because of the criterion for selection) had sold 4 to 10 times as many doses of anthelmintic as the low adoption keymen. High adoption keymen also had a much smaller margin between drugs obtained from the program and drugs sold, which is an advantage for the management of the revolving fund on which the program depends.

The retention of knowledge given to the keymen concerning parasite control at their training course was much higher among high adoption keymen, with 100% of them able to accurately answer four questions on the central features of epidemiology and control of parasitism. Accurate answers were given by only 38 to 50% of low adoption keymen, depending on the question.

Keymen in low adoption areas were more likely to see negative attitudes to the program among farmers in their own and other villages, and to see farmers as disinterested in the program. High adoption keymen saw their farmers as supportive of the program, although some would prefer the drugs to be free.

Of the farmers who had changed their parasite control practices from those used five years earlier, most were high acceptance farmers. The keyman was clearly the major influence on this change of practice, whereas for medium acceptance farmers the keyman and the DLO were equally influential. The keyman could not influence low acceptance farmers since they did not know of his work.

VIEWS OF THE KEYMAN ON THE PROGRAM

The 16 keymen studied appeared to be typical farmers in most respects, although they were clearly people who were heavily involved in community affairs since they acted as representatives of various other official programs in the village. As discussed above, there was a very clear difference between high adoption areas and low adoption areas with respect to the level of effort the keymen

put into the program, and this appeared to be the factor which largely determined the extent to which the program was adopted by farmers. Other factors which had been thought might vary between high and low adoption areas and influence how receptive farmers were in each local area (such as relative interest in crops and animals, cash income available to buy drugs, etc.), appeared unimportant in the eyes of both farmers and keymen. If the keyman was active in promoting the program in the area, acceptance was high and attitudes of farmers were positive. Farmers in low adoption areas were unaware of the program, rather than unwilling to change their practices or pay for drugs.

What is particularly notable in the findings concerning the keymen however is the amount of work they were willing to do for the program for a very small income. They receive 13% of the retail price of each of the drugs, and high adoption keymen reported an annual income from keyman duties of 648 baht (US$26). Low adoption keymen reported an income of 126 baht (US$5). An analysis of actual drug sales shows that these figures if anything slightly overestimate actual income, because the income for high adoption keymen calculated by this method comes to 612 baht (US$24.5), while the equivalent figure for low adoption keymen is 24 baht (US$1). Across the sample of keymen, their drug sales account for 2.1% of income. It is quite remarkable that high adoption keymen are willing to spend 38 days per year to earn such a small amount, even before subtracting costs such as motorcycle travel expenses. It would appear that keymen are acting more out of a sense of responsibility to their community than from a profit motive, and there is a clear need to reward keymen more effectively for their considerable efforts. Not surprisingly, a majority of keymen considered that the markup percentage they receive on drugs should be increased (and some have increased it slightly).

They have to cope with various complaints where animal deaths are attributed to the use of program drugs, although most of these are likely to be animals which were treated when they were already moribund. However it seems unreasonable that keymen should have to deal with such problems, especially when they receive such a small return on their effort. It would appear best for the DLO to investigate such complaints, and for DLOs to have access to methods of resolving such conflicts so that they do not harm the overall success of the program.

From the viewpoint of the keyman, the program appears to operate smoothly at the local level, and they had few complaints. High adoption keymen would like the range of drugs to be increased, so that they can assist with a wider variety of disease problems. Almost all keymen thought that the number of keymen in their area should be increased, because there was more work in the program than they could adequately handle. Because of variation in animal density there is already large variation in the number of animals under the care of a single keyman, as distinct from the number of farmers. It appears that keyman density should be increased, and that the increase should be greatest in areas of high livestock density.

PROGRAM PUBLICITY

It is clear that the single most effective form of promotion for the program is the keyman himself, if he is active in visiting villages and undertaking education programs. The second most effective publicity mechanism is the use of posters on display in the villages. Farmers are much more aware of these than they are of more expensive alternatives, such as leaflets. Videotapes either on television or at local showings are of value in sensitising farmers to the existence and nature of the program, but require follow-up by the keyman if they are to change the practices of farmers.

For the future, the leaflets should be discontinued and replaced by a wider range of posters, which can be changed from time to time to create new interest in the program. An increase in the density of keymen would provide the most powerful method of further increasing publicity, together with an expanded refresher training program to ensure that all keymen are giving accurate advice and are prompted to continue their program efforts.

BENEFITS OF THE PROGRAM TO THE INDIVIDUAL FARMER

Farmers who have used the recommended treatment program have very positive views on its benefits. Farmers who have treated calves believe that the animals gain a substantial benefit in improved condition and appetite, and that treatment saves calves which would otherwise have died. This is supported by evidence on death rates, which show that low acceptance farmers lost 32% of buffalo calves and 19% of cattle calves within the first twelve months of life, whereas the comparable

figures for high acceptance farmers were 19% and 7%.

Among adult animals treated for liver fluke, virtually all show improved condition and body weight gain. About 20% considered that their animals also worked better in rice paddy preparation and other tasks after treatment. Although treatment probably also lowers the death rate of adults, the size of the sample was not sufficient to gain an accurate assessment of this effect in the study, especially bearing in mind that the study relied on retrospective farmer diagnosis.

Farmers were asked about the effect these various benefits would have on the market price obtained for animals they sold. Eighty one adults had been sold after fluke treatment, and the price margin which farmers attributed to treatment was 1811 baht (US$72.4) in low adoption areas and 1112 baht (US$44.5) in high adoption areas. This represents a substantial increase in value, and for the analysis untreated animals have been valued at US$182.21, with treated animals being valued at US$270.82, an increase of 49%.

The birth rate of calves was also different between high and low adoption farmers, being 56% for buffalo and 61% for cattle among high acceptance farmers, compared with 41% and 52% among low acceptance farmers. Both liver fluke (Hope-Cawdery, 1976) and gastrointestinal nematodes (Murray et al, 1971) have been shown experimentally to influence reproductive performance in sheep, presumably by influencing the metabolic state of the animal. There is no evidence on the matter as far as cattle and buffalo are concerned, but the same principles are likely to hold. This difference may therefore be attributed at least in part to the effect of treatment, although it is not possible to remove the effect of high acceptance farmers also adopting other beneficial practices. To make the economic analysis as conservative as possible, this benefit has been disregarded in the main economic study, even though there is probably a genuine benefit from the program. Other potential gains, such as reduced need for renting of buffalo, manure production, and longer herd life have also been left out of the analysis solely because they are more difficult to document and the aim was to put a minimum guaranteed value on the benefit. The true benefit is likely to be much larger than the calculated figures.

When the actual data for each farmer (including the difference in calving rate) is used in the economic analysis, the net benefit to a buffalo-owning farmer is US$152 and that to a cattle-owning farmer is US$151. Since 88% of farmers keep buffalo and 32% keep cattle, the benefit to the "average" farmer in the study will be approximately $170. The cost to the farmer of achieving this gain will be about $0.85. This represents an enormous return for a very small investment, and there is no need to conduct a sensitivity analysis to confirm the reliability of the results, because the margin of profit is so large that no likely error in any of the components of the analysis would eliminate the profit.

Even when the difference in calving rate is removed from the analysis and the difference in herd size at the beginning of the year is eliminated by using a mean herd size, the benefit remains virtually unchanged.

In a further analysis, all figures were standardised to represent the "average farmer" in the entire survey group, including an allowance for farmers who did not own any animals at the time of the study. The only benefits of the program which were included were those based on hard evidence, namely the effect on calf survival during the previous year and the effect on the market value of adult treated animals, based on actual sale data.

The calculated benefit under these very restrictive assumptions is lower, but still provides an enormous return on investment. For an investment of $0.69, the farmer gains a net return of $103 from buffalo and $40 from cattle, $143 in total. The benefit-cost ratio of this is 209:1, with a 20,000% return on investment under these very conservative assumptions! The program is therefore of great benefit to farmers, and appears to benefit both large and small farmers equally (in contrast to many technical improvements in village agriculture).

There is a notable contrast between the benefit to the farmer and the benefit to the keyman, who makes only US$0.70 per day spent working for the program. At least the keymen should make a reasonable return out of treating their own animals.

Although the benefits of the program as currently used by farmers are very large, they are nevertheless substantially smaller than could be achieved, because few farmers treat all eligible animals. A higher proportion of buffalo than cattle receive treatment, so if all eligible animals are

treated the benefit for the farmer's buffalo herd rises from $103 to $191, while for the cattle herd the increase is from $40 to $124. Thus the total benefit to the typical farmer would then become $315. If only 50% of the eligible but untreated animals are treated the respective incomes from buffalo and cattle are $146 and $82, making a total of $228.

These figures appear large, and of course will only be obtained as cash if the farmer sells the animals (which he may well not want to do immediately in many cases). Nevertheless, they are based directly on measurement from the surveyed farmers, plus figures they gave derived from actual experience, and even if the gain is not turned into cash it will represent an increase in the livestock inventory (number of animals multiplied by value) of the owner, which amounts to an increase in "animal bank" holdings, often preferred by such farmers over cash.

BENEFIT OF THE PROGRAM TO THE STUDY REGION

Implementation of the program incurs costs for training of keymen and promotion of the program, and for the costs of distributing the drugs and maintaining the revolving fund. These are paid by a combination of Government and aid funds.

Therefore in evaluating the community benefit obtained from the program, account must be taken of these "public" costs as well as the private costs to each farmer. Based on the known costs of training and promotion for the four program provinces included in the study, the cost per keyman was estimated at US$15. The cost of providing drugs and maintaining the revolving fund are included in the price charged to the farmer for the drugs, so this was not treated separately. The program is therefore a very cheap one to operate, and as a result the community benefit is very large. This has been calculated for the six provinces which were studied, since estimates of each of the components required for a cost-benefit analysis could be estimated from the survey findings or from official statistics and DLD records. Although the farmers interviewed did not represent a random sample of the population, they do provide an accurate comparison of areas with high or low program effectiveness, and the demographic data on matters such as numbers of animals owned should be an adequate approximation to the true figure since the sample size was quite large and variation in herd size among farmers is not as great as it is in many countries.

Based on these assumptions, the benefit across the six provinces from the program at its current degree of acceptance by farmers was estimated at US$33.64 million. This assumes that 50% of farmers use the program, and that they all treat the same proportion of their animals as did the farmers in the survey population. The figure of 50% acceptance used the fact that over the whole survey population 40% of farmers had purchased drugs for treatment of their animals from their local keyman in the year prior to the survey, and that additional farmers (and especially village headmen) had purchased drugs from the DLO and carried out the program. This figure could not be estimated precisely, but it was considered that it might be of the order of 5 to 10%. In addition, for the purposes of the study only high and low adoption areas at the two extremes of the range were chosen for investigation. The adoption figures are therefore based on a mean of the two extremes rather than a mean for the population overall. Most keyman areas of course will lie between these two extremes, and it is likely that the majority will fall above the midpoint of the range because the low adoption area keymen were chosen as the least effective, and few keymen fall at this low end of the range. On these two grounds it was considered that 50% rather than 40% was an appropriate estimate of current program acceptance. However even if the true figure is 40%, analysis showed only a modest reduction in the benefit of the program to $26.91 million, still a very large return on the investment.

In Chapter 5 various possible ways of further improving the program and its acceptance by farmers were considered. The data from the survey allowed the potential economic benefit of some of these changes to be considered.

It was known from the survey that the highly effective keymen studied had achieved an acceptance rate of 65% among farmers in their areas, so clearly this was possible to achieve more widely by ensuring that all farmers had access to keymen of this quality. This can be achieved by increasing the density of keymen and hence the competition among them, by improving their motivation through raising the return they get for their efforts, and by increasing the promotional effort undertaken to support the keymen.

The cost of doing this could not be estimated from any direct data, so some reasonable

assumptions were made about the cost of achieving these gains. Since additional gains would become increasingly difficult to obtain, it was assumed for the analysis that an increase in acceptance level from 50% to 60% would require that the expenditure on the program be doubled, and that a further doubling of expenditure would achieve 65% acceptance. This would cover training costs for additional keymen to halve in each case the number of villages covered by a single keyman, and would also pay for extra promotional effort beyond that already in place. It was considered unlikely that an acceptance level of over 80% could be achieved regardless of the effort expended, so this was the maximum acceptance level considered. Since it required that the acceptance level exceed those achieved at present by even the best keymen, the assumption was made that it would require most of the improvements described in Chapter 5, and would be quite expensive. The cost was therefore estimated at ten times that required to achieve 65% acceptance.

Despite these high estimates of the extra costs, the net benefit to the community from the program continues increasing as acceptance rate rises, to a maximum of $53.1 million at 80% acceptance. The benefits are so large that the cost of achieving them is of very minor importance in determining the return. It is therefore unimportant to decide whether the costs of the increased effort have been accurately estimated, since they are so small relative to the net benefit that a change in the cost will have negligible effect on the outcome. Formal sensitivity analysis was therefore not conducted on the results, since it was clear from the analysis that the net benefit was not sensitive to errors in any of the major factors going into the analysis, especially those which had to be estimated subjectively.

There are two ways of increasing use of the program - by increasing the number of farmers who participate, and by convincing participating farmers to treat more of their animals. The results from Chapter 6 for the effects of increasing the proportion of animals treated by participating farmers were therefore built into the benefit-cost analysis. If participating farmers can be persuaded without additional program cost to treat more of their animals, the net benefit from this change is higher, even at the current 50% acceptance level, than the benefit of raising the acceptance level to 80%.

In other words, if keymen convince just the farmers who cooperate in the program at present to treat at least 50% of the animals which are at present left untreated, the gain to the community is greater than from raising the percentage of farmers who cooperate. It should also be much easier to achieve. Even if a substantial cost for achieving this improvement is included, the results will still be similar. The goal of spreading the benefit as widely as possible across the community would however not be met, and clearly there is a need to involve additional farmers in the program. What the findings do show, however, is that keymen should be encouraged to work more intensively with their existing cooperators as well as expanding the scope of their work.

If the goal of persuading 80% of farmers to treat all of their animals was achieved, the net benefit of the program would rise from the present $33.6 million to $118 million, for a total investment of approximately $1 million, shared about equally by the farmers and the Government. This clearly is highly beneficial to the community of the region, yet requires far smaller public expenditure than most development programs. The calculated figures also exclude a number of the likely benefits of the program which could not be documented firmly enough to be included. The figures are therefore minimum estimates which probably understate the true benefit substantially.

The findings are consistent with those from a variety of other economic studies, which have shown that the economic benefit from most forms of disease control are unusually large, and that this is particularly true in developing countries where there is serious under-investment in animal disease control, compared with the importance of animals in the farming system (Ellis and James, 1979a; Morris and Meek, 1980; Morris, 1984c). Morris (1986b) has analysed the reasons for this very high return, and has shown that it is due principally to the fact that diseases alter the efficiency with which animals convert feed into useable products and services (such as draught power), so that controlling disease will commonly increase the efficiency with which a variety of other resources are used. Hence the measured profitability of disease control will be high. While there have been various studies which have shown high benefits to the national economy from animal disease control programs, this study is somewhat unusual in that all of the basic data used has been derived directly from village farmers, so that it represents as closely as possible their economic viewpoint on the profitability of the program.

REASONS FOR THE SUCCESS OF THE PROGRAM

By any method of assessment, this must be regarded as a very successful program. Within as little as one year after its introduction, there had been a major change in the approach used to parasite control by village farmers, achieving an average of 40% of farmers across the entire sample using the services of the village keyman and treating animals in their herds. In areas with highly effective keymen use of the program was at least 65%, with the true figure probably being about 75% when adjustment is made for sources of drugs other than the village keyman. Farmers had also changed substantially the sources to whom they went for advice concerning animal health matters, and were now far more likely to consult a source with some technical training in the field (and with access to additional technical data) than they had been five years earlier. This change in thinking and practices has occurred at a much faster rate than has commonly been reported in examinations of the adoption of innovative farming practices (Rogers and Shoemaker, 1971).

Yet the general view is that changes in practices are much more difficult to achieve in a traditional and very culturally stable community such as that of north-east Thailand. For a number of reasons it is considered difficult to change farming practices under these circumstances.

The production system which has evolved over a very long time achieves the goal of maintaining a stable supply of staple foods despite fluctuations in weather and other factors, and an important factor in this stability is the inter-connected nature of the various enterprises undertaken by the village farmer. It is thus risky to try to change one factor in the system because it may adversely affect some other component of the system. As DeBoer and Welsch (1978) state "The analysis of bovine production in [a particular village in north-east Thailand] has indicated that it is difficult to alter one part of the interrelated crop-bovine production system without changing other parts. Hence increases in bovine output from Thai villages will depend on changes in both crop technology and bovine production technology. Changes in only one area are not likely to be enough." They later go on to draw various conclusions, including one that "Communal grazing also makes investment in improved animal health measures irrational for the individual farmer. A village or regional approach is required." Linked to this issue of the integrated production system is the risk that controlling parasitism and hence saving animals which would otherwise have died may cause subsequent feed shortages, potentially eliminating much of the benefit of the parasite control program.

In seeking to introduce an innovation to village farmers in north-east Thailand, it is also essential to introduce them in a way which is compatible with the culture of the region. Even between the north and the north-east of Thailand there are numerous differences in cultural practices with regard to animals (De Boer and Welsch, 1978; Falvey, 1979), and an innovation which is well-accepted in a particular form in one area may need to be adjusted in a nearby area, and certainly in a different country. It was thus vital that the program be designed in a form which was acceptable and attractive to people of the north-east.

In addition to these requirements concerning consistency with community beliefs and attitudes, the program must also satisfy a number of practical requirements. Adapting the list of requirements suggested by Gladwin (1980), if the program is to be successful it must pass all of the following tests:

1. *Supply* The drugs must be readily available at a source that can be used without difficulty by the farmer.

2. *Awareness knowledge* The farmer must be aware of the program and the method by which he can participate.

3. *How-knowledge* The farmer must understand how and when to administer the drugs.

4. *Physical response* The farmer must expect a substantial improvement in his animals as a result of treatment, which will commonly be based on observing improvements in animals treated for others in the village by the keyman.

5. *Financial return* The expected financial return must be adequate to justify spending part of the farmer's limited cash income on treatment.

6. *Risk* The farmer must believe that the risk of the animal becoming worse is very low, and must believe there is only a small chance that no improvement will be achieved.

7. *Labour or time* The farmer must have time to treat animals himself at the recommended time, or must be able to use someone else to carry out the treatment.

8. *Capital or credit* The farmer must have funds to pay for the drug (or barter goods), or must be able to obtain credit. In this case the drug cost is very small, but nevertheless some farmers obtained drugs on credit from the keyman and paid later.

Prior to commencement of the farmer self-help program in the villages, very few farmers followed the currently recommended program for parasite control. The most important reasons for this were:

1. Supply problems - it was difficult for farmers to obtain suitable anthelmintics in a form that was easy to use.

2. Awareness knowledge - very few farmers would have been aware of the benefits which their animals could be expected to show after treatment.

3. How knowledge - farmers lacked information on almost all of the relevant technical points such as choice of anthelmintic, dose rate, treatment timing, etc.

Although the DLO had all the required information and limited supplies of suitable drugs, he could not cope with demands of all the villagers in his area, so not surprisingly had virtually no effect on parasitism. His recognition by farmers appeared to grow as a consequence of the commencement of the program, because he could provide back-up technical information through the keymen whereas previously his contact with the village farmers was predominantly in relation to epidemic diseases, and vaccination programs against these diseases.

The success of the parasite control program seems to have been due to the fact that it dealt with a problem seen to be important by the village farmers, it overcame a number of important barriers to adoption of effective control measures, and it was made available to farmers through one of their immediate peers - another village farmer, with the visible support of the staff of the DLD. Moreover, its benefits were demonstrated through showing the results of treating animals in the village, which clearly supported the value of the treatment.

Given these positive features, it was possible to achieve high adoption rates over a short period, contrary to the widespread opinion that progress of any disease control program under village conditions will be slow and will face considerable problems in convincing farmers to change their previous practices. In this instance the main barrier to adoption was lack of awareness of the existence of the program and of the appointment of a program keyman to serve the area. A high proportion of farmers who were aware of the program followed its recommendations with at least some of their animals, by purchasing drugs from either the keyman or the DLO. They did this based on an expectation of positive results rather than on an understanding of the principles of sound treatment, since only a small proportion yet understood the epidemiology of the important parasites against which they were carrying out treatment. An important factor in establishing the program is considered to have been the fact that drugs were purchased at moderate prices rather than given away. Both keymen and farmers were motivated to use the drugs effectively in order to gain their share of the financial benefit of the purchase made by a farmer.

The principles of this program should be applicable to other countries, and offer considerable scope for expanding the effectiveness of disease control in countries which have large numbers of small-holder farmers each owning a small number of animals.

SCOPE FOR IMPROVEMENT OF THE PROGRAM

Possible areas for improvement of the program were considered in Chapter 5. Of these, the single most important is clearly to increase the density of keymen in areas already covered by the program. This has a low cost, but would substantially raise farmer use of the program by making the keyman more visible and available within each village. The density of keymen should depend to

some extent on livestock density, but distance from the keyman's village to the furthest village he must serve is certainly the most important factor which should be used to decide on the location of keymen. No farmer should be more than 1.5 to 2 km from a keyman.

Increased keyman density will mean a larger volume of drugs in the distribution pipeline, mainly sitting in the keyman's house awaiting a buyer. Poorly effective keymen not only reduce the effectiveness of the program, they also keep far too much of the capital value of drugs in their stock, with low turnover. With the present system of payment of keymen, the DLD does not have a good way of solving the problem of inactive keymen. It has been shown that the payment obtained by keymen per unit of work effort put into the program is so low that the work of the highly effective ones is more a form of community service than a method of generating income. As the number of keymen is expanded, the main task will be to incorporate ways of rewarding the keymen more effectively for their effort (and definitely in proportion to their level of activity). Various quite simple methods could be used, such as increasing their percentage of the drug price as they sell more doses, by a method such as giving them one dose free for each ten doses they order. Rather than eliminating poor keymen from the program, the introduction of a more commercial system of distribution involving payment for drug on delivery would discourage poorly effective keymen from continuing, although a change to this approach would have to be accompanied by a substantial increase in the return to the keyman, and would have to take account of the limited amount of cash available to the keymen for such an arrangement.

There is clearly some scope for increasing the range of products handled by the keymen, and if this becomes much larger the payment system will have to be changed if the revolving fund is not to be made bankrupt by the stocks held by ineffective keymen.

An important step in the further development of the program will be to provide additional refresher training for keymen, and to provide stimulation and incentives for them to increase their promotional efforts for the program. The results of the survey show that promotion of the program should concentrate very firmly on the keymen, and that broader publicity should be targeted principally at promoting the value of the program and the role of the keyman in it, so that the effect is to direct the attention of farmers to finding their keyman and using his services. Program posters are a very cheap but effective way of increasing farmer recognition of the program. Other possibilities have been described in Chapter 5.

Promotional activities should aim to have each cooperating farmer treat all of his animals in order to reduce transmission and gain maximum benefit from the program, as well as trying to increase the number of users. The economic analysis has shown the importance of this aspect, which could easily be overlooked. Although the program would provide substantial additional benefits if it was expanded to other provinces, it is considered that the first goal should be to get the best possible results in the existing provinces, and then expand this "ideal" version of the program, rather than increasing coverage and then have to modify the program over a larger area after experience with the improvements which are proposed here.

This study has not concentrated on the administrative aspects of the program beyond the keyman, but a number of improvements have been suggested in Chapter 5. The system of administration and oversight of the program needs to be improved if the program is to become permanently established, and the proposals outlined in Chapter 5 would resolve most of the important difficulties seen at present. Consideration should also be given to the possibility of involving local chemists in the program in some way, since they clearly represent a potentially useful resource, and one which serves a group of farmers as yet poorly reached by the keymen.

Finally, it will be essential to regularly reassess the technical components of the program, to ensure that they are consistent with the best available knowledge. For example, Roberts (1988, pers. comm.) working on control of parasitism in buffalo calves in Sri Lanka has found that pyrantel is a superior anthelmintic for treatment of these calves, and that a single treatment is cheaper and considerably more effective than treatment with piperazine and thiabendazole. This finding will need to be evaluated under Thai conditions to test whether the change should be made.

ANIMAL HEALTH PROGRAMS IN THE CONTEXT OF REGIONAL DEVELOPMENT

Using the method of economic assessment adopted in this study, the program has very major

benefits to village farmers. Moreover the benefits are obtained at least as much by farmers with small herds as by wealthier farmers. However as discussed earlier, the livestock system in north-east Thailand is part of a tightly integrated crop-livestock complex, and changes in one component may adversely affect others. It must therefore be recognized that one possible outcome of the program might be an imbalance between increased livestock numbers and limited feed supply, especially in the drought years to which the area is prone.

On the other hand, as pointed out in Chapter 1 the area has difficulty in meeting the need for animals for draught and food. As discussed earlier, since parasitism decreases the efficiency of feed conversion, improved parasite control will not increase feed requirements as much as (say) importing new animals into the area to improve production, but taking no action to control parasitic disease. This program therefore represents a very appropriate first step to raise the efficiency of livestock production in the area while imposing the smallest possible demands for additional feed.

Nevertheless, if the program is successful on a large scale it will impose a demand for additional feed and for improvements in other aspects of animal management, as well as increasing the immediate income and assets of the farmers. If farmers of the north-east are not to slip even further behind other areas of the country in financial rewards, then the answer must lie in carrying out a similar program of development, implementation and evaluation as has been used here for parasitism, rather than deciding against any improvement on the grounds that it will upset the stability of the production system. In some parts of the world the conclusion from such follow-up studies may be that total numbers must be restricted within the carrying potential of the area, although it is almost inconceivable that this would be best achieved by maintaining a high calf mortality rate rather than (for example) by modifying reproductive management to achieve an equal number of calves at 12 months from a smaller breeding base.

In the circumstances of north-east Thailand, there appears to be considerable scope for modifying the production system to take advantage of the higher calf survival, but it will require positive action to convince farmers to follow appropriate management strategies, rather than simply implementing the parasite control program and leaving farmers to cope with whatever problems arise from improved calf survival and adult condition. It may even be that improved condition in adult animals will allow a change of policy by farmers so that they get higher calving rates and can reduce their breeding herd, moving the herd to a lower average age and gaining income from sale of surplus animals to other areas which have a deficit of stock. DeBoer and Welsch (1978) have shown that many villages have such deficits.

It is therefore considered that this program is ideally suited to be the first stage of a continuing village-based development effort, in which further modifications to the management system are tested in the village, then promoted to the farmers through the village keymen. The keymen can also be used a source of information to monitor areas in need of further investigation.

In this way the program can make a very valuable contribution to village development in north-east Thailand, and probably in other regions as well.

EVALUATION OF THE RESEARCH METHOD

When the study was being designed, it was quite unclear how realistic it would be to obtain all the information which was considered necessary to achieve the objectives described in Chapter 3. It was also unclear what factors were likely to explain the differences between high adoption and low adoption areas, and whether they were at all under the control of the keyman. The study also faced substantial problems with regard to practical issues such as working in two languages, implementing a large-scale field survey procedure under the difficult travel and communication conditions of the area, obtaining access to an unbiased sample of village farmers, and obtaining accurate information from them.

In retrospect, the findings of the study have proved to be far simpler, more clearcut, and of far greater practical value than was feared might be the case during the design phase. This study has shown that it is quite practical to evaluate a village-based program by sampling farmer opinion at the local level, and that the information obtained is consistent and understandable. Moreover it has provided very clear guidelines for future action, whereas before the study planning had to be based largely on guesswork and volunteered views of people with whom program staff came in contact.

It is therefore considered that the project method has been very successful, and that the techniques used could equally well be applied to other countries and other disease or production problems, at relatively low cost.

REFERENCES

Armour, J.(1983): Pharmacological basis of large animal medicine Edited by J.A. Bogan, P. Lees, and A.T. Yoxall.Blackwell Scientific Publications, pp.174-186.

Bhannasiri, T. (1970): Primary study of water buffaloes in the northeastern part of Thailand. The Department of Livestock Development, Ministry of Agriculture, Bangkok, Thailand. Cited by Rufener, W.H. (1971) pp.35-36.

Bhannasiri, T. (1980): Asian Pacific Food and Fertilizer Technology Centre. Extension Bulletin, Taipeh, Taiwan, pp.21-28.

Buckley, J.J.C. (1938): On a dermatitis in Malays causedby the cercariae of Schistosoma spindale Montgomery. Jour. Helminth 14:117-120.

Cason, R., and Geering, W.A. (1979): An economic evaluation of possible Australian policies to meet the threat of an exotic pest-the screw worm fly, Chrysomya bezziana. Proceeding of the 2nd International Symposium on Veterinary Epidemiology and Economics Canberra, Australia, pp.463-470.

Chain, P., (1979): Public participation and communication in latin american disease control programs. Proceeding of the 2nd International Symposium on Veterinary Epidemiology and Economics Canberra, Australia, pp.335-340.

Chompoochantra, T., Apiwathanagorn, B., Senewong Na Ayuthaya, V., and Penpiratgul, S. (1976): Study on the life cycle of liver fluke of cattle in Thailand. Thai Jour. Vet. Med. Ass. 27 No.4:43-47.

Chantaraprateep, P. (1985): Schistosomiasis in a buffalo calf: A case report. Thai Jour. Vet. Med. Ass. 36:73-77.

Clark, C.H., Kiesel, G.K., and Goby, C.H. (1962): Measurements of blood loss caused by H.contortus infection in sheep. Ame. Jour. Vet. 23:977-980.

Corba, J.,Scales, B., and Frod, G. (1969): The effect of DL-tetramisole on Thelazia rhodesii (Eye worm) in cattle. Trop. Anim. Health Prod. 1:19-22

DeBoer, A.J. (1972): Technical and economic constraints on bovine production in three villages in Thailand. Ph.D. Thesis. University of Minnesota, pp.174

De Boer, A.J. and Welsch, D.E. (1977) Constraints on cattle and buffalo production in a north-eastern Thai village. Chapter 5 (pp. 115-141) in Tradition and Dynamics in Small-Farm Agriculture. Ames: Iowa State University Press.

Dissamarn, R. (1955): The survey of liver fluke infection. Thai Jour. Vet. Med. Ass. 6: No.4:64-67.

Dissamarn, R. (1961): A note of some parasitic diseases of cattle and buffalo in Thailand. Bull. of Int. Epizoot. 56:1002-1004.

Ellis, P.R., and James, A.D. (1979a): The economics of animal health-(1) Major disease control programmes. Veterinary Record 105:504-506.

Ellis, P.R., and James, A.D. (1979b): The economics of animal health-(2) Economics in farm Practice. Veterinary record 105:523-526.

Falvey, L. (1979) Some economic aspects of the livestock industry in the highlands of north Thailand. J. trop. Geog. 49: 11-18.

Georgi, Jay R. (1985): Parasitology for Veterinarians. 4th edition W.B.Saunders Company,

344 p.

Gladwin, C.H. (1980) A theory of real-life choice: applications to agricultural decisions. Chapter 3 (pp. 45-85) in Agricultural decision making. Anthropological contributions to rural development. New York: Academic Press.

Griffiths, R.B. (1974): Parasites and parasitic diseases. In the husbandry and health of the domestic buffalo FAO, Rome.:254-257.

Griffiths, H.J. (1978): A hand book of veterinary parasitology, domestic animals of North America, Univ. of Minnesota press.

Harinasuta, C., and Kruatrachue, M. (1964): Schistosoma in Thailand. Transactions of Tropical Medicine and Hygiene 65 (5):125-129.

Hope Cawdery, M.J. (1976) The effects of fascioliasis on ewe fertility. Brit. vet. J. 132: 568-575.

Hörchner, F., Leidl, K., Gamperl, H.J., Lingelbach, W., Pholpark, M., Tantasuvan, D., Srikitjakarn, L., and Löhr, K.F. (1986): Economically important helminthoses of buffalo and cattle in Northeast Thailand. Part 1. Occurrence and animal age relative prevalence. Rev. Elev. Med. Vet. Pays Trop. (submitted)

Hörchner, F., Srikitjakarn, L., Pholpark, M., Leidl, K., Gamperl, H.J., and Löhr, K.F. (1988): Economically important helminthoses of buffalo and cattle in Northeast Thailand. Epidemiological aspects of control of liver fluke infections. Trop. Med. & Parasit. (submitted).

James, A.D., and Ellis, P.R. (1979): The evaluation of production and economics effects of disease. The Proceedings of the 2nd International Symposium on Veterinary Epidemiology and Economics Canberra, Australia, pp.363-372.

Jareeyapath, J. (1985): The atlas of Thailand (73 Provinces) p.72.

Kamonpatana, M., Kunawongkrit, A., Leenanuruksa, D., Bodhipaksha, P., Schams, D., and Van De Wiel, D.F.M. (1978): Annual report. The Co-operative Buffalo Production Research Project, Bangkok, Thailand. pp.2-20.

Leidl, K., and Löhr, K.F.(1984a): Investigating a "Tetanoid Syndrome" in Northeast Thailand. Part 1. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians working in ASEAN Countries. pp.247-259.

Leidl, K., Chongwatanakul, P., Srikitjakarn, L. Gamperl, H.J., and Löhr, K.F. (1984b): Buffalo health status and productivity baseline survey in 8 villages of Northeast Thailand. Part 2. Productivity. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians working in ASEAN Countries. pp.22-49.

Löhr, K.F.(1982): Annual report. Regional Veterinary Investigation Centre. Tha Phra, Khon kaen, Ministry of Agriculture and Cooperatives, Department of Livestock Development, Thailand.

Löhr, K.F., and Leidl, K. (1984a): Buffalo health status and productivity base-line survey in selected villages in Northeast Thailand. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. 12-23 Nov.1984. GTZ and DSE, Khon Kaen, Thailand. pp.177-213.

Löhr, K.F., Meemark, N. Leidl, K. (1984b): Worm control farmer self-help programme and Basic Animal Health Service in Northeast Thailand. Proceedings of the 2nd

Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. Khon Kaen, Thailand. Part 1. pp.76-87.

Löhr, K.F., Bhannasiri, T, Meemark, N., Leidl, K., Gamperl, H.J., Chongwatanakul, P., Srikitjakarn, L., and Chompoochantra, T. (1985): Basis Animal Health Service (Ed. Thai-German Animal Health Project), Tha Phra, Thailand. 24 p.

Löhr, K.F., Pholpark, S., Siriwan, P., Leesirikul, N., Srikitjakarn, L., and Staak, C. (1986a): Trypanosoma evansi infection in buffaloes in Northeast Thailand. Part 2. Abortions. Tropical Animal Health Production 18:103-108.

Löhr, K.F., Chongwatanakul, P., Leidl, K., Gamperl, H.L.,Srikitjakarn, L., Siriwan, P., Triemer, A., Betterman, G., and Morris, R.S. (1986b): A Profile of the Health and Productivity of Swamp Buffalo (Bubalis bubalis) kept under village conditions in North-East Thailand. 1. Epidemiological Aspects, 14 p.

Morris, R.S. (1969): Assessing the economic value of veterinary services to primary industries. Australia Veterinary Journal 45 June, pp.295-300.

Morris, R.S. (1979a): The application of disease surveillance and epidemiological methods to developing countries. FAO Seminar on Veterinary Epidemiology, Disease Surveillance Systems and Economics. Denpasar, Bali, Indonesia. 17-21 September 1979. 17 p.

Morris, R.S. (1979b): Veterinary epidemiology and economics. Lecture given in Denpasar (Indonesian Veterinary Association) and Yogyakarta (Faculty of Veterinary Medicine) August, 1979. 5 p.

Morris, R.S. and Meek, A.H. (1980): Measurement and evaluation of the economic effects of parasitic disease. Veterinary Parasitology 6:165-184.

Morris, R.S. (1984a): Epidemiological apporoach to village livestock health. The basic principles. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. Part 1. pp.1-8.

Morris, R.S. (1984b): Methods of investigating complex disease problems in cattle and buffaloes. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. Part 1. pp.233-246.

Morris, R.S. (1984c): Economics of animal disease control. Proceedings of the 2nd Speccialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. Part 2. pp. 162-183.

Morris, R.S. (1984d): Mounting a specific disease control program. Proceedings of the 2nd Specialist Workshop on Epidemiological Techniques in Animal Health for Veterinarians Working in ASEAN Countries. Part 2. pp.151-161.

Morris, R.S. (1986a): Report to Deutsche Gesellchaft für techniche Zusammenarbeit, concerning the Thai-German Animal Health Project. 4 p.

Morris, R.S. (1986b): Measuring the economic effects of disease on productivity in ruminants. Proceeding of International Conference on Veterinary Preventive Medicine and Animal production Melbourne, Australia 1985. Australia Veterinary Journal(Special supplyment) pp. 53-57.

Muanguai, M., and Luengyosluechakul, S. (1980): The variation of nematode eggs in buffalo calves. Thai Jour. Vet. Med. Ass. 10 No.4:243-249.

Murray, J., Leaning, W.H.D. and Martin, C.A. (1971) Pre-mating anthelmintic treatment of ewes and its effect on lambing performance. N.Z. vet. J. 19: 1-4.

Prapertchob, P., and Kachamart, P. (1983): Traditional farming systems in Northeast Thailand with special emphasis on the role of livestock. Department of Agricultural Economics, Faculty of Agriculture, Khon Kaen University, Thailand. pp.1-5, 77-134.

Reinecke, R.K.(1983): Veterinary Helminthology, Butterworths, 392 p.

Roberts, F.H.S., Elek, P., and Keith, R.K.(1962): Studies on resistance in calves to experimental infection with the nodular worm Oesophagostomum radiatum. Aus. Jour. Agri. Res.13:551-573.

Rogers, E.M. and Shoemaker, F.F. (1971) Communication of Innovations. New York: The Free Press.

Rufener, W.H. (1971): Cattle and water buffalo production in villages of Northeast Thailand. Ph.D. Thesis. University of Illinois at Urbana-Champaign. pp.154.

Soulsby, E.J.L.(1965): Textbook of Veterinary Clinical Parasitology Vol.1 Helminths, Black well. 1120 p.

Soulsby, E.J.L.(1982): Helminths, Arthropods and Protozoa of Domesticated Animals, Balliere Tindall. 809 p.

Srikitjakarn, L.(1986): Zür Bekämpfung der Helminthosen bei Kälbern und der Fasciolose bei adulten Büffeln in Nordost-Thailand. Vet. Med. Diss. Berlin FU pp.22-46.

Srikitjakarn, L., Loehr, K. F., Leidl, K., and Hörchner F. (1987) : Metaphylactic deworming program for buffalo calves (Bubalis bubalis) in Northeast Thailand. Trop. Med. and Parasit. Georg Thieme Verlag Stuttgart. New York, 38:191-193.

Sukhapesna, V.(1977): Parasites in swamp buffalo, Thai jour. Vet. Med. Ass. 28 No.4:37-46.

Sukhapesna, V.(1978): Variation in the number of worm eggs in the faeces of buffalo calves, Thai Jour. Vet. Med. Ass. 29 No.2:101-103.

Sukhapesna, V.(1981): Ascariasis in buffalo calves. Thai Jour. Vet. Med. Ass.32 No.3:263-268.

Thrusfield, M.V. (1986): Veterinary Epidemiology. Butterworths. pp. 199-205.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M., and Jennings, F.W. (1987): Veterinary Parasitology 1:114-115.

Usanakornkul, S., and Sukhapesna, V. (1980): Diseases and parasites in swamp buffaloes: Buffalo production in small farms ASPAC FFTC, Taiwan. pp.167-169.

Viboolyavatana, J. (1981): Life history of the snail Lymnea (Radix) auricularia rubiginosa Michalin 1831 in Laboratory. Thai Jour. Vet. Med. Ass. 32 No.2:135-144.

Warren, E.G. (1971): Observation on the migration and development of Toxocara vitulorum in natural and experimental hosts. International Journal for Parasitology 1:85-99.

Woo, P.T.K. (1969) Can. J. Zool. 47: 921.

Wongsongsarn, C., Bhuchongmatta, C., and Dissamarn, R. (1967): The worm parasites of cattle and buffalo and their control in Thailand. Report presented at O.I.E.-F.A.O. Regional Conference on Epizootics in Asia and Far East. Cited by Rufener,

W.H. (1971) pp.40.

Yutisri, P. (1978): Studies on some important intestinal nematodes in buffalo calves. Thai Jour. Vet. Med. Ass. 8 No.2:82-87.

Yutisri, P., Sukhapesna, V., and Usanakornkul, S. (1980): Study on life cycle of Strogyloides papillosus in Thai swamp buffalo. Annual report The co-operative buffalo production research project. Bangkok, Thailand, pp.180-189. Cited by Muanguai (1980) pp. 243-249.

APPENDICES

APPENDIX 1

POPULATIONS OF BUFFALO, CATTLE AND PROGRAMME KEYMEN IN THE NORTHEAST REGION

Province	Buffalo	Cattle	Keymen
Mahasarakam	178068	56599	218
Surin	287674	74746	622
Khon Kaen	281249	91243	312
Loei	48914	36454	156
Udornthanee	306214	61431	-
Kalasin	184456	48121	-
Bureerum	127292	92329	250
Chaiyapum	350482	129510	194
Korat	257991	261960	-
Mukdahan	78367	36851	-
Nakornpanom	159477	65737	-
Nongkai	170977	27003	-
Roiet	266011	103741	-
Sakolnakorn	226855	87882	214
Srisaket	282889	97059	-
Ubon	389528	157209	-
Yasothorn	109768	40499	-
Total	3666214	1468374	1966

Source: The Regional Veterinary Offices 1987.

APPENDIX 2

FARMER AND VILLAGE HEADMAN INTERVIEW QUESTIONNAIRE

FARMER INTERVIEW QUESTIONNAIRE

1. Questionnaire number F.....

2. Date of interview .....

3. Interviewer .....

Version 19 February 1987, for Use in First Phase of Study

BASIC FARMING INFORMATION

First I would like to ask you some questions about you and your family, and about the village.

4. Farmer's name: .....

5. Sex of farmer Male _____ Female _____

6. Age of farmer ..... years

7. Address: .....

.....

.....

Ask questions 8 and 9 to headman, transfer to farmer questionnaires from same village.

---

8. How many families are there in this village? .....

9. How many people are there in this village? .....

---

10. How many people(including yourself) are there in your family? ....

11. What is your most important farming activity? (rice, cattle, etc.)

.....

12. What other farming activities do you have?

....

....

....

13. Is farming your main job, or do you have some other job that is more important to you? (shop, etc.)

.....yes .....no

14. If yes, what is main job?

.....

15. How large an area do you have for the whole of your farming activity?

.....rai owned .....rai rented

16. Do you use any public areas for raising animals? Yes..... No.....

If yes, when do you use these areas during the year?

.....

....

17. What was your annual income for 1986 (2529)?

B.....

18. About how much

Buffalo B.....

Cattle B.....

Other animals (specify) B..... from .....

Rice	B.....	Sugar cane	B.....
Cassava	B.....	Maize	B.....
Kenaf	B.....		

Other crops (specify) B..... from.....

ANIMAL OWNERSHIP

Next I would like to ask some questions about numbers of buffaloes and cattle.

Ask next two questions of village headmen only, transfer to questionnaires for farmers from same village.

19. How many Buffalo and Cattle are there in this village?

_____ buffalo _____cattle

20. How many Buffalo and Cattle were there in the village a year ago?

_____ buffalo _____cattle

21. How many buffalo and cattle do you own?

_____ buffalo _____cattle

22. What are the ages and sexes* of each of the buffalo and cattle you own?

	B=Buffalo,C=Cattle	Age (years/months)	Sex*
1.			
2.			
3.			
4.			
5.			
6.			
7.			

* M = male
MC = castrated male
F = female

More animals? Yes..... No..... If yes, list on opposite blank page.

TRADING OF ANIMALS

23. How much do you think buffalo are worth at present in each of the following age groups?

B..... Up to 4 mths. old. B..... bulls more than 3 yrs

B..... 4 to 12 mths. old. B.....steers 1 to 3 years old

B..... Cows 1 to 3 yrs old B.....steers more than 3 years

B..... Cows more than 3 years old.

B..... bulls 1 to 3 years old

24. How much do you think cattle are worth at present in each of the following age groups?

B..... Up to 4 mths old B..... bulls more than 3 yrs

B..... 4 - 12 mths. old B.....steers 1 to 3 years old

B..... Cows 1-3 yrs old B.....steers more than 3 years

B..... cows more than 3 years old.

B..... bulls 1 to 3 years old

25. Did you buy buffalo or cattle last year?

_____yes _____no

26. If yes, please tell me for each animal the reason you bought it, its age, and its sex, first for buffalo and then for cattle:

	Buffalo Why Bought?	Age (years/months) When bought	Sex*
1			
2			
3			
4			
5			
6			
7			

* M = male
MC = castrated male
F = female

	Cattle - Why Bought?	Age (years/months) When Bought	Sex*
1			
2			
3			
4			
5			
6			
7			

27. Did you sell any of your buffalo or cattle last year?

_____yes _____no

28. If yes, please tell me for each animal the reason you sold it, its age, and its sex, first for buffalo and then for cattle:

	Buffalo Reason Sold	Age (years/months) When Sold	Sex*
1			
2			

* M = male
MC = castrated male
F = female

3.....	.....	.....	.....
4.....	.....	.....	.....
5.....	.....	.....	.....
6.....	.....	.....	.....
7.....	.....	.....	.....

Cattle Reason Sold

1.....	.....	.....	.....
2.....	.....	.....	.....
3.....	.....	.....	.....
4.....	.....	.....	.....
5.....	.....	.....	.....
6.....	.....	.....	.....
7.....	.....	.....	.....

ANIMAL MANAGEMENT

Now I would like to ask you about the way in which you manage your animals.

29. What are the main reasons why you keep buffalo?
Interviewer to ask without making suggestions, then mark answers included

Working in paddy field.....

To sell when I need money....

To produce calves to sell....

We use the manure....

To pull a cart....

Other (please give details) .....

30. What are the main reasons why you keep cattle?

Working in paddy field.....
To sell when I need money....
To produce calves to sell....

We use the manure....

To pull a cart....

Other (please give details) .....

31. Which members of your family do the following jobs in caring for your animals? (Self, wife, children, parents, others)

Bringing feed and water.....

Taking out to graze .....

Organizing mating of cows.....

Deciding about buying and selling animals.....

Watching animals for sickness.....

Deciding about treatment and prevention of disease.....

32. Have you hired buffalo at any time in the last year?

_____yes _____no

If no, go to question 35

33. If yes, why did you hire the buffalo?

.....

.....

34. For how many months did you keep the hired animal during the year?

.....

.....

35. How much did you pay for one hired animal during that period?

B..... for ..... months

36. Do you feed your buffalo anything other than grass and rice straw?

_____yes _____no

37. If yes, what else do you feed them and when during the year?

.....

.....

.....

38. Do you feed your cattle anything other than grass and rice straw?

_____yes _____no

39. If yes, what else do you feed them and when during the year?

.....

.....

40. What expenses did you have in 1986 for animal raising?

Artificial insemination B.....

Medicines B.....

Feed B.....

Other B.....

DISEASE PROBLEMS IN BUFFALO AND CATTLE

Next I want to learn about the disease problems of cattle and buffalo in your village.

41. Did any calves aged up to one year old die in this village during the last year (Jan.-Dec.1986.)?

_____yes _____no _____don't know

42. If yes, could you tell me how many buffalo calves? .....

How many cattle calves? .....

43. What are the main reasons why calves died in this village during 1986?

.....

.....

.....

44. Have any of your own calves up to one year old been sick <u>but</u> later recovered during 1986?

.....yes .....no

45. If yes, what was wrong with each of these calves? Describe the signs you saw in each calf and what you treated it with:

Calf 1 (Buffalo/cattle).....

.....

Calf 2. (Buffalo/cattle).....

.....

Calf 3. (Buffalo/cattle).....

.....

46. Have any of your calves <u>died</u> during 1986?

.....yes .....no

47. If yes, what was wrong with each of these calves that died? Describe the signs you saw in each calf and what you treated it with:

Calf 1. (Buffalo/cattle).....

.....

Calf 2. (Buffalo/cattle).....

.....

Calf 3. (Buffalo/cattle).....

.....

48. What do you usually do if one of your calves gets sick?

.....

.....

.....

49. Is this any different from what you would have done five year ago?

.....yes .....no .....don't remember

50. If yes, what would you have done five years ago, and why have you changed?

.....

.....

.....

51. When a calf dies in the village what is done with the carcass?

.....

52. Do people usually look inside the animal to find out what killed it?

.....yes .....no .....don't know

53. If so, have you seen anything which might have killed the animals?

.....

.....

54. Are there any important diseases which kill adult cattle or buffaloes in this village?

.....yes .....no .....don't know

55. If yes, give details.....

.....

.....

56. Are there any important diseases which make adult cattle or buffaloes sick in this village but do not usually kill them?

.....yes .....no .....don't know

57. If yes, give details.....

.....

.....

58. What do you usually do if one of your adult animals gets sick?

.....

.....

.....

59. Is this any different from what you would have done five year ago?

.....yes .....no .....don't remember

60. If yes, what would you have done five years ago, and why have you changed?

.....

.....

.....

HEALTH CARE

Now I would like to ask you some questions about the people who can help you deal with health problems in your animals.

61. Who do you go to for information about treatment of sick calves?

_____Don't need help

_____Friend

_____Keyman

_____Village headman

_____Chemist

_____District veterinarian

_____Other .....

62. If you need a drug to treat a sick calf, who would you buy it from?

_____Village headman

_____Keyman

_____Chemist

_____District veterinarian

_____Other .....

63. Do you know what these are? (Show them the parasites)

.....

.....

64. Do you know where these things live?

.....

.....

65. Could you tell me how a calf gets worms in its intestines?

.....

.....

66. What effects do you think these worms have on calves?

.....

.....

67. Can you tell an animal which has worms from one which doesn't?

.....yes .....no .....don't know

68. If yes, how do you tell?

.....

.....

.....

69. Do most animals have worms, or only some?

Most ..... Only some ..... Don't know .....

70. Do you do anything to help prevent calves from becoming sick?

.....yes .....no .....don't know

71. If so, what?

.....

.....

72. Is there any value in giving worm treatment to calves which have worms but do not look sick?

.....yes .....no .....don't know

73. If yes, why would you treat these calves?

.....

74. Have you heard of the parasitic treatment farmer self-help program?

.....yes .....no .....don't know

75. If yes, please describe it briefly to me?

.....

.....

.....

.....

76. Do you know that there are keymen in the parasitic treatment farmer self-help programme?

_____yes _____no

If no, go to question 93 (Lymnaea identification)

77. If yes, what is their job in the programme?

.....

.....

.....

78. What is the name of the keyman who provides parasite treatment drugs for your village?

.....

79. In which village does he live?

.....

80. During the last year have you seen the keyman for your village?

_____yes _____no

81. Did he talk to you about parasite control during 1986?

_____yes _____no

82. Did he sell you any worm drugs during 1986?

_____yes _____no

83. Do you know of any occasions when he talked to others in this village about the parasite treatment farmer self-help programme during 1986?

_____yes _____no

84. What did he recommend that you do about parasites in young calves?

.....

.....

85. Did you follow his recommendation on the programme?

_____yes _____no

86. If not, what were your reasons for not following the keyman's recommendation?

.....

.....

87. Could you tell me something about how your keyman works on the scheme? (Ask like this first to generate list like the one below)

Which of the following list best describes the work of the keyman for the parasite control programme in your village? (up to 3 answers)

_____ He is busy with many jobs and does not spend much time on the parasite control program

_____ Most people believe him and use the drug to control parasites

_____ I do not know what he is supposed to do

_____ We believe what he tells us, but cannot afford to use the drug

_____ I have not been able to get the drug from him when I wanted it

_____ He tries to get people to use the worm drug, but most people prefer the treatment their parents taught them

_____ Some farmers use the drug, but most people in the village do not think their animals need to be treated

88. Do you have difficulties buying medicines for your animals?

_____yes _____no

89. If yes, what are the difficulties?

.....

.....

90. Have you ever bought worm drug for calves from the keyman?

_____yes _____never

91. Which age animals did you use the drug on?

Calves at_____ months (list all times up to adult)

_____

_____

Adult buffalo_____ Adult cattle_____

92. Which do you think saves more animals - the treatment you learned from your parents or the drug you can get from the keyman?

_____ From parents _____ From keyman

93. Do you think the animals were better after the deworming?

.....yes .....no .....don't know

94. If yes, in what ways?

.....

.....

95. Have you ever seen this kind of snail?
(show the farmer Lymnaea snail in sample)

_____yes _____no

96. Do you know where it lives?

.....

97. Do you know anything special about this kind of snail?

.....

.....

98. Do you know what this is? (show liver flukes)

.....

.....

99. Do you know where it lives?

.....

100. Have you ever seen any of them in an animal which died in the village?

_____yes _____no

101. How many of your own animals have been injected against liver fluke by the keyman during 1986?

.....

102. Did you notice any differences in your animals after injection?

.....yes .....no .....don't know

103. If yes, in what ways?

.....

.....

.....

104. How many animals treated in 1986 have you since sold? .....

105. Could you comment on any effect of treatment on the value of your animals?

Number of animals	Animal value before treatment	Animal value after treatment
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

106. Have you ever seen media information about the parasite treatment farmer self-help programme?

.....yes .....no .....don't know

107. If yes, which:

Poster.....

Film.....

Leaflet.....

Other..... .....

108. To finish up, is there any thing else you would like to comment on about the subjects we've discussed today?

_____

_____

_____

_____

Thank you for answering my questions, which will help us to improve our work for the people in villages in the north-east.

APPENDIX 2

KEYMAN INTERVIEW QUESTIONNAIRE

KEYMAN INTERVIEW QUESTIONNAIRE

1. Questionnaire number K.....

2. Date of interview .....

3. Interviewer .....

Version 19 February 1987, for Use in First Phase of Study

BASIC INFORMATION

4. Questionnaire number_____

5. Date of survey _____

6. Keyman's name _____

7. Sex of keyman Male _____ Female _____

8. Age of keyman _____ years

9. Address _____

_____

_____

_____

10. Marital status _____married _____single _____separated

11. How many people (including yourself) are there in your family? .....

12. What is your most important farming activity? (rice, cattle, etc.)

.....

13. What other farming activities do you have?

....

....

....

14. Is farming your main job, or do you have some other job that is more important to you? (shop, being a keyman, etc.)

.....yes .....no

15. If yes, what is main job?

.....

16. How large an area do you have for the whole of your farming activity?

.....rai owned .....rai rented

17. Do you use any public areas for raising animals? Yes..... No.....

18. If yes, when do you use these areas during the year?

.....

.....

19. What was your annual income for 1986 (2529)?

B.....

20. About how much came from:

Buffalo B.....

Cattle B.....

Other animals (specify) B..... from .....

Rice B..... Sugar cane B.....

Cassava B..... Maize B.....

Kenaf B.....

Other crops (specify) B..... from.....

Being a keyman B.....

ANIMAL OWNERSHIP

Next I would like to ask some questions about numbers of buffaloes and cattle.

21. How many Buffalo and Cattle are there in this village?

_____ buffalo _____cattle

22. How many Buffalo and Cattle in the Tumbon are you responsible for as keyman?

_____ buffalo _____cattle

23. How many buffalo and cattle do you own?

_____ buffalo _____cattle

24. What are the ages and sexes* of each of the buffalo and cattle you own?

	B=Buffalo, C=Cattle	Age (years/months)	Sex*
1.			
2.			
3.			
4.			
5.			
6.			
7.			

* M = male
MC = castrated male
F = female

More animals? Yes..... No..... If yes, list on opposite blank page.

TRADING OF ANIMALS

25. How much do you think buffalo are worth at present in each of the following age groups?

B..... Up to 4 mths. old. B..... bulls more than 3 yrs

B..... 4 to 12 mths. old. B.....steers 1 to 3 years old

B..... Cows 1 to 3 yrs old B.....steers more than 3 years

B..... Cows more than 3 years old.

B..... bulls 1 to 3 years old

26. How much do you think cattle are worth at present in each of the following age groups?

B..... Up to 4 mths old B..... bulls more than 3 yrs

B..... 4 - 12 mths. old B.....steers 1 to 3 years old

B..... Cows 1-3 yrs old B.....steers more than 3 years

B..... cows more than 3 years old.

B..... bulls 1 to 3 years old

27. Did you buy buffalo or cattle last year?

_____yes _____no

28. If yes, please tell me for each animal the reason you bought it, its age, and its sex, first for buffalo and then for cattle:

	Buffalo Why Bought?	Age (years/months) When bought	Sex*
1.			
2.			
3.			
4.			
5.			
6.			
7.			

* M = male
MC = castrated male
F = female

	Cattle - Why Bought?	Age (years/months) When Bought	Sex*
1.			
2.			
3.			
4.			
5.			
6.			
7.			

29. Did you sell any of your buffalo or cattle last year?

_____yes _____no

30. If yes, please tell me for each animal the reason you sold it, its age, and its sex, first for buffalo and then for cattle:

	Buffalo Reason Sold	Age (years/months) When Sold	Sex*
1.			
2.			
3.			
4.			
5.			

* M = male
MC = castrated male
F = female

6.....	.....	.....	.....
7.....	.....	.....	.....

Cattle Reason Sold

1.....	.....	.....	.....
2.....	.....	.....	.....
3.....	.....	.....	.....
4.....	.....	.....	.....
5.....	.....	.....	.....
6.....	.....	.....	.....
7.....	.....	.....	.....

ANIMAL MANAGEMENT

Now I would like to ask you about the way in which you manage your animals.

31. What are the main reasons why you keep buffalo?

Interviewer to ask without making suggestions, then mark answers included

Working in paddy field.....

To sell when I need money....

To produce calves to sell....

We use the manure....

To pull a cart....

Other (please give details) .....

32. What are the main reasons why you keep cattle?

Working in paddy field.....

To sell when I need money....

To produce calves to sell....

We use the manure....

To pull a cart....

Other (please give details) .....

33. Which members of your family do the following jobs in caring for your animals? (Self, wife, children, parents, others)

Bringing feed and water.....

Taking out to graze .....

Organizing mating of cows.....

Deciding about buying and selling animals.....

Watching animals for sickness.....

Deciding about treatment and prevention of disease.....

34. Have you hired buffalo at any time in the last year?

_____yes _____no

If no, go to question 35

35. If yes, why did you hire the buffalo?

.....

.....

36. For how many months did you keep the hired animal during the year?

.....

.....

37. How much did you pay for one hired animal during that period?

B..... for ..... months

38. Do you feed your buffalo anything other than grass and rice straw?

_____yes _____no

39. If yes, what else do you feed them and when during the year?

.....

.....

.....

40. Do you feed your cattle anything other than grass and rice straw?

_____yes _____no

41. If yes, what else do you feed them and when during the year?

.....

.....

42. What other expenses did you have in 1986 for animal raising?

Artificial insemination B.....

Medicines B.....

Feed C.....

Other B.....

DISEASE PROBLEMS IN BUFFALO AND CATTLE

Next I want to learn about the disease problems of cattle and buffalo in your village.

43. Did any calves aged up to one year old die in this village during the last year (Jan.-Dec.1986.)?

_____yes _____no _____don't know

44. If yes, could you tell me how many buffalo calves? .....

How many cattle calves? .....

45. What are the main reasons why calves died in this village during 1986?

.....

.....

.....

46. Have any of your own calves up to one year old been sick <u>but</u> later recovered during 1986?

.....yes .....no

47. If yes, what was wrong with each of these calves? Describe the signs you saw in each calf and what you treated it with:

Calf 1. (Buffalo/cattle).....

.....

Calf 2. (Buffalo/cattle).....

.....

Calf 3. (Buffalo/cattle).....

48. Have any of your calves <u>died</u> during 1986?

.....yes .....no

49. If yes, what was wrong with each of these calves that died? Describe the signs you saw in each calf and what you treated it with:

Calf 1. (Buffalo/cattle).....

.....

Calf 2. (Buffalo/cattle).....

.....

Calf 3. (Buffalo/cattle).....

.....

50. What do you usually do if one of your calves gets sick?

.....

.....

.....

51. Is this any different from what you would have done five year ago?

.....yes .....no .....don't remember

52. If yes, what would you have done five years ago, and why have you changed?

.....

.....

.....

53. Are there any important diseases which kill adult cattle or buffaloes in this village?

.....yes .....no .....don't know

54. If yes, give details.....

.....

.....

55. Are there any important diseases which make adult cattle or buffaloes sick in this village but do not usually kill them?

.....yes .....no .....don't know

56. If yes, give details.....

.....

.....

57. What do you usually do if one of your adult animals gets sick?

.....

.....

.....

58. Is this any different from what you would have done five year ago?

.....yes .....no .....don't remember

59. If yes, what would you have done five years ago, and why have you changed?

.....

.....

.....

KEYMAN ACTIVITIES

Next I would like to ask you about your work as a keyman.

60. Did you ever inject animals before you were the keyman?

_____yes _____never

61. How long have you been a keyman?

_____year(s)

62. What other official activities are you responsible for in your own village?

1. _____
2. _____
3. _____
4. _____

63. Are you the keyman of projects other than the parasite treatment farmer self-help programme?

_____yes _____no

64. How many villages are there in your Tumbon?

_____villages

65. How many villages do you look after for the parasite control scheme in your Tumbon?

_____villages

66. Since becoming a keyman, have you gone to promote the scheme in villages other than your own?

_____yes _____never

67. If yes, how many of these villages have you visited?

_____villages

68. How many have you visited for the programme in 1986?

_____ villages

69. Does someone else sell the drugs for you when you are away?

_____yes _____no

70. Did you receive enough materials from the Department of Livestock Development for your promotion work?

_____yes _____no

71. Which materials have you used, and how helpful were they in your promotion work?

	Very useful	Some help	No help
Posters.....			
Film.....			
Leaflets.....			
Other.....			
.....			
.....			

72. Have you used other people to help you promote the scheme?

.....yes .....no .....don't know

73. If so, who?

Other farmers _____

District veterinary officer _____

Village headman _____

Staff from Tha Pra laboratory _____

Wife _____

Other members of family _____

Others (give details)_____

_____

74. How did you promote the scheme during the last year?

	Your village	Other villages
Talked to farmers I met	Yes/no	Yes/no
Talked at village meeting	Yes/no	Yes/no
Distributed leaflets	Yes/no	Yes/no
Put up posters	Yes/no	Yes/no
Other (give details)		
_____		
_____		
_____		

75. How much time have you spent promoting the scheme in 1986?

_____ days

76. In your own village do farmers accept the parasite treatment program any better or worse than other villages for which you are keyman?

Better..... Same..... Worse.....

77. What additional help would you like to assist you in promoting the scheme?

_____

_____

_____

FARMER KNOWLEDGE ABOUT PARASITES

78. Do you think the farmers controlled parasites of cattle and buffalo effectively before the farmer self-help scheme was introduced?

_____yes _____no

79. If yes, what kind of methods did they use for calves and adult animals?

calves	adult buffalo and cattle
_____	_____
_____	_____
_____	_____
_____	_____

80. Which of the following statements apply to <u>your own</u> village? (one or more)

_____ Most people believe me and use the drug to control parasites

_____ Most people do not know what my role is for the farmer self-help scheme

_____ Most people believe what I tell them, but cannot afford to use the drug

_____ People are not interested in controlling the parasites

_____ I try to get people to use the worm drug, but most people prefer the treatment their parents taught them

_____ Some farmers use the drug, but most people in the village do not think their animals need to be treated

81. Which of the following statements apply to <u>other</u> villages for which you are keyman? (one or more)

_____ Most people believe me and use the drug to control parasites

_____ Most people do not know what I am supposed to do for the farmer self-help scheme

_____ Most people believe what I tell them, but cannot afford to use the drug

_____ People are not interested in controlling the parasites

_____ I try to get people to use the worm drug, but most people prefer the treatment their parents taught them

_____ Some farmers use the drug, but most people in the village do not think their animals need to be treated

82. Have you ever used the drugs provided through the scheme to treat your own animals?

_____yes _____no

83. If yes, what were the differences before and after treatment?

_____

_____

_____

84. If no, what were the reasons?

_____

_____

I want to ask about whether or not farmers believe treatment is effective?

85. How often do the farmers say their animals are healthier after using the drugs?

_____quite often _____occasionally _____never

86. How often do the farmers say their animals are no better after using the drugs?

_____quite often _____occasionally _____never

87. What do <u>you</u> think? Are their animals better or worse after treatment?

Better..... Same..... Worse.....

88. Could you estimate how much the animals changed in value after treatment?

Type of animal	animal worth before treatment	animal worth after treatment
Calf to 1 year old		
Female buffalo		
Female cattle		
Bulls		

Steers | |

ADMINISTRATION OF THE SCHEME

89. What do you think about these things?

Drug supply _____

_____

_____

Price of drugs _____

_____

Range of drugs provided _____

_____

_____

90. Do you keep drug receiving and selling records?

Drugs received _____yes

_____no

Drugs sold _____yes

_____no

91. Have any animals in your keyman area become sick or died apparently due to the drugs used in the scheme?

Animal became sick soon after treatment _____yes _____no

Number _____

Animal died _____yes _____no

Number _____

92. Do you have any difficulties in storing and distributing the drugs?

_____yes _____no

93. Do you still keep the drugs and equipment in the shoulder bag?

_____yes _____no

94. How much do you charge the farmer for the calf deworming drug?

B.....

95. How much do you charge the farmer for each injection of liver fluke treatment?

_____7 Baht/100-200kg body wt.

_____8.50 Baht/250-350kg body wt.

_____11 Baht/>350kg body wt.

_____10 Baht/each

_____15 Baht/each

_____20 Baht/each

_____More than 20 Baht/each

96. What do you think about the 13% incentive payment from the scheme?

_____

_____

_____

97. What do you think about 2 keymen/Tumbon?

_____ I could look after more villages

_____ about right

_____ too much work

98. How many packages of deworming drugs did you obtain and sell during last year(1986)?

	Obtained Drugs	Sold drugs
PIP-THIP(formula 1)*		
PIP-THIP(formula 2)**		

***

99. How many bottles of Niclofolan did you obtain and use during last year(1986)?

	Drugs obtained	Drugs sold
Niclofolan		

100. Could you tell me briefly what you tell farmers about <u>how a calf gets parasites in its intestine?</u>

_____

_____

_____

101. What do you tell farmers about the ages at which calves should be dewormed?

_____

102. What do you tell farmers about how an animal gets infected with liver fluke?

_____

_____

_____

103. What do you tell farmers about <u>when</u> and <u>how often</u> the adult buffalo and cattle should be treated against liver fluke?

_____

_____

104. Would you like to see any changes in keyman training and refresher training?

_____

_____

105. To finish up, is there any thing else you would like to comment on about the subjects we've discussed today?

_____

_____

_____

_____

Thank you for answering my questions, which will help us to improve our work in the parasite treatment farmer self-help program.

* ** Deworming drugs in powder form contained of Piperazine and Thibendazole in ratio 2:1, for the 3 and 6 weeks old calves respectively.

*** Injected solution against liver fluke in ruminant, recommended dose is 2 ml./100kg.body wt.

APPENDIX 2 (cont.)

Farmer and Village Headman Interview Questionnaires
(in Thai)

แบบสอบถามสำหรับเกษตรกร/ผู้ใหญ่บ้าน

1. แบบสอบถามหมายเลข F 294 /

VH —

2. วันที่สอบถาม 4 มิ.ย 30 (4/6/87)

3. ผู้สอบถาม [illegible]

ข้อมูลพื้นฐาน (ข้อ 8, 9 ถามเฉพาะผู้ใหญ่บ้าน)

4. ชื่อ [illegible]

5. เพศ (/) ชาย ( ) หญิง

6. อายุ 44 ปี

7. ที่อยู่ 313 หมู่ 7 บ. [illegible] ต. [illegible] อ. [illegible] จ. [illegible]

8. ประชากรในหมู่บ้านนี้มี — หลังคาเรือน

9. ประชากรในหมู่บ้านนี้มี — คน, ชาย — คน, หญิง — คน

10. สมาชิกในครอบครัวท่านมีทั้งหมด 8 คน (รวมทั้งตัวท่านด้วย)

11. อาชีพหลักทางการเกษตร

(1.) ทำนา
2. เลี้ยงโค
3. เลี้ยงกระบือ
(4.) เลี้ยงโคและกระบือ
5. อื่น ๆ _____

12. อาชีพรองทางการเกษตร

(1.) ทำไร่มันสำปะหลัง
2. ทำไร่ปอ
3. ทำไร่ฝ้าย
4. ทำการเพาะปลูกพืชชนิดอื่น ๆ
5. ทอผ้า
6. อื่น ๆ _____

13. ทำอาชีพทางการเกษตรเป็นงานหลักใช่หรือไม่

(✓) ใช่ ( ) ไม่ใช่

14. งานหลักที่ทำอยู่ขณะนี้ ทำนา - เลี้ยงสัตว์

15. อาชีพอื่น ๆ ที่ไม่เกี่ยวกับการเกษตร

1. ค้าขาย
2. ขับรถ
3. ช่างไม้
4. รับจ้าง
5. อื่น ๆ (ระบุ) _____

16. มีเนื้อที่ทำกินของตัวเอง 15 ไร่, เช่าคนอื่น ____ ไร่

ทำนา 12 ไร่

ทำไร่ 3 ไร่

17. ในการเลี้ยงสัตว์ท่านใช้พื้นที่สาธารณะหรือไม่

( ) ใช้ (✓) ไม่ใช้

18. ถ้าใช้, ใช้ในช่วงไหนของแต่ละปี _____

19. ปี 2529 ท่านมีรายได้จาก

กระบือ 1-1 บาท

โค 30000 บาท

สัตว์ชนิดอื่น ๆ (ระบุ)

1 _____ _____ บาท

2 _____ _____ บาท

3 _____ _____ บาท

ข้าว 3000 บาท

มันสำปะหลัง _____ บาท

ปอ _____ บาท

อ้อย _____ บาท

ข้าวโพด _____ บาท

พืชชนิดอื่นๆ (ระบุ)

1 _____ _____ บาท

2 _____ _____ บาท

3 _____ _____ บาท

20. สรุปปีที่ผ่านมา(2529) ท่านมีรายได้รวม 33,000 บาท

<u>การถือครอบครองสัตว์</u> (ข้อ 21, 22 ถามเฉพาะผู้ใหญ่บ้าน)

21. จำนวนกระบือในหมู่บ้านปีนี้_____ตัว, โค_____ตัว

22. จำนวนกระบือในหมู่บ้านปี 2529_____ตัว, โค_____ตัว

23. ขณะนี้ท่านมีกระบือ 2 ตัว, โค 4 ตัว

24. อายุและเพศกระบือและโคของท่านมีดังนี้

ลำดับที่	กระบือ	โค	อายุ (เดือน) / เพศ
1	✓		4 ปี ♂
2	✓		3 ปี ♀
3		✓	2 ปี ♀
4		✓	8 ปี ♀
5		✓	7 ปี ♀
6		✓	4 ด. ♂

ลำดับที่	กระบือ	โค	อายุ (เดือน) / เพศ
7			
8			
9			
10			
11			
12			

<u>การซื้อขายสัตว์</u>

25. ท่านคิดว่ากระบือที่มีอายุดังต่อไปนี้มีค่าตัวละประมาณเท่าใด

ลูกกระบืออายุประมาณ	4	เดือน	800 บาท
กระบืออายุ	1	ปี	2000 บาท
แม่กระบืออายุ	3	ปี	4000 บาท
แม่กระบืออายุ	5	ปี	5000 บาท
กระบือผู้อายุ	3	ปี	5500 บาท
กระบือผู้อายุ	5	ปี	6000 บาท

26. ท่านคิดว่าโคที่มีอายุดังต่อไปนี้มีค่าตัวละประมาณเท่าใด

ลูกโคอายุประมาณ	4	เดือน	1000 บาท
โคอายุ	1	ปี	3000 บาท
แม่โคอายุ	3	ปี	4500 บาท
แม่โคอายุ	5	ปี	6000 บาท
โคผู้อายุ	3	ปี	5000 บาท
โคผู้อายุ	5	ปี	7000 บาท

27. ปีที่ผ่านมา (2529) ท่านเคยซื้อกระบือ , โค หรือไม่

○ เคยซื้อ ⊘ ไม่เคยซื้อ

28. ถ้าเคยซื้อกระบือ,โคกรอกข้อความข้างล่างนี้

กระบือ(อายุ,เพศ)	เหตุผลที่ซื้อ

โค(อายุ,เพศ)	เหตุผลที่ซื้อ

29. ปีที่ผ่านมา(2529) ท่านเคยขายกระบือ,โคหรือไม่

⊘ เคยขาย ○ ไม่เคยขาย

30. ถ้าเคยขายกระบือ,โค กรอกข้อความข้างล่างนี้

กระบือ(อายุ,เพศ)	เหตุผลที่ขาย

โค (อายุ,เพศ)	เหตุผลที่ขาย
5 ปี ♀	
3 ปี ♂	ต้องการเงินใช้ในครอบครัว
3 ปี ♂	และ มีลูกเยอะ หนักมือ
2 ปี ♀	
1 ปี ♀	

การจัดการ

31. เหตุผลในการเลี้ยงกระบือ

(1.) เพื่อทำนา

2. เพื่อขายเวลาต้องการใช้เงิน

(3.) ผลิตลูกขาย

(4.) เอาอุจจาระทำปุ๋ย

5. ลากล้อ-เกวียน

6. ให้ผู้อื่นเช่า

7. เหตุผลอื่น ๆ _____

32. เหตุผลในการเลี้ยงโค

1. เลี้ยงไว้ทำนา

(2.) เลี้ยงไว้ขายเมื่อต้องการใช้เงิน

3. ผลิตลูกขาย

(4.) เอาอุจจาระทำปุ๋ย

(5.) ลากล้อ-เกวียน

6. เป็นพ่อพันธุ์

7. เหตุผลอื่น ๆ _____

33. บุคคลใดในครอบครัวทำหน้าที่ต่อไปนี้

1. เกี่ยวหญ้าและหาน้ำให้โคและกระบือ _____
2. นำโค-กระบือออกไปเลี้ยง _____ } 3
3. จัดการเกี่ยวกับการผสมพันธุ์ _____
4. ตัดสินใจซื้อ-ขายสัตว์ _____ } 1
5. ดูแลเมื่อสัตว์เจ็บป่วย _____
6. ตัดสินใจรักษาและป้องกันโรคสัตว์ _____

34. ปีที่แล้วเคยเช่ากระบือหรือไม่

○ เช่า ✓ ไม่ได้เช่า

35. ถ้าเช่า เพราะเหตุใด _____

_____

36. ปี 2529 ได้เช่ากระบือเป็นเวลานาน _____ เดือน

37. ในช่วงเวลาดังกล่าวเสียค่าเช่าสัตว์/ตัว เป็นเงิน _____ บาท

38. นอกจากหญ้ากับฟางแล้ว ท่านให้กระบือกินอะไรเป็นอาหารเสริม

○ ให้ ✓ ไม่ให้

39. ถ้าให้ ใช้อะไรเป็นอาหารเสริมระหว่างปี

_____

40. นอกจากหญ้ากับฟางแล้วท่านให้โคกินอะไรเป็นอาหารเสริม

○ ให้ ✓ ไม่ให้

41. ถ้าให้ ใช้อะไรเป็นอาหารเสริมระหว่างปี

_____

42. ปีที่แล้ว ท่านมีรายจ่ายอะไรบ้างสำหรับการเลี้ยงสัตว์

ค่าผสมเทียม - _____

ค่ายารักษาโรค 130 _____

ค่าอาหารเสริม - _____

ค่าซ่อมแซมคอกสัตว์ - _____

อื่น ๆ - _____

<u>ปัญหาโรคในโคและกระบือ</u>

43. ปีที่แล้ว(มค.-ธค. 2529) เคยมีลูกโค-กระบืออายุแรกเกิด- 1 ปี ตายในหมู่บ้านนี้บ้างหรือไม่

✓ เคย ○ ไม่เคย ○ ไม่ทราบ

44. ถ้าเคย พอจะบอกได้ไหมว่าเป็นลูกกระบือ 1 ตัว

ลูกโค 2 ตัว

45. อะไรเป็นสาเหตุสำคัญที่ทำให้ลูกโค - กระบือ ตายในหมู่บ้านนี้ช่วงปีที่ผ่านมา

ลำไส้อักเสบ เพราะมีพยาธิในลำไส้เยอะ ดูดกินลำไส้

46. ลูกสัตว์ของท่านที่มีอายุไม่เกิน 1 ปี เคยป่วยและหายได้เองในปีที่ผ่านมาหรือไม่

○ เคย ✓ ไม่เคย

47. ลูกสัตว์ของท่านที่ป่วยมีอะไรผิดปกติบ้าง และทำการรักษาอย่างไร

ลูกสัตว์ตัวที่ 1 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 2 ลูกกระบือ/ลูกโค _____

_____

48. ลูกสัตว์ของท่านตายบ้างหรือไม่ในปีที่ผ่านมา

○ ตาย ✓ ไม่ตาย

49. ถ้าตาย ก่อนตายลูกสัตว์แสดงอาการผิดปกติอย่างไร และก่อนตายได้ทำการรักษาหรือไม่ รักษาอย่างไร

ลูกสัตว์ตัวที่ 1 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 2 ลูกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 3 ลูกกระบือ/ลูกโค _____

_____

50. ปกติท่านทำอย่างไร เมื่อลูกสัตว์และสัตว์โตเต็มที่เริ่มป่วย

ลูกสัตว์	สัตว์โตเต็มที่
— ปรึกษาคนอื่น. —	

51. วิธีที่ท่านรักษาลูกสัตว์และสัตว์โตเต็มที่ ขณะนี้ต่างจากการรักษาเมื่อ 5 ปีที่แล้วไหม

(✓) แตกต่าง ( ) ไม่แตกต่าง ( ) จำไม่ได้

52. ถ้าแตกต่าง เมื่อ 5 ปีที่แล้วทำอย่างไร และทำไมจึงเปลี่ยนมาใช้วิธีใหม่

สมัยก่อนใช้ยาฉีดอย่างเดียว - ไม่ได้ผล - สัตว์ตายมาก
เมื่อปีที่แล้ว - ช่วงนี้ ปรึกษาคนอื่น - สัตว์รักษาหายดีขึ้นมาก

53. กรณีที่มีลูกสัตว์ตายในหมู่บ้าน ทำอย่างไรกับซากลูกสัตว์

ผ่าซากดูเพื่อหาสาเหตุ.

54. โดยมากชาวบ้านเปิดซากดูอวัยวะภายในหลังจากสัตว์ตาย เพื่อหาสาเหตุการตายหรือไม่

(✓) เปิดซาก ( ) ไม่เปิดซาก ( ) ไม่ทราบ

55. ถ้าเปิดซาก ท่านเคยเห็นอะไรที่อาจเป็นสาเหตุทำให้สัตว์ตายบ้าง

ตามอวัยวะ ลักษณะผิดปกติ

56. ในหมู่บ้านของท่าน ท่านคิดว่ามีโรคสำคัญที่เป็นสาเหตุทำให้โค-กระบือตายหรือไม่

(✓) มี ( ) ไม่มี ( ) ไม่ทราบ

57. ถ้ามี มีโรคอะไร ตามที่ในคู่มือสัตว์

_____

58. ในหมู่บ้านของท่าน ท่านคิดว่ามีโรคสัตว์ที่สำคัญที่จะเป็นสาเหตุให้โค-กระบือป่วยแต่ไม่ถึงกับตายบ้างไหม

(✓) มี ( ) ไม่มี ( ) ไม่ทราบ

59. ถ้ามี มีอะไร ลูกสัตว์ไม่แข็งแรง (Abortion)

การดูแลสุขภาพสัตว์

คำถามต่อไปนี้ต้องการทราบเกี่ยวกับบุคคลที่ช่วยดูแลสุขภาพสัตว์ของท่าน

60. เมื่อลูกสัตว์ป่วยท่านปรึกษาใคร

- ○ ไม่ปรึกษาใคร
- ○ ปรึกษาเพื่อน
- ✓ ปรึกษา อพสม.
- ○ ปรึกษาผู้ใหญ่บ้าน
- ○ ปรึกษาร้านขายยา
- ○ ปรึกษาปศุสัตว์อำเภอหรือสัตวแพทย์
- ○ อื่น ๆ _____

61. กรณีที่ท่านมีความต้องการจะรักษาลูกสัตว์ที่ป่วย ท่านจะซื้อยาจาก

- ○ ผู้ใหญ่บ้าน
- ✓ อพสม.
- ○ ร้านขายยา
- ○ ปศุสัตว์อำเภอหรือสัตวแพทย์
- ○ อื่น ๆ _____

62. ท่านทราบไหมว่าสิ่งนี้คืออะไร (เอาตัวอย่างพยาธิให้ดู) ทราบ

63. ท่านทราบไหมว่ามันอาศัยอยู่ที่ไหน ในลำไส้สัตว์

64. ท่านพอจะบอกได้ไหมว่าพยาธิเข้าไปอยู่ในลำไส้ลูกสัตว์ด้วยวิธีใด

ไม่ทราบ

65. ท่านคิดว่าพยาธิเหล่านี้มีผลต่อลูกสัตว์อย่างไร

ทำให้สัตว์ผอม เป็นอาหาร

66. เมื่อพบเห็นสัตว์ท่านพอจะบอกได้ไหมว่าสัตว์ตัวใดมีพยาธิภายในอาศัยอยู่

- ✓ บอกได้
- ○ บอกไม่ได้

67. ถ้าบอกได้ จงอธิบาย สัตว์สังเกตการยืนของ เช่น ขัว หงอยซึม

68. ท่านคิดว่าสัตว์ที่ท่านเคยพบเห็นมีพยาธิไหม?

- ○ ส่วนมากมี
- ○ มีเป็นบางตัว
- ✓ ไม่ทราบ

69. ท่านเคยปฏิบัติอย่างไรบ้างหรือไม่ ในการจะช่วยป้องกันลูกสัตว์จากการป่วย(โรคอื่น ๆ)

(✓) ทำ ( ) ไม่ได้ทำ

70. ถ้าทำ ทำอะไรบ้าง

ถ่ายพยาธิเมื่อลูกมีอายุ 3 สัปดาห์ และ 2 เดือน

71. ท่านเคยซื้อยาถ่ายพยาธิถ่ายให้ลูกสัตว์ โดยที่ลูกสัตว์นั้นไม่แสดงอาการบ้างไหม

( ) เคยใช้ (✓) ไม่เคยใช้ ( ) ไม่ทราบ

72. ถ้าใช้ ทำไมจึงคิดที่จะรักษาสัตว์เหล่านั้น _____

_____

73. ท่านทราบข่าวเกี่ยวกับการขายยาสัตว์ราคาถูกในหมู่บ้านหรือไม่

(✓) ทราบ ( ) ไม่ทราบ

74. ถ้าทราบ ขอให้อธิบายว่าทราบอย่างไร

อพสม. รายงานถ่ายพยาธิ ตามราคาในราคาถูก ตามโครงการ

75. ท่านทราบหรือไม่ว่ามีตัวแทนเกษตรกรที่จำหน่ายยาสัตว์ราคาถูกในตำบล, หมู่บ้าน

(✓) ทราบ ( ) ไม่ทราบ (ถ้าไม่ทราบให้ข้ามไปถามข้อ 91เลย)

76. ถ้าทราบ พอจะบอกได้ไหมว่า ตัวแทนเหล่านี้ทำหน้าที่อะไรบ้าง

ประชาสัมพันธ์ให้ความรู้เรื่องการกำจัดพยาธิ และขายยาราคาถูก

ในหมู่บ้านของตน และบ้านข้างเคียง

77. ตัวแทนเกษตรกร(อพสม.) ชื่ออะไรที่นำยามาขายในหมู่บ้านของท่าน

ทวบ - นายคำสิงห์ ดวงแก่นสาร

78. ตัวแทนเกษตรกรดังกล่าวอยู่บ้านไหน บ. หาร หมู่ 1

79. ในปีที่ผ่านมาท่านเคยเห็น อพสม.เข้ามาในหมู่บ้านท่านหรือไม่

(✓) เคย ( ) ไม่เคย ( ) ไม่ทราบ

80. ในปีที่ผ่านมา อพสม.ได้เคยพูดคุยกับท่านเกี่ยวกับการป้องกันและกำจัดพยาธิบ้างหรือไม่ (✓) เคย ( ) ไม่เคย

81. ในปีที่ผ่านมา อพสม.เคยขายยาถ่ายพยาธิอย่างใดอย่างหนึ่งให้ท่านบ้างไหม

(✓) เคย ( ) ไม่เคย

82. ท่านพอจะทราบไหมว่า อพสม.ได้ทำการประชาสัมพันธ์โดยพูดคุยกับคนอื่น ๆ ในหมู่บ้านนี้เกี่ยวกับโครงการธนาคารยาสัตว์บ้างหรือไม่ระหว่างปีที่ผ่านมา

(✓) ทราบ ( ) ไม่ทราบ

83. อพสม.ให้คำแนะนำอะไรท่านบ้างเกี่ยวกับการกำจัดพยาธิในลูกสัตว์
แนะนำให้ถ่ายพยาธิเมื่อลูกสัตว์อายุ 3 เดือน 1 ครั้ง

84. ท่านทำตามคำแนะนำของอพสม.ไหม
(✓) ทำ ( ) ไม่ทำ

85. ถ้าไม่ทำท่านมีเหตุผลอะไรจึงไม่ปฏิบัติตามคำแนะนำของ อพสม.

86. ขอให้ท่านวิจารณ์การทำงานของ อพสม.ว่าเป็นอย่างไร
ท่านมีความเชื่อถือเขาอย่างไรบ้าง

( ) อพสม.มีธุรกิจมากจึงไม่มีเวลาเพียงพอกับงานขนาดารยาสัตว์
(✓) เกษตรกรส่วนใหญ่เชื่อถือเขาและใช้ยาในการกำจัดพยาธิ์
( ) ไม่ศรัทธาในความสามารถของ อพสม.เลย
( ) ไม่ทราบว่า อพสม.มีหน้าที่อะไร
( ) เชื่อทุกอย่างที่ อพสม.แนะนำ, แต่ไม่สามารถหาเงินซื้อยาได้
( ) ไม่สามารถซื้อยาจาก อพสม.ได้เมื่อต้องการ
( ) อพสม.พยายามให้เกษตรกรใช้ยาถ่ายพยาธิ์ แต่เกษตรกรส่วนใหญ่นิยมรักษาสัตว์แบบดั้งเดิม
( ) มีเกษตรกรบางคนใช้ยาแต่เกษตรกรส่วนใหญ่คิดว่าสัตว์ไม่จำเป็นต้องรักษา
( ) อื่น ๆ _____

87. ท่านมีความลำบากในการซื้อยามารักษาสัตว์โรคทั่ว ๆ ไปของท่านไหม
( ) ลำบาก (✓) ไม่ลำบาก

88. ถ้าลำบากเนื่องจากสาเหตุใด _____

89. ท่านเคยซื้อยาถ่ายพยาธิ์สำหรับลูกสัตว์จากอพสม.หรือไม่
(✓) เคย ( ) ไม่เคย

90. สัตว์อายุเท่าใดที่ท่านใช้ยาถ่ายพยาธิ์,
ลูกสัตว์ 3 ~~สัปดาห์~~ เดือน 7 ตัว, ( ) ไม่แน่นอน
กระบือใหญ่ 2 ปี 2 ตัว,
โคใหญ่ 4 ปี 1 ตัว

91. วิธีใดที่ท่านคิดว่าจะรักษาชีวิตสัตว์ได้ดีกว่ากัน

ก. รักษาโดยวิธีดั้งเดิม

(ข.) รักษาโดยยาของ อพสม.

92. ท่านคิดว่าสัตว์มีสุขภาพดีขึ้นหรือไม่หลังจากถ่ายพยาธิ์

(ดี) ○ ไม่ดี ○ ไม่ทราบ

93. ถ้าดี คืออย่างไร ดูแข็งแรงมีสุขภาพแข็งแรงดี อ้วนขึ้น

94. ท่านเคยเห็นหอยชนิดนี้ไหม (แสดงตัวอย่างหอย)

(เคย) ○ ไม่เคย

95. ท่านทราบไหมหอยชนิดนี้อาศัยที่ไหน ในหนองน้ำข้างบ้าน

96. ท่านทราบอะไรเป็นพิเศษอีกหรือไม่เกี่ยวกับหอยชนิดนี้

ทราบแต่ว่าทำให้คัน - นอกจากนี้ไม่ทราบ -

97. ท่านทราบหรือไม่ว่านี้เป็นอะไร (แสดงตัวอย่างพยาธิ์ใบไม้ตับ)

ทราบ

98. ท่านทราบไหมว่าพยาธิ์ใบไม้ตับอาศัยอยู่ที่ส่วนใดของร่างกายสัตว์ ตับ

99. ท่านเคยเห็นพยาธิ์ชนิดนี้บ้างไหมในสัตว์ที่ตายในหมู่บ้านของท่าน

(เคยเห็น) ○ ไม่เคยเห็น

100. สัตว์ของท่านเองเคยรับการฉีดยาถ่ายพยาธิ์ใบไม้ตับจาก อพสม.บ้างหรือไม่ระหว่างปีที่ผ่านมา

(เคย) ○ ไม่เคย

101. ท่านเคยสังเกตความแตกต่างของสัตว์ของท่านหลังฉีดยาหรือไม่

(เคย) ○ ไม่เคย ○ ไม่ทราบ

102. ถ้าเคยแตกต่างอย่างไร สัตว์อ้วนท้วนขึ้น - กินหญ้าดีขึ้น เหงื่อออกดีขึ้น เพราะกินยา 1 เดือน

103. ปีที่ผ่านมาท่านขายสัตว์ที่ฉีดยาถ่ายพยาธิ์ใบไม้ตับไปแล้วกี่ตัว 3 ตัว

104. ท่านพอจะให้ความเห็นเกี่ยวกับผลการรักษาสัตว์ของท่าน ดังต่อไปนี้ได้หรือไม่

สัตว์ตัวที่	ราคาก่อนรักษา	ราคาหลังรักษา	ขายไปหลังจากถ่ายพยาธิ์แล้ว
1	4090	5000	1 เดือน
2	3500	4500	1 เดือน
3	4000	5500	1 เดือน
			เดือน

105. ท่านเคยเห็นสื่อประชาสัมพันธ์เกี่ยวกับโครงการธนาคารยาสัตว์บ้างไหม

- [x] เคยเห็น
- [ ] ไม่เคยเห็น
- [ ] ไม่ทราบ

106. ถ้าเคยเห็น เคยเห็นจากอะไร

- [x] โปสเตอร์
- [ ] ภาพยนต์, วีดีโอ, สไลด์, โทรทัศน์
- [ ] เอกสาร
- [ ] อื่น ๆ ____________________

107. ท่านมีความคิดเห็นเพิ่มเติมอะไรบ้าง เกี่ยวกับการสัมภาษณ์ในวันนี้

โครงการนี้ดีมาก - มีประโยชน์ต่อสุขภาพสัตว์โดยส่วนรวม
ในหมู่บ้าน ลูกสัตว์ลดการตายลงได้มาก สัตว์ใหญ่แข็ง
แรง และใช้งานได้ดีขึ้น เป็นที่น่าพอใจต่อเกษตรกรมาก.

APPENDIX 2 (cont.)

Keyman Interview Questionnaires

(in Thai)

แบบสอบถามสำหรับ อพสม.

1. แบบสอบถามหมายเลข K 6
2. วันที่สอบถาม 24/7/30 (24/7/87)
3. ผู้สอบถาม นพดล อินทร

ข้อมูลเบื้องต้น

4. ชื่อ อพสม. พ.ต.สมโภชน์ ปัจจิตพงษ์
5. เพศ (✓) ชาย ( ) หญิง
6. อายุ 21 ปี (14ต.ค.10/11)
7. ที่อยู่ 48/2 หมู่ 11 ม.ถนนชัย ต.บ้านไทร อ.ปากช่อง จ.สุรินทร์
8. สถานะทางครอบครัว (✓) แต่งงานแล้ว ( ) โสด ( ) หย่าร้าง
9. สมาชิกในครอบครัวท่านมีทั้งหมด 4 คน(รวมตัวท่านด้วย)

10. อาชีพหลักทางการเกษตร

(1) ทำนา
2 เลี้ยงโค
3 เลี้ยงกระบือ
4 เลี้ยงโคและกระบือ
5 อื่น ๆ

11. อาชีพรองทางการเกษตร

1 ทำไร่มันสำปะหลัง
2 ทำไร่ปอ
3 ทำไร่ฝ้าย
4 ทำการเพาะปลูกพืชชนิดอื่น ๆ
5 ทอผ้า
(6) อื่น ๆ เป็น ศอม. สุรินทร์ (ศอม. = ยุทธศึกษาอาสาสมัครประจำหมู่บ้าน)

12. ทำอาชีพทางการเกษตรเป็นงานหลักใช่หรือไม่

(✓) ใช่ ( ) ไม่ใช่

13. งานหลักที่ทำอยู่ขณะนี้ ทำนา

14. อาชีพอื่น ๆ ที่ไม่เกี่ยวกับการเกษตร

1 ค้าขาย

2 ขับรถ

3 ช่างไม้

4 รับจ้าง

5 อื่น ๆ (ระบุ)

15. มีเนื่อที่ทำกินของตัวเอง 25 ไร่, เช่าคนอื่น - ไร่

ทำนา 25 ไร่

ทำไร่ - ไร่

16. ในการเลี้ยงสัตว์ท่านใช้พื้นที่สาธารณะหรือไม่

( ) ใช้ (✓) ไม่ใช้

17. ถ้าใช้, ใช้ในช่วงไหนของแต่ละปี

18. ปี 2529 ท่านมีรายได้จาก

กระบือ 8000 บาท

โค - บาท

สัตว์ชนิดอื่น ๆ (ระบุ)

1 _____ _____ บาท

2 _____ _____ บาท

3 _____ _____ บาท

ข้าว 10000 บาท

มันสำปะหลัง _____ บาท

ปอ _____ บาท

อ้อย _____ บาท

ข้าวโพด _____ บาท

~~พืชชนิด~~อื่น ๆ (ระบุ)

1 @พสม. 1650 บาท (@พสม = อาสาพัฒนาสัตวแพทย์ ม.ล.ลำพูน = Keyman)

2 _____ _____ บาท

3 _____ _____ บาท

19. สรุปปีที่ผ่านมา (2529) ท่านมีรายได้รวม 19,650 บาท

การถือครอบครองสัตว์ (ข้อ 21, 22 ถามเฉพาะผู้ใหญ่บ้าน)

20. จำนวนกระบือในหมู่บ้านปีนี้ 318 ตัว, โค 18 ตัว

21. จำนวนกระบือในหมู่บ้านปี 2529 3257 ตัว, โค 413 ตัว

22. ขณะนี้ท่านมีกระบือ 3 ตัว, โค - ตัว

23. อายุและเพศกระบือและโคของท่านมีดังนี้

ลำดับที่	กระบือ	โค	อายุ (เดือน) / เพศ
1	✓		4 ♂
2	✓		5 ♀
3	✓		1 ♂
4			
5			
6			

ลำดับที่	กระบือ	โค	อายุ (เดือน) / เพศ
7			
8			
9			
10			
11			
12			

การซื้อขายสัตว์

24. ท่านคิดว่ากระบือที่มีอายุดังต่อไปนี้มีค่าตัวละประมาณเท่าใด

ลูกกระบืออายุประมาณ	4	เดือน	1000 บาท
กระบืออายุ	1	ปี	2500 บาท
แม่กระบืออายุ	3	ปี	4000 บาท
แม่กระบืออายุ	5	ปี	5000 บาท
กระบือผู้อายุ	3	ปี	6000 บาท
กระบือผู้อายุ	5	ปี	7000 บาท

25. ท่านคิดว่าโคที่มีอายุดังต่อไปนี้มีค่าตัวละประมาณเท่าใด

ลูกโคอายุประมาณ	4	เดือน	2000 บาท
โคอายุ	1	ปี	3000 บาท
แม่โคอายุ	3	ปี	4000 บาท
แม่โคอายุ	5	ปี	5000 บาท
โคผู้อายุ	3	ปี	4500 บาท
โคผู้อายุ	5	ปี	5000 บาท

26. ปีที่ผ่านมา (2529) ท่านเคยซื้อกระบือ, โคหรือไม่

○ เคยซื้อ ✓ ไม่เคยซื้อ

27. ถ้าเคยซื้อกระบือ,โคกรอกข้อความข้างล่างนี้

กระบือ(อายุ,เพศ)	เหตุผลที่ซื้อ

โค(อายุ,เพศ)	เหตุผลที่ซื้อ

28. ปีที่ผ่านมา(2529) ท่านเคยขายกระบือ,โคหรือไม่

✓ เคยขาย ○ ไม่เคยขาย

29. ถ้าเคยขายกระบือ,โค กรอกข้อความข้างล่างนี้

กระบือ(อายุ,เพศ)	เหตุผลที่ขาย
5 ปี♂	ต้องการเงินมาลงทุน

โค(อายุ,เพศ)	เหตุผลที่ขาย

การจัดการ

30. เหตุผลในการเลี้ยงกระบือ

(1) เพื่อทำนา

2 เพื่อขายเวลาต้องการใช้เงิน

3 ผลิตลูกขาย

(4) เอาอุจจาระทำปุ๋ย

5 ลากล้อ-เกวียน

6 ให้ผู้อื่นเช่า

7 เหตุผลอื่น ๆ _____

31. เหตุผลในการเลี้ยงโค

1 เลี้ยงไว้ทำนา

2 เลี้ยงไว้ขายเมื่อต้องการใช้เงิน

3 ผลิตลูกขาย

4 เอาอุจจาระทำปุ๋ย

5 ลากล้อ-เกวียน

6 เป็นพ่อพันธุ์

7 เหตุผลอื่น ๆ _____

32. บุคคลใดในครอบครัวทำหน้าที่ต่อไปนี้

1 เกี่ยวหญ้าและหาน้ำให้โคและกระบือ _____

2 นำโค-กระบือออกไปเลี้ยง _____

3 จัดการเกี่ยวกับการผสมพันธุ์ _____

4 ตัดสินใจซื้อขายสัตว์ _____ 1

5 ดูแลเมื่อสัตว์เจ็บป่วย _____

6 ตัดสินใจรักษาและป้องกันโรคสัตว์ _____

33. ปีที่แล้วเคยเช่ากระบือหรือไม่

(○) เช่า (✓) ไม่ได้เช่า

34. ถ้าเช่า เพราะเหตุใด _____

_____

35. ปี 2529 ได้เช่ากระบือเป็นเวลานาน _____เดือน

36. ในช่วงเวลาดังกล่าวเสียค่าเช่าสัตว์/ตัว เป็นเงิน _____ บาท

37. นอกจากหญ้ากับฟางแล้วท่านให้กระบือกินอะไรเป็นอาหารเสริม

○ ให้ ✓ ไม่ให้

38. ถ้าให้ ใช้อะไรเป็นอาหารเสริมระหว่างปี

_____

39. นอกจากหญ้ากับฟางแล้ว ท่านให้โคกินอะไรเป็นอาหารเสริม

○ ให้ ✓ ไม่ให้

40. ถ้าให้ ใช้อะไรเป็นอาหารเสริมระหว่างปี

_____

41. ปีที่แล้ว ท่านมีรายจ่ายอะไรบ้างสำหรับการเลี้ยงสัตว์

ค่าผสมเทียม -

ค่ายารักษาโรค 20

ค่าอาหารเสริม -

ค่าซ่อมแซมคอกสัตว์ -

อื่น ๆ ค่าเชือก 30

<u>ปัญหาโรคในโคและกระบือ</u>

42. ปีที่แล้ว(มค.-ธค 2529) เคยมีลูกโค-กระบืออายุแรกเกิด- 1 ปี ตายในหมู่บ้านนี้บ้างหรือไม่

○ เคย ✓ ไม่เคย ○ ไม่ทราบ

43. ถ้าเคย พอจะบอกได้ไหมว่าเป็นลูกกระบือ_____ตัว

ลูกโค _____ตัว

44. อะไรเป็นสาเหตุสำคัญที่ทำให้ลูกโค - ลูกกระบือ ตายในหมู่บ้านนี้ช่วงปีที่ผ่านมา

_____

45. ลูกสัตว์ของท่านที่มีอายุไม่เกิน 1 ปี เคยป่วยและหายได้เองในปีที่ผ่านมาหรือไม่

○ เคย ✓ ไม่เคย

46. ลูกสัตว์ของท่านที่ป่วยมีอะไรผิดปกติบ้าง และทำการรักษาอย่างไร

ลูกสัตว์ตัวที่ 1 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 2 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 3 ลูกกระบือ/ลูกโค _____

47. ลูกสัตว์ของท่านตายบ้างหรือไม่ในปีที่ผ่านมา

○ ตาย ⊘ ไม่ตาย

48. ถ้าตาย ก่อนตายลูกสัตว์แสดงอาการผิดปกติอย่างไร และก่อนตายได้ทำการรักษาหรือไม่ รักษาอย่างไร

ลูกสัตว์ตัวที่ 1 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 2 ลูกกระบือ/ลูกโค _____

_____

ลูกสัตว์ตัวที่ 3 ลูกกระบือ/ลูกโค _____

_____

49. ปกติท่านทำอย่างไร เมื่อลูกสัตว์และสัตว์โตเต็มที่เริ่มป่วย

ลูกสัตว์	สัตว์โตเต็มที่
ใช้ยาในโครงการตามคำสั่ง	ปรึกษาปศุสัตว์อำเภอ (ปสอ)
ถ้าเกินความสามารถปรึกษา ปสอ.	

50. วิธีที่ท่านรักษาลูกสัตว์และสัตว์โตเต็มที่ขณะนี้ต่างจากการรักษาเมื่อ 5 ปี ที่แล้วไหม

⊘ แตกต่าง ○ ไม่แตกต่าง ○ จำไม่ได้

51. ถ้าแตกต่าง เมื่อ 5 ปีที่แล้วทำอย่างไร และทำไมจึงเปลี่ยนมาใช้วิธีใหม่

เคยใช้ยาสมุนไพรรักษาสัตว์ แต่ไม่ได้ผลเท่าที่ควร.

ต่อมาจึงได้ใช้ยาในโครงการตามคำสั่งฯ เพราะมีประสิทธิภาพดี, สะดวก

52. กรณีที่มีลูกสัตว์ตายในหมู่บ้าน ทำอย่างไรกับซากลูกสัตว์

ฝังหมดครับ.

53. โดยมากชาวบ้านเปิดซากดูอวัยวะภายในหลังจากสัตว์ตาย เพื่อหาสาเหตุการตายหรือไม่

⊘ เปิดซาก ○ ไม่เปิดซาก ○ ไม่ทราบ

54. ถ้าเปิดซาก ท่านเคยเห็นอะไรที่อาจเป็นสาเหตุทำให้สัตว์ตายบ้าง

พยาธิในเลือด, ปอดอักเสบ ลำไส้

55. ในหมู่บ้านของท่านท่านคิดว่ามีโรคสำคัญที่เป็นสาเหตุทำให้โค-กระบือตายหรือไม่

○ มี ✓ ไม่มี ○ ไม่ทราบ

56. ถ้ามี มีโรคอะไร _____

_____

57. ในหมู่บ้านของท่าน ท่านคิดว่ามีโรคสัตว์ที่สำคัญที่จะเป็นสาเหตุให้โค-กระบือป่วย แต่ไม่ถึงกับตายบ้างไหม

✓ มี ○ ไม่มี ○ ไม่ทราบ

58. ถ้ามี มีอะไร _____

_____

กิจกรรม อพสม.

59. ท่านเคยฉีดยาสัตว์ก่อนท่านมาเป็น อพสม. ไหม (ครบ)

○ เคย ✓ ไม่เคย

60. ท่านเป็น อพสม.มาแล้วเป็นเวลา 3 ปี

61. ท่านมีภาระกิจเป็นทางการอะไรบ้าง ในหมู่บ้านของท่าน (ไม่นับการเป็นอพสม.)

1) ผช.สส.(ผู้ช่วยช่างสาธารณสุขประจำหมู่บ้าน)

2) _____

3) _____

4) _____

62. ท่านเป็นอาสาสมัครในโครงการอื่นนอกจากโครงการธนาคารยาสัตว์หรือไม่

✓ เป็น ○ ไม่เป็น

63. ในตำบลของท่านมี 16 หมู่บ้าน

64. ในตำบลของท่าน ท่านต้องควบคุมการกำจัดพยาธิ์ 8 หมู่บ้าน

65. ตั้งแต่ท่านเริ่มเป็น อพสม.ท่านเคยไปทำการประชาสัมพันธ์โครงการฯในหมู่บ้านอื่นนอกจากหมู่บ้านของท่านไหม

✓ เคย ○ ไม่เคย

66. ถ้าเคย ท่านเคยไปทำการประชาสัมพันธ์ 8 หมู่บ้าน

67. ในปีที่ผ่านมาท่านไป 8 หมู่บ้าน

68. มีคนช่วยขายยาสัตว์เวลาท่านไม่อยู่หรือไม่

(✓) มี ( ) ไม่มี

69. ท่านได้รับอุปกรณ์ในการประชาสัมพันธ์โครงการธนาคารยาสัตว์จากกรมปศุสัตว์เพียงพอหรือไม่

( ) เพียงพอ (✓) ไม่เพียงพอ

70. ท่านคิดว่าสิ่งต่อไปนี้เป็นประโยชน์ต่อการประชาสัมพันธ์โครงการมากน้อยเพียงใด

	มีประโยชน์มาก	มีประโยชน์บ้าง	ไม่ให้ประโยชน์
โปสเตอร์	✓		
ภาพยนต์	✓		
เอกสาร	✓		
อื่น ๆ			

71. ท่านให้ผู้อื่นช่วยประชาสัมพันธ์โครงการนี้บ้างหรือไม่

(✓) ให้ช่วย ( ) ไม่เคยให้ช่วย

72. ถ้าให้ผู้อื่นช่วย ให้ใครช่วยบ้าง

(✓) เพื่อนบ้าน ( ) ภรรยา

(✓) ปศุสัตว์อำเภอ ( ) เจ้าหน้าที่จากศูนย์ชันสูตรท่าพระ

(✓) ผู้ใหญ่บ้าน ( ) สมาชิกคนอื่นในครอบครัว

( ) อื่น ๆ _____

73. ปีที่แล้วท่านทำการประชาสัมพันธ์โครงการนี้อย่างไร (ขีดข้อความที่ไม่ต้องการ)

	หมู่บ้านตัวเอง	หมู่บ้านอื่น
1) พูดคุยกับเกษตรกรที่พบปะ	(ทำ), ไม่ทำ	(ทำ), ไม่ทำ
2) พูดคุยระหว่างประชุมหมู่บ้าน	(ทำ), ไม่ทำ	(ทำ), ไม่ทำ
3) แจกเอกสาร	ทำ, (ไม่ทำ)	ทำ, (ไม่ทำ)
4) ติดโปสเตอร์	(ทำ), ไม่ทำ	ทำ, (ไม่ทำ)
5) อื่น ๆ	ทำ, ไม่ทำ	ทำ, ไม่ทำ

74. ในปีที่ผ่านมาท่านทำการประชาสัมพันธ์โครงการธนาคารยาสัตว์มากน้อยเพียงใด

1) ประชุมชี้แจงเกษตรกรร่วมกับผู้ใหญ่บ้านในหมู่บ้านตัวเอง 2 ครั้ง

2) ประชุมชี้แจงเกษตรกรร่วมกับผู้ใหญ่บ้าน/กำนันในหมู่บ้านอื่น 32 ครั้ง

3) พูดคุยหรือแนะนำเกษตรในเรื่องการป้องกันกำจัดพยาธิ์สัตว์ 8 ครั้ง

75. การยอมรับของเกษตรกรในหมู่บ้านของท่าน เกี่ยวกับโครงการธนาคารยาสัตว์เป็นอย่างไรบ้างเมื่อเทียบกับหมู่บ้านอื่น

○ ดีกว่า ✓ เหมือนกัน ○ น้อยกว่า

76. ในการประชาสัมพันธ์โครงการธนาคารยาสัตว์ ท่านต้องการความช่วยเหลืออะไรเพิ่มเติมบ้าง ต้องการให้มีการประชาสัมพันธ์มากขึ้นโดยการสื่อมวลชน เช่น วิทยุ โทรทัศน์ ในระดับหมู่บ้านอย่างน้อยเดือนละครั้ง

ความรู้พื้นฐานของเกษตรกรเกี่ยวกับพยาธิ์

77. ท่านคิดว่าเกษตรกรมีวิธีการกำจัดพยาธิ์โคและกระบือได้ผลดีก่อนมีโครงการนี้หรือไม่

○ ได้ผลดี ✓ ไม่ได้ผลดี

78. ถ้าได้ผลดี เกษตรกรใช้วิธีใดในการถ่าพยาธิ์ลูกสัตว์และโค-กระบือใหญ่

ลูกสัตว์	โค-กระบือใหญ่

79. หลังจากประชาสัมพันธ์ให้เกษตรกรในหมู่บ้านของท่านทราบแล้ว เขาตอบสนองท่านอย่างไรบ้าง(ควรตอบ 1 ข้อหรือมากกว่า)

○ เกษตรกรเห็นว่าควรจะแจกยามากกว่าขาย

✓ เกษตรกรส่วนใหญ่เชื่อถือและใช้ยาในการกำจัดพยาธิ์

○ เกษตรกรส่วนใหญ่ไม่ทราบว่าท่านมีหน้าที่อะไรในโครงการธนาคารยาสัตว์

○ เกษตรกรเชื่อแต่ไม่สามารถหาเงินมาซื้อยาได้

○ เกษตรกรไม่สนใจในการกำจัดพยาธิ์สัตว์

○ ท่านได้พยายามกระตุ้นเกษตรกรให้ใช้ยากำจัดพยาธิ์กว่าเกษตรกรต้องการใช้วิธีเดิม

○ มีเกษตรกรบางคนใช้ยาแต่เกษตรกรส่วนใหญ่ในหมู่บ้านไม่คิดที่จะรักษาสัตว์

80. หลังจากประชาสัมพันธ์ให้เกษตรกรในหมู่บ้านอื่น ทราบแล้วเขาตอบสนองท่านอย่างไรบ้าง

- ○ เกษตรกรเห็นว่าควรจะแจกยามากกว่าขาย
- ✓ เกษตรกรส่วนใหญ่เชื่อถือท่านและใช้ยากำจัดพยาธิ์
- ○ เกษตรกรส่วนใหญ่ไม่ทราบว่าท่านทำหน้าที่อะไรในโครงการฯ
- ○ เกษตรกรส่วนใหญ่เชื่อแต่ไม่สามารถหาเงินมาซื้อยาได้
- ○ เกษตรกรส่วนใหญ่ไม่สนใจการกำจัดพยาธิ์สัตว์
- ○ ท่านได้พยายามกระตุ้นเกษตรกรให้ใช้ยากำจัดพยาธิ์แต่เกษตรกรต้องการใช้วิธีเดิม
- ○ เกษตรกรบางคนใช้ยาถ่ายพยาธิ์ แต่เกษตรกรส่วนใหญ่ในหมู่บ้านไม่คิดที่จะรักษาสัตว์

81. ท่านเคยใช้ยาในโครงการธนาคารยาสัตว์ถ่ายพยาธิ์สัตว์ของท่านเองบ้างหรือไม่

✓ เคย ○ ไม่เคย

82. ถ้าเคย หลังจากถ่ายพยาธิ์แล้วสัตว์ของท่านเป็นอย่างไรบ้าง

สัตว์มีสุขภาพดีขึ้น และ น.น.เพิ่มมากขึ้น เป็นที่น่าพอใจมาก

83. ถ้าไม่เคย เพราะอะไรจึงไม่ใช้ยาในโครงการฯ

---

84. หลังจากใช้ยาถ่ายพยาธิ์แล้วเกษตรกรพูดให้ฟังถึงสุขภาพสัตว์ที่ดีขึ้นอย่างไรบ้าง

✓ พูดให้ฟังบ่อย ๆ ○ บางครั้ง ○ ไม่เคยพูดถึง

85. หลังจากใช้ยาถ่ายพยาธิ์แล้วเกษตรกรมักจะบ่นว่ายาไม่มีประสิทธิภาพอย่างไรบ้าง

○ พูดให้ฟังบ่อย ๆ ○ บางครั้ง ✓ ไม่เคยพูดถึง

86. หลังจากการถ่ายพยาธิ์แล้วตัวท่านเองเห็นว่าสุขภาพสัตว์ของเกษตรกรเป็นอย่างไร

✓ ดีขึ้นกว่าเดิม ○ เหมือนเดิม ○ เลวลงกว่าเดิม

87. ท่านพอจะประเมินราคาของสัตว์หลังการใช้ยาถ่ายพยาธิ์เท่าที่ได้พบเห็นมาได้หรือไม่

ชนิดสัตว์	ราคาสัตว์ก่อนถ่ายยา	ราคาสัตว์หลังถ่ายยา
ลูกสัตว์อายุไม่เกิน 1 ปี	1000	1500
กระบือเพศเมีย	2000	3000
โคเพศเมีย	2500	3500
โคพ่อพันธุ์	3000	4500
กระบือพ่อพันธุ์	4000	6000
กระบือตอนแล้ว	4000	6000
โคตอนแล้ว	3500	5000

การจัดการเกี่ยวกับโครงการ

88. ท่านมีความเห็นอย่างไรในเรื่องต่อไปนี้

การจ่ายยาของปศุสัตว์อำเภอ ไม่ค่อยสม่ำเสมอ บางครั้งยาหมด stock

ราคายาในโครงการขนาดยาสัตว์ ถูกพอสมควร

ชนิดของยาที่จัดให้ขาย น้อยเกินไป - ต้องการยาบางชนิดเพิ่มเติม นอกเหนือจากยาถ่ายพยาธิ เช่น ยาปฏิชีวนะ อุปกรณ์ต่างๆ สำหรับสัตว์

89. ท่านจัดทำสมุดบันทึกการรับและการขายยาหรือไม่

บันทึกการรับยา ✓ ทำ ○ ไม่ทำ

บันทึกการขายยา ✓ ทำ ○ ไม่ทำ

90. หลังการใช้ยาถ่ายพยาธิเคยปรากฏว่ามีสัตว์ แพ้ยา หรือ ตาย บ้างหรือไม่

สัตว์ป่วยหลังการใช้ยาไม่นาน ✓ เคยมี ○ ไม่เคยมี

ถ้ามี เป็นลูกโค/ลูกกระบือ - ตัว

เป็นโค/กระบือใหญ่ 2 ตัว

สัตว์ตายหลังการใช้ยา ○ เคยมี ✓ ไม่เคยมี

ถ้ามี เป็นลูกโค/ลูกกระบือ _____ ตัว

เป็นโค/กระบือใหญ่ _____ ตัว

91. ท่านมีความยุ่งยากในการเก็บรักษายาหรือไม่

○ มี ✓ ไม่มี

92. ท่านยังคงเก็บรักษายาและอุปกรณ์ไว้ในกระเป๋ายาที่จัดไว้ให้หรือไม่

✓ เก็บไว้ ○ ไม่ได้เก็บ

93. ท่านเก็บค่ายาถ่ายพยาธิลูกสัตว์อย่างไร

สูตร 1 7 บาท

สูตร 2 10 บาท

94. ท่านคิดราคายาฉีดกำจัดพยาธิใบไม้ตับอย่างไร

○ 7 บาท/น้ำหนักสัตว์ประมาณ 100-200 กิโลกรัม

○ 8.50 บาท/น้ำหนักสัตว์ประมาณ 250-350 กิโลกรัม

○ 11 บาท/น้ำหนักสัตว์มากกว่า 350 กิโลกรัม

✓ 10 บาท/ตัว

○ 15 บาท/ตัว

○ 20 บาท/ตัว

○ มากกว่า 20 บาท/ตัว

○ ซี.ซี.ละ บาท

95. ท่านมีความเห็นอย่างไรบ้างสำหรับค่าตอบแทน 13 % ที่ทางการจัดให้

ดีอยู่

96. ท่านมีความเห็นอย่างไรบ้างสำหรับ อพสม. 2 คน/ตำบล

○ สามารถที่จะบริการหมู่บ้านอื่นได้อีกด้วย

○ พอดีแล้ว

✓ น้อยเกินไปทำให้เกินกำลังที่จะบริการได้ควรมี 6 คน

97. ปีที่ผ่านมาท่านรับและขายยาถ่ายพยาธิมากน้อยขนาดไหน

	รับยา	ขายยา
สูตร 1	220 ขวด	200
สูตร 2	130 ขวด	111

98. เมื่อท่านเดินทางไปประชาสัมพันธ์โครงการกำจัดพยาธิในหมู่บ้านอื่นท่านเดินทางโดยอะไร

1 เดินไป

2 ใช้รถจักรยาน

(3) ใช้รถมอเตอร์ไซค์

4 ใช้รถยนต์

99. ปีที่ผ่านมาท่านรับและขายยาฉีดไบลีวอนไปแล้วกี่ขวด

รับยา 72 ขวด , ขายยา 70 ขวด

100. ท่านพอจะบอกได้ไหมว่าลูกสัตว์ได้รับพยาธิเข้าไปอยู่ในลำไส้อย่างไร

(อพสม. บอกได้ลูกสัตว์)

101. ท่านแนะนำเกษตรกรให้ถ่ายพยาธิลูกสัตว์เมื่ออายุเท่าใดบ้าง

3 และ 10 เดือน

102. ท่านเข้าใจไหมว่าสัตว์ติดโรคพยาธิใบไม้ตับด้วยวิธีใด

(อพสม. บอกได้ลูกสัตว์ - มีความเข้าใจพอสมควร)

103. ท่านพอจะบอกได้ไหมว่า โคและกระบือใหญ่จำเป็นต้องกำจัดโรคพยาธิใบไม้ตับ เมื่อใด และบ่อยแค่ไหน (อพสม. บอกได้ถูกต้อง)

ถ่าย ครั้งแรกเมื่อ สัตว์อายุประมาณ 1 ปี และต่อไปปีละ 1 ครั้ง เป็นอย่างน้อย

104. ท่านอยากให้มีการเปลี่ยนแปลงการติดตามผลอพสม.หรือไม่อย่างไร

ต้องการให้มีการติดตามผลในหมู่บ้าน บ่อยๆ

105. ท่านมีความเห็นเพิ่มเติมอย่างไรบ้างเกี่ยวกับเรื่องโครงการนี้

① ยาที่ใช้ในโครงการมีคุณภาพดี ราคาถูก ไม่ทำให้เกษตรกร เดือดร้อน และราคาก็ไม่แพง ไม่ต้องไปซื้อจากตลาด.

② โครงการกองทุนยาสัตว์ช่วยแบ่งเบาภาระของปศุสัตว์อำเภอ ได้มาก เพราะเกษตรกรสามารถช่วยตัวเองในด้านดูแลสุขภาพ สัตว์ขั้นพื้นฐาน.

APPENDIX 3

PERIODS OF SURVEY IN PHASES 1 AND 2

Date	Planning for field survey
2-3 Mar.1987	Discussed and arranged the survey with the local supervisors and staff involved in the program at the NE-VRDC, Tha Phra, Khon Kaen.
4-6 Mar.1987	Questionnaire forms were prepared in Thai version for farmers and keymen.
3-13 Mar.1987	Official contact was made with the survey to: 1. The six Provincial Livestock Officers of Mahasarakam, Surin, Khon Kaen, Loei, Udorn and Kalasin 2. Twenty four District Livestock Officers

Survey in Phase 1 **(Mahasarakam)**

Date	Survey team	Area interviewed (Districts)	Number of interviewees
6 Mar.1987	3,4	Gosumpisai *	8F+4VH
	1,2	Borabue **	8F+4VH
17 Mar.1987	1,2	Gosumpisai	8F+4VH
	3,4	Borabue	8F+4VH+1KM
19 Mar.1987	1,4	Gosumpisai	8F+4VH
	3,2	Borabue	8F+4VH
20 Mar.1987	1,3	Gosumpisai	8F+4VH+1KM
	2,4	Borabue	7F+4VH
23 Mar.1987	3,4	Gosumpisai	8F+4VH
	1,2	Borabue	6F+4VH
24 Mar.1987	1,2	Chiengyuen *	8F+4VH
	3,4	Payakhapumpisai **	8F+4VH
26 Mar.1987	1,4	Chiengyuen	8F+4VH
	2,3	Payakhapumpisai	8F+4VH
27 Mar.1987	1,3	Chiengyuen	8F+4VH
	2,4	Payakhapumpisai	8F+4VH
30 Mar.1987	1,4	Chiengyuen	8F+4VH
	2,3	Payakhapumpisai	6F+4VH
31 Mar.1987	1,4	Chiengyuen	8F+4VH
	2,3	Payakhapumpisai	7F+4VH
7 Apr.1987	Prof. R.S. Morris Dr. S.Srihakim Dr. Krudenner Dr. K.Leidl Dr. M.Polpark Dr. L.Srikitjakarn Dr. N.Meemark	Chiengyuen Payakhapum.	2F+1VH+1KM 2F+1VH+1KM

Survey team: *1 = Dr. Nopadon Meemark*
2 = Dr. Lertruk Srikitjakarn
3 = Ms. Rungsuda Sukhamol
4 = Dr. Manviga Polpark

Survey in Phase 2 (SR,KK,LE,UD,KS)

Date	Area interviewed	Number of interviewees
	Khon Kaen	
13-14 May 1987	Munjakeeree **	6F+3VH+1KM
18-19 May 1987	Pon **	6F+3VH+1KM
20 May 1987	Phuphaman *	6F+3VH+1KM
21 May 1987	Chumponburee *	6F+3VH+1KM
	Loei	
3 June 1987	Wangsa pung **	6F+3VH+1KM
4 June 1987	Chiengkan **	6F+3VH+1KM
16 June 1987	Maung *	6F+3VH+1KM
17 June 1987	Phuruoe *	6F+3VH+1KM
	Udorn	
7 July 1987	Na klang	6F+3VH
8 July 1987	Ban dung	6F+3VH
9 July 1987	Srithat	6F+3VH
10 July 1987	Nonghan	6F+3VH
	Kalasin	
14 July 1987	Maung	6F+3VH
15 July 1987	Kamalasai	6F+3VH
16 July 1987	Yangtalad	6F+3VH
17 July 1987	Sahassakan	6F+3VH
	Surin	
20 July 1987	Prasart **	6F+3VH+1KM
21 July 1987	Rattanaburee **	6F+3VH+1KM
22 July 1987	Chompra *	6F+3VH+1KM
23 July 1987	Chumponburee *	6F+3VH+1KM

** Low adoption area*
*** High adoption area*
F = Farmer
VH = Village headmen
KM = Keyman

APPENDIX 4

Geographical Information Concerning the Study Area

The following Figures describe the areas in which the study was carried out.

Figure 4.1 Thailand, showing the provinces of the north-east in which the project took place

Figure 4.2 Mahasarakam province, showing the study sites for Phase 1

Figures 4.3 to 4.6 Villages in which the study was conducted in Mahasarakam, with scale on Figure 4.3

Figures 4.7 to 4.11 Maps of the five provinces studied in Phase 2, showing the location of the study areas

Figures 4.12 to 4.23 Villages in which the study was conducted in Phase 2. Each figure shows details of the villages studied and the keymen used by the farmers, plus a map showing the distance from each study village to the village of the keyman serving the area.

Figure 4.1 THE PROVINCES IN THE STUDY AREAS

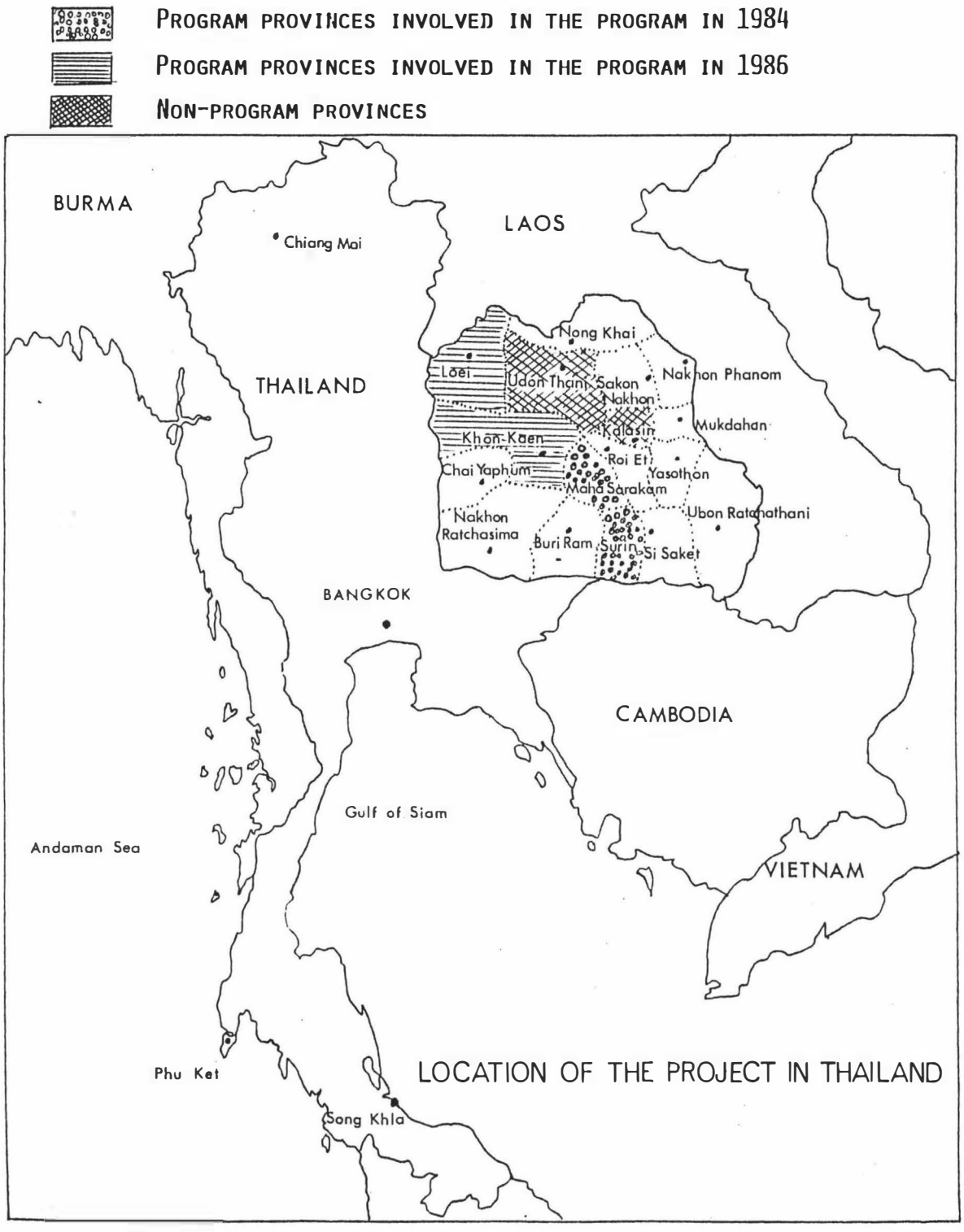


Figure 4.2

GEOGRAPHICAL INFORMATION SHOWS STUDY AREAS IN PHASE 1: MAHASARAKAM

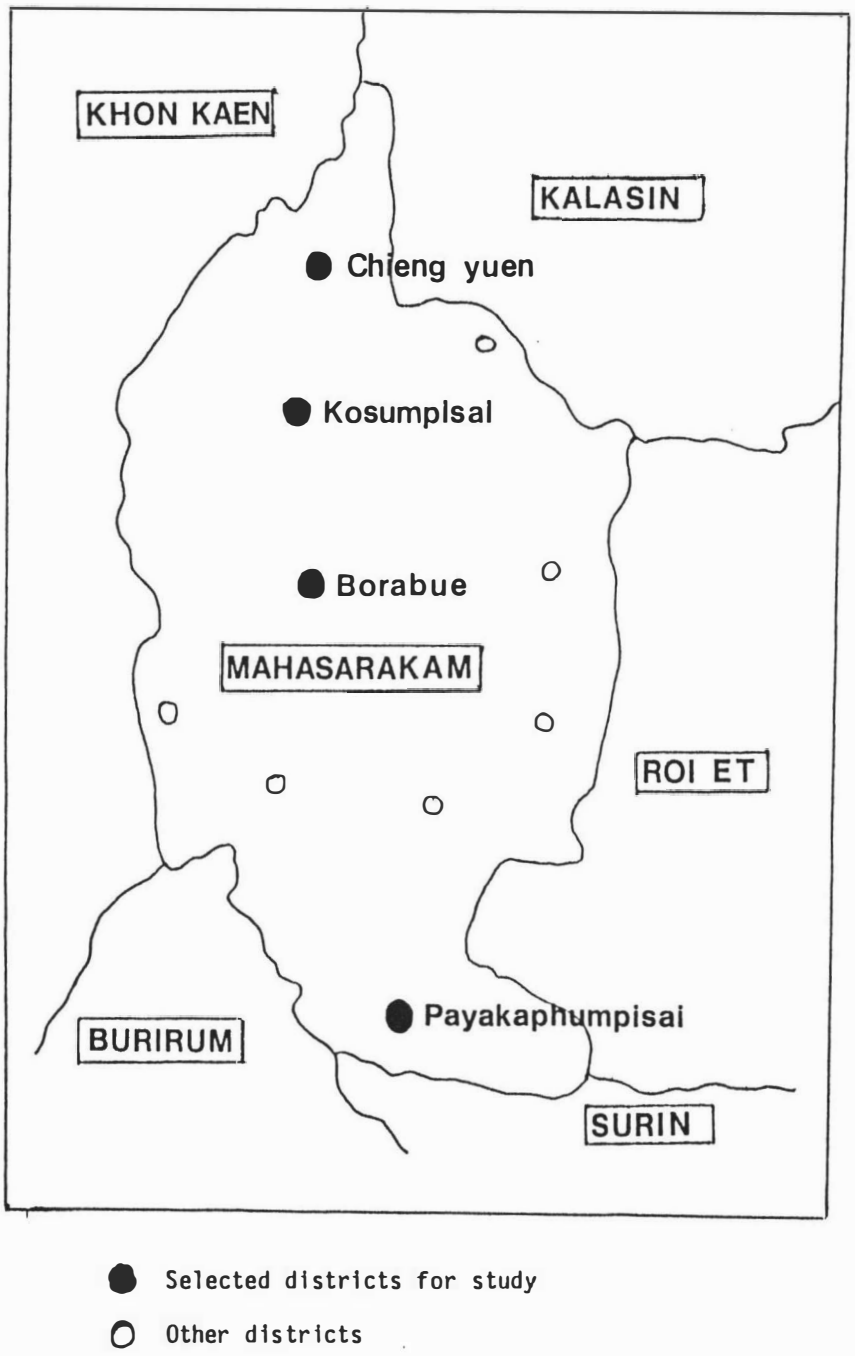
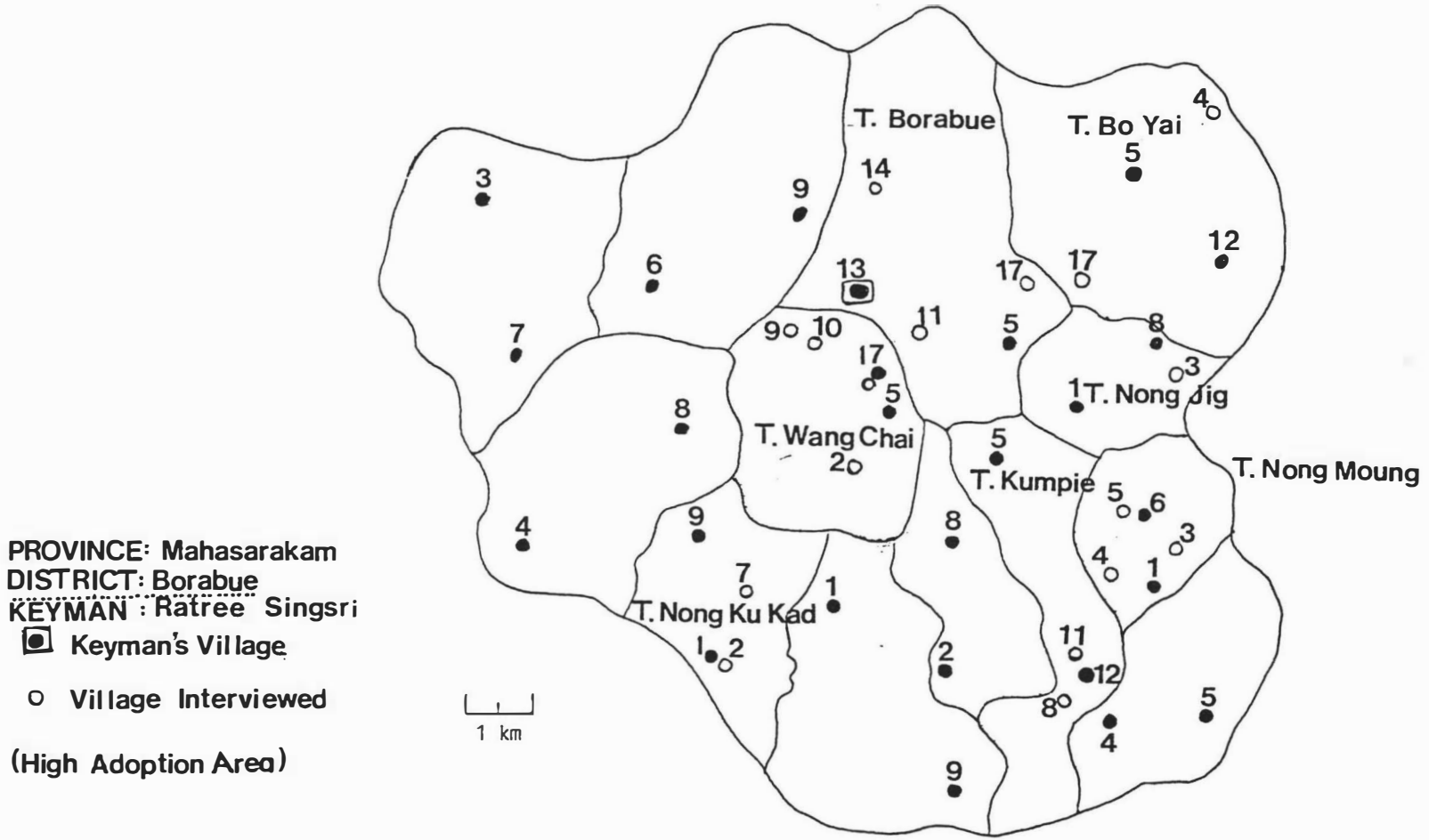


Figure 4.3 ILLUSTRATED VILLAGES FOR FIELD SURVEY IN BORABUE

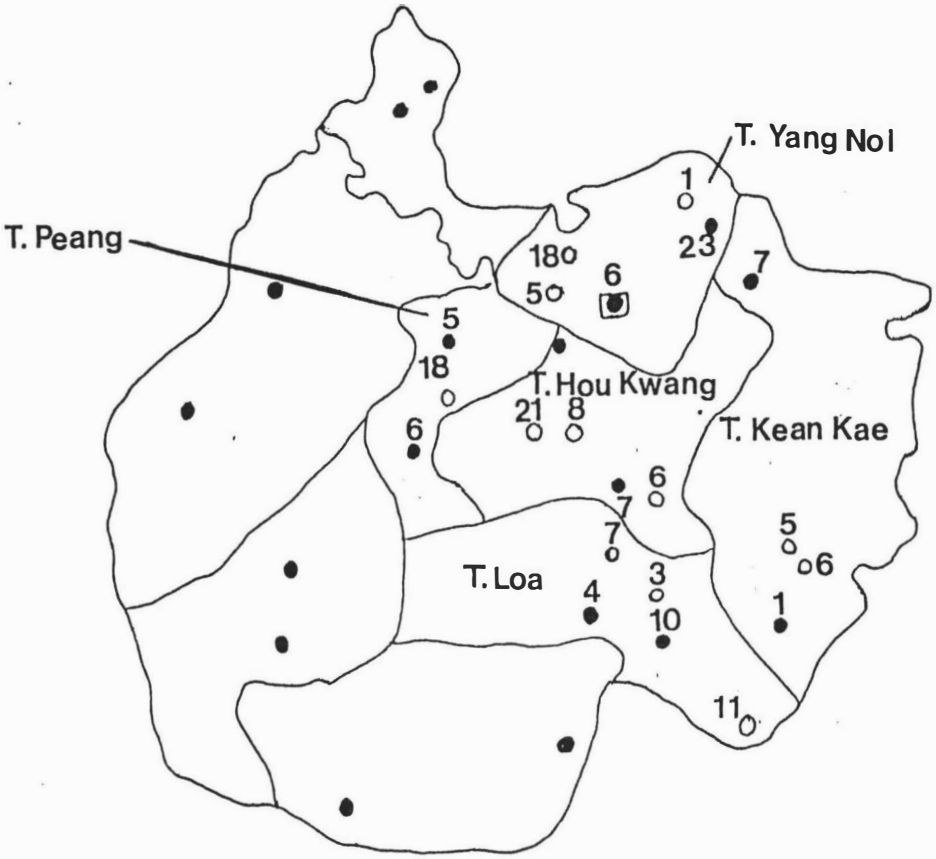


PROVINCE: Mahasarakam
DISTRICT: Borabue
KEYMAN : Ratree Singsri
▣ Keyman's Village
o Village Interviewed

(High Adoption Area)

Figure 4.4

ILLUSTRATED VILLAGES FOR FIELD SURVEY IN GOSOMPISAI



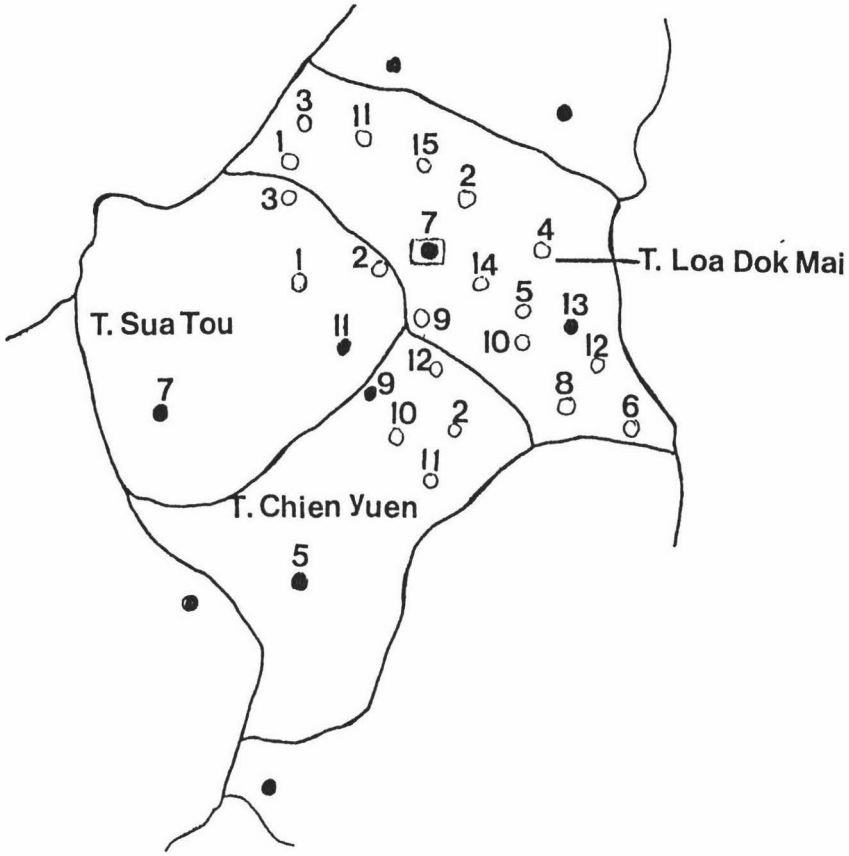
PROVINCE: Mahasarakam
DISTRICT: Gosompisai
KEYMAN: Somsak Suphohong

◉ Keyman's Village
O Villages Interviewed

(Low Adoption Area)

Figure 4.5

ILLUSTRATED VILLAGES FOR FIELD SURVEY IN CHIENG YUEN



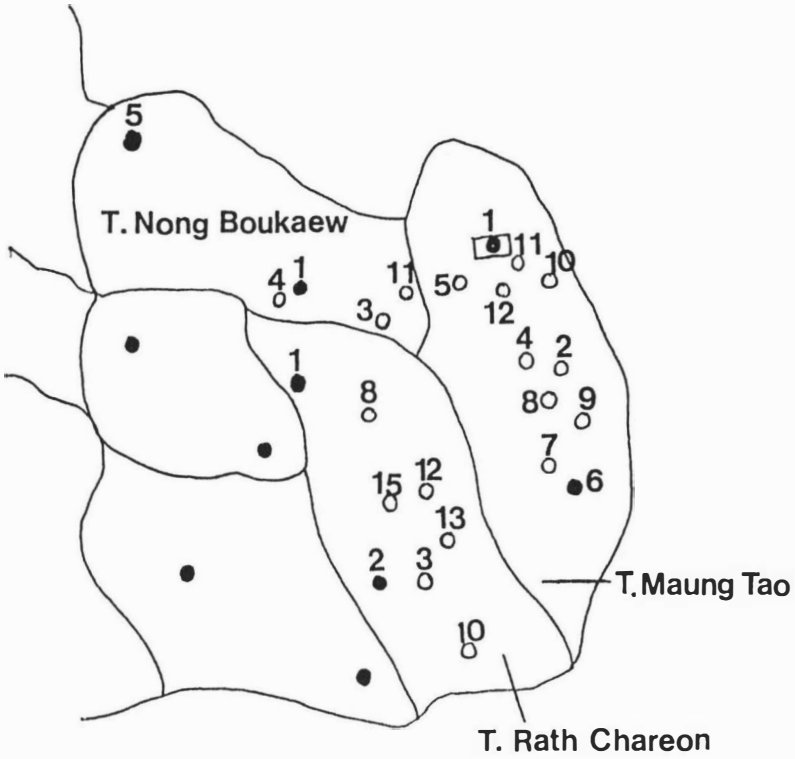
PROVINCE: Mahasarakam
DISTRICT: Chieng Yuen
KEYMAN: Kularb Kengrit

▣ Keyman's Village
O Village Interviewed

(Low Adoption Area)

Figure 4.6

ILLUSTRATED VILLAGES FOR FIELD SURVEY IN PAYAKAPUM PISAI



PROVINCE: Mahasarakam
DISTRICT: Payakapum Pisai
KEYMAN: Sa Kaewprasert

◉ Keyman's Village
○ Village Interviewed

(High Adoption Area)

Figure 4.7

GEOGRAPHICAL DATA SHOWS STUDY AREAS IN PHASE 2
SURIN PROVINCE

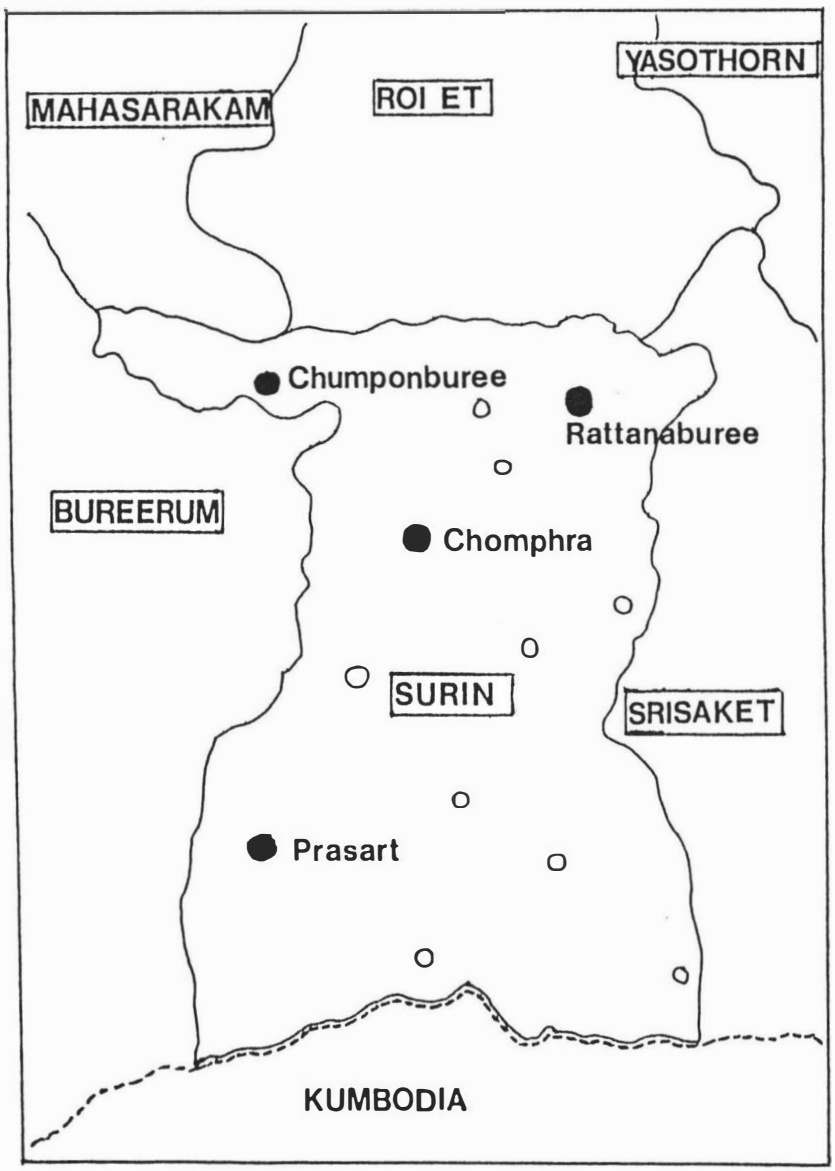


Figure 4.8
GEOGRAPHICAL DATA SHOWS STUDY AREAS IN PHASE 2: KHON KAEN PROVINCE

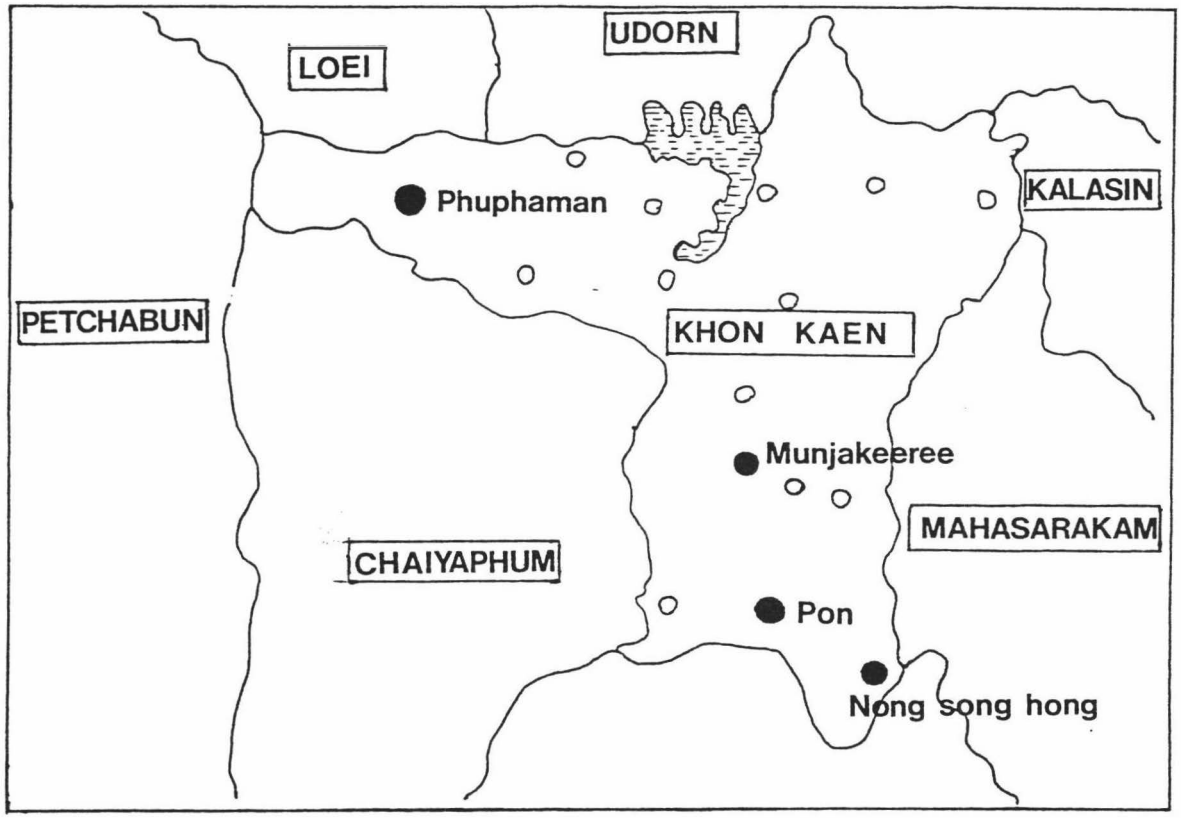


Figure 4.9

GEOGRAPHICAL DATA SHOWS STUDY AREAS IN PHASE 2
LOEI PROVINCE

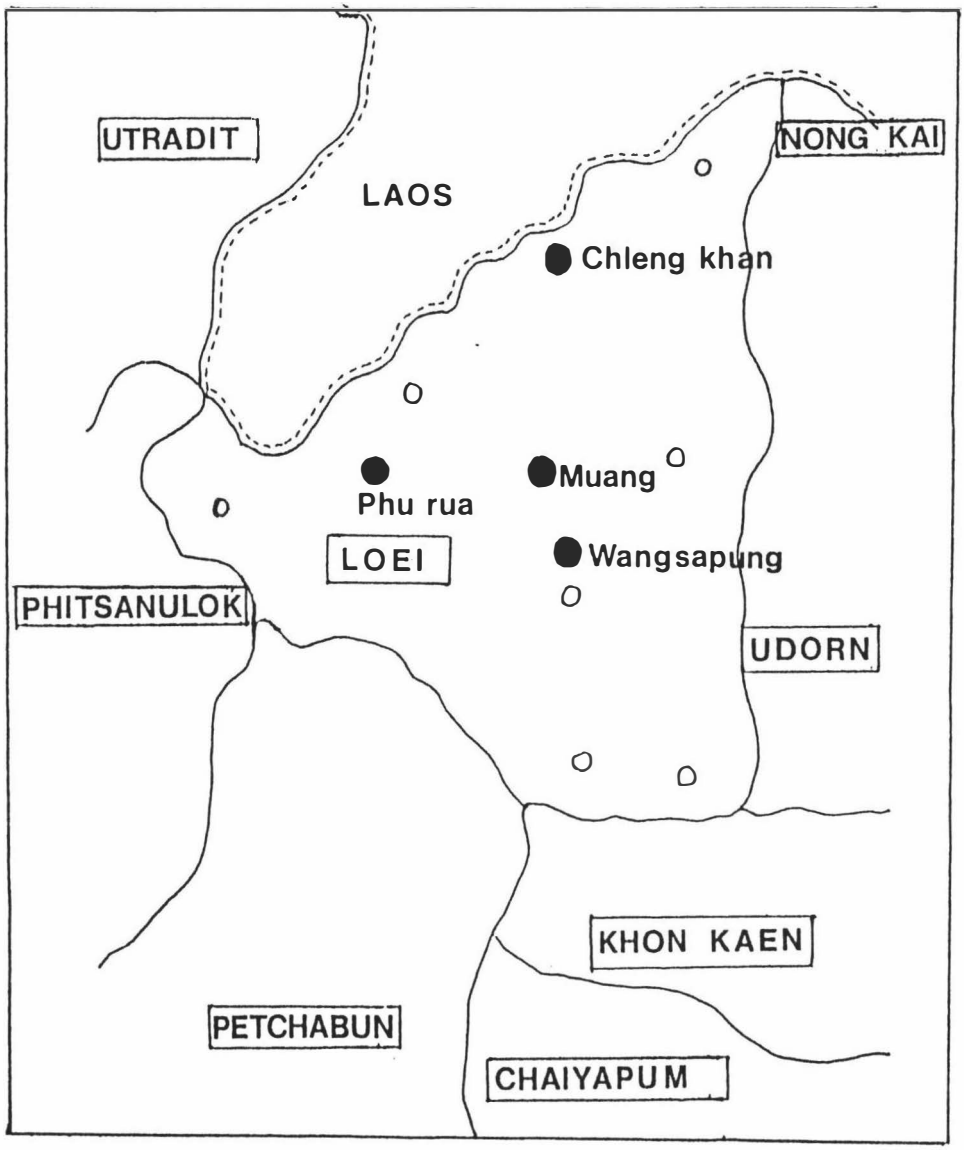


Figure 4.10 GEOGRAPHICAL DATA SHOWS STUDY AREAS IN PHASE 2 UDORNTHANEE PROVINCE

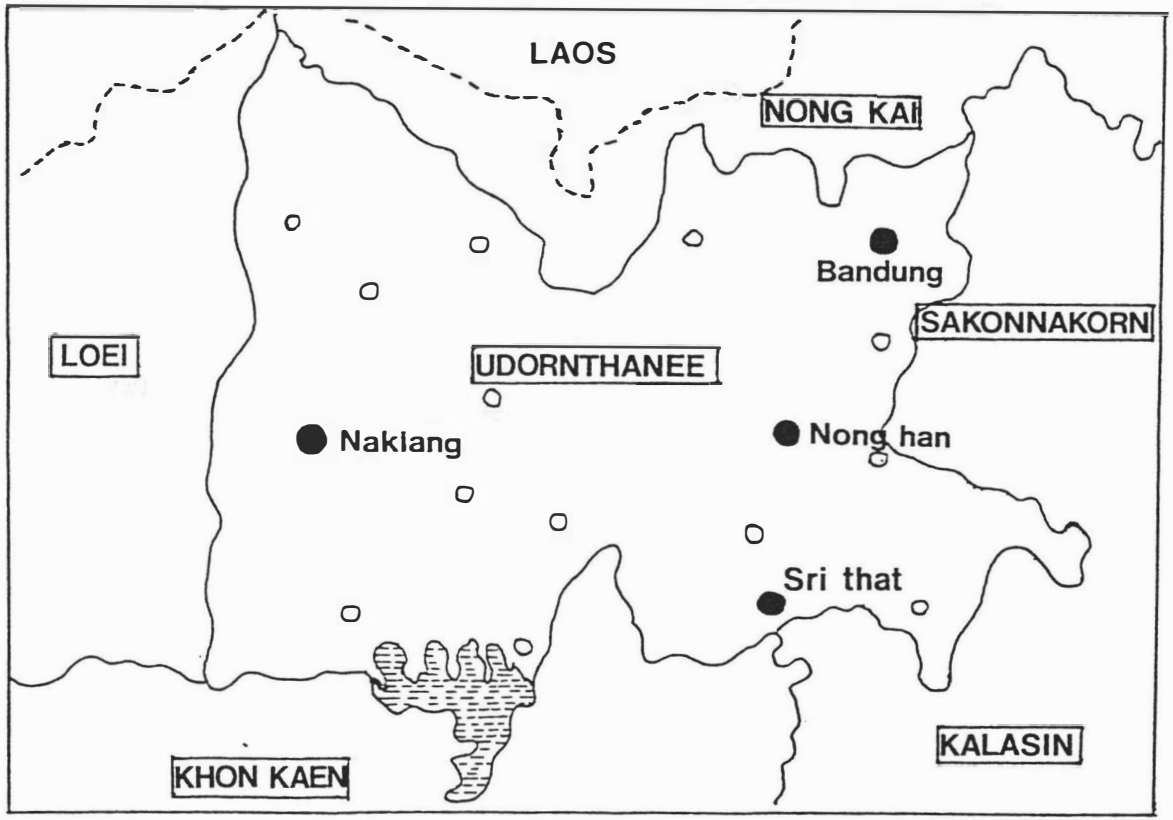


Figure 4.11 GEOGRAPHICAL DATA SHOWS STUDY AREAS IN PHASE 2 KALASIN PROVINCE

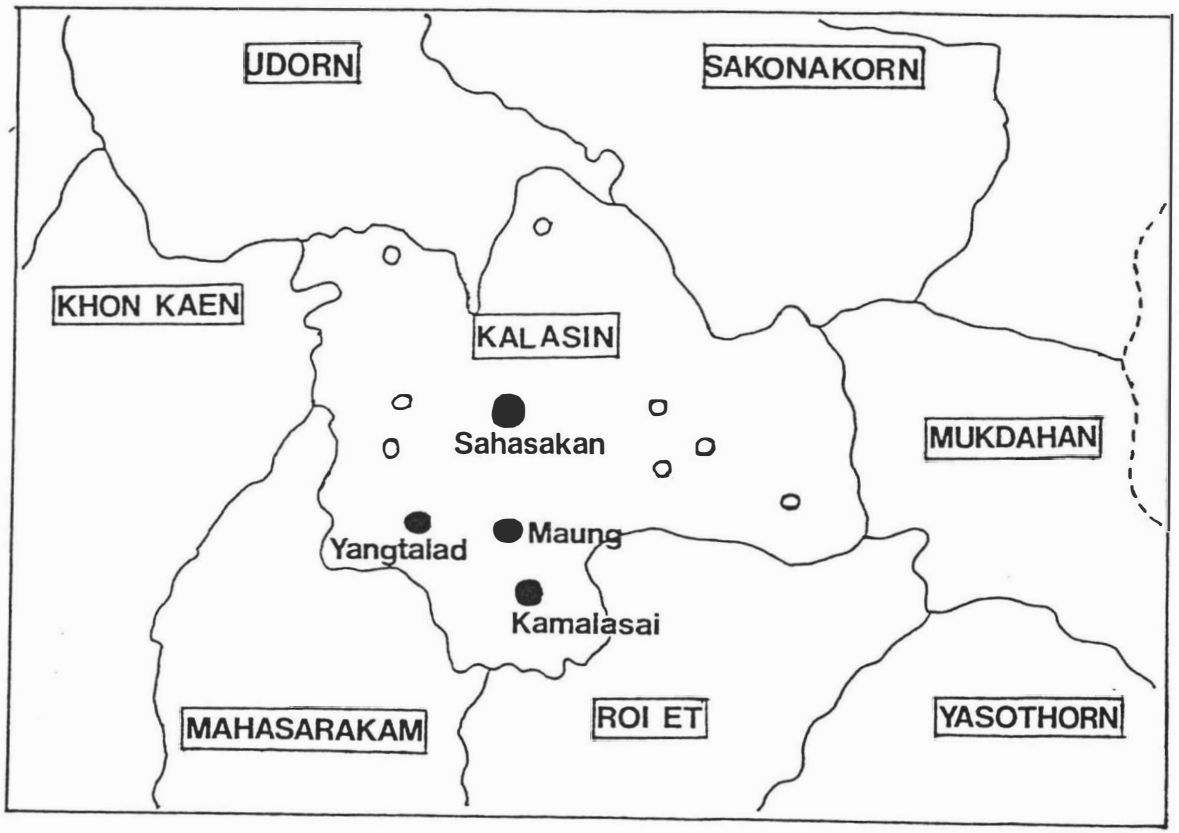


Figure 4.12

Villages of keyman and farmers	#Farmer used own keyman (Keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never known keyman
Keyman's vil. 14071011 B.Tanonchai	3 (Somphoth)	-	-	-
Vill.<2km. 14071014 B.Sano	3 (Somphoth)	-	-	-
Vill.>2km. 14071016 B.Tajad	3 (Somphoth)	-	-	-

(High adoption area)

Province :Surin (14)
Amphur :Prasart (07)
Tumbon :Ban Sai (10)
Village No.: 11,14 and 16

Keyman's name : Somphoth Jingjaikla

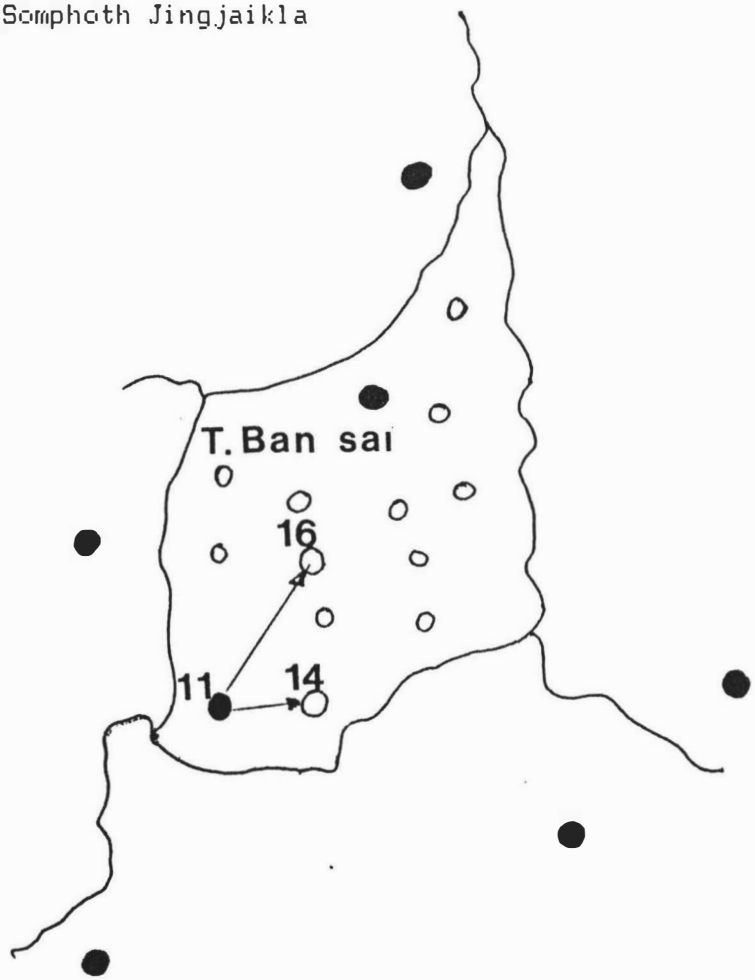


Figure 4.13

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#farmer used keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never known keyman
Keyman's vl. 14081107 B.Nong Pue	3 (Chang)	-	-	-
Vil.<2km. 14081105 B.Nong khon	3 (Chang)	-	-	-
Vil.>2km. 14081202 B.Nong Yai	-	-	3 (Chang)	-

Province: Surin (High adoption area)
Amphur : Rattanaburee
Tumbon : Berd, Nong Luang
Village No.: 7,5 and 2

Keyman's name : Chang Boonyo

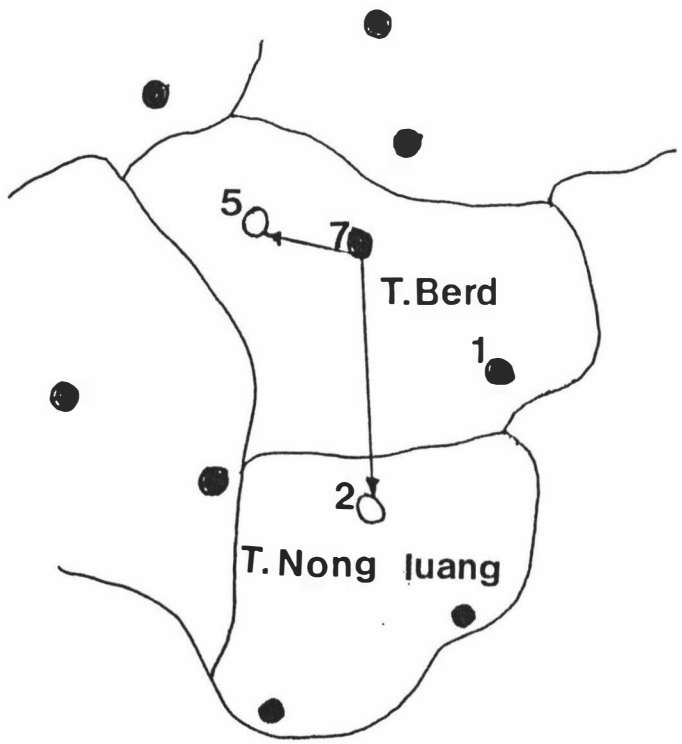


Figure 4.14

Villages of keyman and farmers	#Farmer used own keyman (Keyman's name)	#Farmer used Keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never Known keyman
Keyman's vil. 14041407 B.Sra Keaw	3 (Somboon)	-	-	-
Vill.<2km. 14041403 B. Chad	2 (Somboon)	-	-	1
Vill.>2km. 14041402 B.Non Klang	-	-	-	3

(Low adoption area)

Province : Surin (14)
Amphur : Chumponburee (04)
Tumbopn : Maung Bua (14)
Village No.: 7,3 and 2

Keyman's name : Somboon Buphamala

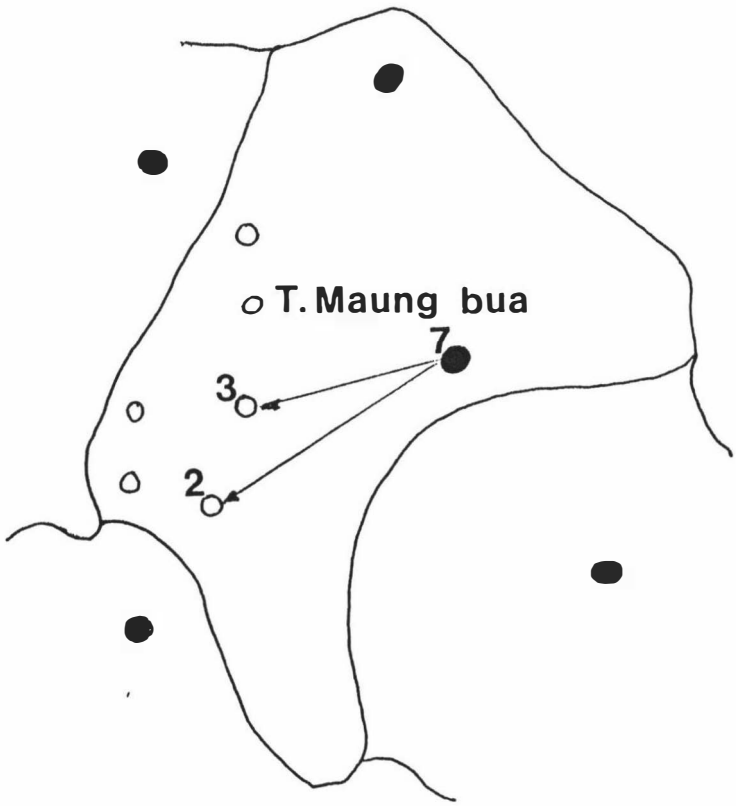


Figure 4.15

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in other Tumbons	#Farmer who never known keyman
keyman's vl. 14031307 B.Kham	2 (Prakob Srisaku)	-	-	1
Vil.<2km. 14031304 B.Nong Sim	-	-	-	3
Vil.>2km. 14031308 B.Non Sung	-	-	-	3

Province: Surin (14) (Low adoption area)
Amphur : Chompra (03)
Tumbon : Chompra (13)
Village No. : 1,4 and 7

Keyman' name : Prakob Srisaku

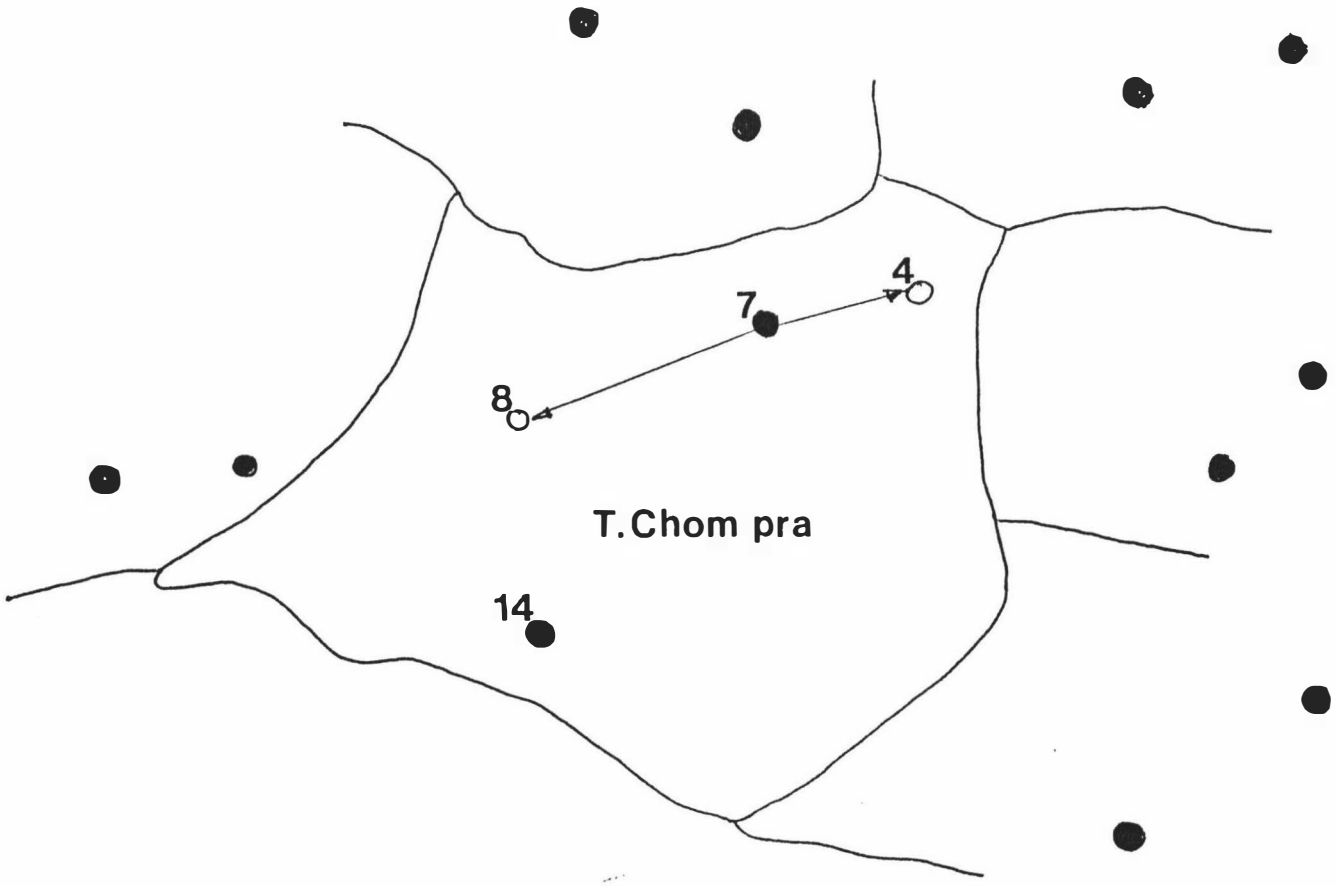


Figure 4.16

Villages of keyman and farmers	#Farmer used keyman and keyman's name	#Farmer used keyman in same Tumbon	#Farmer used keyman in other Tumbons	#Farmer who never known keyman
Keyman's vl. 4100407 B.Nong Rua	3 Kumploew	-	-	-
Vil.<2km. 4100408 B.Mued Ae	3 Kumploew	-	-	-
Vil.>2km. 4100405 B.Tua Lex	-	-	-	3 -

(High adoption area)

Province: Khon kaen (4)
Amphur : Pon (10)
Tumbon : Jode Nong Kae (04)
Village No.: 7,8 and 5

Keyman's name :Kumploew Hongbin

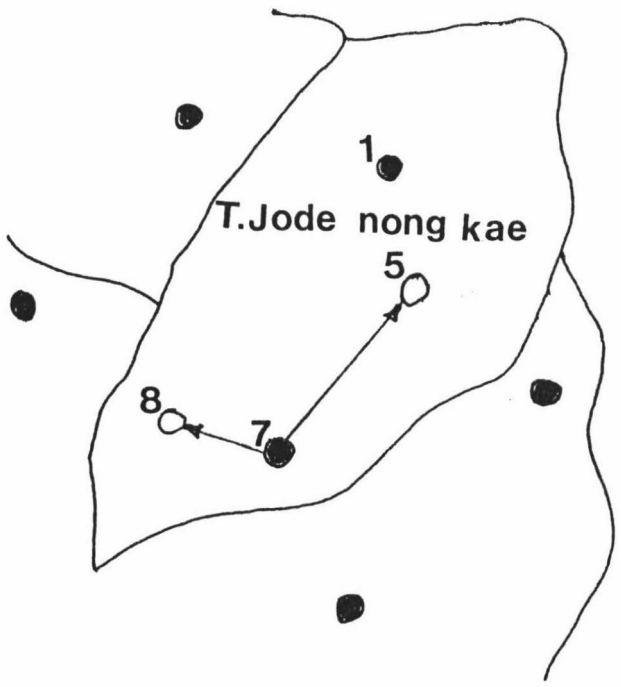


Figure 4.17

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never known keyman
Keyman's vil. 4160502 B.Nong Seang	3 (Sri Kumklo-ng)	-	-	-
Vill.<2km. 4160501 B.nong weang yaw	-	-	-	3
Vill.>2km. 4160503 B.Non Ton	-	-	-	3

(Low adoption area)

Province : Khon Kaen (4)
Amphur : Nong Song Hong (16)
Tumbon : Don Du (05)
Village No.: 2,1 and 3

Keyman's name : Sri Kumklong

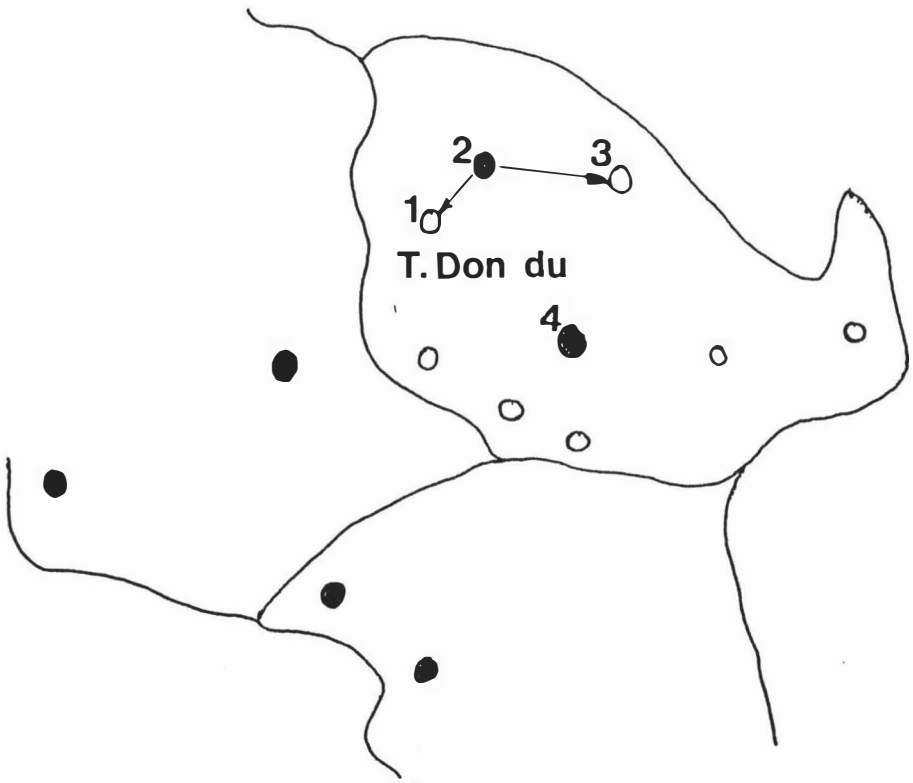


Figure 4.18

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in Same Tumbon	#Farmer used keyman in other Tumbons	#Farmer who never known keyman
Keyman's vl. 4190303 B.Sawang Non song	2	-	-	1
Vil.<2km. 4190302 B.Sum Phu Thong Tai	-	-	-	3
Vil.>2km. 4190305 B.Na Num Sum	-	-	-	3

Province : Khon Kaen (04) (Low adoption area)
Amphur : Phu Pha Man (19)
Tumbon : Phu Pha Man (03)

Keyman's name : Jieng Rattanaviset

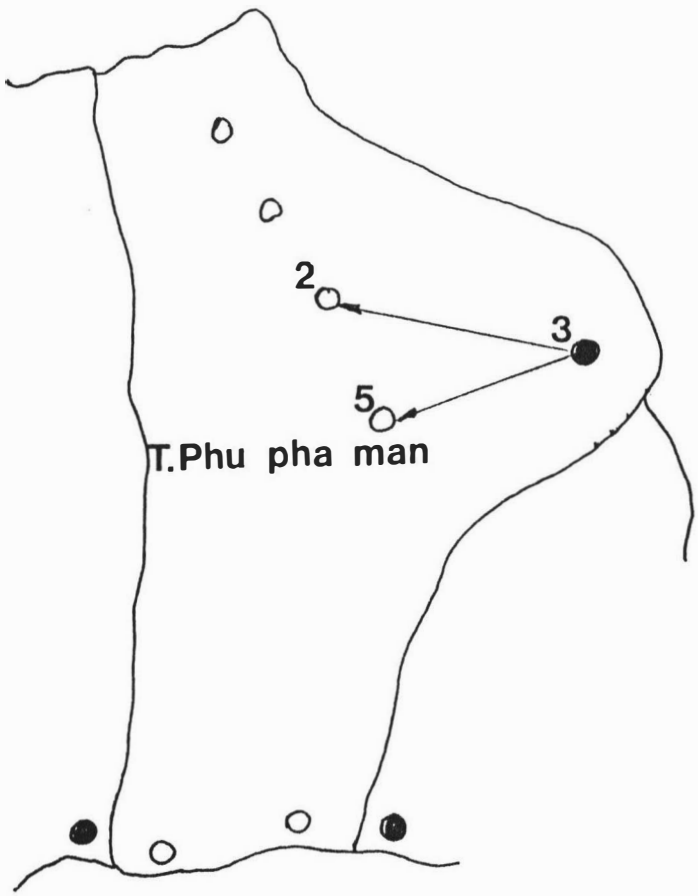


Figure 4.19

Villages ofkeyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in other Tumbons	#farmer never known keyman
Keyman's vl. 4200110 B.Tha sala10	3 (Boonyung)	-	-	-
Vil.<2km. 4200102 B.Tha sala2	3 (Boonyung)	-	-	-
Vil.>2km. 4200210 B.Kham pom10	-	-	3 (Boonyung)	-

Province: Khon Kaen (4) (High adoption area)
Amphur : Munjakeeree (20)
Tumbon : Tha sala (01)
Tumbon : Ponpex (02)
Village No. 10,2 and 10

Keyman'name : Boonyung Gingkum

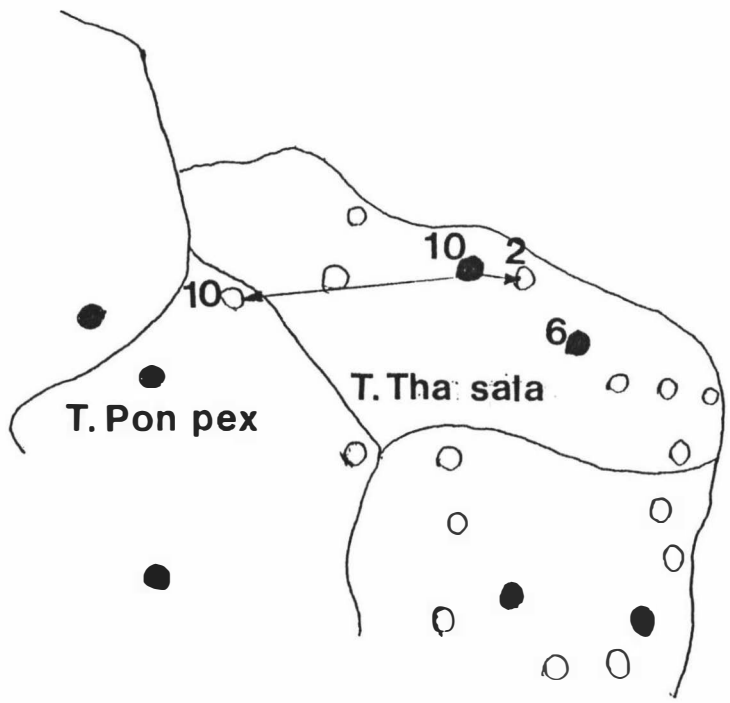


Figure 4.20

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never known keyman
keyman's vil. 5060905 B.K.P.Sean Eim	-	-	-	3
Vill.<2km. 5060908 B.K.P.Rim San	-	-	-	3
Vill.>2km. 5060906 B.Kean Lan	-	-	-	3

(Low adoption area)

Province : Loei (5)
Amphur : Phurua (06)
Tumbon : Rongjig (09)
Village No.: 5,8 and 6

Keyman's name : Chumpon

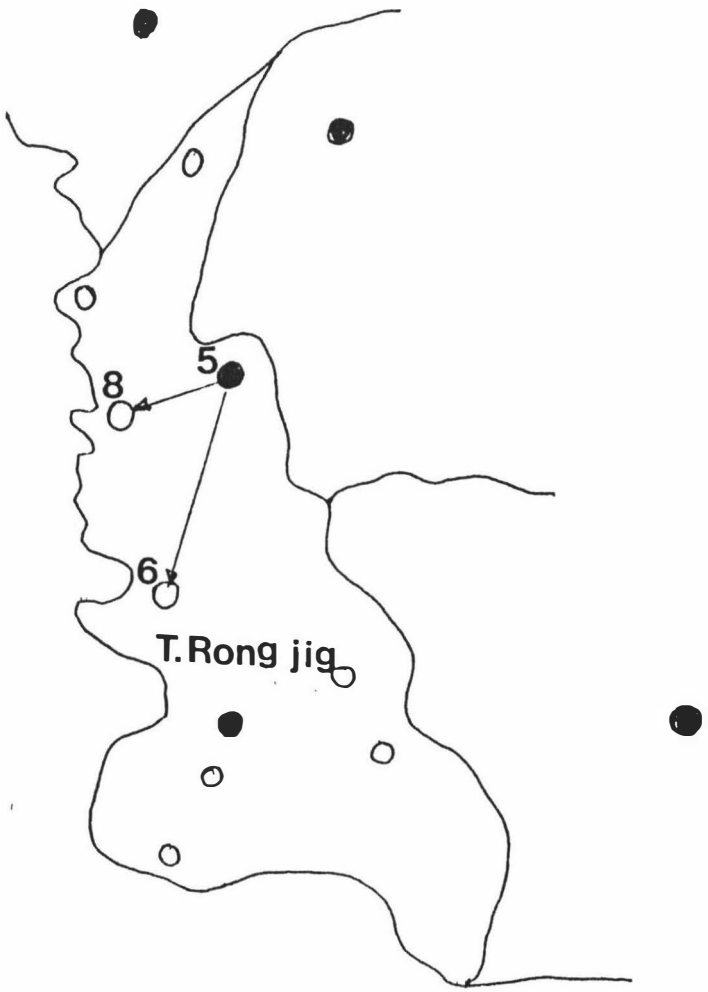


Figure 4.21

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	# Farmer used keyman in other Tumbons	#Farmer who never known keyman
Keyman's vl. 5020701 B.Na Soa 1	3 (Kumsing)	-	-	-
Vil. <2km. 5020704 B.Mai ta Seang	2 (Kumsing)	-	-	1
Vil. >2km. 5020707 B.Na Soa 7	-	3 (Kumsing)	-	-

(High adoption area)

Province: Loei (5)
Amphur : Chieng Khan (02)
Tumbon : Na soa (07)
Village No. : 1,4 and 7

Keyman's name : Kumsing Kaenphukeaw

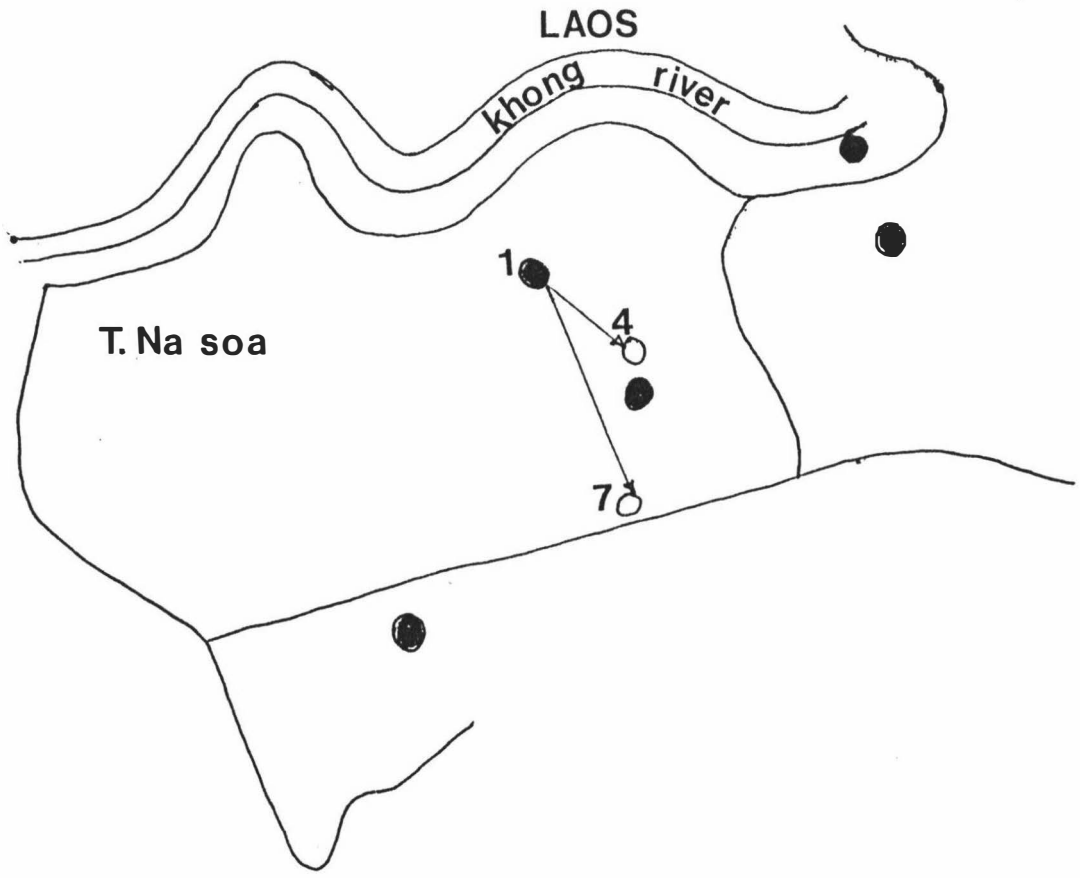


Figure 4.22

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	Farmer used keyman in same Tumbon	#Farmer used keyman in other Tumbons	#Farmer who never known keyman
Keyman's vl. 5010807 B. Wang Kan	3 (Kaew Suna)	-	-	-
Vil.2km. 5010805 B.Nongkokbou	1 (Kaew Suna)	-	-	2
Vil.>2km. 5010808 B.Sum Pu	-	-	-	3

Province : Loei (5)
Amphur : Maung (01)
Tumbon : Num Soay (08)
Village No. 7,5 and 8
Keyman's name : Kaew Suna

(Low adoption area)

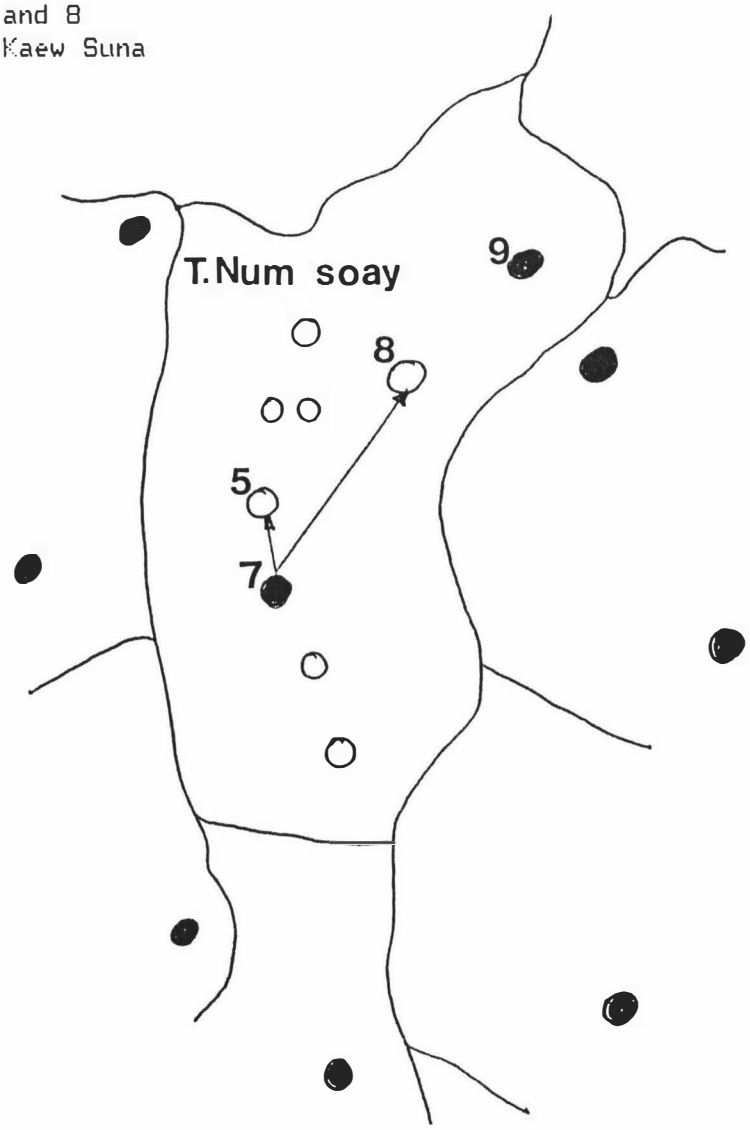
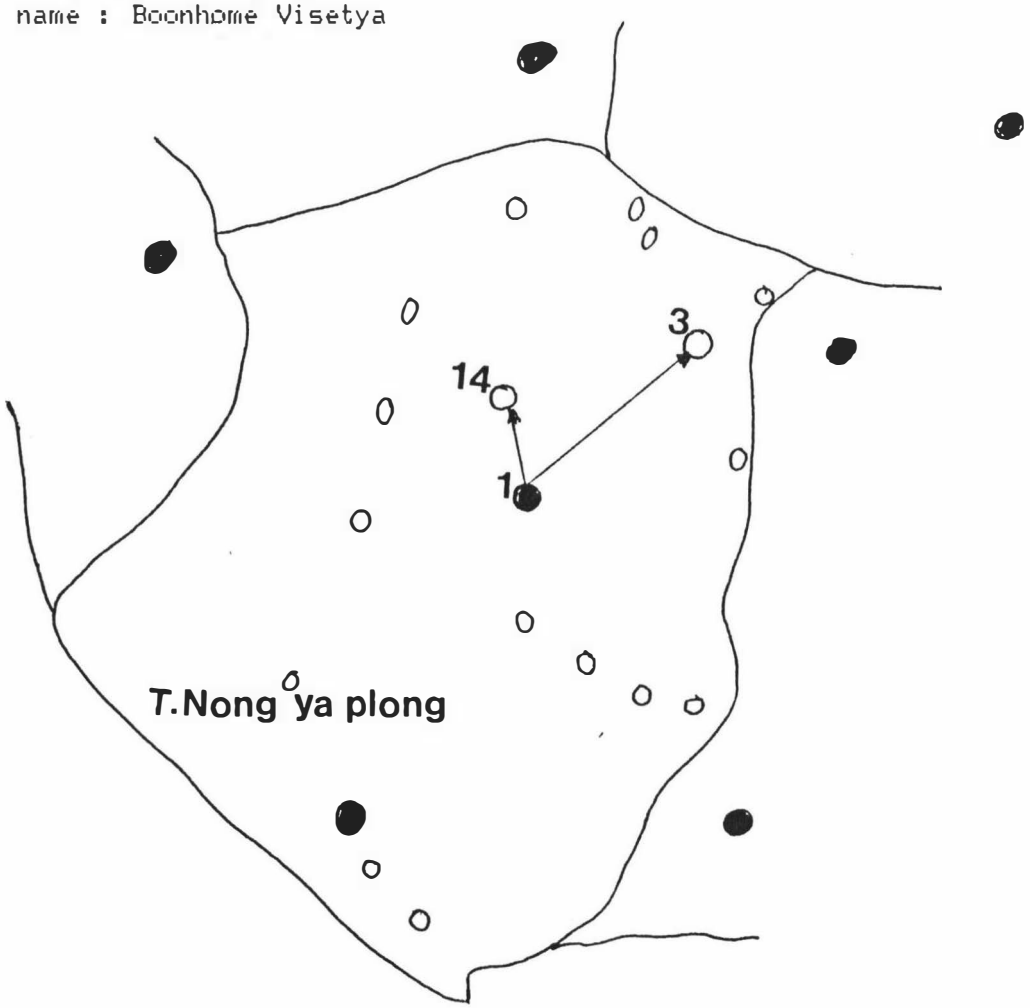


Figure 4.23

Villages of keyman and farmers	#Farmer used own keyman (keyman's name)	#Farmer used keyman in same Tumbon	#Farmer used keyman in oth. Tumbons	#Farmer who never known keyman
Keyman's vil. 5080601 B.Klang	3 (Boonhome)	-	-	-
Vill.<2km. 5080614 B.Wang Kok Dua	3 (Boonhome)	-	-	-
Vill.>2km. 5080603 B.Kud Sawan	3 (Boonhome)	-	-	-

(High adoption area)

Province : Loei (5)
Amphur : Wang Sapung (08)
Tumbon : Nong Ya Plong (06)
Village No. 1, 14 and 3
Keyman's name : Boonhome Visetya



APPENDIX 5

CODE DESCRIPTION FOR QUESTIONNAIRE SURVEY

Used in Panacea "FARMER" Dataset

TABLE 1. Farmer code description

Number of questionnaire		Code	Code description
3	Interviewer names	1	Nopadon
		2	Lertrak
		3	Rungsuda
		4	Manviga
5	Sex	1	Male
		2	Female
7	Addresses		See Appendix 6
11	Main Farm Activity	1	Rice Planting
	Code farm main job	2	Animal raising
		3	Cropping
		4	No main farming activity
12	1st farm activity		Animal raising
	2nd farm activity		Tapioca planting
	3rd farm activity		Kenaf planting
	4th farm activity		Sugar cane planting
	5th farm activity		Maize planting
	6th farm activity		Tobacco planting
	7th farm activity		Other crops planting
14	Off-farm job	1	Shopkeeper
		2	Driver
		3	Weaver
		4	Carpenter
		5	Fishery
		6	Employee
		7	keyman
26	Reasons for buffalo	1	Draught purpose
	and cattle bought	2	Need of more trained buffalo
		3	For breeding
		4	For trading
		5	To replace the old one

28	Reason for B,C sold	1	Need of money for social and cultural affairs
		2	For housing and repairing
		3	Need of money for the dept problem
		4	No place for grazing
		5	Too old
		6	Breeder
		7	Buffalo has no skill for ploughing
		8	To replace the old one
		9	Need money for paddy field
		10	Need money for Tractor (Iron buffalo)
31	Persons in charge of herd	1	Father
		2	Mother
		3	Children
		4	Whole family
		5	Employee
33	Reasons to hire buffalo	1	No buffalo at all
		2	No trained buffalo
		3	All buffaloes died
		4	No stockman available
		5	Not enough buffalo for work
37	Feeding management	1	Traditional pasture and mineral supplement
		2	Trad. pasture and cassava chip
		3	Leucaena
		4	Mineral + Cassava chip
		5	Mineral + Leucaena
		6	Cassava chip + Leucaena
		7	Bran
		8	Bran + mineral
		9	Others(Corn leaves,dry cassava leaves)
43	Causes of calf mortality	1	Parasite infestation
		2	Lack of milk
		3	Severe emaciation
		4	Enteritis
		5	Severe skin disease
		6	Unknown
45	Diseases in sick calves observed.	1	Parasitic problems
		2	Malnutrition
47	Diseases in dead calves observed.	3	Skin disease
		4	Unspecified diarrhoea
		5	Abortion
		6	Omphalophlebitis
		7	Unknown
		8	Abnormalities
		9	Accidental death
		10	Depression, Anorexia
48	Farmer response when calf was sick.	1	Go to see the DLO
		2	Go to see the keyman
58	Fermer response when adult animal was sick	3	Go to see the village head man
		4	Go to the chemist
		5	Go to see the neighbour

		6	Traditional treatment used
		7	No response at all
		8	Treatment due to superstitious belief
		9	Go to see quack doctor
50	Resulting in BAHS	1	Modern drug is more effective (the chemist)
		2	Suggestion by the DLO
73	Why do you treat them?	3	Suggestion by the keyman
		4	Suggestion by the village headman
		5	Suggestion by neighbour
		6	Need to prevent worm infection
		7	Need of healthy animals
		8	Owner are afraid of animal death.
		9	Keyman use drugs in scheme for his own animal.
51	Carcass disposal	1	Entirely buried, not opened
		2	Opened and buried
		3	Consumed
		4	Sold
		5	Don't know, no experience
53	PM findings on death animals	1	Severe parasitic animal infestation (Nematodes)
		2	Foreign body in alimentary tract(adult animals)
		3	Dry omasum
		4	Parasite obstruction + dry omasum
		5	Emaciation and liver cirrhosis due to liver flukes
		6	Internal bleeding
		7	Food poisoning
		8	Unknown
55	PM.findings on adults and history prior death	1	Food Poisoning
		2	Emaciation and liver cirrhosis due to liver flukes
		3	Stiffness (tetanoid syndrome)
		4	Lameness
		5	Skin disease (Sarcoptic mange)
		6	FMD
		7	Conjunctivitis
		8	Acute or chronic tympanitis (bloat)
		9	Severe emaciation
		10	Unknown
61	Information provided to treat sick calf	1	Don't need any advice
		2	Friend
		3	Keyman
		4	Village headman
		5	Chemist
		6	District veterinarian
		7	Herbal med.
		8	Never administered any medicine

62	Drugs provided by	1	Village headman
		2	Keyman
		3	Chemist
		4	District Livestock Officer
		5	Never administered
68	Clinical finding observed prior to death (Method of detection)	1	Loss of condition and appetite
		2	Calf scour, depression
		3	Worm detection
		4	Abdominal pain, stiffness
		5	Convulsion and paresis
		6	Whole symptoms as mentioned
71	How to prevent animal loss?	1	Timed deworming of calf
		2	DLO'S recommendation
		3	Keyman's recommendation
		4	Keyman's recommendation (when calf is at 3 and 10 wk. of age)
		5	Herbal medicine used
		6	Treatment due to superstitious belief
77	Keyman's action	1	Keyman provides drugs according to recommended price.
		2	Keyman always promotes his activities.
		3	Keyman is inactive but drugs are still available.
		4	Keyman's activity was unknown to farmers, and no activities at all.
		5	Difficulty in explanation
		6	Don't know anything
86	Why did you ignore keyman recommendation?	1	Never had sick animals
		2	Don't believe keyman
		3	No money
		4	Keyman village is too far away to get drug
		5	Personal antipathy
		6	No sufficient information
		7	No adult animal
		8	No calf
		9	Preference for traditional medicine
		10	Preference for superstitious methods
89	Major handicap not to contact keyman	1	No transportation
		2	Keyman's drug is limited
		3	No money to buy drugs
		4	Difficulty in seeing keyman
		5	Keyman's village is too far away
94	Nature of condition improvement	1	Better appetite, weight gain
		2	Roundworm excretion
103	Effects of fluke treatment	3	Improved working ability

The following code descriptions edited for the new created variables:

	Subjects	Code	Code description
1.	Province codes	1	Mahasarakam
		2	Surin
		3	Khon Kaen
		4	Loei
		5	Udornthanee
		6	Kalasin
2.	Time in scheme	1	Provinces have not yet involved in the scheme (Udornthanee and Kalasin)
		2	One year program provinces (Khon Kaen and Loei)
		3	Three year program provinces (Mahasarakam and surin)
3.	Level of adoption areas (advised by the DLO)	0	Low adoption
		1	High adoption
4.	Acceptance levels of farmers	1	Low
		2	Medium
		3	High
5.	Farmer age group	1	<20
		2	20-29
		3	30-39
		4	40-49
		5	50-59
		6	60-69
		7	>70

Table 2. Keyman code description for Panacea "KEYMAN" Dataset

Number of questionnaire		Code	Code description
3	Interviewer name	1	Nopadon
		2	Lertruk
		3	Rungsuda
		4	Manviga
10	Family status	1	Married
		2	Single
		3	Separated
13	1st activity	1	Keyman of Human Public Health agencies
	2nd activity	2	Keyman of Social welfare
	3rd activity	3	Keyman of Educational Agencies
15	Farming main job coded	1	Rice planting
		2	Animal raising
		3	Cropping
71	Effects of posters	1	Very useful
		2	Some help
		3	No help
	Effects of film	1	Very useful
		2	Some help
		3	No help
	Effects of leaflets	1	Very useful
		2	Some useful
		3	No help
	Effects of others	1	Very useful
		2	Some help
		3	No help
73	Help in promotion the scheme obtained from	1	The DLO
		2	The village headman
		3	Staff from Tha Phra laboratory
		4	Wife
		5	Other members of family
		6	Other farmers
76	Farmer response in you own village compared to others villages	1	Better
		2	Same
		3	Worse
77	Additional help needed	1	DLO's assistance
		2	Film on program activities
		3	Slides on program activities
		4	Television program (videotapes)
		5	Others

79	Parasite control methods farmers used for calves and adults before scheme	1	Herbal medicine used
		2	Modern medicine used
		3	Superstitious preferred
		4	No interest in any treatment
85	Farmer talked on healthy animal after using the drugs	1	Quite often
		2	Occasionally
		3	Never
86	Farmer talked on bad animal after using the drugs	1	Quite often
		2	Occasionally
		3	Never
87	Condition of animal after treatment	1	Better
		2	Same condition
		3	Worse
89	Comments on drug supply	1	Very convenient
		2	Inadequate
		3	Couldn't get drug as needed
		4	Need drugs other than anthelmintics
		5	No comments
89	Comments on price of drugs	1	Too expensive
		2	Too cheap
		3	Quite reasonable
		4	No comments
89	Range of drugs provided	1	Too long
		2	Reasonable period
		3	No comments
95	Drug against liver fluke charged	1	7 Baht/100-200 kg body wt.
		2	8.50 Baht/250-350 kg body wt.
		3	11 Baht per >350 kg body wt.
		4	10 Baht/each
		5	15 Baht/each
		6	20 Baht/each
		7	More than 20 Baht/each
		8	2 Baht/ml
96	Comments on 13% incentive payment	1	Not enough
		2	Enough
		3	No comments
97	Comments on 2 keymen/Tumbon	1	1 keyman/Tumbon needed
		2	About right
		3	Too much work
*Transportation of keyman		1	On foot
		2	A bike
		3	A motorcycle
		4	A car
		5	Never gone anywhere

APPENDIX 6

CODES FOR AREA INTERVIEWED AND ANIMAL POPULATION

Province	District	Tumbon	Cattle	Buffalo
06 MK	08 Borabue	01 Borabue (17)*	829	2265
		02 Boyai (18)	1032	2754
		03 Wangchai (19)	714	2214
		04 Nongkukad (13)	345	1096
		05 Kumpie (18)	678	2147
		06 Nongjig (15)	605	1690
		07 Nong moung (11)	327	1190
	09 Payakhapum.	09 Maungtao (12)	457	864
		10 Boukaew (12)	154	814
		11 R.charoen (16)	211	996
	05 Chiengyuen	12 Luadokmai (16)	354	1532
		13 Chiengyuen (14)	316	1313
		14 Suatao (11)	178	1517
	04 Gosumpisai	15 Loa (14)	591	1389
		16 Yang noi (23)	181	1264
		17 Peang (22)	812	1623
		18 Houkwang (16)	542	1222
		20 Keang Kae (16)	475	1288
14 SR	07 Prasart	10 Bansai (16)	413	3257
	08 Rattanaburee	11 Bert (12)	317	1404
		12 Nong loang (14)	674	2879
	03 Chompra	13 Chompra (14)	390	2377
	04 Chumponburee	14 Maungbou (14)	1366	2002
04 KK	20 Munjakeeree	01 Thasala (10)	759	2078
		02 Ponpex (11)	2092	2669
	10 Pon	04 J.nong kae (10)	816	2307
	19 Phuphaman	03 Phuphaman (6)	181	313
	16 N.songhong	05 Dondu (10)	617	2673
05 LE	08 Wangsapung	06 N.ya plong (12)	223	825
	02 Chiengkan	07 Namsoa (8)	3129	1685
	01 Maung	08 Namsoy (10)	1242	865
	06 Phuruoe	09 Rongjig (8)	322	433

APPENDIX 6 (cont.)

Province	District	Tumbon	Cattle	Buffalo
16 UD	05 Na Klang	18 Fangdaeng (10)	135	1165
	08 Bandung	17 Dong yen (12)	204	1032
	13 Srithat	16 Banprong (10)	128	1245
	20 Nonghan	15 Pungngu (12)	320	1450
03 KS	01 Maung	15 Pai (13)	1258	2845
	02 Kamalasai	16 Thanya (12)	452	1856
	08 Yangtalad	18 Yangtalad (16)	431	2255
	11 Sahassakan	17 N.L.Thaong (11)	398	1488
		Total	24668	66218

The figures located in front of the Provinces, Districts, and Tumbon are codes of those areas used for Panacea data file entry. The following interpretation shows the address of the corespondents.

The code for Surin province (SR)	=	14
The code for Prasart district	=	07
The code for Tumbon Bansai	=	10
The village number	=	11

Then, that area is represented by the numerical code of 14071011 * The figure in brackets are the total number of all districts in Tumbon

APPENDIX 7

ANALYSIS OF VARIANCE

Statistical analysis of data obtained from field surveys using the method of analysis of variance. The mean value of each variable is shown in the following. The data is that required for the economic evaluation.

ANALYSIS OF VARIANCE

Produced on 29/06/88 at 15:39

DATASET : FARMR2

CASES INCLUDED IF BUFFALO OWNED (Variable 46) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 6.596078 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 3.695557E-02

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	32.5041001	2	16.2520500	2.9231095	0.0576
RESIDUAL	1918.1481987	345	5.5598498		
TOTAL	1950.6522988	347			

GROUP MEANS AND OTHER STATISTICS OF BUFFALO OWNED

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	2.3026315	.2688635	76	5.4938596		75			
					1.2431493		1.7591708	207	0.0811
1	2.9398496	.2266076	133	6.8296878		132			
					1.5589027 ###		.5540928	253	0.5805
3	3.1007194	.1775348	139	4.3810864		138			
AGGREGATED	2.8649425	.1270370	348	5.6214763		347			

ANALYSIS OF VARIANCE

Produced on 24/03/35 at 00:01

ATASET : FARMR2

SES INCLUDED IF #FEM.BUFF. 4+YRS.OLD (Variable 54) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

ARCH COVERS CASES 1 TO 420

artlett's Test of Homogeneity of Variance

i-squared = 19.47773 with 2 degrees of freedom
e probability of samples with equal variances producing a value as large as this = 5.894746E-05

. This test is very sensitive to departures from normality

nalysis of Variance Table

URCE OF RIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
CEPTANCE F FARMER	7.3101145	2	3.6550572	3.0983253	0.0488
ESIDUAL	351.5470283	298	1.1796880		
OTAL	358.8571428	300			

ROUP MEANS AND OTHER STATISTICS OF #FEM.BUFF. 4+YRS.OLD

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	.5423728	.09149078	59	.4938632		58			
					2.5385307 ***		2.2050826	168	0.0294
3	.921875	.09896696	128	1.2536909		127			
					1.1554146		.1706661	240	0.8648
1	.9473684	.1127227	114	1.4485328		113			
AGGREGATED	.8571428	.0630401	301	1.1961904		300			

ANALYSIS OF VARIANCE

Produced on 18/06/88 at 07:07

DATASET : FARMR2

CASES INCLUDED IF BUFF CAVS.BIRTH%/YR. (Variable 279) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 4.89011 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 8.677137E-02

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	14034.4647867	2	7017.2323933	1.7895221	0.1715
RESIDUAL	643091.2837162	164	3921.2883153		
TOTAL	657125.7485029	166			

GROUP MEANS AND OTHER STATISTICS OF BUFF CAVS. BIRTH%/YR.

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
1	40.625	6.5763035	64	2767.8571428		63			
					1.6632136	###	1.4180946	138	0.1588
3	55.8441558	7.7321679	77	4603.5543403		76			
					1.0326469		.6174308	101	0.5383
2	65.3846153	13.5218429	26	4753.8461538		25			
AGGREGATED	51.4970059	4.8606802	167	3958.5800464		166			

ANALYSIS OF VARIANCE

Produced on 18/06/88 at 05:14

DATASET : FARMR2

CASES INCLUDED IF %BUFF CAVSSURV TRETM (Variable 287) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = .7292268 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = .694465

** This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	2171.3447842	2	1085.6723921	.5810169	0.5624
RESIDUAL	112114.3695014	60	1868.5728250		
TOTAL	114285.7142857	62			

GROUP MEANS AND OTHER STATISTICS OF %BUFF CAVS SURV TRETM

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
1	60.1818101	10.1639451	22	2272.7272727		21			
					1.2784090		.6723338	30	0.5065
2	80	13.3333331	10	1777.7777777		9			
					1.1022222		.04366064	39	0.9654
3	80.6451612	7.2131226	31	1612.9032258		30			
AGGREGATED	76.1904761	5.4091603	63	1843.3179723		62			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 00:25

DATASET : FARMR2

CASES EXCLUDED IF #BUFF CAVSM+F < 1YR. (Variable 247) EQ 0
AND ALL BUFF CAVS DIED (Variable 275) EQ 0
OR #BUFF CAVSM+F < 1YR. (Variable 247) EQ 0
AND #BUFF CAVS<1YR SOLD (Variable 252) EQ 0

SEARCH COVERS CASES 1 TO 420

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	8.0416973	2	4.0208486	30.5462191	0.0000
RESIDUAL	19.4814814	148	.1316316		
TOTAL	27.5231788	150			

GROUP MEANS AND OTHER STATISTICS OF #BUFF CAVS TRETD NO 1

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	0	0	32	0		31			
1	0	0	65	0		64			
3	.4814814	.08250422	54	.3675751		53			
AGGREGATED	.1721854	.03485902	151	.1834878		150			

ANALYSIS OF VARIANCE

Produced on 04/04/35 at 05:39

DATASET : FARMR2

CASES INCLUDED IF TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 7.737001 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 2.088967E-02

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	3697771.910161	2	1848885.955080	2.6187124	0.0771
RESIDUAL	243579871.7679	345	706028.6138202		
TOTAL	247277643.6781	347			

GROUP MEANS AND OTHER STATISTICS OF 12MTHS.OLD BUFF.WORTH

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	2172.3021582	65.1929674	139	590767.1254300		138			
					1.0259725		.7539582	213	0.4524
2	2254.6052631	87.0429262	76	575811.8421052		75			
					1.5639068	***	1.0701647	185	0.2867
1	2403.7593984	82.2848580	133	900516.0628844		132			
AGGREGATED	2278.7356321	45.2520292	348	712615.6878333		347			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 00:46

DATASET : FARMR2

CASES EXCLUDED IF #ADULT BUFM+F >1YRS. (Variable 249) EQ 0
AND #ADLT BUFF>1YR.SOLD (Variable 254) EQ 0

SEARCH COVERS CASES 1 TO 420
72 CASES EXCLUDED DUE TO MISSING DEPENDENT VARIABLE

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	85.8994666	2	42.9497333	66.7548603	0.0000
RESIDUAL	221.9712230	345	.6433948		
TOTAL	307.8706896	347			

GROUP MEANS AND OTHER STATISTICS OF #ADLT BUFF TREATED

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	0	0	76	0		75			
1	0	0	133	0		132			
3	1.0143884	.1075725	139	1.6084871		138			
AGGREGATED	.4051724	.05049284	348	.8872354		347			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 02:59

DATASET : FARMR2

CASES INCLUDED IF UNTREATED ADULT BUFF (Variable 320) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 7.913584 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 1.912437E-02

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	97.6629965	2	48.8314982	10.9957572	0.0000
RESIDUAL	1323.4001263	298	4.4409400		
TOTAL	1421.0631229	300			

GROUP MEANS AND OTHER STATISTICS OF UNTREATED ADULT BUFF

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	1.90625	.1730620	128	3.8336614		127			
					1.1825121		2.3420515	185	0.0208
2	2.6101694	.2344110	59	3.2419637		58			
					1.7701803	###	1.4488490	149	0.1500
1	3.1754385	.2243677	114	5.7388604		113			
AGGREGATED	2.5249169	.1254477	301	4.7368770		300			

ANALYSIS OF VARIANCE

Produced on 22/03/35 at 02:09

ATASET : FARMR2

SES INCLUDED IF AVE.VALUE ADLT BUFF. (Variable 305) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

ARCH COVERS CASES 1 TO 420

artlett's Test of Homogeneity of Variance

i-squared = 13.66183 with 2 degrees of freedom
e probability of samples with equal variances producing a value as large as this = 1.079869E-03

. This test is very sensitive to departures from normality

nalysis of Variance Table

URCE OF RIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
CEPTANCE FARMER	4238090.866135	2	2119045.433067	2.7143723	0.0703
ESIDUAL	269333174.6511	345	780675.8685539		
OTAL	273571265.5172	347			

ROUP MEANS AND OTHER STATISTICS OF AVE.VALUE ADLT BUFF.

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	4478.4892086	70.7620385	139	696010.0198102		138			
					1.4235342	***	.3683628	178	0.7133
2	4512.5	80.2078681	76	488931		75			
					2.1167696	***	1.4377639	200	0.1531
1	4716.0902255	88.2134439	133	1034954.294827		132			
AGGREGATED	4576.7241379	47.5971415	348	788389.8141707		347			

ANALYSIS OF VARIANCE

Produced on 22/03/35 at 23:59

TASET : FARMR2

S INCLUDED IF ADLT BUFF IM.CON.VAL (Variable 312) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

CH COVERS CASES 1 TO 420

OUP MEANS AND OTHER STATISTICS OF ADLT BUFF IM.CON.VAL

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	2158.3333333	328.3526704	36	3881357.142857		35			
AGGREGATED	2158.3333333	328.3526704	36	3881357.142857		35			

ANALYSIS OF VARIANCE

Produced on 23/03/35 at 00:00

TASET : FARMR2

ES INCLUDED IF ADLT CATT IM.CON.VAL (Variable 313) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

RCH COVERS CASES 1 TO 420

OUP MEANS AND OTHER STATISTICS OF ADLT CATT IM.CON.VAL

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	2777.7777777	794.3861672	9	5679444.444444		8			
AGGREGATED	2777.7777777	794.3861672	9	5679444.444444		8			

ANALYSIS OF VARIANCE

Produced on 29/06/88 at 15:42

DATASET : FARMR2

CASES INCLUDED IF CATTLE OWNED (Variable 55) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 17.04313 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 1.991273E-04

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	46.1622340	2	23.0811170	2.0354523	0.1351
RESIDUAL	3912.1452371	345	11.3395514		
TOTAL	3958.3074712	347			

GROUP MEANS AND OTHER STATISTICS OF CATTLE OWNED

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
1	1.1954887	.2356519	133	7.3857370		132			
					2.0577073	###	1.7777855	247	0.0780
3	1.9280575	.3306597	139	15.1976853		138			
					1.3570212		.08612605	213	0.9315
2	1.9736842	.3838739	76	11.1992382		75			
AGGREGATED	1.6580459	.1810507	348	11.4072261		347			

ANALYSIS OF VARIANCE

Produced on 24/03/35 at 00:18

ATASET : FARMR2

CES INCLUDED IF No. female4+ yrs (Variable 62) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

ARCH COVERS CASES 1 TO 420

artlett's Test of Homogeneity of Variance

.-squared = 8.312508 with 2 degrees of freedom
e probability of samples with equal variances producing a value as large as this = 1.566614E-02

. This test is very sensitive to departures from normality

nalysis of Variance Table

URCE OF IATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
CEPTANCE FARMER	.6008806	2	.3004403	.1012149	0.9038
ESIDUAL	338.3905723	114	2.9683383		
OTAL	338.9914529	116			

ROUP MEANS AND OTHER STATISTICS OF No. female 4+ yrs

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	1.3333333	.3228227	30	3.1264367		29			
					1.2159329		.3446826	82	0.7312
3	1.4814814	.2653277	54	3.8015373		53			
					2.6306838	###	.1080191	85	0.9142
1	1.5151515	.2092610	33	1.4450757		32			
AGGREGATED	1.4529914	.1580419	117	[illegible]		116			

ANALYSIS OF VARIANCE

Produced on 18/06/88 at 08:18

DATASET : FARMR2

ASES INCLUDED IF CATT CAVSBIRTH% /YR (Variable 280) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

EARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

hi-squared = 7.609029 with 2 degrees of freedom
he probability of samples with equal variances producing a value as large as this = 2.227001E-02

B. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	F	p
ACCEPTANCE OF FARMER	3131.3131313	2	1565.6565656	.2161467	0.8059
RESIDUAL	825757.5757575	114	7243.4875066		
TOTAL	828888.8888888	116			

GROUP MEANS AND OTHER STATISTICS OF CATT CAVS BIRTH% /YR

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	50	14.9712362	30	6724.1379310		29			
					1.7575964		.08326227	61	0.9339
1	51.5151515	10.7671745	33	3825.7575757		32			
					2.5070054	###	.4759030	85	0.6354
3	61.1111111	13.3272172	54	9591.1949685		53			
AGGREGATED	55.5555555	7.8149502	117	7145.5938697		116			

ANALYSIS OF VARIANCE

Produced on 18/06/88 at 08:44

ATASET : FARMR2

SES INCLUDED IF %CATT CAVSSURV TRETM (Variable 290) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

ARCH COVERS CASES 1 TO 420

artlett's Test of Homogeneity of Variance

i-squared = 4.494815 with 2 degrees of freedom
e probability of samples with equal variances producing a value as large as this = .1056728

. This test is very sensitive to departures from normality

nalysis of Variance Table

URCE OF RIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
CEPTANCE FARMER	1801.9614793	2	900.9807396	.7831676	0.4617
ESIDUAL	67875.4570754	59	1150.4314894		
OTAL	69677.4193548	61			

ROUP MEANS AND OTHER STATISTICS OF %CATT CAVS SURV TRETM

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
1	80.9523809	8.7805183	21	1619.0476190		20			
					1.1480519		.2644313	32	0.7931
2	84.6153846	10.4154839	13	1410.2564102		12			
					2.0502958		.8140111	39	0.4206
3	92.8571428	4.3563477	28	687.8306878		27			
AGGREGATED	87.0967741	4.2922526	62	1142.2527763		61			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 00:35

DATASET : FARMR2

CASES EXCLUDED IF #CATT CAVSM+F <1 YR. (Variable 248) EQ 0
AND ALL CATT CAVS DIED (Variable 276) EQ 0
OR #CATT CAVSM+F <1 YR. (Variable 248) EQ 0
AND #CATT CAVS<1YR SOLD (Variable 253) EQ 0

SEARCH COVERS CASES 1 TO 420

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	.02459893	2	.01229946	1.0457366	0.3546
RESIDUAL	3.9636363	337	.01176153		
TOTAL	3.9882352	339			

GROUP MEANS AND OTHER STATISTICS OF #CATT CAVS TRETD NO 1

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	0	0	56	0		55			
1	0	0	174	0		173			
3	.01818181	.0181818	110	.03636363		109			
AGGREGATED	.00588235	.00588235	340	.01176470		339			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 06:12

DATASET : FARMR2

CASES INCLUDED IF TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 90.00504 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = 2.855316E-20

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	12261905.97237	2	6130952.986185	5.6093572	0.0047
RESIDUAL	377080421.6138	345	1092986.729315		
TOTAL	389342327.5862	347			

GROUP MEANS AND OTHER STATISTICS OF 12MTHS.OLD CATT.WORTH

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
1	2318.0451127	54.6935240	133	397853.7252221		132			
					1.5925748 ###	75	2.9700927	129	0.0036
2	2579.6052631	91.3071588	76	633611.8421052					
					3.1684332 ###	138	.8638701	213	0.3894
3	2740.6474820	120.1784264	139	2007556.824105					
AGGREGATED	2543.9655172	56.7820990	348	1122023.998807		347			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 00:48

DATASET : FARMR2

CASES EXCLUDED IF #ADUT CATTM+F>1YRS. (Variable 250) EQ 0
AND #ADLT CATT>1YR.SOLD (Variable 255) EQ 0

SEARCH COVERS CASES 1 TO 420

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	1.3910414	2	.6955207	7.4518424	0.0009
RESIDUAL	38.9208633	417	.0933354		
TOTAL	40.3119047	419			

GROUP MEANS AND OTHER STATISTICS OF #ADLT CATT TREATED

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
2	0	0	76	0		75			
1	0	0	205	0		204			
3	.1223021	.04504476	139	.2820352		138			
AGGREGATED	.04047619	.01513508	420	.09620979		419			

ANALYSIS OF VARIANCE

Produced on 06/04/35 at 03:04

DATASET : FARMR2

CASES INCLUDED IF UNTREATED ADULT CATT (Variable 321) NE Missing data code
AND TIME IN BAHS (Variable 237) NE 1

SEARCH COVERS CASES 1 TO 420

Bartlett's Test of Homogeneity of Variance

Chi-squared = 2.195081 with 2 degrees of freedom
The probability of samples with equal variances producing a value as large as this = .3336909

NB. This test is very sensitive to departures from normality

Analysis of Variance Table

SOURCE OF VARIATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
ACCEPTANCE OF FARMER	13.4028749	2	6.7014374	.6863538	0.5055
RESIDUAL	1113.0757575	114	9.7638224		
TOTAL	1126.4786324	116			

GROUP MEANS AND OTHER STATISTICS OF UNTREATED ADULT CATT

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	3.5	.4468618	54	10.7830188		53			
					1.5619846		.4716331	85	0.6384
1	3.8181818	.4573775	33	6.9034090		32			
					1.6017406		.6853582	61	0.4957
2	4.3333333	.6071038	30	11.0574712		29			
AGGREGATED	3.8034188	.2880975	117	9.7110226		116			

ANALYSIS OF VARIANCE

Produced on 22/03/35 at 02:10

.TASET : FARMR2

ES INCLUDED IF AVE. VALUEADLT CATT. (Variable 307) NE Missing data code
AND TIME IN BANS (Variable 237) NE 1

RON COVERS CASES 1 TO 420

rtlett's Test of Homogeneity of Variance

squared = 6.433713 with 2 degrees of freedom
probability of samples with equal variances producing a value as large as this = 4.000086E-02

This test is very sensitive to departures from normality

alysis of Variance Table

CE OF IATION	SUM-OF-SQUARES	d.f.	MEAN SQUARE	f	p
EPTANCE FARMER	24490822.80824	2	12245411.40412	3.4623932	0.0345
IDUAL	1220158015.122	345	3536689.838906		
TAL	1244648837.931	347			

OUP MEANS AND OTHER STATISTICS OF AVE. VALUE ADLT CATT.

ACCEPTANCE OF FARMER	MEAN	STANDARD ERROR	N	VARIANCE	VARIANCE RATIO	d.f.	't'	d.f.	p
3	4911.7266187	166.5923973	139	3857670.910228		138			
					1.6339029 ###		.3644613	188	0.7162
2	4988.8157894	176.2554860	76	2361015.912280		75			
					1.6307502 ###		1.7213242	188	0.0878
1	5481.6541353	170.5611184	133	3863115.424925		132			
AGGREGATED	5146.3793103	101.5240774	348	3586884.253167		347			