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EMPLOYMENT AND INCOME FROM FARMING, NONFARM ENTERPRISES AND OFF-FARM WORK ON IRRIGATED AND RAINFED FARMS, KHON KAEN, THAILAND

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EMPLOYMENT AND INCOME FROM FARMING, NONFARM ENTERPRISES AND OFF-FARM WORK ON IRRIGATED AND RAINFED FARMS, KHON KAEN, THAILAND

By

Somsak Priebprom

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ABSTRACT

EMPLOYMENT AND INCOME FROM FARMING,
NONFARM ENTERPRISES AND OFF-FARM WORK ON
IRRIGATED AND RAINFED FARMS, KHON KAEN, THAILAND

By

Somsak Priebprom

The primary objective of this study was to appraise alternative uses of family resources for farm, nonfarm enterprises and off-farm work and their impact on production, employment and income of rural farm households in Khon Kaen Province. The study attempted to provide detail on household nonfarm and off-farm activities and their relationship to farm activities and to study their contribution to family income and their share of total labor utilization.

The data used in this study were obtained from the Rural Off-Farm Employment Assessment Project in Thailand and from a supplemental survey conducted in Khon Kaen Province, Northeast Thailand for the agricultural year 1980/1981.

A poly-period linear programming model was developed to represent farm households with three different farm size groups for both rainfed and irrigated areas. The model contained the usual farm enterprises consistent with the major enterprises actually found in the study area. In addition, major nonfarm enterprises and off-farm employment opportunities were included in detail to test the complementarity and competitiveness of farm, nonfarm enterprises and off-farm employment. The

model specified an objective function to maximize net farm household income subject to land, labor, capital, subsistence needs and other constraints. The planning period covered one year, beginning with the wet season and continuing for 12 months through the dry season up to the beginning of the next wet season. Simulation analyses with some assumed situations varying from the initial model were performed to obtain insights into how some government policies and programs might be used to increase rural household income and employment through a change in some alternative nonfarm enterprises and off-farm work opportunities, including alternative crop enterprises during the dry season.

Some of the findings of the study are as follows:

(1) In the case of rainfed farms, farm enterprises provided the primary source of family net income for the medium and large size farm, while the most important sources of family net income for small farm size was off-farm work. The net farm income proportional to total income was positively related to the operational size of farm. Income obtained from off-farm work on the basis of a percentage of the family net income seemed to show a close relationship to the farm size, but in the opposite manner. Nonfarm enterprise (or cottage industry) generated a significant amount of income for every farm size class in the rainfed area. The average family net income per household of the irrigated farm households was higher than that for the rainfed farm households. Farm enterprise was the most important source of family earning for all farm size classes of the irrigated farms. Off-farm employment also played a significant role in generating income for farm families even in the irrigated area. Nonfarm enterprise provided some supplementary income to the irrigated farm families.

(2) For all sample households, the importance of farm work expressed as the percent of total family labor used increased with the size of the operational farm. The relative share of family labor in farm work for the irrigated farms was higher than for the rainfed farms. The share of nonfarm work (cottage industry) proportional to the total family labor use for the rainfed farm was larger than for the irrigated farms. The contribution of off-farm work proportional to total family labor use decreased as farm size increased for the total sample of households as well as for both rainfed and irrigated farm households.

(3) The composition of enterprise mix suggested by the programming solutions for the rainfed and irrigated farm households with every farm size class demonstrated the possibility for both rainfed and irrigated farmers to combine farm, nonfarm enterprises and off-farm work to achieve maximum net family income under existing family resource constraints with subsistence and living expenditure requirements.

(4) Three common nonfarm enterprises of sericulture, silk weaving and sticky rice container making were recommended in the optimal plan for the rainfed farm households, whereas cotton weaving, mat making and basket making were recommended in the optimal plan for the irrigated farm households.

(5) In the optimum solutions, every farm size class of the rainfed and irrigated farm household, had some members (both males and females) with off-farm work. Without these farm employment opportunities, both rainfed and irrigated farm household would be worse off because their family net income and employment would decline substantially. Conversely, with the assumption of more off-farm employment opportunities the rainfed and irrigated farm households would have substantially higher

family net income and employment. The model results also suggested that both rainfed and irrigated family labor always enthusiastically respond to an off-farm work offering a wage ranging from 24 to 35 baht per day (or more).

To my mother, whose attitude of
perseverance shaped my character and career.

To my beloved father who laid down the foundation
but has passed away before seeing my dream come true.

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CHAPTER 1

INTRODUCTION

1. Introduction

1.1 General Background to the Problem

Agriculture has played an important part in the economy of Thailand and it is expected to play the same pivotal role in the future. Although other sectors of the economy are rapidly gaining in importance, rougly 80 percent of the population live in rural areas and mostly as farm households [NESDB, 1980]. Agricultural employs at least 62.5 percent of the total labor force [ESCAP, 1979] and provides some 73 percent of total export earnings [Bangkok Bank, 1980].

Thailand, like other developing countries undergoing the process of economic development, has development planning which is based on successive five year plans. Even though three five-year plans have been implemented to date, most Thai farmers, who are regarded as the backbone of the nation, still have relatively low incomes. According to a report of the Fourth-Five Year National Plan, the average per capita income per year for farming is 7,113 baht (20 bahts = 1 dollar), while those engaged in manufacturing, banking (and financial business) and services earned 44,215 baht, 70,339 baht and 32,665 baht per year per person respectively. This reflects a serious problem of uneven income distribution not only between the agricultural sector and the nonagricultural sector, but also between rural and urban dwellers, since most of the farmers are living in rural areas. By far the largest income disparity is that which compares income on a regional basis. In 1977, for example, income in the Central Region was more than twice that of the Northeast while that in Bangkok was seven times greater [USAID-Bangkok, 1980]. In addition, widespread unemployment and underemployment also exist in the rural area due to lack of employment opportunity, including rapid population growth in the rural area and absence of off-farm employment opportunity.

For the most recent planning period 1974-78 it was expected that the level of unemployment would reach an annual average of 3.5 to 5.0 percent of the total labor force. It was estimated that the number of unemployed persons would reach 1 million people or about 5.4 percent of the total labor force in 1980, and would reach 1.2 million people or about 5.6 percent in 1981 (NESDB, 1977). The labor force has been growing at up to 3 percent per year, requiring the Thai economy to generate more than 500,000 new jobs, annually for the age cohort of the 1950's and 60's population boom [USAID-Thailand, 1980]. About two-thirds of the labor force is engaged in agriculture which is generating labor supply at about twice the rate that is being absorbed in the industrial and service sectors.

Besides, the agricultural production pattern is characterized by a large degree of underemployment. In general, both underemployment and unemployment persists in the agricultural sector, but there is some variation in this pattern due to seasonality of agricultural activities and regional difference. This could be seen through the seasonal variations in labor utilization in the North and the Northeast. According to data from National Statistical Office (NSO, 1976), in the North in 1974, 47 percent of the male labor force in agriculture worked less than 30 hours a week in the dry season while 35 percent worked more than 70 hours a week in the rainy season. In Northeast, 42 percent of the male labor force in agriculture worked less than 30 hours per week in the dry season while 32 percent worked more than 70 hours a week in the rainy season. This type of seasonal characteristic gives rise to a large and expanding pool of labor in the agriculture sector, especially in the dry season. This has led to a higher level of rural and urban unemployment, including a substantial migration inter-regionally, and permanent moves, usually to Bangkok. Migration into Bangkok increased from 92,000 in 1976 to 324,000 in 1979 (NSO, 1980). This will create several problems such as urban unemployment, low income of unskilled urban worker, population congestion and other social problems [Charsombat, 1981].

If increased employment and income opportunities are to be provided, more off-farm jobs and nonfarm employment must become available.[1] To have the greatest impact on agriculture, some of the off-farm jobs must provide employment opportunities during periods of the year when agricultural labor requirements are at low levels (Framingham, et al., 1977).

Because of the above unsatisfactory agricultural and rural situation, the Royal Thai Government (RTG) Fourth Five-Year Plan offered the following objectives for the rural sector:

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[1]"Off-farm" refers to wage earnings obtained away from the farm premises. "Nonfarm" refers to income generating activities by the household members taking place on the farm premises but not including crop or livestock activities.

(1) to raise the income level, the standard of living and socio-economic status of farmers and increase social stability in the rural areas;

(2) to increase production of major crops in order to increase exports as the most important means to correct the adverse trade and balance of payments situation;

(3) to reduce unemployment and underutilization of farm labor and to slow down rural-urban migration; and

(4) to narrow the income gap between the urban and rural areas.

More specifically, under this plan, rural development was to be fully supported by high priority programs, such as comprehensive agricultural development at the farm level and the development of cottage and rural industries. To alleviate unemployment and rural underemployment, in particular, rural projects must be intensive in the use of labor.

However, in order to achieve those objectives it is necessary to have appropriate strategies and policies, including the right actions. Recently governments of many developing countries have begun to devote increasing attention to the development of policies and programs for expanding productive employment and earning opportunities in the various rural nonfarm activities as a means to overcome rural problems as mentioned above, such as Taiwan (Ho, 1976), Nigeria (Norman, 1973), Sierra Leone (Byerlee, et al., 1977), Korea (Cho, 1963) and Philippines (ILO, 1974).

Chuta and Liedholm (1979) provide empirical evidences of the important role of nonfarm activities in many developing countries, such as Taiwan, Korea and the Philippines. Nonfarm activities are a source of not only primary employment but also secondary or part-time employment in rural areas. They have provided a source of employment for 30 to 50 percent of the rural labor force. Besides, nonfarm activities contributed from 22 to 70 percent of the total rural household income in those countries. Other empirical evidence indicates that nonfarm activities in rural areas in some developing countries are a source of primary employment for approximately a quarter of the rural labor force. If one includes those part-time farmers who engage in nonfarm activities as a secondary occupation, the percentage increases to 40 or 50 percent.

In Thailand, a recent study of the redistribution of the labor force between the agricultural sector and nonagricultural sector (Charsombat, 1978) indicates that the nonfarm activities provided about 36 percent of the total farm household income. In addition, two studies undertaken in some villages in the northern part of the country show that nonfarm activities contributed from 43 to 76 percent of the total income for small and landless farmers under conditions of less intensive cropping and as much as 42 percent under intense cropping. Somewhat over 50 percent of rural households' time was devoted to nonfarm activities (Thodey and Seetisan, 1975; Sektheera, 1978).

Based on the above evidence, the policies and programs of nonfarm enterprises in rural areas and market towns, including those engaged in small scale public works activities appear to be one of the more promising approaches for helping the Royal Thai Government to achieve objectives stated in the Fourth Plan, in particular, to increase income and reduce unemployment and underemployment in rural areas.

There is a growing body of data which suggests that rural small scale enterprises are generally <u>labor intensive</u> and hence, provide substantial employment (Liedholm and Chuta, 1976), thus reducing the pressure to migrate to already crowded urban areas (Byerlee and Eicher, 1972). Furthermore, establishing manufacturing firms in geographically dispersed rural areas allows small firms to serve the needs of local markets. Nonfarm enterprises produce goods for local household consumption, goods for export such as local handicrafts, provide construction services in public works projects, and product inputs for agricultural production. Thus, expansion of the rural nonfarm enterprise sector offers the potential of being economically viable by providing employment for rural households on a seasonal or even permanent basis, supplying consumption needs of the local community, and raising agricultural productivity through provision of inputs (AID Project No. 493-0306, 1979; Charsombat, 1978).

1.2 Need For the Study

Promotion of the nonfarm rural enterprise sector, however, cannot be done independently of the agricultural sector. Particularly in Thailand, where agriculture is the predominant economic sector, the expansion of the nonfarm rural enterprise sector must be integrated with agricultural development. More specifically, the linkage or interrelationship between farm and nonfarm activities must be taken into account before the government will be able to design and implement appropriate programs and policies for stimulating the rural off-farm sector.

Many U.S. agricultural economists such as Salter (1940), Ruttan (1955), Fuller (1976), and Kada (1979) stress the need for more attention to be focused on the farm-nonfarm combination adjustment of the family farm. This type of farming has come to be regarded as neither a minor nor abnormal, but as a significant part of the rural economy (Salter, 1940; Fuller, 1976). It has been not only a way of life to a large proportion of the farm families, but also may be both economically rational and consistent with the goals of maximizing family income and making efficient use of farm and family resources (Lee, 1965; Krasovec, 1979; Kada, 1979). Numerous empirical studies in many developing countries indicate that from 10 to 20 percent of the rural male labor force are engaged in nonfarm work on a part-time basis. For instance, in Korea, 20 percent of the rural males had undertaken part-time nonfarm work, while in Sierra Leone, Afghanistan, and Nigeria, the figures were 11, 16, and 20 percent respectively (Chuta and Liedholm, 1979). In Thailand, approximately 36 percent of all farm households worked in off-farm employment on a part-time basis (Thai government, 1975; Chalamwong, 1981).

Unfortuantely, little research work has been done in the developing agricultural countries, in particular Thailand, to economically appraise farm and nonfarm combination of family resources, including its impacts on production, employment and farm income of rural farm households. Most farm management studies in Thailand have focused on the organization and operation of farm activities while failing to provide details on rural nonfarm activities, including their relation to farm activities [see Vanchainavin, 1980; Sriswasdilek, 1979; Thodey and Seetisan, 1975; Gramble, 1973]. There have been a few rural employment surveys (National Economic Development Board 1972; Fuhs, 1972) but, these have not included any information on the nature, extent and composition of the nonfarm enterprises, which can provide the various opportunities for on- and off-farm employment.

Lack of data and knowledge, including inadequate research work in Thailand, has limited the ability of policy makers in identifying and developing appropriate programs and policy for stimulating rural farm and nonfarm enterprise development and enhancing the contribution of these to overall development, employment, and the reduction of rural poverty.

Thus, this study will go beyond previous farm management studies in Thailand to provide more detail on nonfarm and off-farm activities and their relationships to farm activities. In addition, a farm level model will be developed to assess the effect of nonfarm employment on family resource use, farm organization and household income among the rural farm households (see Bishop, 1956; Gardiner and Wysong, 1975; and Flander, 1977). The results from this study should contribute to a better understanding of farm household's total employment behavior and provide some of the information currently needed by the RTG policy makers for better decisions and actions regarding rural nonfarm enterprise employment policy.

1.3 Related Research

The combination of farming with off-farm employment--dual employment or part-time farming--has been of interest for many years in the United States, as an economically viable alternative for improving farm family income and overcoming employment problems in the agricultural sector. An indication of this interest is reflected in the following studies which were selected to summarize what has been learned about certain aspects of dual employment farming.

Salter, Jr. and Diehl (1940) and Berstrand (1967) reviewed over 24 studies on part-time farming in the U.S.A. They concluded that the researchers had difficulty in defining a part-time farm and there was a need for more precise definitions and refinement of concepts. All studies reviewed were essentially static and descriptive. They suggested, however, that part-time farming was not seriously competing with full-time commercial farms; that outside income was not related to the amount of farming on part-time farms; that part-time farmers were not at a serious disadvantage in securing employment; that most part-time farm families liked their mode of living; and that many part-time farmers had considerable farm experience.

Lee (1965) provided a theoretical foundation for explaining the allocation of farm and family resources to nonfarm employment. This was an initial step in the study of the nonfarm employment of farm resources in micro and macro models of structural adjustment and production response. The model demonstrated the conditions under which farm operators could combine farm and nonfarm employment to maximize income, and explained the attractiveness of part-time farming as a permanent or a transitory organization of resource use. Given the farming situation and the new off-farm employment opportunity, the farmer can combine farm and off-farm work to maximize income at the point of tangency between the leisure-income transformation curve and his indifference function. This concept can also be applied to nonoperator family labor or total family labor to be allocated between farm and nonfarm employment. One of the interesting implications is that awareness of nonfarm employment opportunities reduces the "lumpiness" of the labor input on family farms. This reduces the technical underemployment of labor and improves the overall efficiency of resource use.

Several linear programming studies have attempted to include both farm and nonfarm activities in the analysis. The first pioneering study was done by Bishop (1956). He defined part-time farming:

> "...part-time farming involves the combination of farm and off-farm uses of labor resources, controlled by one family household or decision making unit."

A typical part-time farm from the Southern Piedmont of North Carolina was selected for his study. It was characterized as a small farm area with a high proportion of farm families engaged in off-farm, part-time work. A large proportion of the farm residents were employed in textile mills. Linear programming was employed to derive optimal resource use for families on part-time farms. The effects of changes in prices of major commodities, in wage rates of off-farm employment, and in investment capital were determined through sensitivity analysis. Nonfarm employment appeared as one of the enterprises in the optimal farm organization. Most of the net revenue came from two enterprises: nonfarm employment and production of commercial eggs. An increase in wage rate generated additional nonfarm employment and effected the optimum use of resources and enterprise mix.

Flanders (1977) surveyed 30 small farm families in the state of Maine. A part-time farmer was defined as having 100 days or more off-farm employment. Linear programming was the major analytical technique. Off-farm employment was particularly important when cropland was limited. It was one economically viable alternative to increase total family income in the optimum farm plan.

Gardiner and Mysong (1975) studied part-time farmers who worked off their farm 100 days or more a year. Linear programming and budgetary analysis were the main analytical techniques used. They concluded that off-farm work with part-time farming was a very profitable alternative. Operators deciding whether to take up off-farm employment were advised to budget alternatives to determine the economic feasibility of the off-farm job. Part-time farming can be a permanent or transitional activity.

Hartman, et al. (1974) used linear programming in an economic analysis of small farm production in the state of Missouri. The study revealed considerable underemployment on small farms, and nonfarm employment was a viable alternative to reduce the problem. However, when more capital was made available, land and labor became constraints on part-time farms.

A recent innovative study of Kada (1980) involved the comparative analysis of part-time farmers in the state of Wisconsin in the U.S. and in Shiga Prefecture, Japan. The results revealed substantially more off-farm work than normally reported in aggregate statistics. A central feature of the study was an analysis of farm level adjustments that are made in response to off-farm employment. In Wisconsin, farmers shift to less labor-intensive enterprises such as beef cattle or cash grain. In Japan, farmers reduce production of winter crops resulting in a monocropping pattern of rice.

Much of the quantitative research on dual employment in development countries has concerned Asian countries. Birowa (1975) and Hart (1978) studied rice farming households in Java, Indonesia. Both studied the effect of wealth on time allocation and the type of farm and off-farm work of households. They found that off-farm work decreased with increases in farm size. When larger farmers worked off the farm, they tended to work at jobs that pay substantially higher renumeration than small farms. Hart argued that access to off-farm work was frequently associated with the socioeconomic status of the household, and that wealthier households had better opportunities to obtain higher paying jobs.

Several studies conducted by researchers in the Philippines relative to farm household behavior were reported in a 1978 special issue of the Philippine Economic Journal. Evenson presented a theory of household resource allocation and Quizon reported on an application of the theory to a study of time allocations of sampled farm households. Time allocation was divided into the three activity groups of market, home production and leisure time. Market time included income earning activities both on and off the farm. The regression model tested showed that the father's and mother's market time was positively influenced by wage rates and education.

Smith and Meyer (1979) analyzed data collected from 188 farm households in the province of Laguna, Philippines, to estimate off-farm labor supply response of small rice producing farms. Thirty-three percent of the households engaged in off-farm employment. Working husbands worked on the average just over 100 days, regardless of whether or not their wives worked off the farm. Working wives, however, worked more than twice as many days off the farm when their husbands did not. Children reported about 100 days of off-farm work. Nearly 40 percent of household income was obtained from off-farm sources when both husband and wife had off-farm employment. Regression analysis was used to estimate off-farm labor supply response. The results showed that husbands were responsive to off-farm wage rates with the labor supply elasticity with respect to wage rate approaching four. Farm size had a negative effect on off-farm work supporting the hypothesis of a negative relationship between nonfarm income and farm size. The number of young and old children had a positive effect on off-farm work.

The earliest large-scale detailed research on time allocation and income generation in Thai farm households was conducted by the program of Rural Manpower-Utilization Studies which collected day by day information from farms in selected villages in Ayuthaya in the Central Region, Khon Kaen and Kalasin in the Northeast, Chiang Mai in the North, Nakorn Sithammarat and Songkla in the South. The results were analyzed by Fuks and Vingerhoets (1972), Amyot (1976), Pongsapich (1976) and Na Ayuthaya, et al. (1979). Wide variations were found among the villages in farm and nonfarm enterprises and time allocated to the various enterprises. However, the proportion of household time spent on farm activities consistently averaged about 55 to 60 percent. Domestic work accounted for 15 to 20 percent, and the remaining time was devoted to nonfarm enterprises and off-farm work. Attempts were made to estimate the amount of income earned per hour of work in various activities. With the exception of brickmaking, nonfarm enterprises normally generated less income per hour than farm enterprises. With the exception of the Ayuthaya villages, income per hour of off-farm work was higher than the per hour income of farm activities.

One of the first attempts to model villages in a multiple period framework was the study by Thody (1974) in the Chiang Mai Valley. He employed a poly-period linear programming model to derive the optimal multiple cropping systems for several representative farms. The resulting systems produced the highest net income available to the farm under the resources (land, labor and capital) and other conditions (such as crop, hired labor and loan limits) assumed. Some conditions were varied to examine their impact on multiple cropping systems, level of resource use, and income earned. The study, however, excluded nonfarm enterprises in the analysis. Thus, there is no guarantee that the optimal cropping pattern would provide the highest income if nonfarm enterprises such as handicraft making and community activities were introduced in the model.

Sektheera (1979) analyzed labor use in more detail in Ban-Pa-Mark, a village in Northern Thailand. The study analyzed labor use in typical noncrop farm production enterprises (such as community service, religious functions, weddings, etc.). A poly-period linear programming model was employed to derive optimum cropping patterns in both rainy and dry seasons for representative farms and selected case households. Nonfarm activities were studied for their contribution to family income and their share of total labor utilization. The time spent in nonfarm and off-farm income producing activities was also analyzed. Some 52 percent of total labor utilization was spent on nonfarm activities with 48 percent on farm production. Of the total time spent on nonfarm activities, 5 percent was devoted to exchange labor, 77 percent to nonfarm income earning work and the remaining 18 percent to community activities and other nonincome producing activities. On-farm activities produced 70 percent of family gross income, whereas off-farm labor activities contributed 30 percent.

Most of the studies mentioned above included only a single nonfarm activity in the model, rather than disaggregating to the several enterprises typically found in the households. Such disaggregation requires detailed records on labor utilization of farm households. For this study nonfarm activities are defined according to the different types of nonfarm employment opportunities found on representative farm households. This approach is considered more appropriate for a country like Thailand where farm families engage in various types of nonfarm enterprises (Sektheera, page 53, and Monkolchant).

1.4 Objectives of the Study

The objectives of this study are as follows:

(1) To examine the nature, extent and composition of farm, nonfarm and off-farm activities and their relationships in order to:

(a) identify the kinds and combinations of income generating activities in the rural study area;

(b) compare rainfed with irrigated farms with regard to cropping patterns, off-farm employment and nonfarm activities;

(c) describe seasonal profile of total hours worked each month by family members in alternative employment opportunities; and

(d) assess the relative importance of different farm, nonfarm enterprises and off-farm work with regard to labor absorption and income generation and to compare the importance of noncropping activities for farms of different sizes.

(2) To develop analytical models to represent the irrigated and rainfed farm household situations found in Khon Kaen villages. These models, then, can be used to analyze the optimum

allocation of the family labor and other household resource among farm and nonfarm enterprises, and off-farm work opportunities consistent with the constraints of initial farm and family resources, including family subsistence constraints.

(3) To use the models developed to evaluate the effect of alternative nonfarm enterprises and off-farm work opportunities, and wage change on enterprise combinations, employment and income earned.

(4) To evaluate the possible effect of alternative farm enterprises, especially during the dry season, on enterprise combinations, employment, resource use and income earned.

(5) To propose possible policies and programs to assist in improved household income and to stimulate employment of members of farm household in farm and nonfarm enterprise and off-farm works.

1.5 Methodology

1.5.1 Data Collection Procedure for the Study Area

1.5.1.1 Study Area

Data used in this thesis were obtained from the Rural Off-Farm Employment Assessment Project in Thailand (AID Project No. 443-030b, 1979) and from a supplemental survey conducted in the same study sites as the Project's. Thus, the data collection procedures for this thesis corresponds to those followed by the Project and are herein summarized from ROFEAP Research Paper No. 3, namely Rural Off-Farm Employment Survey (Mead and Meyer, 1981) as they pertain to the Northeast Region.

Northeast Thailand was selected as one of the regions for study because of the RTG's and USAID's interest in developing this region. The region is important not only as to national area with 42.4 percent of the total agricultural land and 43.3 percent of the nation's agricultural population [RTG, 1979], but also because it is a sensitive area with respect to political instability and national security. The region accounts for 35.9 percent of the total income, but per capita income is below the national average. It is the poorest region of the country and has some of the most serious employment problems. The region is also affected by war among Thailand's neighboring countries. This fact has been recognized and stated in the national social and economic development plan [NEDB, 1978], and thus, RTG pays special attention to the Northeast Region through research support and heavy investment in various development projects.

Within the Northeast Region, Khon Kaen, along with Roi Et Province, were chosen as the study areas using the following criteria: (1) cropping pattern and primary nonfarm enterprise; (2) consideration of its previous studies in order to be able to do a comparative analysis which could provide insights into changes in the rural economy over time; (3) the ease of access to the Project's local research base; and (5) the interest of RTG, USAID and other donor agencies. There was empirical evidence that in Khon Kaen, various nonfarm enterprises were important for many farm households. According to a previous economic survey in this area [Fuh and Vingerhoets, 1971; Pongsapich, 1976], a large proportion of total farm households had been involved in various kinds of part-time and nonfarm work such as handicrafts (e.g., basket, mat-making, silk weaving), carpentry and other services. Nonfarm income, as a proportion, represented about 30 percent of total family income. The time reported in farm cottage industry and other off-farm work represented 32 to 39 percent of total work time.

The criteria mentioned above were also used to select districts (ampurs) the administrative unit within province (Table 1.1). Four districts in Khon Kaen, namely, Muang, Ban Phai, Chonnabot and Nam Phong were chosen.

1.5.1.2 Sampling Procedure

For lack of detailed village information a Phase I survey was conducted to provide preliminary information of farm and nonfarm activities in the study areas. This survey was conducted in three stages. The first stage involved the collection of background information about economic activity, farm and nonfarm, in all of the villages of the districts selected for study. This information was obtained from interviews with a variety of local government officials, community development officers, agricultural extension workers, and others. This in turn led to the second stage, a purposive selection of villages for follow-up work. Interviews were held with village headmen who are the elected administrative officers of the villages. Village headmen usually keep record of the number of the households and the population of their villages, and are very knowledgeable about the village and its dwellers. In Khon Kaen, there were 24 headmen interviewed between October 18 and October 28, 1979 from which villages were selected for the third and final stage in the Phase I survey. Again, purposive rather than random selection procedures were used to choose the villages for further study. In general, at least two villages were chosen with reported production of each of major nonfarm enterprises found in the headmen interviews. In the selection of these villages, attention was also paid to the agricultural production characteristics of the village (e.g., availability of water, farm size, cropping patterns, etc.) the degree of isolation of the village and its size. Finally, on the basis of all these considerations, the sample of 10 villages in Khon Kaen was chosen for house-by-house enumeration in the Phase I survey. The enumeration reached a random sample of all households in the village. The sampling farm was the household list obtained from each village headman. The sampling percentages ranged from 20 to 50 percent, depending on the heterogeneity of the households in the village, as reported in the headmen interview.

Based on information in the Phase I survey, 9 out of 10 villages in the Phase I survey of Khon Kaen study area were purposively chosen for the Phase II survey. The villages include: three villages in the Amphur Muang (village Kok Nang Nqarm, Nong Ta Kai, and Ban Bed), one village in Amphur Ban Phai (Kok Sam Ran), two villages in Amphur Chonnabot (Don Kar and Ma Khambia) and three in Amphur Nam Phong (Kok Soong, Wang Toa and Ta Kaserm). Table 1.1 depicts a list of these villages. The project Phase II survey was designed to collect detailed information in order to describe the patterns of labor and land use, of gross and net income earned, and the sources and uses of finance among the diverse farm and nonfarm enterprises within the village household, over the course of one year.

Table 1.1

Village Phase I and Phase II Survey in Khon Kaen Province

District (Amphur)	Village Name	H.H. in Village	Phase I Headman Interviewed	H.H. Interviewed	Phase II: H.H. in Sample
Muang			12		
	Kok Nang Ngarm	243		48	18
	Ban Moung	192		39	--
	Nong Ta Kai	210		63	20
	Ban Ped	206		64	16
Nam Phong			6		
	Kok Soong	136		40	20
	Ta Ka Serm	176		21	27
	Wang Toa	40		61	10
Chonnabot			2		
	Don Kar	54		18	9
	Ma Kam Bid	41		14	
Ban Phai			4		
	Kok Sam Ran	232		50	27
Total		1338	24	418	141

Once the villages had been chosen, the sample of farm households were consequently chosen through the sample farm provided from Phase I survey using a stratified random sampling procedure. The stratification was based on the existence or nonexistence of a nonfarm enterprise as reported in the Phase I survey. The sampling percentage was the same within each of the two strata in any one village, but varied from village to village, depending on: (1) the number of farm households which one or two enumerator can handle as the enumerators were to be chosen from within the village; (2) the diversity of the village in terms of all economic activities, the more diverse the village was, the larger the sample size should be; and (3) the expectation of a drop out rate among households i.e. the starting sample size was set larger than the longer-run target figure. Finally, 141 farm households were obtained as the desired sample in the Khon Kaen study areas. Table 1.1 provides a listing of the villages and number of sample households chosen for the study.

1.5.1.3 Data

The data used in this thesis were obtained from two major surveys, the project Phase II survey mentioned above and a supplemental survey conducted by this researcher. The Phase II survey provided "stock data" such as general characteristics of farm households and farm inventory (land, buildings, tools, livestock and poultry and initial cash on hand. The "flow data" collected throughout the year included farm and nonfarm output, labor utilization patterns of both farm and nonfarm enterprises, family income and monthly household expenditure. This information was used to provide insight into the village households for developing the representative models which could be used to analyze the situations found in the villages.

Since the project Phase II survey was inadequate to provide the detailed information needed for this farm modelling analysis, a supplemental survey was designed to collect data which included the input-output coefficients, labor use with respect to each activity and enterprise of farm and nonfarm, cost and return of each farm and nonfarm enterprises, wage rates, labor supply and demand at alternative wage rate, different technology used in crop production etc. These data were obtained by interviewing at least 5 households for each enterprise.

It should be mentioned here that the time spent on various supplementary farming enterprise and activities such as poultry, pigs and the production of fruit and vegetables produced solely for home consumption and various nonincome generating activities e.g. household domestic chores, religious, cultural and social activities, were also collected in order to compute the potential hours available by family member in income generating activities found in the villages. Furthermore, the data obtained from both surveys were validated by checking and comparing with another previous farm household research in the Northeast.

1.5.2 Procedure

To fulfill the objectives as mentioned above, the analysis will be pursued in the following manner. To achieve the first objective, a descriptive analysis will be done using basic statistical technique such as cross tabulation, simple averages, frequencies, and percentages for each of the different farm size groups. This descriptive analysis will also guide in the specification of representative farm households for subsequent analysis in using a poly-linear programming model to meet the rest of the objectives. The models will be developed for representative farm households within different farm size groups (small, medium and large farm size) of the rainfed and irrigated agriculture situations in Khon Kaen Province (see the details of the model structure in Chapter 4). Finally, simulation analysis will be conducted with some assumed situations varying from the basic models and results will be compared to those from the basic models in order to achieve the fourth and fifth objectives. More specifically, the following alternatives will be analyzed and compared to the basic model to investigate their impact on enterprise combinations, family labor use, income from nonfarm enterprises and off-farm work opportunities, and alternative crop enterprises during the dry season: (1) no off-farm employment opportunity; (2) more off-farm employment opportunities; (3) change in wage of off-farm work (4) change in nonfarm enterprise opportunities; (5) change in rice yield; and (6) fully irrigation water supply in the dry season with introducing new alternative crop.

1.6 Organization of the Study

The next chapter is devoted to the description of the study area in terms of its physical and general characteristics in order to provide background of the Northeast Region, and Khon Kaen Province as well as the survey villages. Then, in Chapter 3 the general characteristics of the sample households including their resource endowment and utilization of these resources on farm, nonfarm and off-farm activities by farm size groups will be presented. These characteristics will help specify the representative situations found in the villages for the modelling work to follow. The details of the analytical model are discussed in Chapter 4, with emphasis on the objective function, activities, constraints and assumptions. Chapters 5 and 6 present the basic optimum farm organization and family labor use for better farm and nonfarm activities of rainfed and irrigated farms. Then, the simulation analysis with various assumed conditions to assess the impact of nonfarm enterprise and off-farm work opportunities will be presented and discussed in Chapter 7. Finally, Chapter 8 provides a summary of findings and implications drawn from programming and simulation analysis.

CHAPTER 2

DESCRIPTION OF THE STUDY AREA

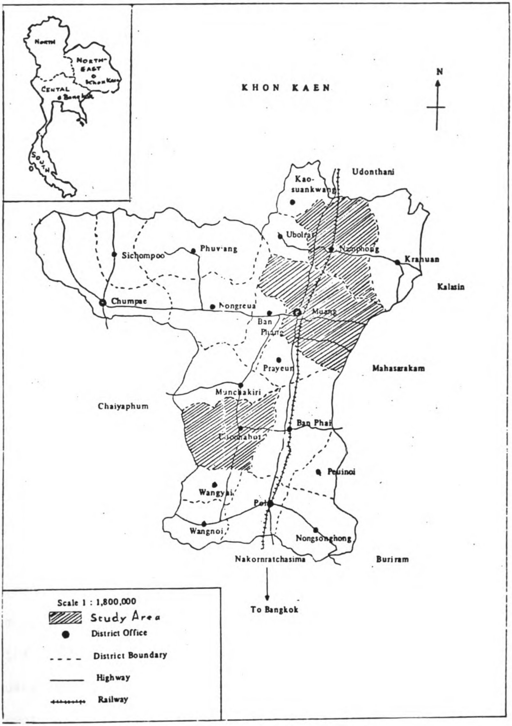
This chapter consists of three main sections. The first two sections give the general background information of Northeast Thailand and Khon Kaen Province. The last section describes the characteristics of the selected villages.

2.1 Northeast Thailand

Geographically, the Northeastern Region is a high plateau bounded by the Mekong River in the North and East and Dong Praya Yen Mountain in the West. It contains the large Korat plateau rising about a thousand feet above the central plain and sloping down toward the Mekong River. Its area covers 170,226 square kilometers or about one-third of the country. Also its people represent nearly the same proportion of the total population [RTG, 1978].

The value of gross products produced during 1973-1977 indicates that the Northeast Region's share of the national gross domestic product have remained at 15 percent. Per capita income of the Northeast Region is about 3,500 baht[1] [NESDB, 1977] or about 29 percent of the Central Region excluding Bangkok, 42 percent of the Southern Region and 67 percent of the Northern Region (Bangkok of Thailand, 1977). This is the lowest in the nation, a level less than half of the national average (฿,652). The economic structure of the region is dominated by agriculture with its share of the gross national product averaging 16

[1]One U.S. Dollar = approximately 20 baht.



NORTH
NORTH-EAST
CENTAL
SOUTH
KHON KAEN
N
Udonthani
Kao-suankwang
Ubolrat
Namphong
Kranuan
Kalasin
Sichompoo
Phuvang
Chumpae
Nongreua
Muang
Ban Phang
Prayeun
Mahasarakam
Munchakiri
Chaiyaphum
Ban Phai
Peuinoi
Wangyai
Pol
Wangnoi
Nongsonghong
Nakornratchasima
Buriram
Scale 1 : 1,800,000
Study Area
District Office
District Boundary
Highway
Railway
To Bangkok

percent [Sriswasdilek, 1980]. Regarding the agriculture sector, main crops of the Northeast are rice, and some upland crops such as cassava and kenaf. At least 3 million rai[2] of farmland is under rice cultivation [RTG, 1980]. Manufacturing plays a minor role in the economy of the Northeast. Most of the industrial establishments produce primary goods based on local agricultural resources. About 75-85 percent of total firms in this area are small rice mills scattered in the villages throughout the area. These small rice mills operate for only a few hours a day mostly to serve the local consumption needs. Other types of manufacturing activities for this region are related to cassava products (chips, pellets and flour), kenaf products (bale and gunny bag), sugarcane products, wood based products, construction materials, engine repairs and maintenance workshops, foundries, etc. [ESCAP, 1979]. Percentage of rice mills among the manufacturing units in the Northeast is relatively high, 86.5 percent, which indicates that the economy of the region mainly depends upon rice production.

According to the Labor Force Survey [NSO, 1976] about 28 percent of total population of the region were categorized as labor force of which only 1.1 percent were unemployed.

The climate of Northeast Thailand is tropical and governed by the Southwest and Northeast monsoons. The average annual rainfall ranges from 1,100 millimeters in the Western provinces to over 1,600 millimeters in the Eastern provinces. Average temperatures range between 20^{o}C. in January and 30^{o}C. in April. The relative humidity ranges from 75 to 85 percent in the rainy season and from 55 to 70 percent in the dry season.

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[2]One rai = 0.16 hectare.

Evaporation is on the order of 1,800 to 2,000 millimeters [Sriswasdilek, 1980].

2.2 Khon Kaen

Khon Kaen is one of the 16 provinces of the Northeast. It is located between 16-17^{o}N and 102-103^{o}E. Khon Kaen occupies 13,404 square kilometers or approximately 11.4 million rai which is 7.8 percent of the Northeast total area. Khon Kaen is administratively divided into 18 districts, 128 subdistricts and 1,604 villages [Khon Kaen Provincial Office, 1978].

2.2.1 Physical Features

2.2.1.1 Soil Type

Soil types of the area, which are parts of the Quaternary sedimentary deposits consists of sands, clays, gravels of the river valleys together with residual "laterites" deposits of the plains. In general, soil in Khon Kaen is mostly sandy and strongly red throughout due to the oxide strain. The moisture holding capacity and the fertility of this soil are quite low. In the northern part of the Province soil quality in terms of fertility and moisture holding capacity is better. Soil in the southern part is salty and not suitable for cultivation.

2.2.1.2 Climate

Climatological data for Khon Kaen during the period of 1957-1975 are presented in Table 2.1. The climate of this Province is seasonal in nature. Beginning with the month of April, the precipitation increases steadily as the wet season progresses until the maximum monthly rainfall is reached, which normally occurs in September. This is accompanied

Table 2.1

Climatological Data for Khon Kaen During the Period of 1951-1975

Month	Temperature (°C.)	Humidity (%)	Rainfall (mm)	Evaporation (mm)
January	23.2	64	8.9	168.1
February	25.9	62	18.0	174.2
March	28.7	61	37.2	218.0
April	30.3	64	61.6	231.5
May	29.5	72	165.4	210.9
June	28.7	76	179.6	169.6
July	28.2	77	156.3	176.4
August	27.7	80	186.8	159.9
September	27.2	82	266.0	144.3
October	26.7	80	89.4	163.7
November	25.1	70	15.9	164.8
December	23.2	66	2.7	167.6
Year	27.0	71	1,187.8	2,149.0

Source: Climatological Data of Thailand, 25 year period (1951-1975) (Meteorological Department, 1977).

with a slight rise in humidity and a simultaneous decrease in temperature and radiation. The total rainfall per year is 1,188 millimeters. The average number of rainy days per year during the period of 1972 to 1976 was 138 with 118 days during the rainy season and the other 20 days spread throughout the rest of the year [Khon Kaen Provincial Office, 1978]. The temperature falls to a minimum in December or January with the average temperature of 23^{o}C. then rises rapidly at first and then more gradually until it reaches a maximum in April (30.3^{o}C.). During this period, the weather is hot and dry moderated slightly by light breezes, cool nights and very occasional light showers. The seasonal variation of evaporation is regular in transition from minimum values in September-October to maximum values in March-April. The average evaporation per year is 2,149 millimeters.

2.2.2 Demographic Features

In 1979, the total population in Khon Kaen was 1,290,143 of which approximately 80 percent were farmers. It was composed of 648,677 (50.3 percent) males and 641,736 (49.7 percent) females. The population density was approximately 93 persons per square kilometer. During 1971 to 1979 the population growth rate was 1.6 percent per year which was relatively low compared with other provinces in the region. In 1975, approximately 50 percent of the total population was in the working age group, increasing to about 51 percent in 1979 [Khon Kaen Provincial Office, 1980].

2.2.3 Irrigation

There are two important rivers running through Khon Kaen Province, namely Nam Chi and Nam Phong. In addition, there are 25 small natural water resources scattered throughout the province with a water surface area not less than 0.64 square kilometers. The most important water resource development in Khon Kaen is Ubolratana Reservoir. It is located approximately 50 kilometers northwest from the city of Khon Kaen. Its storage capacity is 2,550 million cubic meters. Approximately 40 kilometers downstream from the reservoir is a diversion dam called Nong Wai. This dam was constructed to regulate the irrigation flow from the Ubolratana Reservoir in the Nam Phong Irrigation Project area. This project covered an area of 117,000 rai for the whole Northeast Region, but only 32,000 rai of Khon Kaen was irrigated [RTG, 1978]. Also, there are seven tank (small reservoir) irrigation projects in this area. These seven projects served an area of 16,150 rai [Royal Irrigation Department-RID, 1976]. Four other small reservoirs also existed in the province intended for the storage of water for domestic consumption only. Their storage capacity was approximately 2.09 million cubic meters. Much of the agricultural production depends on rainfall. Less than 10 percent of total cultivated land of the province is fully irrigated in the wet season and partially irrigated in the dry season. Rainfed farming, therefore, is common and extends throughout the province. Nevertheless, the rainfall is usually adequate to meet crop water requirements during five months of the year [A.I.T., 1978]. However, the rainfall is very erratic, and the water holding capacity of most Khon Kaen soils is low. Part of the rainfall is thus lost to runoff from heavy rains and deep percolation from the lightsoils. Thus, intermittent drought periods make cropping risky and yield erratic.

2.2.4 Transportation and Communication Systems

Transportation networks in Khon Kaen may be roughly separated into intra-provincial and inter-provincial routes. Within Khon Kaen there are highways and provincial roads of asphalt that connect the different provincial districts and other provinces in the Northeast. Village roads are also available to almost all villages, although some of the roads are poor and in the rainy season cannot be used except by carts, horses and motorcycles. During the dry seasons, buses, minibuses and motorcycles are modes of transport between districts. There is also a railway and good highway connecting Khon Kaen with Bangkok and other provinces. These good transportation networks help shipping agricultural products and other goods from other provinces through Khon Kaen to Bangkok as well as from Bangkok through Khon Kaen to other provinces. Also, transport by air is provided by Thai Airways.

2.2.5 Economic Aspect

The economic activity of Khon Kaen is dominated by agriculture. The share of agriculture in the provincial gross domestic product (GDP) has increased from 31.8 percent in 1973 to 36.2 percent in 1977. Khon Kaen's GDP has expanded remarkably as seen through its increased share in gross regional product (GRP) from 9.6 percent in 1973 to 10.5 percent in 1977. In 1977, its GDP was 3,676 million bahts, with 1,330 million bahts coming from agriculture [ESCAP, 1978].

Due to the rolling topography, the land use under cultivation in Khon Kaen Province may be classified into three types: upland (high terrace); upper (middle-terrace); and low land (low terrace) areas. The upland and upper (middle-terrace) are more suitable for upland crops than for rice [Khon Kaen University, 1976]. But, in Khon Kaen, rice is normally started on the lower fields as soon as they are wet enough for transplanting and proceeds to higher elevations as the fields become saturated. For Khon Kaen farmers, as well as Northeast farmers, rice is their main staple food and always receives first consideration. In upland areas, kenaf and cassava and the recently introduced sugarcane are the main crops which occupy most of the area.

In 1980, the area planted to rice was 1.9 million rais. Kenaf was planted on 139,610 rais while cassava occupied 369,681 rais [Khon Kaen Provincial Office, 1981]. Corn, tobacco and sugarcane have been recently introduced, but production levels have not picked up yet. Khon Kaen's farmers, as well as other Northeast farmers, are predominately rice growers and will diversify agricultural production only if their subsistence is assured. Even in the case of rice varieties grown, although regular rice fetches higher in price, in a risk aversion posture the Northeasterner will grow glutinous rice, despite the price differential, because he will still have his preferred food to eat if the crop is small.

In summary, the most important crops grown in Khon Kaen area are rice, and some upland crops such as kenaf and cassava. Agricultural production is supplemented by livestock raising, especially cattle and buffalo, the former for meat and the latter primarily for draft animals. Increases in livestock production are usually limited by feed shortages, especially in the late dry season and very late in the rainy season when land is occupied with crop production. Pig raising is conducted primarily on a small scale basis, with feed coming from rice by-products. There are few commercial poultry flocks in the region, but almost every village household has a few chickens or ducks providing both food and some cash income. In addition to farming, various nonfarm activities bring supplementary income. These include sericulture and silk weaving, bamboo product making, itinerant trade, etc. Rice mills are the predominate form of manufacturing in Khon Kaen. Most of them are small and diesel powered and do custom grinding. However, in the irrigated parts of the province, where rice is grown for the market, larger mills are fairly common. Most of these larger mills do custom grinding and also serve as local collection points for rice exporters located in Bangkok. The charge for the service by the small rice mills is in the form of rice bran, the by-product, which they keep. This rice bran is used for animal feed. Cassava and sugarcane mills, including the recently built paper pulp mill are other important processing industries in this province. There are still other secondary, light industries and commercial establishments which provide employment opportunities and which contribute toward the local economy. Such establishments include construction material, engine repairs and maintenance work shops, foundries, etc.

2.3 Village Characteristics

Considering the characteristics of the villages, they may be grouped into three main situations.

2.3.1 Irrigated or intensive farming in which two crops are normally cultivated each year, some supplemental water is available in the dry season, and besides the traditional land preparation (buffalo plowing), a number of households use mechanized plowing with owned or rented two-wheel tractors. Few nonfarm enterprises of cotton weaving, basket and mat making are undertaken by most households. This is the typical situation represented by Kok Nangrarm and Ta Karserm.

2.3.2 Upland crop farming with wet season rice production and large amounts of upland cropping of cassava, kenaf and sugarcane. These villages have some nonfarm enterprises such as mat making and cotton weaving. Kok Sam Ran and Kok Soong represent this type of situation.

2.3.3 Rainfed farming with only wet season rice production, but with several nonfarm bamboo products, and numbers of several households are engaged in off-farm jobs. This is the type of situation found in most of the remaining Khon Kaen villages.

However, only two situations, irrigated and rainfed farming, are included in this dissertation. Since, the rainfed agriculture situation is predominant in Khon Kaen and throughout the Northeast Region. In the case of irrigated farming, which is also chosen, even it is not the major type of farming found in Khon Kaen, because it is becoming of interest due to the strong support of the RTG for irrigation projects in the Northeast as a means to help develop this rural area. Besides, study of the excluded upland crop farming situation is being undertaken by another graduate student [see Apibunyopas, J., 1981].

2.3.4 Amphur Muang

2.3.4.1 Kok Nang Ngarm

Kok Nang Ngarm is a relatively large irrigated village with 243 households located 15 kilometers north of Khon Kaen. Forty eight households were included in the Phase 1 survey. These households had 220 working age persons of which 148 worked in agriculture, 24 in nonagricultural activities and 43 worked outside the village.

Rice is the main crop and can be grown twice a year due to the village's good irrigation water supply from the Nam Pong Irrigation Project. San Pa Tong variety, a long maturing glutinous rice variety, is commonly grown by farmers in the wet season. Dry season rice varieties are RD7 and Mali. Some farm households also grow vegetables in the dry season. Some of the village land was subject to reconsideration during the year of this study, but all of the specific households drawn in the sample were cultivating their land. Nonfarm enterprises include cotton weaving and some mat and basket making. This village is one of the two irrigated villages selected to provide the data base for the linear programming analysis.

2.3.4.2 Nong Ta Kai

Nong Ta Kai is located 20 kilometers west of Khon Kaen. It had 200 households and 63 were interviewed. They had 312 working persons of which 223 reported work in agricultural activities, 127 in nonagricultural activities and 52 worked outside the village.

In this rainfed village, agriculture is of relatively low intensity with one crop season per year. The main wet season crop is rice. San Pa Tong, a long maturing glutinous rice variety, and Dang, a middle maturing nonglutinous rice variety, are commonly grown in the rainy season for home consumption. Most farmers use baffalo and oxen for land cultivation.

There are a relatively large number of households involved in nonfarm enterprises such as sticky rice container making, sericulture and silk weaving and off-farm work in town.

This is the first of the three rainfed villages selected to provide the data base for the linear programming analysis.

2.3.4.3 Ban Ped

Ban Ped is located 5 kilometers west of Khon Kaen. It reported 206 households and 64 were interviewed. They had 310 working persons, 219 in agriculture, 60 in nonagricultural activities and 82 working outside the village.

This rainfed village is very similar to Nong Ta Kai except for nonfarm enterprises. The village's nonfarm activities involve sericulture, silk weaving, mat making and large amounts of off-farm work.

This is the second of the three rainfed villages selected to provide the data base for the linear programming analysis.

2.3.5 Ban Pai District

Kok Sam Ran Village is located just off the highway from Khon Kaen to Ban Pai, about 42 kilometers south of Khon Kaen and 19 kilometers north of Ban Pai. It is a large village, with 232 households and 50 were interviewed. They reported 222 working age persons, of which 211 reported work in agriculture, 101 in nonagriculture and only 3 work outside the village.

The village agriculture relies largely on rainfall. However, it can get access to water from a nearby canal if the local irrigation agency provides the pump. It may be classified as an upland village with a farming system excluded from the focus of this study.

The upland crops of kenaf and cassava are grown by many farmers. A big pond is located close to the village so it has a comparative advantage in producing kenaf for retting and processing into fiber. The long maturing glutinous rice variety, Ban Pai, is commonly grown in the wet season by farmers for home consumption.

The village's main nonfarm enterprises are mat making and cotton weaving, while there are very few households engaging in off-farm work.

2.3.6 Chonnabot District

The two small Chonnabot villages are adjacent to each other about 6 kilometers south of the Amphur Chonnabot. Together they have 89 households. Interviews were conducted in a total of 32 households with 152 persons reported of working age, of which 129 worked in agriculture, 52 in nonagricultural activities and 22 worked outside the village.

The main agricultural activity is one crop of rice per year in the wes season, as the village relies heavily on rainfall. Kam Pai, native variety of long-maturing glutinous rice, and Dang, a middle-maturing nonglutinous rice, are largely grown in the village. All farm households are involved in silk weaving either as their own weaving or as subcontractors to firms located in nearby towns.

A sample of nine households was drawn from these two villages to further represent rainfed agriculture. This is the third of three village samples selected for linear programming analysis.

2.3.7 Nam Pong District

2.3.7.1 Kok Soong

Kok Soong is located 40 kilometers northeast of Khon Kaen and 5 kilometers north of Amphur Nam Pong. It reported 129 households and 40 were interviewed. They had 186 working age persons; 107 working in agriculture, 93 in nonagricultural activities and 40 outside the village.

Classified as an upland village, sugarcane is the most important crop in the village. It is located close to a sugarcane refinery plant.

Some farmers grow cassava. Besides upland cropping, farmers also plant rice, especially glutinous rice for their home consumption. There are two or three native varieties of long-maturing rice (e.g., San Pa Tong, Man Ped, Luang Boon Ma) and middle-maturing rice (e.g., Khao Klang, Khao Yai), commonly grown in the village. Most crops are rainfed. It may have a high potential for kenaf production because of the new kenaf pulp plant built in the Nam Pong District. This village grew kenaf before switching to sugarcane and cassava.

Mat making is the major nonfarm enterprise in the village. The main source of off-farm work is as paid laborers in the sugarcane refinery plant, especially during its operation period of October to February.

2.3.7.2 Wang Toa

Wang Toa is a small village located 45 kilometers northeast of Khon Kaen and 3 kilometers south of Nam Pong. Twenty-one of the 38 households were interviewed. They reported 68 working age persons with 57 working in agriculture, 55 in nonagriculture and 22 outside the village.

The most important enterprise of this village is pottery production instead of farming. Most households have had long experiences in making pottery. Their ancestors migrated from Dan Kwein District of Korat Province, which is well-known for pottery making in the Northeast, to Wang Toa, which has good soil for pottery making.

This village was excluded from the linear programming analysis because of its highly specialized nonfarm activities and its limited farming.

2.3.7.3 Ta Kaserm

Ta Kaserm is a large village of 183 households located 60 kilometers northeast of Khon Kaen and 16 kilometers south of Nam Pong. Sixty-one households were interviewed and they reported 343 working age persons, with 230 working in agriculture, 105 in nonagricultural activities and 43 working outside the village.

This irrigated village has a relatively good water supply and most farmers normally grow two crops a year. Rice is the major crop grown in both wet and dry seasons. But not more than half of the farmers' paddy land can be cultivated to grow short-maturing rice due to a 50 percent reduction in irrigation water supply available from the Nam Phong irrigation project in the dry season. Farmers tend to grow only nonglutinous for sale in the dry season unless wet season glutinous rice production is insufficient for total household consumption. In this case, they also grow glutinous rice in the wet season.

Long maturing varieties of glutinous and nonglutinous rice, namely San Pa Tong and Mae Loop, respectively, are commonly grown in the wet season, while the short-maturing variety of nonglutinous rice, RD 7, is largely grown in the dry season.

Buffalos and oxen are normally used for plowing, but two-wheel tractors are being used by some farmers in recent years. There are relatively few nonfarm enterprises. Cotton weaving and mat making is done by some households during the dry season. Mat and basket making are also done by some households in both wet and dry seasons. The maintenance of the irrigation canal can provide occasional employment to villagers.

This is the second of the two irrigated villages selected to provide a data base for the linear programming analysis.

The descriptive analysis presented in the following is based on the two irrigated and three rainfed villages identified above. However, four households in Ban Ped, two households in the Chonnabot villages and one household in Kok Sam Ran were excluded from further analysis because in the year of study they were cultivating no farmland.

CHAPTER 3

HOUSEHOLD CHARACTERISTICS

General characteristics of North Eastern Thailand and survey villages were presented in the previous chapter to give an overview of the main features of the study area. This information helps us to understand the environmental constraints which should be kept in mind as models are developed for in the villages under study.

This chapter is devoted to the characteristics of farm households in both rainfed and irrigated villages in order to identify those features which should be taken into account for the programming analysis to be done in the next chapter.

As a reminder, the information reported in this chapter is based on the Phase II survey results and on a supplemental survey of selected households conducted by this researcher. The irrigated village data are from 17 households in Kok Nang Ngarm (1 household was excluded) and 21 households in Ta Kaserm. For the rainfed area all 20 households of Nog Ta Kai, 12 out of 16 households in Ban Ped and 7 out of 9 households in Don Kar were used for a total of 39 households. The excluded households did not cultivate land in the year of this study.

All sections of this chapter are based on the Phase II survey except for Section 3.3 (non-farm enterprises).

3.1 <u>Land and Farm Size</u>

Land is one of the major resources for the farm households. The amount of land operated, the fertility and the kinds of an amount of crops grown on it will, to a great extent, determine the level of farm household income, family labor utilization, household's participation in nonfarm activities and off-farm work. Thus, the aspects of land to be discussed in this section includes the land area operated by both rainfed and irrigated farm households, the terminology of farm size and its disaggregation, including land tenure, and the matter of land fragmentation.

3.1.1 Land Holding and Farm Size

The land area operated by individual farm households ranged from 5 rai to 52 rai with a mean of 19.88 rai in the sample rainfed villages, and ranged from 3.0 rai to 45.8 rai with a mean of 17.26 rai in the sample irrigated villages (Table 3.1). About 30 percent of the total households operated less than 10 rai of land in both rainfed and irrigated areas. The next larger group that accounts for about 20 percent of the total households was in the land size class of over 30 rai for the rainfed farm and of 15.0 to 19.99 rai for the irrigated farms.

To meet the objectives stated in the previous chapter, there is a need to classify the farm population according to farm size. For this, the farm households were arrayed according to the amount of their land area devoted to rainy season crops. Those which fall in the lowest quartile of this array were defined as "small farms." Those which fall in the highest quartile were defined "large" and the "medium" farms those which fall in the middle half of the array. Using these definitions, for the rainfed farm households there were 10 small farms ranging from 5.0 to 8.7 and with a mean of 6.33 rais of land area. The 19 medium farms ranged from 8.8 to 25.4 rais with a mean of 17.77 rais,

Table 3.1

Distribution of Land Area Operated by Households

Size Class (rai)	Rainfed Farm No. of Households	Rainfed Farm Average (rai)	Rainfed Farm Percent No. of Households	Irrigated Farm No. of Households	Irrigated Farm Average (rai)	Irrigated Farm Percent No. of Households
Less than 5.0	--	--	--	4	3.87	10.5
5.0 - 9.99	12	6.84	29.3	9	7.17	23.6
10.0 - 14.99	3	12.20	7.3	4	11.87	10.5
15.0 - 19.99	6	17.46	12.2	8	17.10	21.1
20.0 - 24.99	7	21.84	14.6	5	23.11	13.2
25.0 - 29.99	4	27.82	12.2	3	25.26	7.9
30.0 and Over	7	41.24	19.5	5	37.96	13.2
Total & Average	39*	19.88	100.0	38*	17.26	100.0

*Excluding 6 households in the rainfed villages and 1 household in the irrigated villages that had no land under cultivation.

and the 10 large farms ranged from 28.0 to 52.0 rai with a mean of 37.46 rais (Table 3.2). For the irrigated farm households, there were 10 small farms ranging from 3.0 to 7.2 rais with a mean of 5.39 rais. The 18 medium farms ranged from 8.0 to 23.8 rai with a mean of 15.45 rais and the 10 large farms ranged from 24.0 to 45.8 with a mean of 32.36 rais.

3.1.2 Land Tenure

Table 3.2 also summarizes the types of land ownership of rainfed and irrigated farm households. It can be seen that the level of tenancy was very low for both rainfed and irrigated farm households. Only 3 or 7.5 percent of the sample rainfed farm households operated as a full tenant, and there were only 3 of the total irrigated farm households reported to be partially tenant. Most of the rental agreements found on the sample households were with relatives and were commonly paid in kind in terms of a crop-share arrangement. Normally, the crop-share agreement is about 40 percent of the harvested crop.

3.1.3 Land Fragmentation

The matter of land fragmentation, that is the location and number of separate land parcels operated by a family, may, to some extent, enter into the decision of what individual crops will be grown [Rapeepun, 1979]. Furthermore, farms with scattered fields may impede the introduction of a new irrigation system to that area, since the water supply to one field must pass through several other fields, which in turn requires much more time to drain and distribute the water supply [Chalamwong and Onchan, 1981].

Table 3.2

Land Ownership by Farm Size
Groups of Rainfed and Irrigated Farms

Item	Households		Total Cultivated Area (rai household)	Land Ownership					
				Ownership Only		Tenants Only		Own Plus Rent	
	No.	Percent		No.	Percent	No.	Percent	No.	Percent
Rainfed Farms and Size Class:									
Small	10	25.6	6.33	9	23.1	1	2.5	-	--
Medium	19	48.8	17.77	17	43.5	1	2.5	1	2.5
Large	10	25.6	37.46	8	20.4	1	2.5	1	2.5
All Farms	39	100.0	19.88	34	87.0	3	7.5	2	5.0
Irrigated Farms and Size Class:									
Small	10	26.3	5.39	10	26.3	-	--	-	--
Medium	18	47.4	15.45	16	42.1	-	--	2	5.3
Large	10	26.3	32.36	9	23.7	-	--	1	2.6
All Farms	38	100.0	17.26	35	92.1	-	--	3	7.9

The number of noncontiguous fields and area per field operated by rainfed and irrigated farmers are shown on the basis of farm size in Table 3.3 and 3.4 respectively. As expected, the larger the farm size, the more noncontiguous fields there are. For instance, the small farm for both rainfed and irrigated farms averaged 1.7 fields per household, while those in the large farm size category averaged about 3.4 fields and 2.9 fields per household for rainfed and irrigated farms respectively.

Also, the size of field in the large farm size category for both rainfed and irrigated farms averaged about twice the size of the average field size for the smallest farms.

However, even though land fragmentation can have a bearing on cropping patterns, this feature will be ignored in the modelling work to follow because: (1) seventy percent of the sample households in both rainfed and irrigated farms have only 1 or 2 fields; (2) all fields are not very far away from the farmers' dwelling and can be reached by walking; (3) all fields within the survey villages in both irrigated and rainfed areas are very similar with regard to fertility, and rainfed areas are very similar with regard to fertility, water availability, and other such management considerations; and (4) available data omits any reference to farming activities by field.

3.1.4 Land Use

Table 3.5 indicates that most of the land operated by rainfed and irrigated farmers was used for growing glutinous and nonglutinous rice. Glutinous rice, the staple food for people in the Northeast, was mainly grown for family consumption but if there is excess, it will be sold on the market.

Table 3.3

Noncontiguous Fields by Farm Size
Group of Rainfed Farm in Khon Kaen

	Farm Size Class						All Households	
	Small		Medium		Large			
Field* Distribution	Households (No.)	Percent	Households (No.)	Percent	Households (No.)	Percent	Households (No.)	Percent
1	4	40.0	3	15.8	-		7	17.9
2	5	50.0	6	31.6	3	30.0	14	35.9
3	1	10.0	6	31.6	3	30.0	10	25.6
4	-		2	10.5	2	20.0	4	10.3
5	-		2	10.5	1	10.0	3	7.7
6 & >	-		-		1	10.0	1	2.6
Total	10	100.0	19	100.0	10	100.0	39	100.0
Fields/Household	1.7		2.7		3.4		2.6	
Rai/Field	3.72		6.62		11.9		7.89	
Rai/Home Plot	0.33		0.54		0.51		0.46	

*Excluding houseplot.

Table 3.4

Noncontiguous Field Plots by Farm Size
Group of Irrigated Farm in Khon Kaen

Field* Distribution	Farm Size Class						All Households	
	Small		Medium		Large			
	Households (No.)	Percent	Households (No.)	Percent	Households (No.)	Percent	Households (No.)	Percent
1	5	50.0	1	5.6	1	10.0	7	18.4
2	3	30.0	8	44.4	4	40.0	15	39.5
3	2	20.0	2	11.1	1	10.0	5	13.2
4	-	--	4	22.2	3	30.0	7	18.4
5	-	--	2	11.1	1	10.0	3	7.9
6 & >	-	--	1	5.6	-	--	1	2.6
Total	10	100	18	100.0	10	100.0	38	100.0
Fields/Household	1.7		3.0		2.9		2.6	
Rai/Field	3.17		5.16		11.15		6.56	
Rai/Home Plot	0.5		0.65		0.78		0.65	

*Excluding houseplot.

Table 3.5

Crops and Area Planted by Farm Size Class of the Rainfed and Irrigated Farms

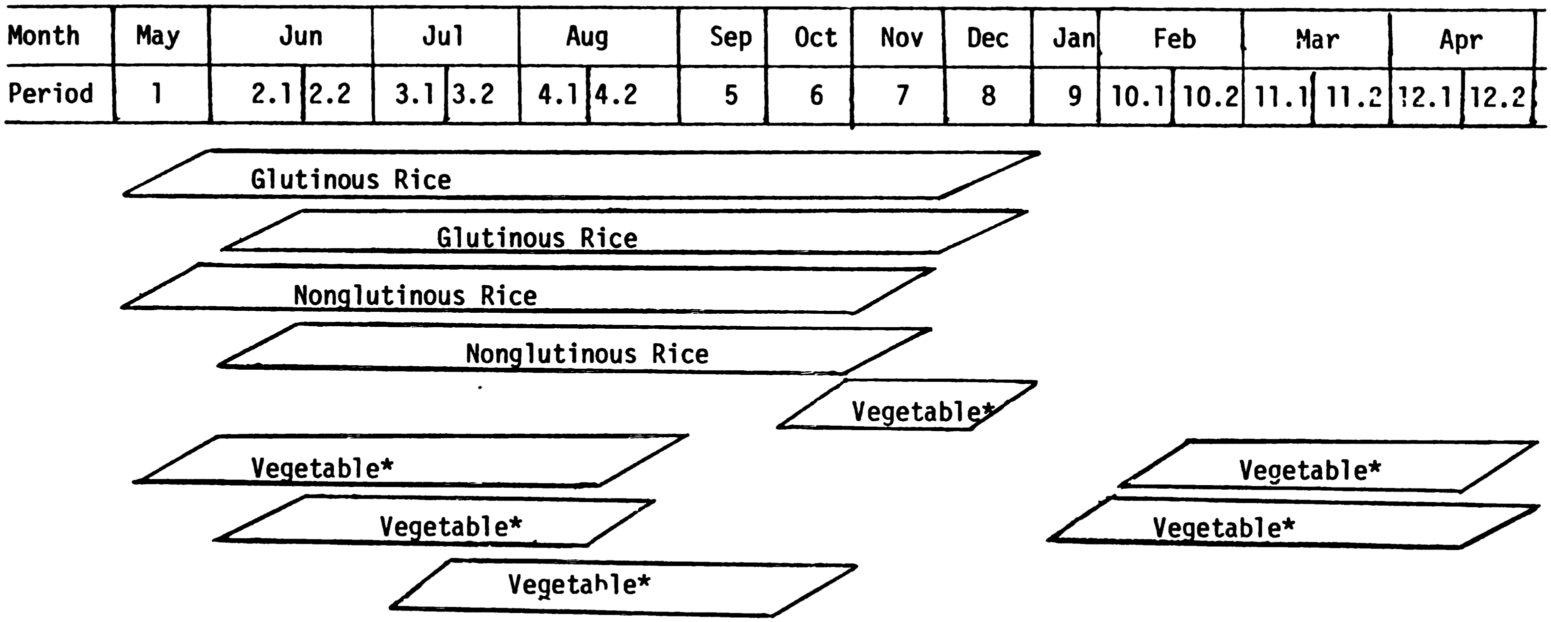
Item	Crops and Area Planted (rai/household) in Wet and Dry Season											
	Rice		Tobacco		Corn		Vegetable		Orchard		All Crops	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Rainfed Farm:												
Small	6.13	--	--	--	--	--	0.01	--	0.19	0.19	6.33	0.19
	(96.8)	--	--	--	--	--	(0.2)	--	(3.0)	(3.0)	(100.0)	(3.0)
Medium	17.26	--	--	--	--	--	0.16	--	0.35	0.35	17.77	0.35
	(97.1)	--	--	--	--	--	(0.9)	--	(2.0)	(2.0)	(100.0)	(2.0)
Large	36.97	--	--	--	--	--	0.2	--	0.29	0.29	37.46	0.29
	(98.7)	--	--	--	--	--	(0.5)	--	(0.8)	(.8)	(100.0)	(.8)
All Farms	19.47	--	--	--	--	--	0.12	--	0.29	0.29	19.88	0.29
	(97.9)	--	--	--	--	--	(0.6)	--	(1.5)	(1.5)	(100.0)	(1.5)
Irrigated Farm:												
Small	5.11	5.11	--	--	--	--	0.18	0.02	0.1	0.1	5.39	5.23
	(94.8)	(94.8)	--	--	--	--	(3.4)	(.4)	(1.8)	(1.8)	(100.0)	(97.0)
Medium	14.70	11.16	0.2	--	--	0.2	0.28	0.02	0.27	0.27	15.45	11.65
	(95.2)	(72.2)	(1.3)	--	--	(1.3)	(1.8)	(.1)	(1.7)	(1.7)	(100.0)	(75.4)
Large	30.77	15.41	0.2	--	--	0.2	.04	0.02	1.35	1.35	32.36	16.98
	(95.1)	(47.6)	(0.6)	--	--	(0.6)	(0.12)	(0.6)	(4.2)	(4.2)	(100.0)	(52.5)
All Farms	16.41	10.68	0.15	--	--	0.15	0.19	0.02	0.51	0.51	17.26	11.36
	(95.1)	(61.9)	(0.9)	--	--	(0.09)	(1.10)	(0.01)	(2.9)	(2.9)	(100.0)	(65.8)

Note: Figures in parentheses are the percentage of total cultivated land in wet season.

Nonglutinous rice is consistently produced for commercial purposes. Therefore, it is necessary for the households to grow enough rice for their consumption for it is a disgrace to have to buy rice. Small areas of vegetables are also grown, sometimes with supplemental water from swamps or shallow wells in the rainfed area. The orchard of the rainfed farm households is mostly for the growing of mulberry to support their sericulture or silkworm rearing enterprise which is common in this area. For the irrigated farms where a double cropping of rice is normally found, the area used for rice production in the dry season (January to April) is less than that in the wet season (May to December) due to a shortage of irrigation water supply in the dry season. This is because the Nam Pong Irrigation Project has a policy to conserve enough water for generating electricity in that period. This causes most of the irrigated farmers, especially the medium and large farmers to cut down their total planted area for rice by 25 and 50 percent, respectively. The medium and large irrigated farmers also grow some cash crops, namely tobacco and glutinous corn, besides vegetables, but in a very small limited area of 0.2 rai per household due to locally limited market for glutinous corn and a deliberate supply control program for tobacco.

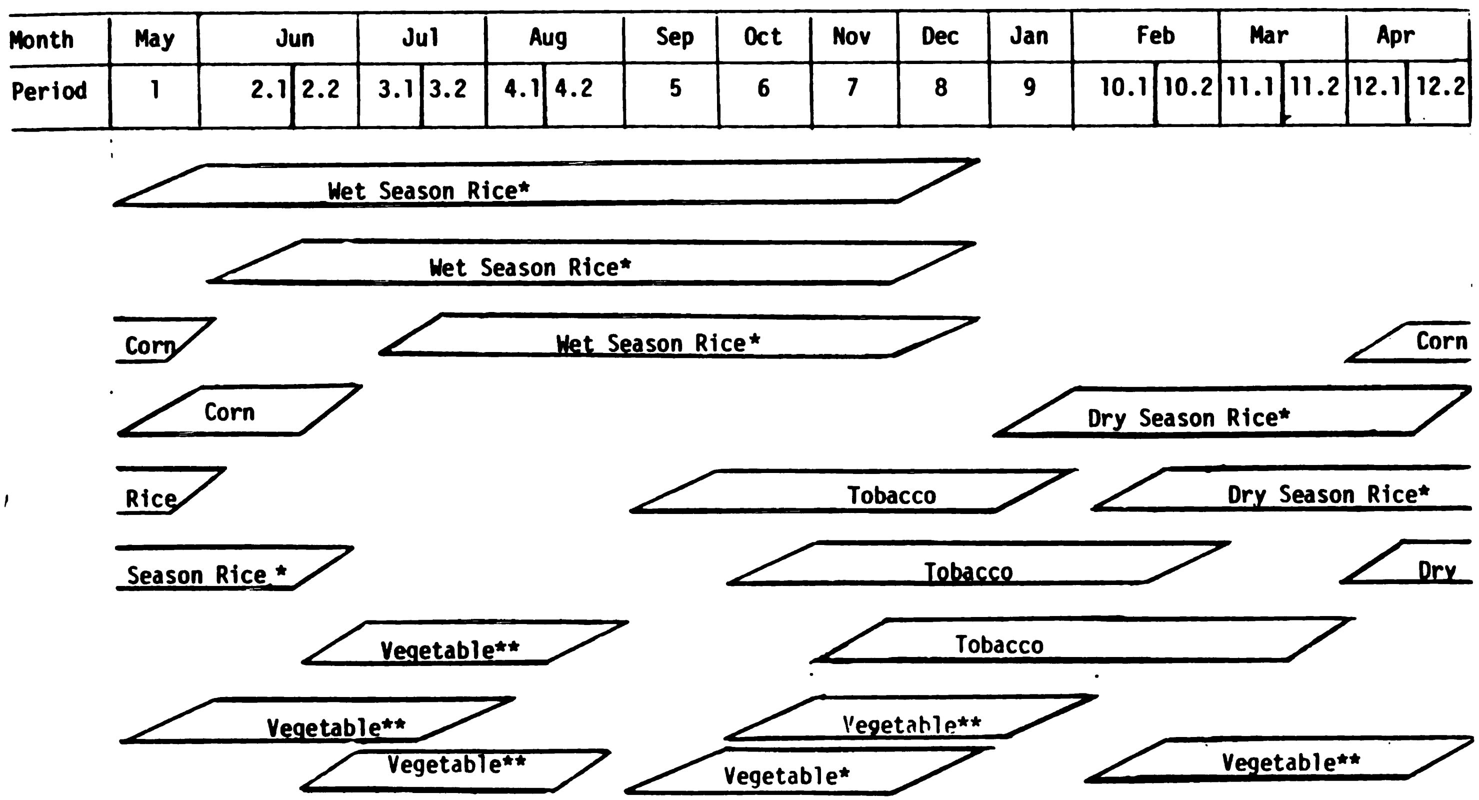
3.1.5 Existing Cropping Patterns

The cropping patterns found in both rainfed and irrigated farms were very simple as shown in Figures 3.1 and 3.2. This represents a composite of all cropping alternatives, but for most rainfed farms the cropping pattern is simply glutinous and nonglutinous rice in the rainy season. The nursery of rice can be prepared as early as May and as late as the end of June. This allows the rainfed farmers more flexibility in transplanting and planting rice in June or July which, in turn, may help the



*Vegetable Garden (noncommercial)

Figure 3.1 Existing Cropping Alternatives of Rainfed Farms in Khon Kaen



*Both glutinous and nonglutinous rice. **Vegetable garden (noncommercial)

Figure 3.2 Existing Cropping Alternatives of Irrigated Farms in Khon Kaen farmers to avoid a problem of a labor shortage during the planting period. It is interesting to note that the rainfed farmers also choose different glutinous and nonglutinous rice varieties. Part of this is explained by the desire to stagger periods and thus to cope with typical labor shortages at the harvesting season. The local photosensitive variety of "Dang" which is known as a middle maturing variety of nonglutinous rice (i.e., it can be ready for harvest in late October no matter whether it is planted in June or July) to be grown along with the late maturing San Pa Jong variety of glutinous rice, which matures in November no matter whether it is planted in June or July. However, this flexibility resulting from the choice of rice planting dates as well as the choice of rice variety will be of greater help for the small farmer in smoothing out planting and harvesting labor requirements.

A double cropping pattern with the long-maturing variety of wet season rice and short-maturing variety of dry season rice along with a small area of tobacco in wet season and glutinous corn in dry season was commonly found on the irrigated farms. The local photosensitive variety of long-maturing glutinous rice, namely San Pa Tong and nonglutinous rice, namely Mae Loop, were grown by most irrigated farmers in the wet season. The high-yielding nonphotosensitive with a short maturation period were planted in the dry season after wet season rice. These high yielding rice varieties require only 90 days for their maturation counting from their planting dates. Most of the dry season rice was produced mainly for commercial purposes to provide income for the family rather than for family consumption.

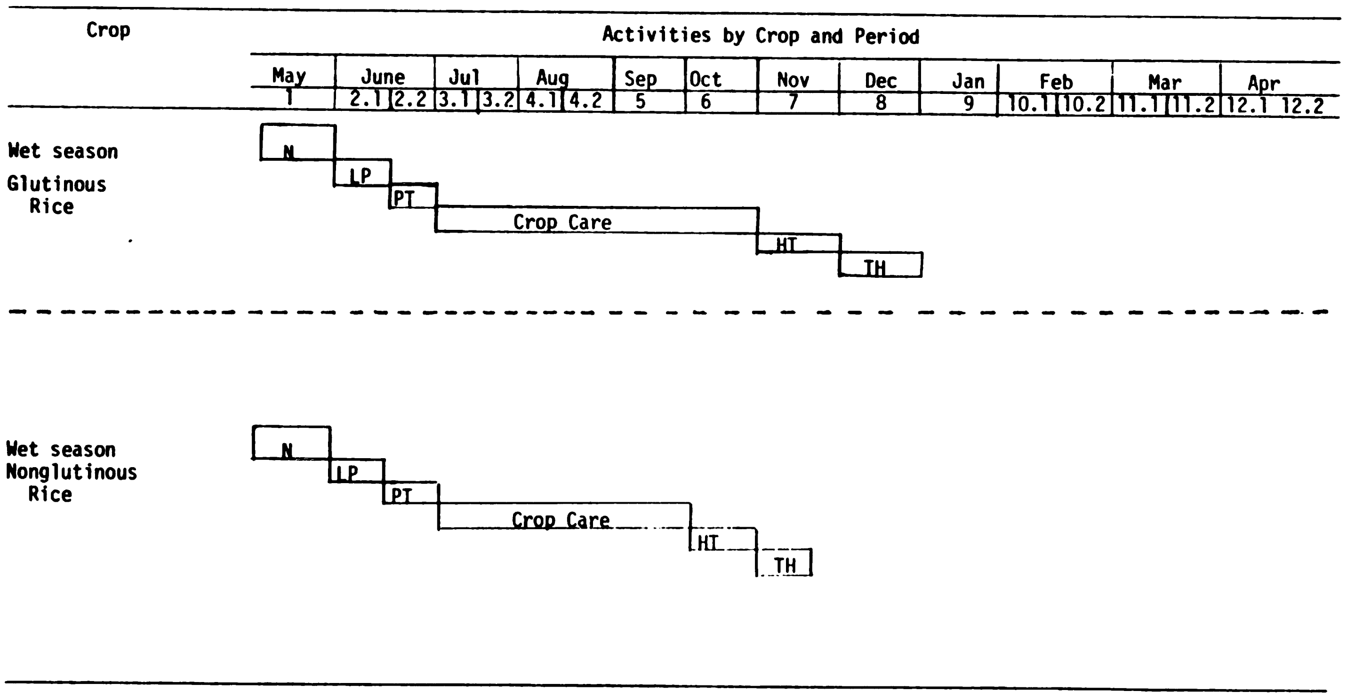
The labor activities profile by periods for rice and other cash crops grown by rainfed and irrigated farmers are illustrated in

Figures 3.3 and 3.4. On the irrigated farm, due to their better availability of water, there seems to be more time flexibility for preparing a nursery of wet season rice compared with the rainfed farms. The nursery of wet season rice can be prepared from May to July for the irrigated farms, but the rainfed farmers can establish the nursery from only May to June.

Land preparation for rice production is another area differentiating rainfed and irrigated farms. It was found that most of the sample households of the rainfed farms use water buffalo to plow their paddy land, while on irrigated farms, the land preparation was done by either water buffalos or a small, two-wheel machine tiller in both wet and dry seasons.

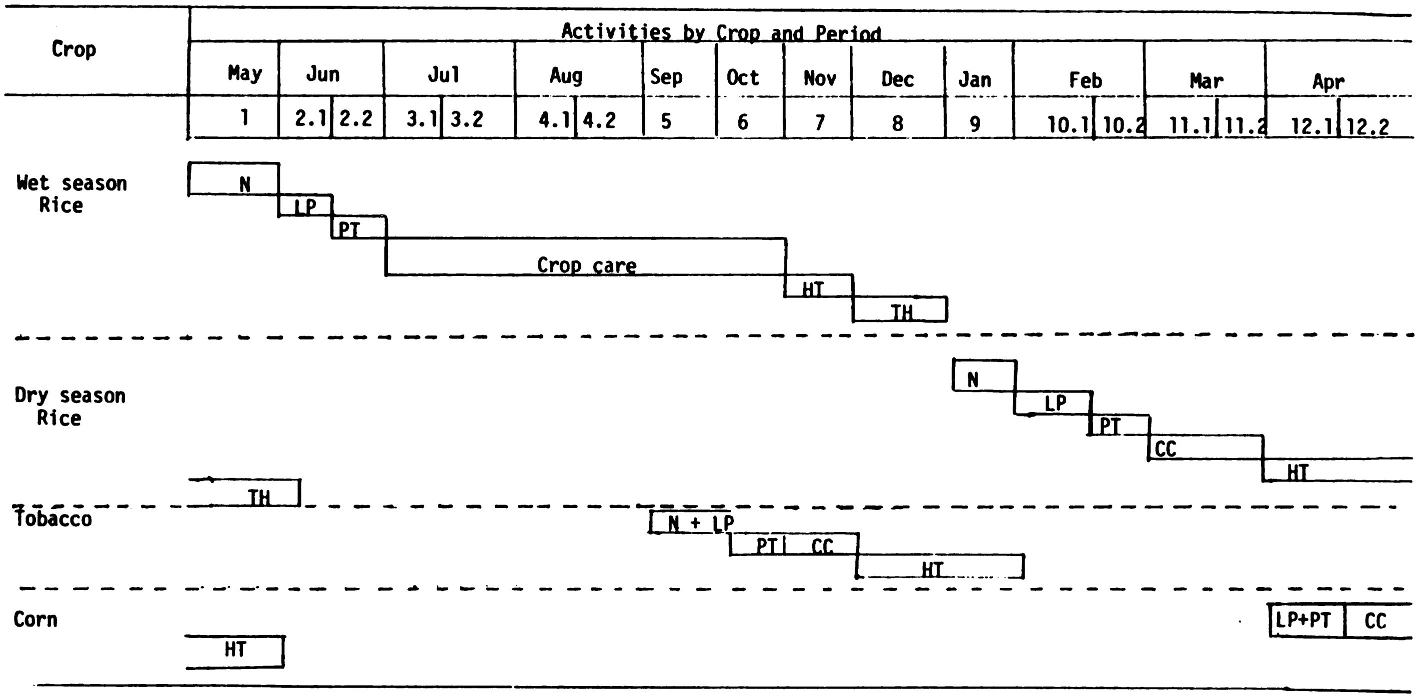
3.2 Family Net Income and Farm Size

Household net income is defined as the gross value of the production from farm and nonfarm enterprises minus their respective cash operating expenses plus the value of wages earned off the farm. The net income earned from farm enterprises includes the net value of farm products (e.g. rice, vegetables, fruits, livestock and poultry) or the gross value of farm product produced by the farmers minus the farm operating expenses. However, for the purposes of this study the sale of capital asset such as land, cattle and water buffalo owned for more than one year have been excluded. These sales are infrequent and viewed from an accrual accounting point of view, the cost of such animal are roughly offset by their end of year inventory value and their sale value is offset by their beginning of the year inventory value.



Note: N = Nursery; LP = Land Preparation; HT = Harvesting; TH = Threshing

Figure 3.3 Crop Activities Profile by Period of Rainfed Farm in Khon Kaen



Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; TH = Threshing

Figure 3.4 Crop Activities Profile by Period of Irrigated Farm in Khon Kaen

Net income from nonfarm enterprises is the difference between the gross value of nonfarm products produced in the households (such as silk fabric, mats and bamboo products) and the total operating expenses incurring in the household nonfarm production activities.

Income from family off-farm work refers to wages earned by family members who work as paid laborers in field work, construction, manufacturing or salary earners in commerce and services.

Table 3.6 shows the three main components of family net income by farm size class for rainfed and irrigated farms. In the case of medium and large sized rainfed farms, farm enterprises provide the primary source of family net income while the most important sources of family net income for small farm is off-farm work. Net income from farm enterprises accounts for 44, 42 and 27 percent of the total family net income for the large, medium and small farms respectively.

This suggests that the net farm income as a proportion of total net income is positively related to the size of farm operated by the households. This may be explained in part by the fact that the major contributor to farm income is rice production which is largely dependent on the amount of farmland. Thus, the household operating the larger farm can earn more income from farm enterprises than the ones operating smaller farms.

Off-farm work makes a very significant contribution to net income for rainfed farms, especially, the small farm size group. It provides 52 percent of the total family net income for the small farm household whereas the households operating medium and large farm obtain 38 and 37 percent of their total family income respectively from off-farm work. Again, income obtained from off-farm work (or hiring out farm family

Table 3.6

Composition of Family Net Income by Source and Farm Size Class of Rainfed and Irrigated Farms

	Net Income of Rainfed Farms by Farm Size Class (baht per household)				Net Income of Irrigated Farms by Farm Size Class (baht per household)			
	Small	Medium	Large	All Farms	Small	Medium	Large	All Farms
Farm Income	4233 (26.6)	7686 (41.7)	8778 (44.0)	7081 (39.0)	9535 (54.7)	18941 (75.6)	25047 (84.2)	18073 (74.4)
Nonfarm Income	3350 (21.0)	3793 (20.6)	3704 (18.6)	3657 (20.1)	68 (0.4)	56 (0.2)	313 (1.0)	127 (0.5)
Off-Farm Income	8351 (52.4)	6939 (37.7)	7482 (37.4)	7440 (40.9)	7842 (44.9)	6041 (24.1)	4398 (14.8)	6083 (25.1)
Total	15934 (100.0)	18418 (100.0)	19964 (100.0)	18178 (100.0)	17445 (100.0)	25038 (100.0)	29758 (100.0)	24283 (100.0)

Note: Numbers in parenthesis are percentages of the column total.

members) as well as net farm income on the basis of a percentage of total family net income, seems to show a close relationship to the farm size, but in the opposite manner. This means that the households operating smaller farm earn proportionately much more income from family members hiring out labor than is the case for the larger farms. This is as one would expect because families on small tracts of land in a rainfed area will find it difficult to utilize as much labor for farm production activities as is possible on larger farms.

Nonfarm enterprises generate about 20 percent of net income for rainfed farms regardless of size. This corresponds with the previous study on the composition of household income in the Khon Kaen rainfed area conducted by Fuhs [1979]. Table 3.6 indicates that the households holding small and medium farms earn 21 percent of their total family net income from nonfarm enterprise whereas large farm households earn 19 percent of the total family net income on the average.

In the case of irrigated farms, net income obtained from farm enterprises is the most important source of family earning for all farm size classes. It accounts for 55, 76 and 84 percent of the family net income of small, medium and large farms, respectively. Nonfarm enterprises provide little supplementary net income to families on the irrigated farms compared with rainfed farms amounting to only about 0.4, 0.2 and 1.0 percent of the total family net income for small, medium and large, respectively.

It is interesting to note that off-farm employment also plays a significant role in generating income for farm families even in the irrigated area. As an income earner, it is next to the farm enterprises and provides 45, 24 and 15 percent of the total family net income for the households who operate small, medium and large farms, respectively. So, we may generalize the conclusion that for all farms, nonfarm income as a percentage of total has an inverse relationship to farm size and that the net farm income as a proportion of total net income has a positive relationship to farm size.

3.3 Nonfarm Enterprises

In the past decade, rural nonfarm enterprise or cottage industry were commonly regarded as an insignificant part the rural household economy. But it is apparent that their contribution has been previously understated in their contribution to rural economy in terms of income generating activity as well as their contribution to household self-employment.

However, in recent years, there has been a growing body of evidence obtained from many studies of the rural economy at the village level in the north, northeast and central regions of Thailand, (see Fuhs, 1979; Sektheera, 1979), which support the important role of cottage industry in providing income to family and in increasing family labor employment. The figures of household earnings from nonfarm enterprises shown in Table 3.6 add support to these recent findings.

The specific form of nonfarm enterprises varied between rainfed and irrigated areas.

Table 3.7 reveals that there are four nonfarm enterprises found in the sample households of rainfed farms and irrigated farms. Mat making is the only common enterprise found in both farming situations. Comparing on the basis of number of households engaged in nonfarm enterprises, the rainfed farm households appear to participate more

Table 3.7

Types of Nonfarm Enterprises, Off-Farm Work and Number of Farm Households Engaged

Item	Product	Rainfed Farms Household Nos.	Rainfed Farms Percent	Irrigated Farms Household Nos.	Irrigated Farms Percent
Total Households		39	--	38	--
Type of Nonfarm Enterprise:					
Sericulture	Silk Thread	22	56.4	--	--
Silk Weaving	Patterned Fabric	23	58.9	--	--
Rice Container Marketing	Sticky Rice Container	20	51.2	--	--
Mat Making	Mat	7	17.9	7	18.4
Basket Making	Basket	--	--	10	26.3
Cotton Weaving	Cotton Fabric	--	--	19	50.0
Off-Farm Work	Wage	36	92.3	19	50.0

in nonfarm enterprises, than is the case for the irrigated farm households. There is only one nonfarm enterprise found to have 50 percent of the total households engaged for the rainfed farms while more than 50 percent of total rainfed farm households engaged in 3 main nonfarm enterprises. The fact that more than one nonfarm enterprise may be found on many rainfed farms is shown by a total of 72 enterprises being reported for 39 households. This, of course, results in a total of all individual percentages of the sample adding to more than 100.

Silk weaving, sericulture and the making of sticky rice containers are the dominant nonfarm enterprises for the rainfed farm households with more than half of the total households engaged in them. Cotton weaving appears to dominate the other two nonfarm enterprises--mat and basket making for the irrigated farms with 50 percent of the total households engaged in this enterprise.

The nature of each type of nonfarm enterprises, including its process are discussed as follows.

3.3.1 Sericulture

Sericulture has been practiced as the supplementary enterprise to rice production by the Northeast farm households for many decades. Ninety-eight percent of the total households engaged in sericulture were found to be in Northeast with Khon Kaen Province producing about 16.4 percent of the total national silk yarn production [Charsombut, 1981]. Sericulture involves both growing mulberry and raising silk worms, as the mulberry leaves are the main feed of silk worms. The main final product of sericulture is silk thread or yarn, which can be produced through two stages in the production process. The first stage is to raise and feed silk worms until they become cocoons. It takes about 25-30 days from the time eggs are hatched before they become cocoons. Then, the successive process includes boiling the cocoon (to prevent them from becoming pupas) reeling and spinning to obtain silk threads from the filament of the cocoon. The sericulture production cycle can be repeated up to 6 times a year, but in practice for the sample farm households, the process was repeated only 4 times a year. This is because the mulberry grown by the household at the edge of their compound area or on a small piece of land located near the compound area, can not produce enough mulberry leaves to raise slikworms year round. In addition, agricultural scientists have found that most of the mulberry grown in the villages was a local variety which usually produces leaves at a relatively low level of production. The first two lots of sericulture are started in May and July while the third and fourth lots are undertaken in November and March, respectively. Sericulture is dominated by female and child labor. Children (7-13 years old) are found to be very helpful especially in feeding silk worms. Budgets for each nonfarm enterprise were prepared on the basis of farmer experience and are in the appendix. Some budget details are summarized as follows.

To produce 1200 grams of silk thread 107 kilograms of mulberry leaves are required for feeding silk worms and 87 hours of female labor along with 78 hours of child labor are needed for raising silk worms. This includes 64 hours of female labor for processing silk thread. The average price of silk yarn received by the farm household was ฿50 per 100 gram at the time of the survey.

3.3.2 Silk Weaving

Silk weaving is one of the major nonfarm enterprises found along with sericulture in the rainfed farm households. Because sericulture provides the silk yarn used for the silk weaving enterprise. The main product from silk weaving is silk fabric - the woven cloth consisting of numerous yarns running parallel by the warp and running across by the weft. Most of silk fabric found in the sample households is the patterned fabric which is a designed fabric made by tieing wefts into patterns before dyeing. After weaving, the designed patterns appear on the fabric. It is well known by the Thai name of "Pa-Mud-Mee." The patterned fabric is usually woven by a native hand loom called a throw shuttle loom. The production process of patterned fabric includes 3 major steps including warps preparation, weft preparation and weaving. Warp preparation is a process of preparing yarns for running parallel along the length of the fabric. It includes degumming and dyeing warps, winding warps for determining the length of fabric, connecting warps with a loom, and loom setting for strengthening warps and preparing them for weaving. The weft preparation involves a process of preparing silk yarns for beaming. It composes several activities such as spinning yarns together to increase the thickness and weight of the fabric, degumming and dyeing weft, winding weft into a skein for patterning, patterning, wrapping to keep the desired color of the weft by tieing the plastic ribbon on the colored weft before another degumming, unwrapping to remove the plastic ribbon from the weft, and re-reeling the patterned weft from the skein into finer ribbons. The weaving is a final process of beaming by inserting the weft through the warp to make fabric. Tools and equipment used by the household were native and simple such as native throw shuttle loom, wood frame, pot and stove for degumming and dyeing, and making of patterned fabric involves many activities. Thus, silk weaving is very labor intensive and a time consuming enterprise. On the average to make one piece of pattern fabric with the regular size of 1.05 by 1.0 meter requires 45 hours for all activities in production. Females dominate the silk weaving enterprise. An enterprise budget of silk patterned fabric is shown in Appendix Table . The average price of patterned fabric received by the household was 350 baht per piece (1.05 x 1.0 meter). The net return to female family is about ฿2.99 per silk. Silk fabric can be woven by female family labor year round, but it is likely to be found in the period when labor demanded for rice production is minimum.

3.3.3 Sticky Rice Container Making

Sticky rice container making is one of the important family nonfarm enterprise for the rainfed farmers. About 51% of the sample households engaged in this enterprise. It was found to be produced year round, especially during the period when labor is not needed for planting and harvesting of rice. Making sticky rice containers differs from the production of other nonfarm products in the sense that both male and female adults as well as children participate. For instance, to produce 28 sticky rice containers, it takes on average about 63 hours of male labor, 72 hours of female labor and 4 hours of child labor (Appendix Table 5). The main raw material for making sticky rice containers is bamboo. The container is composed of 3 main parts: the container cover, the container body and its stand. The production process of making sticky rice containers is simple. Initially, the bamboo is cut, split and smoothed into small thin strips by male workers. Then, the body and the cover of containers are woven separately by male, female and children. The edges of both body and corner parts are rounded and tied by females with rattan strips and plastic yarn to strengthen it. Finally, each part is assembled (by males) along with the container rounded stand. Sticky rice containers are produced mainly to serve the Khon Kaen local market. Khon Kaen farmers like other Northeast farmers traditionally perfer to keep their cooked glutinous rice in this sticky rice container made from bamboo because it is able to preserve the cooked glutinous rice better than the other nonbamboo-made containers. In addition, the bamboo-made container is light and handy to carry by the farmers to their rice fields. An average price received by the farm household is 10 baht per sticky rice container. The net return to family labor computes to ฿7.60 per container or ฿1.62 per hour.

3.3.4 Mat Making

Production of reed mats is commonly found in many Khon Kaen villages, especially in the upland farming areas. Most of the mats produced in the households are of relatively low quality, and do not last long in normal use because they are woven using native tools and because, the reed strips are of uneven size and may include some of low quality. This causes the mats produced to be coarse and easily loosened. Mat making, is of minor importance in the sample households, used in the immediate study (excluding upland villages) since only 18 percent of the total households in both rainfed and irrigated areas engaged in making mats for sale. Women and children within the household family supply most of the labor in mat making. Normally, it requires two persons to make mats. One is a weaver and another is an assistant to insert reed strips during weaving. The production process starts with harvesting reeds which are first split into narrow width pieces lengthened and then dried for two to three days. Dyeing is done if it is required. Then if dyed, the colored reeds are dried for an additional two to three days before being ready for weaving. Either plastic strings or kenaf strings are used as the warp. The simple tools employed for mat making include the native loom and a wood frame. The stem of the sharep-edge reed naturally grown in swamp and paddy field is the major raw material used along with kenaf strings, plastic strings, and dyes, for making mats. Most mats are used locally by low income people [Charsombut, 1981]. To produce one piece of mat in the regular size of 1.5 by 2 meters requires 3.2 hours of adult female and 1.7 hours of child labor. The price of mats received by the farm households averaged ฿7 per piece. Net return to family labor was ฿4.1 per one mat or ฿0.83 per hour (including child labor). (See Appendix Table 6 where the mat making budget is shown based on 60 mats, the average of the most recent outputs of households interviewed during the supplemental survey.)

3.3.5 Cotton Weaving

Cotton weaving is the major family industry found in the irrigated farm households with 50 percent of the sample households engaged in it. However, none of the rainfed farms reported this activity. This activity occurs mostly during the dry season (January to April). This is explained in part by the high humidity in the wet season making the cotton more difficult to weave [Orapin, 1981]. Furthermore, as pointed out earlier, rainy season rice production makes heavy demands on family labor which may relegate cotton weaving to a dry season activity. The households mainly produce cotton fabric for their own family use, but it can be sold if they produce more than they need. About 7 percent of total production of cotton fabric is sold locally [Orapin, 1981]. The cotton yarn is purchased from the merchant in town rather than being produced by the household.

Cotton weaving like silk weaving is dominated by women. The production of cotton fabric in the household includes many activities similar to those in silk fabric production (i.e., warp preparation, reeling cotton yarn, degumming and dyeing, patterning and weaving). Native thrown shuttle looms and wood frames are the main tools and equipment used in cotton weaving. To complete one piece of cotton fabric with the size of 1 by 1.5 meters, it requires on the average, 12 hours of female family labor. Based on the average sale price received by the household, the net return to family labor is ฿36 per piece or ฿2.90 per hour. (See Appendix Table 18 where the cotton weaving budget is shown based on 16 pieces, the average of the most recent outputs of the households interviewed during the supplemental survey.)

3.3.6 Basket Making

Unlike the other nonfarm enterprises found in the irrigated farm households, the production of baskets is carried out by men. It was found that 26 percent of the sample households produce baskets during the periods not devoted to the farming activities of planting and harvesting. Bamboo is the major raw material along with rattan strip needed for making baskets. Production activities in basket making starts with cutting, splitting and smoothing off the bamboo stem to get bamboo strips, and then weaving and tieing with rattan strips. There are only a few simple tools used by the farmers e.g. bamboo splitting knife, bamboo sizer knife and a saw. To produce two baskets with 12 inches of diameter, 55.5 hours of adult male family labor are required. Baskets are normally sold in the household village. Based on the average sale price of ฿22.5 per basket the net return to family labor is 11 baht per basket or ฿0.39 per hour (Appendix Table 19).

3.4 Off-Farm Employment

The earlier discussion revealed the importance of off-farm work in providing a significant amount of income to the household family in both rainfed and irrigated areas. There are many activities of nonfarm work in which the household family members are engaged. They can be classified into two categories according to whether employment is in farming jobs or whether it is in nonfarming employment pursuits.

3.4.1 Off-Farm Employment in Agricultural Field Work

Hiring out of family labor to work in the rice field is the most common off-farm work found in both rainfed and irrigated farms. Many households with a large labor force relative to their farmland earn wage income by hiring out their excess labor in local field work. This kind of employment opportunity has developed as the production of rice has changed from a family self-sufficient to a more commercially oriented enterprise, especially on the larger farms. Farmers with insufficient family labor to accomplish all of their rice production labor activities, especially during certain critical periods must hire in labor. In addition, the traditional practice of exchanging labor among the farmer families has declined substantially in recent years. Generally, the households operating the larger farms hire the needed labor from the smaller sized farms with a surplus of family labor. The demand for hired labor is concentrated in the peak labor requirement periods of land preparation, transplanting and planting, harvesting and threshing rice. As pointed out earlier, some of these activities are differentiated according to sex. For example, most of the female hired labor is commonly employed for transplanting and planting activities, while male hired labor is employed for land preparation. Both male and female hired labors are employed for harvesting and threshing activities. On the average, wages paid to male and female labor are approximately equal, ranging from ฿2.8 to ฿3.5 per hour.

In addition to off-farm work in rice production in both rainfed and irrigated areas, many farmers reported to have employed some field workers for upland crops such as cassava, kenaf and sugar cane. Upland farmers growing these crops usually hire in many workers from the local area to help in harvesting and hauling activities. The upland farmers pay, on the average, ฿25 per day or 3.2 per hour for either male or female workers.

3.4.2 Off-Farm Employment from Nonagricultural Wage Sources

Many farm family members in both rainfed and irrigated areas were hired out to work in nonagricultural employment areas such as construction, manufacturing, commerce and services. These off-farm income generating activities of family members occurred in every period, but they tended to be concentrated in the slack period during the late wet season (September and February). This period corresponds to the time when most of the major manufacturing activities take place in cassava processing plants, kenaf balling plants and sugar refineries. Thus many farmers can hire out their labor during these periods when local factories are operating. Furthermore, construction activities can function faster during the dry season months than during the period of heavy rain. For these kinds of off-farm work, the wages paid for male are higher than for female. On the average male labor was paid ฿35 a day (or ฿4.38 per hour) and female labor was paid ฿30 per day (or ฿3.75 per hour).

3.5 Family Composition, Labor Force and Labor Profiles

Labor is one of the most important family resources besides land that helps determine the level of family income depending upon its opportunities among farm, nonfarm enterprises and off-farm work. In this section the composition of the household family, the family labor force, and their relationship to cultivated land, as well as the seasonal profile of total hour worked by family in farm and nonfarm enterprises and off-farm employment will be examined.

3.5.1 Family Composition and Labor Force

Khon Kaen farm households like the other Thai rural households are characterized as extended family commonly including the immediate family and occasionally grandparents and grandchildren. The number of members in the sample households averaged 5.9 for the rainfed farm and 5.4 for the irrigated farm respectively. Table 3.8 reveals that, within the rainfed farm households, the average size of household tends to increase with the size of farm. The large-sized farm household has a larger family size (7.1 person per family) than medium farm households (5.7 person per family) and small farm household (5.6 person per family). The

Table 3.8

Number of Family Members by Age Group and Sex by Farm Size Class, Rainfed Farms

Age Class	Farm Size Class and Family Member by Sex											
	Small			Medium			Large			All Farms		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
under 7	6	9	15	7	11	18	4	4	8	17	24	41
7-13	5	6	11	6	4	10	4	5	9	15	15	30
14-20	5	2	7	14	6	20	8	10	18	24	18	45
21-27	3	3	6	14	8	22	5	2	7	22	13	35
28-34	4	3	7	4	3	7	4	3	7	12	9	21
35-41	2	2	4	1	4	5	-	1	1	3	7	10
42-48	-	-	-	4	5	9	4	4	8	8	9	17
49-55	1	2	3	5	4	9	2	2	4	8	8	16
56-65	2	-	2	1	3	4	-	2	2	3	5	8
66 and over	1	-	1	3	2	5	4	3	7	8	5	13
Total	29	27	56	59	50	109	35	36	71	123	113	236
Percent	51.7	48.3	100	54.1	45.9	100	49.3	50.7	100	52.1	47.9	100
Average	2.9	2.7	5.6	3.1	2.6	5.7	3.5	3.6	7.1	3.1	2.8	5.9
Labor force	22	18	40	50	37	87	27	29	56	98	84	182
Percent[1/]	39.2	32.2	71.4	43.5	34.3	79.8	38.0	40.8	78.8	41.9	35.6	77.5
Labor force per family	2.2	1.8	4.0	2.6	1.9	4.5	2.7	2.9	5.6	2.5	2.2	4.7

[1/] Percent of total family members representing the proportion of the household members in the labor force.

relationship between the family size and the size of farm operated by irrigated farm households is not conclusive as all farm size groups were found to have about the same number of person per family. The average number of persons per family is 5.5 for small farm, 5.2 for medium farm and 5.3 for large farm size (see Table 3.9).

Inasmuch as families vary as to size and composition according to age and sex, they likewise vary in their family labor supply and in their needs, as consumers. For this study, the family labor force was defined as including any member of the family who is at least 7 and not more than 65 years old. For this sample of farms, the size of the family labor force varies among the farm size groups and between the rainfed or irrigated farm households. For the rainfed farms, about 4 persons or 71 percent of the household members are in labor force for the small farm, whereas the households with medium-sized farm and large-sized farm have 5.7 person or 80 percent and 5.6 persons or 79 percent of their family members in the labor force, respectively. Among the irrigated farm households the small farm and medium farm households have about 89 percent and 87 percent, or 4.9 persons of their family members in labor force, which is slightly larger than the family labor force of the large household having 4.4 persons or 83 percent of the family member in the labor force.

Classifying the family labor force as to adult male, adult female (with the age from 14 to 65 years old) and children (with the age from 7 to 13 years old) permits discussion according to the different roles and contribution that are made to the family labor supply. For instance, the 7 to 13 year old children must attend the elementary school due to the RTG policy for improving literacy in the rural areas. Consequently,

Table 3.9

Number of Family Members by Age, Sex and Farm Size Class of Irrigated Farm

Age Class	Farm Size Class and Sex											
	Small			Medium			Large			All Farms		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
under 7	2	2	4	3	8	11	2	5	7	7	15	22
7-13	3	3	6	9	11	20	5	2	7	17	16	33
14-20	4	6	10	9	13	22	6	7	13	19	26	45
21-27	5	4	9	9	8	17	3	2	5	17	14	31
28-34	3	1	4	4	2	6	2	4	6	9	7	16
35-41	1	2	3	2	7	9	2	2	4	5	11	16
42-48	5	6	11	5	4	9	2	2	4	12	12	24
49-55	2	1	3	2	3	5	1	2	3	5	6	11
56-65	2	1	3	1	1	2	1	1	2	4	3	7
66 and over	-	2	2	1	1	2	1	1	2	2	4	6
Total	27	28	55	45	58	103	25	28	53	97	114	211
Percent	49.0	51.0	100	43.6	56.4	100	47.2	52.8	100	46.7	53.3	100
Average	2.7	2.8	5.5	2.5	3.2	5.2	2.5	2.8	5.3	2.5	3.0	5.5
Labor force	25	24	49	41	49	90	22	22	44	88	95	175
Percent[1/]	51.0	49.0	89.0	39.8	47.5	87.3	41.9	41.5	83.0	38.5	45.6	84.1
Labor force per family	2.5	2.4	4.9	2.2	2.7	4.9	2.2	2.2	4.4	2.3	2.5	4.8

[1/]Percent of total family members.

they cannot fully contribute to the family labor force and be productive especially during the schooling time. Adult females play the pivotal role in domestic house work e.g. chores, cooking, rearing children and some family industries like silk weaving and mat making. The work of adult males is primarily on farm enterprises. For the rainfed farm household, on the average, each farm size group, small, medium and large, has more adult males than adult females in their family labor force, but the amount of child labor varies little among the three different farm size groups. However, the irrigated farm households averaged more females than males in their labor force for every farm size class. No causal relationship is implied here.

3.5.2 Land-Labor Relationship

For a given area of farmland available, the amount and kind of crops grown may be related both to the number of consuming family members as well as to the amount of family labor that is available to work in the fields.

Some relationships between land and labor are shown in Table 3.10 by farm size. For the rainfed farm households, the ratio of land to labor is 3.0, 4.5 and 7.1 rai per adult for farms in the small, medium and large sized farm respectively (Table 3.10). This suggests that the labor may be in excess supply on small farms and in short supply on large farms as far as meeting crop labor requirements are concerned. This statement would not hold if small farms had more intensive cropping programs than on larger farms. But since rice is the primary rainy season crop on all farms, this conclusion is generally applicable. Indeed, the indication of excess labor on small farms and labor shortages

Table 3.10

Sex and Age Composition of Family Labor Force by
Farm Size Class of Irrigated and Rainfed Farms

	Farm Size Class							
	Small		Medium		Large		All Farms	
	No. per HH	%	No. per HH	%	No. per HH	%	No. per HH	%
Irrigated Farms								
Labor Force								
Adult Male	2.0	41	1.7	35	1.7	39	1.8	39
Adult Female	2.3	47	2.1	43	2.0	45	2.0	43
Child	0.6	12	1.1	22	0.7	16	0.8	18
Total	4.9	100	4.9	100	4.4	100	4.6	100
Cultivated Land (rai)								
Per Household	5.39		15.45		32.60		17.26	
Per Labor Force	7.77		3.15		7.40		3.75	
Per Adult Labor	4.20		4.10		8.80		4.56	
Rainfed Farms								
Labor Force								
Adult Male	1.7	43	2.2	50	2.3	41	2.1	45
Adult Female	1.2	30	1.7	30	2.4	43	1.8	38
Child	1.1	27	0.5	11	0.9	16	0.8	17
Total	4.0	100	4.4	100	5.6	100	4.7	100
Cultivated Land (rai)								
Per Household	8.70		17.77		37.46		19.88	
Per Labor Force	2.17		4.03		6.68		4.22	
Per Adult Labor	3.00		4.55		7.07		5.09	

on large farms is even more pronounced on irrigated farms where the land per adult worker is 4.2, 4.1, 8.8 rai for the small, medium and large farm respectively (Table 3.10).

3.5.3 Distribution of Family Labor to Farm, Nonfarm and Off-Farm Activities

3.5.3.1 Farm Labor

On the basis of the average hour worked per family for all sample households, it was as expected that farm work dominated nonfarm work and off-farm work by accounting for nearly 62 percent of the total family labor use (Table 3.11). In addition, the important role of farm work as the percent of total family labor use increases with the size of the operational farm. For instance, the farm work contributes 53, 62 and 69 percent of the total family labor use to small, medium and large farm size respectively (Table 3.11). There is more farm work to be accomplished on large farms requiring the households with large farm size to devote more of their family labor in farming than the households with smaller sized farm.

Comparing the share of family labor in farm work (as the percent of the total family labor use) between irrigated farm households, and rainfed farm households, we note that the irrigated farmers devote nearly 68 percent of their family labor use to farm work while the rainfed farmers contribute about 55 percent of their family labor use to farm work. This is because the irrigated farmers can grow dry season rice which expands the potential for farm work.

Regardless of farm size or type, farm work was dominated by adult males relative to adult females and children. On the average, about

Table 3.11

Distribution of Family Labor to Farm, Nonfarm and Off-Farm Activities, Rainfed and Irrigated Farms, by Farm Size[1] and Labor Class

Item	Rainfed Farms				Irrigated Farms				All Farms			
Number of Farms	S	M	L	All	S	M	L	All	S	M	L	All
Hours/Household/Year	10	19	10	39	10	18	10	38	20	37	20	77
Farm Work	2726	3230	4364	3392	3549	4118	4423	4048	3138	3674	4394	3722
Male	1290	1854	2411	1852	1543	1805	2168	1832	1416	1830	2289	1842
Female	853	1053	1459	1106	1540	1590	1714	1609	1197	1321	1587	1358
Children	583	323	494	434	466	723	541	607	525	523	518	522
Non-Farm work	1683	1385	1737	1551	337	777	761	657	1010	1081	1249	1106
Male	479	332	583	434	95	244	160	183	287	288	372	310
Female	813	836	981	867	151	405	537	373	482	620	759	620
Children	391	217	173	250	91	128	64	101	241	173	118	176
Off-Farm Work	1448	1210	838	1176	2144	1066	557	1216	1796	1138	697	1194
Male	911	779	431	724	1253	390	147	553	1082	585	289	637
Female	537	431	407	452	891	676	410	663	714	553	408	557
Children	-	-	-	-	-	-	-	-	-	-	-	-
Total Hrs/Household	5857	5825	6939	6119	6030	5961	5741	5921	5944	5893	6340	6022
Male	2680	2965	3424	3010	2891	2439	2475	2568	2786	2702	2950	2789
Female	2203	2320	2847	2425	2582	2671	2661	2645	2392	2496	2754	2535
Children	974	540	667	684	557	851	605	708	766	695	636	698
Percent Distribution[2/]												
Farm Work	46.6	55.4	62.9	55.4	58.8	69.1	77.0	68.4	52.8	62.3	69.3	61.8
Male	47.3	57.4	55.2	54.6	43.5	43.8	49.0	45.3	45.1	49.8	52.1	49.5
Female	31.3	32.6	33.4	32.6	43.4	38.6	38.8	39.7	38.2	36.0	36.1	36.5
Children	21.4	10.0	11.4	12.8	13.1	17.6	12.2	15.0	16.7	14.2	11.8	14.0
Non-Farm Work	28.7	23.8	25.0	25.4	5.6	13.0	13.3	11.1	17.0	18.4	19.7	18.4
Male	28.5	24.0	33.6	28.0	28.2	31.4	21.0	27.8	28.4	26.6	29.8	28.0
Female	48.3	60.4	56.5	56.0	44.8	52.1	70.6	56.8	47.7	57.4	60.8	56.1
Children	23.2	15.6	9.9	16.0	27.0	16.5	8.4	15.4	23.9	16.0	9.4	15.9
Off-Farm Work	24.7	20.8	12.1	19.2	35.6	17.9	9.7	20.5	30.2	19.3	11.0	19.8
Male	62.9	64.4	51.4	61.6	58.4	36.6	26.4	45.5	60.2	51.4	41.5	53.4
Female	37.1	35.6	48.6	38.4	41.6	63.4	73.6	54.5	39.8	48.6	58.5	46.6
Children	0	0	0	0	-	-	-	-	-	-	-	-
Total	100	100	100	100	100	100	100	100	100	100	100	100
Male	45.8	50.9	49.3	49.2	47.9	40.9	43.1	43.4	46.9	45.9	46.5	46.3
Female	37.6	39.8	41.1	39.6	42.8	44.8	46.4	44.7	40.2	42.3	43.5	42.1
Children	16.6	9.3	9.6	11.2	9.3	14.3	10.5	11.9	12.9	11.8	10.0	11.6

1/ S = Small, M = Medium L = Large

2/ Labor class percentages computed as percent of work type.

half of the total hours devoted to farm work is provided by adult males, while adult female and child labor share 37 and 14 percent of their total family labor use in farming respectively (Table 3.11). Despite the dominance of the male role in farming, the important role of both adult females and children (especially with a limited labor supply of children during the schooling period) is very evident.

3.5.3.2 Nonfarm Work

The supplemental role provided by nonfarm work (in family cottage industry) is shown by the observation that about 18 percent of total family labor use for all sample households was allocated to this area. In comparison among farm size groups, the share of family labor to nonfarm work varies little across farm size in the total sample as can be seen from Table 3.11. Considering all farms, nonfarm work accounts for 17, 18 and 20 percent of family labor use for small, medium and large sized farms respectively. As expected, the share of nonfarm work proportional to the total family labor use for the rainfed farms is larger than for the irrigated farms because the farming activities are limited for rainfed farm households and income must be supplemented by engaging more in many varieties of cottage industry.

With regard to the type of labor, women labor in both rainfed and irrigated farm households appears to play the dominant role in nonfarm work by providing more than half (56%) of family labor worked in nonfarm activities while the men's labor share is only 28 percent of total family labor worked use. Children contribute nearly 16 percent of total family labor worked in nonfarm activities for both rainfed and irrigated farms. The role of children in nonfarm employment activities cannot be explained adequately from the data provided in this study. In the cultural setting of rural Thailand, children are expected to develop basic skills and to avoid idleness whether or not their employment is regarded as profitable from a monetary standpoint. The role of women in development has received increased attention in recent years. The role of children may also be an area for more attention in research.

3.5.3.3 Off-Farm Work

For the total sample households, about 20 percent of family labor is allocated to off-farm work. However, the contribution of off-farm work proportional to total family labor use varies widely by farm size group. It decreases as farm size increases for the total sample households as well as for both rainfed and irrigated farm households as can be seen in Table 3.11. For total sample households, off-farm work shares 30, 19 and 11 percent of family labor use for small, medium and large sized farms. For the rainfed farms, it provides 25, 21 and 12 percent of family labor use for small, medium and large farm size, while it accounts for 36, 18 and 10 percent of family labor use for small, medium and large irrigated farms respectively.

As observed earlier, the farm load is heavier on large farms than small farms. However, the proportion of total family labor time spent on nonfarm enterprises does not appear to be related to size of farm. Consequently, the conclusion can be reached that on small farms a smaller proportion of time spent on crop activities is compensated by off-farm employment and on large farms off-farm employment plays a lesser role because of the higher commitment to farm work.

The variation in the proportion of off-farm work being performed by male labor in relation to female is likely explained by the varying proportion of males in the labor force along with the heavy weighting of agricultural activities in the off-farm employment which may have a disproportionate level of male participation.

Table 3.12 has converted the figures in Table 3.11 to average hours per person by dividing the total average hours per household by the corresponding average number of persons in the household labor force. This conversion makes a correction for the varying size of labor force among farm type and farm size classes. Table 3.13 converts the figures in Table 3.12 to percentage computed against total work hours by labor class. These percentages are not comparable with those shown in Table 3.11 which are based on the contributions from different labor classes to a work effort taking into account all members in the labor force. Many of the original conclusions still hold. For example, the male adult involvement in farm work increases with farm size and is higher on irrigated farms than on rainfed farms and the same generalization holds for adult female labor.

The chief purpose of Table 3.13 is to examine the distribution of reported work hours for the average individual by labor class. We observe that farm work is the dominant activity for children and for all adults on the average. Farm work accounts for 66, 54 and 75 percent of the average reported time for men, women and children respectively. About the same proportion of both men and women time is allocated to off-farm work on the average of all households but varies markedly among farm types and farm sizes. As farm size increases, the share of one's time spent in off-farm work decreases for both males and females and

Table 3.12

Hours Worked Per Person, Per Household, Per Year by Type of Work by Labor Class and by Farm Size, Rainfed and Irrigated Farms

Per Family Item	Rainfed Farms				Irrigated Farms				All Farms			
	S	M	L	All	S	M	L	All	S	M	L	All
No. of Adult Males	1.70	2.26	2.30	2.13	2.20	1.78	1.70	1.87	1.95	2.02	2.00	2.00
No. of Adult Females	1.20	1.74	2.40	1.82	2.10	2.11	2.00	2.08	1.65	1.92	2.20	1.95
No. of children	1.10	.53	.90	.77	.60	1.11	.70	.87	.85	.82	.80	.82
Total Labor Force	4.00	4.53	5.60	4.72	4.90	5.00	4.40	4.82	4.45	4.76	5.00	4.77
Ave. Hours/Person												
Farm Work												
Male	759	820	1048	869	701	1014	1275	980	726	906	1144	921
Female	711	605	608	608	846	754	857	773	725	688	721	696
Children	530	609	549	563	777	651	773	698	618	638	647	636
Non-Farm Work												
Male	282	147	253	204	43	137	94	98	147	142	186	155
Female	678	480	409	476	83	192	268	179	292	323	345	318
Children	355	409	192	325	151	115	91	116	283	211	148	215
Off-Farm Work												
Male	536	346	187	340	570	219	86	295	555	290	204	318
Female	447	248	169	248	490	320	205	319	433	288	186	286
Children	--	--	--	--	--	--	--	--	--	--	--	--
Total Work												
Male	1577	1312	1488	1413	1314	1370	1455	1373	1428	1338	1474	1394
Female	1836	1333	1186	1332	1419	1266	1330	1271	1450	1299	1252	1300
Children	885	1018	741	888	928	766	864	814	901	849	795	851
No. of Farms	10	19	10	38	10	18	10	38	20	37	20	77

Source: Computed from Tables 3.7, 3.8 and 3.11. Only persons over 6 and less than 66 years of age are computed.

Table 3.13

Percent of Total Hours Worked Per Person, Per Household, Per Year by Type of Work, by Labor Class and Farm Size, Rainfed and Irriaged Farms

Per Family Item	Rainfed Farms				Irrigated Farms				All Farms			
	S	M	L	All	S	M	L	All	S	M	L	All
No. of Adult Males	1.70	2.26	2.30	2.13	2.20	1.78	1.70	1.87	1.95	2.02	2.00	2.00
No. of Adult Females	1.20	1.74	2.40	1.82	2.10	2.11	2.00	2.08	1.65	1.92	2.20	1.95
No. of Children	1.10	.53	.90	.77	.60	1.11	.70	.87	.85	.82	.80	.82
Total Labor Force	4.00	4.53	5.60	4.72	4.90	5.00	4.40	4.82	4.45	4.76	5.00	4.77
Percent of Labor Force												
Male	42.5	49.9	41.1	45.1	44.9	35.6	38.6	38.8	43.8	42.5	40.0	41.9
Female	30.0	38.4	42.8	38.6	42.9	42.2	45.5	43.2	37.1	40.3	44.0	40.9
Children	27.5	11.7	16.1	16.3	12.2	22.2	15.9	18.0	19.1	17.2	16.0	17.2
Percent of Total Hours/Person												
Male Adults												
Farm work	48.1	62.5	70.4	61.5	53.3	74.0	87.6	71.4	50.8	67.7	77.6	66.1
Non-Farm Work	17.9	11.2	17.0	14.4	3.3	10.0	6.5	7.1	10.3	10.6	12.6	11.1
Off-Farm Work	34.0	26.3	12.6	24.1	43.4	16.0	5.9	21.5	38.9	21.7	13.8	22.8
Total	100	100	100	100	100	100	100	100	100	100	100	100
Female Adults												
Farm work	38.7	45.4	51.3	45.7	59.6	59.5	64.4	60.8	50.0	53.0	57.6	53.5
Non-Farm Work	36.9	36.0	34.5	35.7	5.9	15.2	20.2	14.1	20.1	24.9	27.5	24.5
Off-Farm Work	24.4	18.6	14.2	18.6	34.5	25.3	15.4	25.1	29.9	22.1	14.9	22.0
Total	100	100	100	100	100	100	100	100	100	100	100	100
Children												
Farm Work	59.9	59.8	74.1	63.4	83.7	85.0	89.5	85.7	68.6	75.1	81.4	74.7
Non-Farm Work	40.1	40.2	25.9	36.6	16.3	15.0	10.5	14.3	31.4	24.9	18.6	25.3
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Computed by converting figures of Table 3.12 to percentages.

for both rainfed and irrigated farms. This demonstrates clearly that farm labor needs to be first priority even when off-farm employment may exist.

Nonfarm enterprises in the household constitute a minor allocation of one's time on the average for all three labor classes. However, about a quarter of one's time is engaged in nonfarm enterprises for female adults on the average and reaches more than a third for the women on rainfed farms. In the latter case, nonfarm work involves more time than off-farm employment which is the reverse situation for the adult women on irrigated farms. It is clear that farm work takes precedence for all classes of labor and that off-farm employment diminishes as the demands for farm labor increase with farm size.

3.5.3.4 Total Hours Worked Per Family Worker by Labor Class

Because of the size of family labor force varies across the farm size group as pointed out earlier, the computation of total hours worked per farm family worker by sex and age was made to permit a comparison of family labor contribution to farm, nonfarm and off-farm activities by type and size of farm (Table 3.14).

The hours worked per person as reported in Table 3.14 also permit some observations about the extent of underemployment in the rural villages under study. One can arbitrarily assume an 8 hour working day and convert the hourly figures to daily figures as has been done in Table 3.14. The result for all households is an average of 174 days for adult males, 163 days for adult females and 106 days for children. By further assuming 20 working days per month for 12 months or 240 work days per year, these figures compute to an employment level of 73 percent for adult males, 68 percent for adult females and 44 percent for children.

Table 3.14

Approximate 8-Hour Days of Annual Employment Per Person by Type of Work, Labor Class and Farm Size, Rainfed and Irrigated Farms

Days of Employment by Class	Rainfed Farms				Irrigated Farms				All Farms			
	S	M	L	All	S	M	L	All	S	M	L	All
Average Days/Person/ Farm Work												
Male	95	102	131	109	88	127	159	123	91	113	143	15
Female	89	76	76	76	106	94	107	97	91	86	90	87
Children	66	76	69	70	97	82	97	87	77	80	81	79
Nonfarm Work												
Male	35	18	32	25	5	17	12	12	18	18	23	19
Female	85	60	51	59	10	24	33	22	36	40	43	40
Children	44	51	24	41	19	14	11	15	35	26	18	27
Off-Farm Work												
Male	67	43	23	43	71	27	11	37	69	36	26	40
Female	56	31	21	31	61	40	26	40	54	36	23	36
Children	--	--	--	--	--	--	--	--	--	--	--	--
Total Employment												
Male	197	163	181	177	164	171	182	172	178	167	184	174
Female	230	167	148	166	177	148	166	159	181	162	156	163
Children	110	127	93	111	116	96	108	102	112	106	99	106
Percent of 240 Day Work/ Year												
Male	82	68	78	74	68	71	76	72	74	70	77	73
Female	96	70	62	69	74	66	69	66	75	68	65	68
Children	46	53	39	46	48	40	45	42	47	44	41	44

Source: Computed from Table 3.12 by converting to 8-hour days.

Perhaps surprisingly, the highest employment level for both men and women is found on small rainfed farms where a disproportionate amount of time is spent in both nonfarm and off-farm employment.

The weakness of the assumptions and the tentative nature of the conclusion are readily conceded. Rural people do not behave in a regimen of 8 hour days and 20 days of work each month. The demands and opportunities for employment vary widely among seasons as do the family commitments to nonincome-generating activities. Furthermore, in the accounting of total hours expended, many hours spent in routine household activities (especially for female adults) were omitted in the survey method. Some of these issues will be addressed in subsequent sections.

Again, figures in Table 3.13 reveal the important role of female labor to the performance of farm work. Farm work represents the primary allocation of women's time when compared with nonfarm income generating activities and with off-farm employment. It would appear that the greater the demands for farm work, the higher is the proportion of women's time spent in this activity. The proportion is higher for irrigated farms than for rainfed farms and the proportion tends to increase with farm size.

Children show their significant role in farm work as the portion of their total hours worked which also tends to increase with farm size. However, their efforts in nonfarm enterprises appear to be tied to the commitment to this area by the adult females. On rainfed farms, nonfarm work takes a higher share of the time spent for both children and women than is true on irrigated farms.

3.5.4 Seasonal Distribution of Family Labor Use

The seasonality of the family labor utilization is shown in Figures 3.5 to 3.7 for three farm size classes of the rainfed farm and Figures 3.8 to 3.10 for three farm size classes of irrigated farms. These figures were prepared using data from Tables 3.15 and 3.16 which summarizes the hourly monthly allocation of family labor to farm, nonfarm enterprise and off-farm work for rainfed and irrigated farms.

The farm labor profile reflects the growing cycle of rice for which its planting and harvesting make up the peak periods in labor demand. In general, the nursery can be prepared in either May or June, while June or July is primarily for land preparation, transplanting and harvesting. October and November are the harvesting and threshing periods for the middle maturing variety of nonglutinous, while the long-maturing variety of glutinous rice is harvested and threshed in November and December. August and September become the waiting period involving less labor demand activities for crop care (e.g., weeding, draining). After the production of rice is complete in December, the family labor time spent on farm enterprises declines rapidly starting from January to April (i.e., during the dry season).

The rainy season average of 530 hours per household in the rainy season for all farms and all labor is 6 percent above the annual average of 502 hours, whereas the dry season average of 442 hours is only 88 percent of the annual monthly average (Table 3.17). As would be expected, the seasonal work load is more uniformly distributed on irrigated farms than on rainfed farms because of the opportunity to utilize more family labor for crop production during some months of the dry season. The dry season index was 84 for rainfed farms and 92 for irrigated farms.

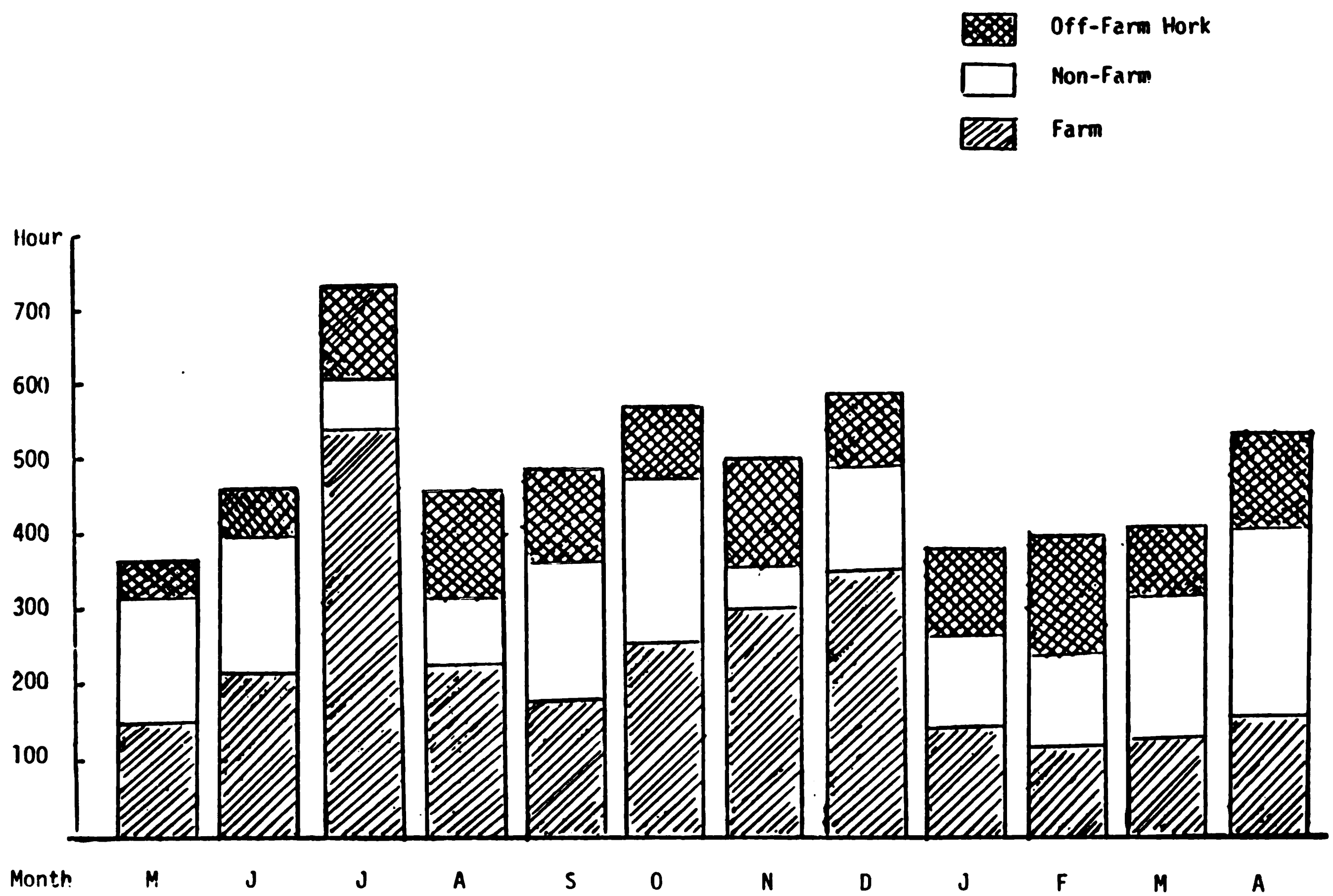


Figure 3.5 Family Labor Profile for the Small Rainfed Farm

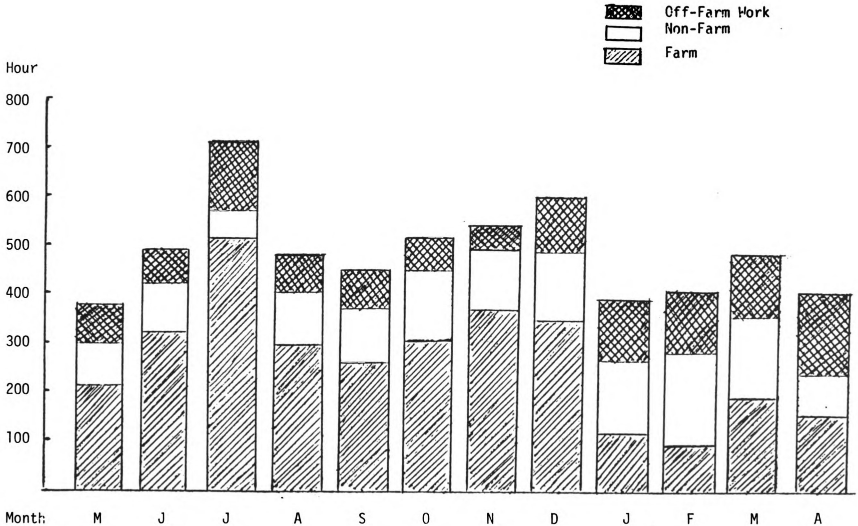


Figure 3.6 Family Labor Profile for the Medium Rainfed Farm

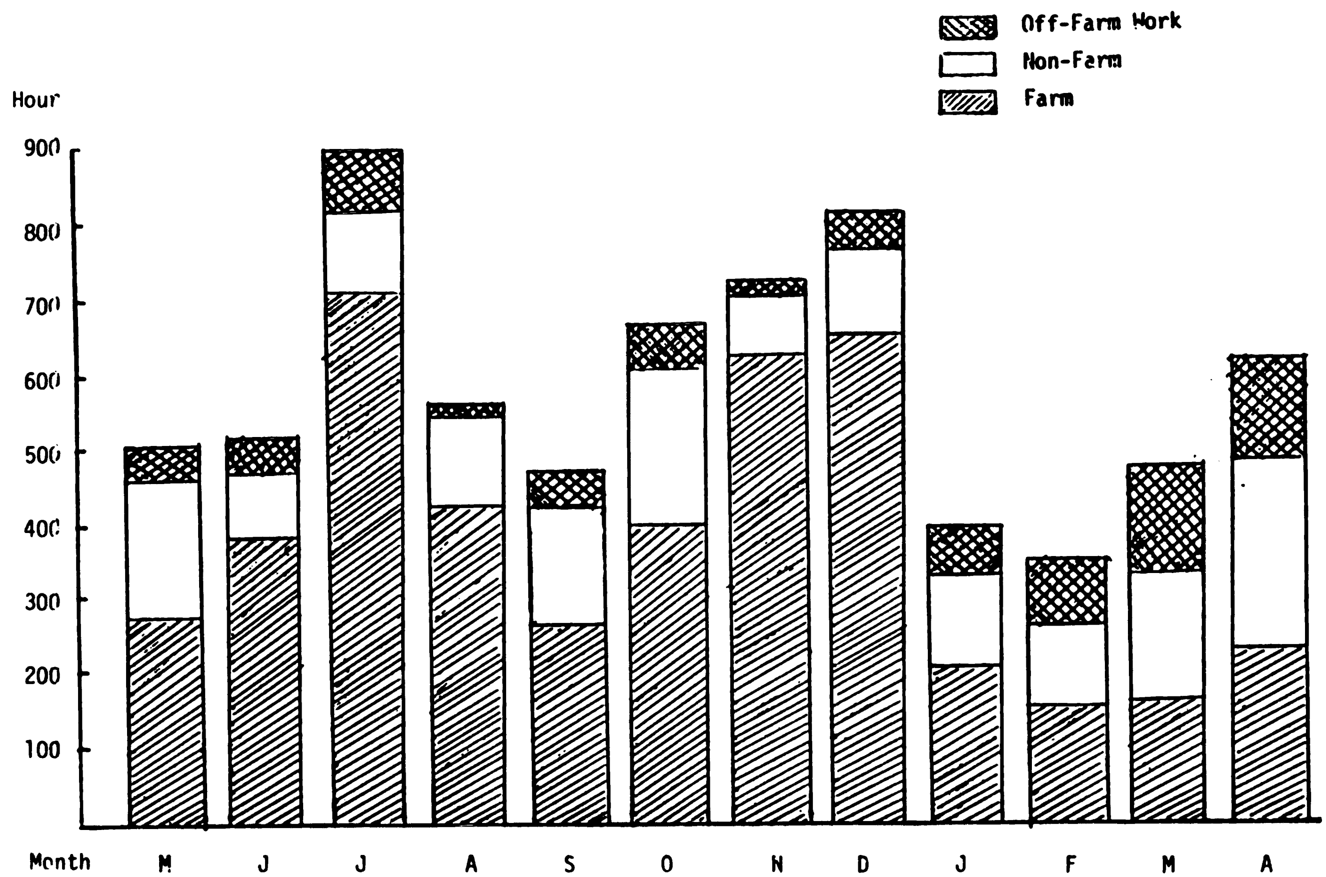


Figure 3.7 Family Labor Profile for the Large Rainfed Farm

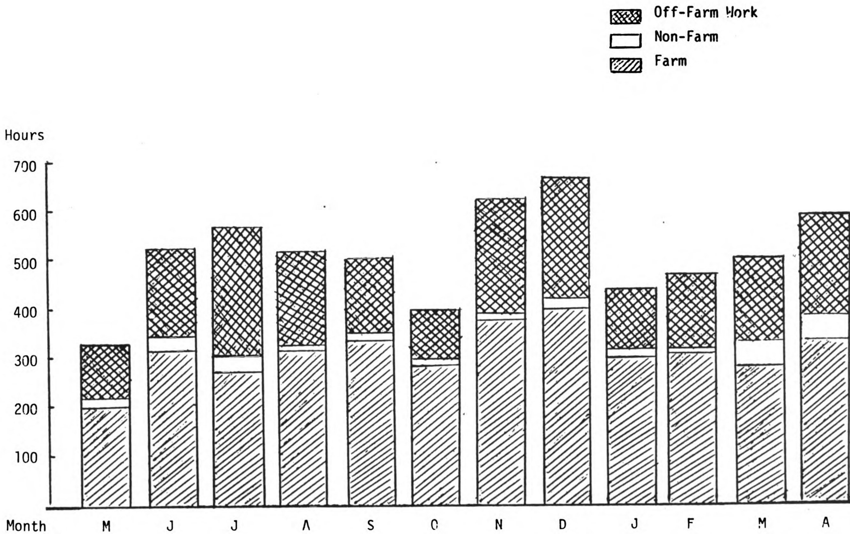


Figure 3.8 Family Labor Profile for the Small Irrigated Farm

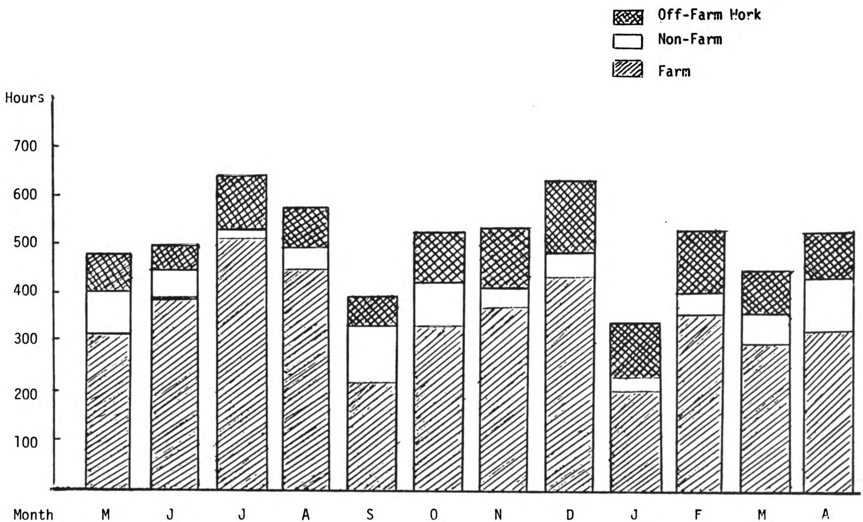


Figure 3.9 Family Labor Profile for the Medium Irrigated Farm

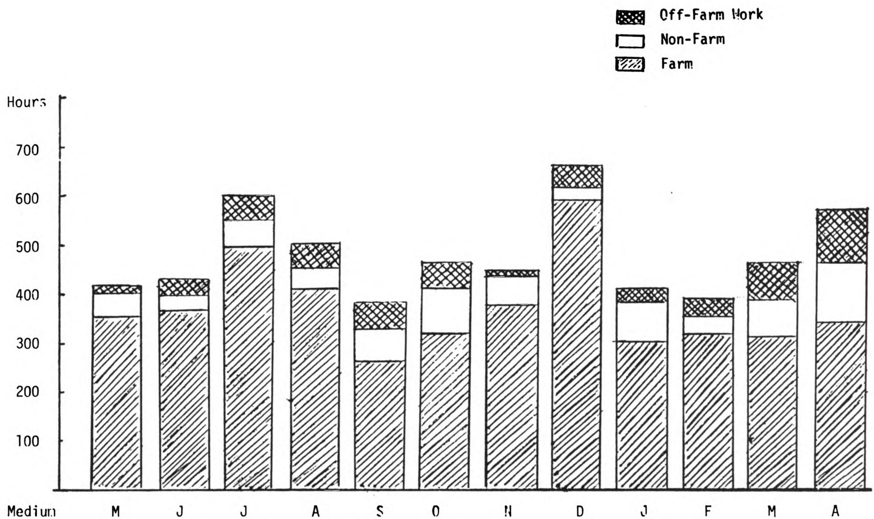


Figure 3.10 Family Labor Profile for the Large Irrigated Farm

Table 3.15

Seasonal Distribution of Family Labor to Farm, Nonfarm Enterprise and Off-Farm Work of the Rainfed Farm

	Average Hour Per Household by Farm Size Class															
	Small (10)				Medium (19)				Large (10)				All Rainfed Farms (39)			
Month	F	NF	OF	TT	F	NF	OF	TT	F	NF	OF	TT	F	NF	OF	TT
May	144	161	70	375	206	94	73	373	272	180	49	501	207	133	66	406
Jun	256	83	127	466	319	101	74	494	372	93	44	509	316	94	80	490
Jul	533	73	132	738	515	56	139	710	705	112	75	892	568	75	121	764
Aug	228	103	135	466	294	99	80	473	432	117	10	559	312	105	76	493
Sep	169	179	132	480	249	116	76	441	246	183	48	477	228	149	83	460
Oct	237	229	92	558	297	146	70	513	383	211	67	661	304	184	75	563
Nov	292	65	132	489	371	103	61	535	615	82	38	735	413	88	73	574
Dec	347	129	105	581	334	153	105	592	647	101	60	808	418	134	93	645
Jan	136	114	133	383	128	149	118	395	199	111	83	393	148	130	113	391
Feb	113	125	156	394	156	119	130	405	134	115	81	330	139	119	124	382
Mar	117	184	106	407	192	164	142	498	138	181	134	453	158	173	131	462
Apr	154	238	128	520	169	85	142	396	221	251	149	621	178	167	140	485

Note: F = farm; NF = nonfarm enterprise; OF = off-farm work; TT = total

Table 3.16

Seasonal Distribution of Family Labor to Farm, Nonfarm Enterprise and Off-Farm Work of the Irrigated Farm

	Average Hour Per Household by Farm Size Class															
	Small (10)				Medium (18)				Large (10)				All Irrigated Farms (38)			
Month	F	NF	OF	TT	F	NF	OF	TT	F	NF	OF	TT	F	NF	OF	TT
May	194	25	109	328	308	94	76	478	352	55	29	436	289	66	72	427
Jun	303	45	175	523	384	50	63	497	362	41	41	444	357	46	87	490
Jul	254	46	258	558	502	33	98	633	497	42	64	603	435	39	131	605
Aug	302	17	196	515	437	51	59	567	405	45	52	502	393	40	102	536
Sep	338	18	137	493	228	107	49	384	250	85	41	376	263	78	70	411
Oct	262	70	125	397	326	93	83	502	334	89	35	458	311	70	82	463
Nov	376	11	238	625	359	60	85	504	367	63	17	447	366	48	107	521
Dec	380	19	259	658	429	46	152	627	582	46	49	677	456	39	153	648
Jan	286	10	132	428	194	34	100	328	323	57	24	404	252	34	88	374
Feb	297	8	145	450	357	33	124	514	327	29	25	381	333	25	104	462
Mar	255	58	177	490	285	75	69	429	291	81	82	454	279	72	101	452
Apr	302	70	193	565	309	101	88	498	333	128	98	559	314	100	118	532

Note: F = farm; NF = nonfarm enterprise; OF = off-farm work; TT = total.

Table 3.17

Monthly Composition of Total Labor Utilization and Seasonal Index of Average Total Family Labor by Farm Type

	Percent of Monthly Total									Seasonal Index*		
	Farm Labor			Nonfarm Labor			Off-Farm Labor			All Labor		
Month	RF	IR	ALL	RF	IR	ALL	RF	IR	ALL	RF	IR	ALL
May	51	68	59	33	15	24	16	17	17	80	87	83
Jun	65	73	69	19	9	14	16	18	17	96	99	98
Jul	74	72	73	10	6	9	16	22	19	150	120	137
Aug	63	73	69	21	8	14	16	19	17	97	109	102
Sep	50	64	56	31	19	26	18	17	18	90	83	87
Oct	54	67	60	33	15	25	13	18	15	110	94	102
Nov	72	70	71	15	9	12	13	21	17	112	106	109
Dec	65	70	68	21	6	13	14	24	19	126	131	129
Rainy Season	63	70	66	22	10	17	15	20	17	108	104	106
Jan	38	67	52	33	9	22	29	24	26	77	76	76
Feb	36	72	56	31	5	17	33	23	27	75	94	84
Mar	34	62	48	38	16	27	28	22	25	91	92	91
Apr	37	59	48	34	19	27	29	22	25	95	108	101
Dry Season	36	64	51	34	13	23	30	23	26	84	92	88
Total Year	56	68	62	25	11	18	19	21	20	100	100	100
Hrs./Mo./ Household												
May-Dec	346	359	352	120	53	87	83	1-0	91	549	512	530
Jan-Apr	156	294	224	147	58	103	127	103	115	430	455	442
Total Year	283	337	309	129	55	92	98	101	99	510	493	502

*Percent of annual average per month.

RF = average of 39 rainfed farms; IR = average of 38 irrigated farms; ALL = average of 77 farms.

The composition of labor according to the monthly allocation is presented in both Tables 3.17 and 3.18. The proportion that off-farm labor is of all labor holds reasonably constant at 15 to 20 percent during the rainy season and jumps to between 25 and 27 percent during the dry season months (Table 3.17). This proportion averages somewhat higher on irrigated farms than on rainfed farms as is also the case for farm labor time as a percent of all labor. As can be seen by the seasonal indices of Table 3.18, the seasonal fluctuation of farm labor and off-farm follow a similar profile in the rainy season. This is probably explained by the fact that off-farm employment is characterized by a heavy farm related work component during this season. The share of total work to both off-farm and nonfarm activities increase substantially during the dry season months for all farm size groups. However, the share of nonfarm work tends to be inversely related to farm size and the share of total labor to off-farm work is directly related to farm size during the dry season. The small farm peak rainy season months for off-farm employment are July, August, November and December with monthly indices of 130, 111, 123 and 121, respectively. The medium sized farm peak during season months for off-farm employment are July and December with index numbers of 125 and 135, respectively. For large farms, the only month of the rainy season with above average labor commitment to off-farm labor activities is the month of July. Unless there is substantial under-employment of family labor and unless the nonfarm employment is largely hired labor for farm work, it is difficult to explain why the peak off-farm labor month is superimposed on the month of July which is already the peak rainy season month for farm work for all farm size classes. Of course, it is well to remember that the index numbers are relative measures and

Table 3.18

Monthly Composition of Family Labor Use and Seasonal Indices of Monthly Family Labor by Labor Type and Size of Farm

Item		Farm Labor			Nonfarm Labor			Off-Farm Labor			All Labor		
		S	M	L	S	M	L	S	M	L	S	M	L
Hrs./Mo./Household													
May-Dec		289	348	427	76	88	97	152	85	45	517	521	569
Jan-Apr		208	224	246	101	96	119	147	115	85	456	435	450
Total Year		262	306	366	84	91	104	150	95	58	496	492	528
Number of Farms		20	37	20	20	37	20	20	37	20	20	37	20
Month	Percent of												
May	Monthly Total	48	60	67	26	22	25	26	18	8	100	100	100
	Annual Average	65	84	85	111	103	113	60	78	67	71	86	89
Jun	Monthly Total	57	71	77	13	15	14	30	14	9	100	100	100
	Annual Average	107	115	100	76	84	64	101	73	74	100	101	90
Jul	Monthly Total	61	76	81	9	7	10	30	17	9	100	100	100
	Annual Average	150	166	164	71	49	74	130	125	121	131	137	142
Aug	Monthly Total	54	70	79	12	15	15	34	15	6	100	100	100
	Annual Average	101	119	114	71	84	78	111	84	53	99	106	101
Sep	Monthly Total	52	58	58	20	27	31	28	15	11	100	100	100
	Annual Average	97	78	68	118	123	129	90	66	78	98	84	81
Oct	Monthly Total	52	61	64	25	24	27	23	15	9	100	100	100
	Annual Average	95	102	98	143	132	144	73	80	88	96	103	106
Nov	Monthly Total	60	70	83	7	16	12	33	14	5	100	100	100
	Annual Average	127	120	134	45	90	70	123	77	48	112	106	112
Dec	Monthly Total	59	62	83	12	17	10	29	21	7	100	100	100
	Annual Average	139	124	168	88	111	71	121	135	95	125	124	160
Rainy Season	Monthly Total	56	67	75	15	17	17	29	16	8	100	100	100
	Annual Average	110	113	117	90	97	93	101	89	78	104	106	108
Jan	Monthly Total	52	44	65	15	26	21	33	30	14	100	100	100
	Annual Average	81	52	71	74	102	81	89	115	93	82	74	76
Feb	Monthly Total	48	55	65	16	17	20	36	28	15	100	100	100
	Annual Average	78	83	63	80	85	69	101	134	91	85	93	67
Mar	Monthly Total	41	51	47	27	26	29	32	23	24	100	100	100
	Annual Average	71	77	59	144	133	126	95	112	186	91	94	86
Apr	Monthly Total	42	53	47	28	21	32	30	26	21	100	100	100
	Annual Average	87	77	76	183	102	183	107	122	214	109	91	112
Dry Season	Monthly Total	46	51	55	22	22	26	32	27	19	100	100	100
	Annual Average	79	73	67	120	105	114	98	121	147	92	88	85
All Year	Monthly Total	53	62	69	17	19	20	30	19	11	100	100	100
	Annual Average	100	100	100	100	100	100	100	100	100	100	100	100

Note: S = small farms; M = medium farms; L = large farms.

that in absolute terms, the hours committed to off-farm employment are inversely related to farm size.

The nonfarm enterprise, in terms of labor use, behave similarily for all farm size classes. With some exception (during the months with high demand for farm labor), nonfarm enterprise labor constitutes roughly 20 percent of the total family labor employed month-by-month for all farm size classes throughout the year. However, viewed in terms of a seasonal profile, nonfarm enterprises are used to take up the slack in the family labor supply not commited to farm work. The months with above average hours utilized for nonfarm activities correspond to those months with lowest farm labor commitment and vice versa.

3.5.5 Variability in the Monthly Distribution of Family Labor Use

The seasonal fluctuations in family labor use can be used as a proxy for the seasonal flow of family income. It is an imperfect proxy because every hour of labor expended does not yield the same return. Nevertheless, it is reasonable to conclude that families with wide fluctuations in seasonal employment will have more difficult cash flow management problems than will families with uniform year-round employment.

Using the total sample to classify the farms, the coefficient of variation (CV), measuring the ratio of the standard deviation of the monthly average to the annual average, was computed for the different farm classes and summarized in Table 3.19. In all cases, the CV reduced as additional work activities are added to the distribution of farm work. For all farms, the CV is 0.30, 0.20, 0.24 and 0.17 for farm work, farm work plus nonfarm employment, farm work plus off-farm work and the total labor utilization distribution, respectively. Off-farm employment contributes less to smoothing monthly labor use fluctuation than

Table 3.19

Mean and Coefficient of Variation for Monthly Family Labor Allocation to Farm Work, Farm Plus Nonfarm, Farm Plus Off-Farm and Total Labor Use by Farm Type and by Farm Size

Item	Type of Farm					
	Rainfed	Irrigated	Small	Medium	Large	All Farms
No. of Farms	39	38	20	37	20	77
Monthly Average						
Farm Work	283	337	262	306	366	309
Farm + Nonfarm	412	392	346	397	470	402
Farm + Off-Farm	394	439	412	401	425	409
All Labor	510	493	496	492	528	502
Coefficient of Variation						
Farm Work	.45	.19	.26	.29	.36	.30
Farm + Nonfarm	.27	.14	.17	.20	.25	.20
Farm + Off-Farm	.31	.19	.23	.23	.30	.24
All Labor	.21	.15	.17	.17	.23	.17

does the nonfarm (cottage industry type) employment because of the particularly high positive correlation with farm employment, especially in the rainy season, as observed earlier.

It is apparent that one of the advantages of irrigation is to open the opportunity for a more uniform use of family labor than is possible on rainfed farms. The CV of 0.19 for farm work on irrigated farms is less than the CV of 0.21 for employment from all sources on rainfed farms. Because of the limited farming opportunities in the dry season for the rainfed farms, heavy reliance is placed on off-farm and nonfarm employment to utilize family labor throughout the year and consequently, to reduce the erratic flow of family earnings.

3.5.6 Labor Requirement for Crops

The labor requirements for individual crops differs depending on the activities to be performed. For the rainfed farm, the labor uses (in terms of hours) for producing one variety of glutinous and non-glutinous by activities are presented in Appendix Tables 1 and 2. To produce one rai of either glutinous or nonglutinous rice, about 104 hours of labor input or 69 hours of male labor and 35 hours of female labor are used on the average. Land preparation and planting activities account for approximately 40 percent of total labor use, while harvesting activity accounts for 36 percent ot total labor use. Thus, during the time these activities take place, farmers having a small labor force relative to their operational farm size may be required to recruit additional labor outside their family.

For the irrigated farm, the labor requirements for individual crops in both wet and dry seasons are shown in Appendix Tables 7 to 17. Again, for the production of rice, the land preparation, transplanting and planting, and harvesting are still the most labor consuming activities. However, the amount of labor used in the production of rice in this irrigated area varies between the two different types of land preparation practiced by the farmers. The production of rice with the buffalo plowing uses more labor input than the one with machine tiller plowing. For instance, to produce one rai of glutinous rice in the wet season, 134 hours of labor are needed for buffalo land plowing, while the faster tiller cultivated glutinous rice needs only 106 hours of labor. Tobacco and glutinous corn are more labor intensive crops than rice, requiring 373 and 190 hours for one rai of tobacco and corn, respectively.

3.5.7 Crop Labor by Source

There are three main sources of labor for crop production: the family, exchange labor from other neighboring households and hired labor. In general, labor for crop production is drawn more from family than from other sources. For the rainfed farm, the family supplies 80 percent of the total labor in the production of rice. In the case of irrigated farms, the share of family labor in the production of the buffalo cultivated rice in both wet and dry seasons is larger than in the production of the tractor cultivated rice. The family supplies about 74 and 61 percent of the total labor use in the production of buffalo and tractor cultivated rice, respectively (Table 3.20).

Exchange labor, the common phenomenon in earlier times, now provides a relatively small portion of total labor use for rice production in both rainfed and irrigated areas. It accounts for only 4.4 percent of total labor in the production of rainfed rice and represents from 4.2 to 5.2 percent of the total labor for irrigated rice production. Exchange

Table 3.20

Percentage Crop Labor Uses in Rice Production by Source and Activities of Rainfed and Irrigated Farm

Activities	Rainfed Farm Wet Season Rice			Irrigated Farm											
				Wet Season Rice With						Dry Season Rice With					
				Buffalo Used			Machine Tiller Used			Buffalo Used			Machine Tiller Used		
	Family	Exchange	Hired	Family	Exchange	Hired	Family	Exchange	Hired	Family	Exchange	Hired	Family	Exchange	Hired
Nursery	100	--	--	100.0	--	--	100.0	--	--	100.0	--	--	100.0	--	--
Land Preparation	79.8	--	20.2	74.8	--	25.2	4.8	--	95.2	75.6	--	25.4	5.7	--	94.3
Transplant/Plant	50.3	5.5	44.2	42.6	4.3	53.1	46.1	3.5	50.4	48.5	3.2	48.3	45.8	2.5	51.7
Crop Care	100	--	--	100.0	--	--	100.0	00	--	100.0	--	--	100.0	--	--
Harvest	69.3	7.1	23.6	57.1	6.5	36.4	55.8	5.4	38.8	60.2	6.0	33.8	58.0	4.9	37.1
Thresh	78.2	13.8	8.0	60.6	20.6	18.8	61.8	18.3	19.9	62.4	18.2	19.4	60.6	18.3	21.1
Total	79.6	4.4	16.0	73.4	5.2	21.4	61.4	4.5	34.1	74.6	4.2	21.2	61.3	4.4	34.3

labor is still used extensively for the threshing of rice in both areas, but is not practiced in the other crops. Normally, the households will keep record of the exchange labor days which have been received and given in order that days given be equal to days received. There is very little indebtedness of exchange labor duty carried over from one month to another.

Hired labor is necessary to supplement family labor for the critical periods of rice production in both rainfed and irrigated areas. It accounts for 16 percent of all labor in the production of rainfed rice. The share of hired labor increases to the total labor in the production of tractor cultivated rice relative to buffalo cultivated rice. About 21 and 34 percent of total labor in the production of buffalo and tractor cultivated rice, respectively, are provided by hired labor.

For minor crop production like tobacco and glutinous corn, most of the labor input is obtained from the family labor. On the average, rainfed and irrigated farmers growing glutinous and nonglutinous rice obtain crop labor from those three main sources.

3.6 Household Consumption Patterns

Household expenditures will be discussed to gain understanding of certain aspects of the family consumption pattern which are needed to specify coefficients for the right-hand side of the linear programming model to follow. These household consumption patterns will be treated as cash expenditures whether purchased or homegrown and will include all outflows not directly related to income generating enterprises for farming and nonfarm activities, plus the value of farm and nonfarm products consumed if they are drawn from household production. Farm production and nonfarm expenses are excluded from this analysis to make them more useful in LP modelling inasmuch as the gross margin budgets take into account the production expenses. The family consumption expenditures are classified into two main categories, food and nonfood expenditures.

3.6.1 Food Expenditures

Since rice is the staple food of Thailand, it is the major component of food expenditures. Normally, each household grows its own rice and sells it only if there is a surplus beyond the consumption requirement. The value of rice consumed is treated as a food expenditure and is computed using the amount of rice consumed based on the household monthly report and the sale price of rice in the local market. Other items consumed besides rice are included as "other food" expenditures and include such items as meat, eggs, vegetables, fruit, fat and oil, condiments and food away from home. The value of these items consumed, if they are drawn from family farm production, are imputed based on the farm prices. These food expenditures have been summarized by farm size class for rainfed and irrigated farms in Table 3.21. It can be seen that the food expenditures account for at least 50 percent of the total family consumption expenditures for the total farm sample. On the average, rice is the main item accounting for 44 and 37 percent of the total family consumption for the rainfed and irrigated farms, respectively. This indicates that in relative terms the rainfed farm household expenditure on rice is higher than the irrigated farm household. It may be explained in part by the observation that on the average the rainfed farm households have relatively lower income than the irrigated farms and will spend a larger proportion of their income on the basic or staple foods, namely rice. The irrigated farm households who have more discretionary

Table 3.21

Average Household Expenditures by Types and Farm Size Group of Rainfed and Irrigated Farms

Unit: Baht per Household

	Rainfed Farm								Irrigated Farm							
	Small		Medium		Large		All Farms		Small		Medium		Large		All Farms	
	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%	Amount (baht)	%
Food Expenditure:	7765	71.4	7040	59.4	8734	57.7	7660	61.6	8076	61.9	7013	50.6	7348	49.2	7380	53.0
Rice	5392	49.6	5023	42.4	6315	41.7	5449	43.8	5122	39.3	5138	37.0	5052	33.8	5111	36.7
Other Food	2373	21.8	2017	17.0	2419	16.0	2211	17.8	2954	22.6	1875	13.5	2296	15.4	2269	16.3
Non-Food Expenditure:	3103	28.6	4814	40.6	6395	42.3	4780	38.4	4973	38.1	6857	49.4	7578	50.8	6548	47.0
Clothing	688	6.3	914	7.7	1127	7.5	951	7.6	1030	7.9	1062	7.7	1237	8.3	1099	7.8
Medical	375	3.5	1196	10.0	1059	7.0	992	8.0	1356	10.4	1142	8.2	757	5.1	1097	7.9
Education	187	1.7	360	3.0	939	6.2	505	4.1	332	2.5	2253	16.2	2999	20.1	1943	14.0
Charity	405	3.7	796	6.7	633	4.2	697	5.6	755	5.8	577	4.2	568	3.8	621	4.5
Entertainment	529	4.9	594	5.0	1035	6.8	671	5.4	755	5.8	875	6.3	893	6.0	848	6.1
General*	574	5.3	452	3.8	546	3.6	547	4.4	426	3.3	312	2.2	393	2.6	363	2.6
Other	345	3.2	502	4.2	1056	7.0	417	3.3	319	2.4	636	4.6	737	4.9	577	4.1
TOTAL	10,868	100.0	12,020	100.0	15,129	100.0	12,400	100.0	13,049	100.0	13,870	100.0	14,926	100.0	13,928	100.0

*Electric, tax, housing maintenance.

income, both relatively and in absolute terms than rainfed farm households and, hence, have more to spend on other things besides rice.

The values of food expenditures proportional to the total expenditures for both rainfed and irrigated farms tend to decrease slightly as farm size increases (Table 3.21). However, the difference between medium and large sized farms with regard to the share of the family budget for food is very slight. The higher budget share for food on small farms may be explained by the low income elasticity of food and the lower expected income for families with small farms than for families with larger holdings. However, it is difficult to explain why the absolute level of food expenditure on small farms for both rainfed and irrigated villages is the highest of all categories except for large rainfed farms. Of course, the absolute level of consumption depends in part on the size and composition of the consuming households. The average household composition by sex and age classifications and by farm type were presented earlier in this chapter. It was noted that larger farms averaged more members in the household than small farms with the exception of large irrigated farm households. Consequently, converting household food consumption expenditure to a per capita or per member of the labor force basis further highlights the higher absolute level of food consumption in monetary terms for the small farm households and the large farms in the irrigated area. If the higher food consumption expenditure situation had occurred only on the small farms, one might have been suspicious that there was a systematic under-reporting bias in the value of home produced consumption or perhaps an over-reporting of the value of purchased rice. Such a situation would have resulted in a higher total average rice consumption figure for small farms because the reported value of rice consumed exceeds the value of home produced rice only on the small farm.

With these findings there is the methodological question of whether the reported averages and their seasonal distribution for individual farm classifications should be used in the linear programming analysis or whether it would be better to use standardized annual and monthly distribution per capita for all farm sizes for both rainfed and irrigated farms. For lack of persuasive arguments to do otherwise, the average figures, as reported in the survey, were incorporated in the LP model with the realization that unequal consumption expenditure requirements for different modelling situations result in constraints that are somewhat regressive against farm size.

3.6.2 Nonfood Expenditures

Family nonfood expenditures in both relative and absolute terms are lower for the rainfed than the irrigated farms and are positively correlated with farm size (Table 3.21). Family nonfood expenditures of the irrigated farm households as a percent of total (47 percent) are higher than in the case for the rainfed farm households (38 percent). Part of this explanation is that the irrigated farm households have a higher income than rainfed farm households as pointed out earlier.

When the matter of farm size was examined, it was found that the share of nonfood expenditures in the total family consumption expenditures by farm size class in both rainfed and irrigated areas increase when size of farm increases (see Table 3.21). This is as would be expected because nonfood expenditures may be regarded as a residual to food expenditure in the typical rural household. The inverse relationship between percent of the budget spent for food and size of farm has been established. Consequently, the opposite relationship would hold for nonfood expenditures.

The family consumption expenditures on the average of all rainfed farm households varies monthly as can be seen in Figure 3.11 which was prepared from data summarized in Table 3.22. This seasonal variation of family food as well as nonfood expenditures may be related to the flow of household income and is also related to the degree of household participation in various local religious and social events. For instance, January and April were the peaks for family nonfood expenditures for the rainfed farm households. Since these periods are when heavy local activities related to social and religious events take place such as Happy New Year celebrations for January and the Song Karn Day occasion (the old, traditional Thai New Year Day) in April, various kinds of entertainment (e.g., open-air movies, theaters, muscial performances), trade fairs and carnivals commonly take place in that period. Accordingly, many rainfed farmers may dispose of rice in December and January so that money is available to help them and their family members to participate and spend more on all those events mentioned above.

The peak expenditures on food items for the all rainfed farms appear in August and February. August is known by Thai Buddhists as the successive period from very late July when the Buddhist monks have to concentrate on learning and practicing the teaching of Buddha and are not allowed to stay overnight outside the monks' resident temple. Thus, in the spirit of Buddhist practice, the farmers have more opportunities and willingness to offer meals to the monks either at the nearby temple or by invitation to the home during this time. This may cause the rainfed farms to willingly have more food expenditures for this period.

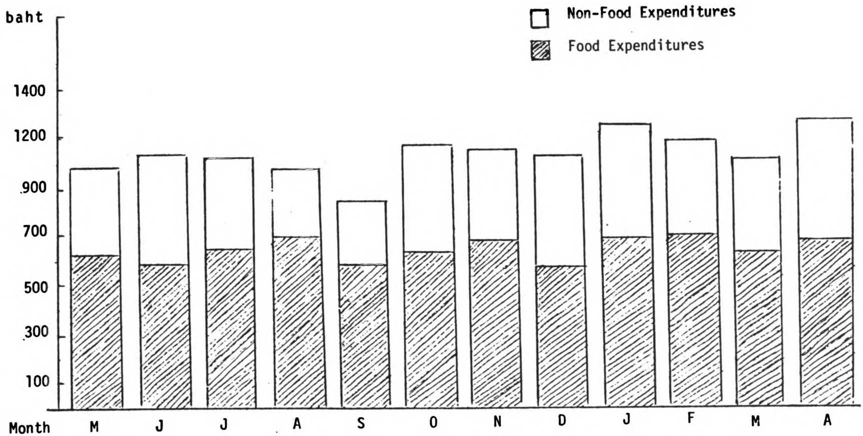


Figure 3.11: Season Distribution of Household Consumption Expenditures for the Rainfed Farm

Table 3.22

Seasonal Household Consumption Expenditures of the Rainfed Farms by Farm Size Group

Unit: Baht Per Household

Month	Food Expenditures				Nonfood Expenditures				Total Expenditures			
	Small	Medium	Large	All Farms	Small	Medium	Large	All Farms	Small	Medium	Large	All Farms
May	664	581	657	622	385	241	560	360	1,049	822	1,217	982
Jun	624	482	765	591	196	528	531	444	820	1,009	1,296	1,035
Jul	597	577	821	645	134	319	722	374	731	896	1,543	1,019
Aug	625	629	848	684	149	403	212	289	774	1,032	1,060	973
Sep	581	559	664	591	140	223	436	256	721	782	1,100	847
Oct	607	611	725	638	235	459	598	437	842	1,070	1,323	1,075
Nov	621	568	873	660	201	476	435	395	822	1,044	1,308	1,055
Dec	648	626	435	583	285	307	871	446	933	1,100	1,306	1,029
Jan	745	611	718	673	409	483	519	473	1,154	1,094	1,237	1,146
Feb	633	648	794	682	391	400	456	412	1,024	1,048	1,250	1,094
Mar	640	590	714	635	329	381	379	367	969	971	1,093	1,002
Apr	780	558	720	656	249	594	676	527	1,029	1,152	1,396	1,183
Total	7,765	7,040	8,734	7,660	3,103	4,814	6,395	4,780	10,868	11,854	15,129	12,440
Monthly Average	647	587	728	638	259	401	533	398	906	988	1,261	1,036

Relatively higher family food expenditures in February may be caused by the flow of household income from rice sales in January.

In cases of all irrigated farms, the average family expenditures on food and nonfood items was 615 and 546 baht per month, respectively (Table 3.23 and Figure 3.12). Assuming and using these average figures as the norm, there are only three months of June, July and December for wet season (May to December) and most of the dry season, that the irrigated farmers' family food expenditures are above the norm. This may relate to the Buddhist point of view that men should devote one time in their life in monkhood in order to learn and practice Buddha's preaching. June and July are the traditional periods for farmers to prepare for and celebrate the occasion of their sons approaching the age of 20 years when they will become a monk. The next three months beginning from very late July to October is the Khao-Pan-Sa period (the period that most of the monks are not allowed to stay overnight outside their resident temple in order to keep focusing on learning and practicing Buddha preaching). The host farmers are likely to invite many of their friends and relatives to attend the event at home and at the temple as their guest and enjoy meals served by the host farm household family members. Thus, these two periods are expected to have relatively high food expenditures compared to the norm. The relatively high family food expenditures for the irrigated farmers for December and the rest of the dry season may consequently be caused by the flow of household income for December and January when the irrigated farmers tend to sell their wet season rice.

The peaks for nonfood expenditures of the irrigated farm were in March and May as can be seen through Figure 3.12. Part of this explanation is that March is the period for many farmers to celebrate the

Table 3.23

Seasonal Household Consumption Expenditures of the Irrigated Farms by Farm Size Group

Month	Food Expenditures (฿)				Nonfood Expenditures (฿)				Total Expenditures (฿)			
	Small	Medium	Large	All Farms	Small	Medium	Large	All Farms	Small	Medium	Large	All Farms
May	646	561	544	578	507	643	883	670	1,153	1,204	1,427	1,248
Jun	686	649	574	639	312	401	559	419	998	1,050	1,133	1,058
Jul	736	722	563	684	371	580	255	492	1,107	1,302	1,018	1,176
Aug	627	556	616	590	377	638	571	552	1,004	1,194	1,187	1,142
Sep	602	461	533	517	180	284	301	261	782	705	834	778
Oct	623	536	554	564	344	409	658	457	967	945	1,212	1,021
Nov	686	484	628	575	464	685	690	628	1,150	1,169	1,318	1,203
Dec	659	625	719	659	511	673	696	589	1,170	1,198	1,415	1,248
Jan	730	553	674	631	395	519	861	577	1,128	1,073	1,535	1,208
Feb	771	578	666	652	522	659	623	613	1,293	1,237	1,289	1,265
Mar	638	652	632	643	484	819	888	748	1,122	1,471	1,520	1,392
Apr	672	636	645	648	503	647	393	542	1,175	1,283	1,038	1,190
Total	8,076	7,013	7,348	7,380	4,973	6,857	7,578	6,548	13,049	13,870	14,926	13,928
Monthly Average	673	584	612	615	414	572	632	546	1,087	1,156	1,244	1,169

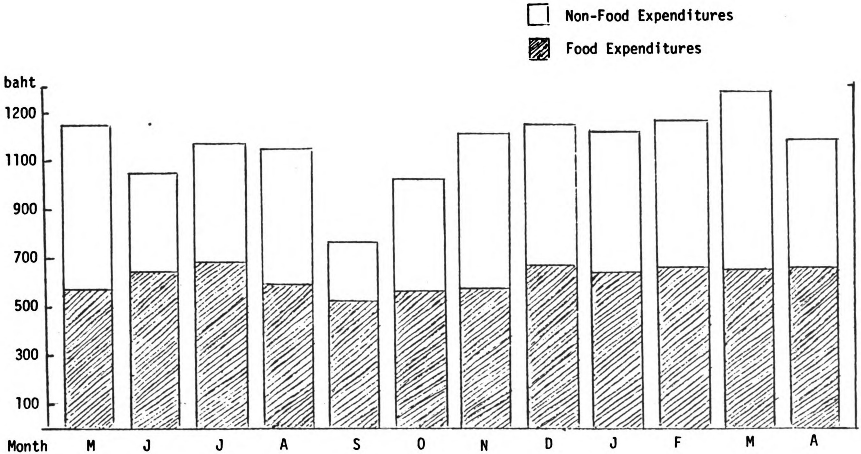


Figure 3.12 Season Distribution of Household Consumption Expenditures for the Irrigated Farm

occasion of Ma-Kha-Boo-Cha, the day that the Buddha declared himself and gave his first preaching lesson to the people on that day. As Buddhist spirit, the farmers are supposed to see and listen to the monks' preaching and to offer necessary things such as candles, matches, flowers, cloth and medicine to the monks at the temple. Thus, the irrigated farmers are expected to have a relatively high nonfood expenditure in March as well as in May which is the most likely period for irrigated farmers to sell their dry season rice.

However, it should be mentioned here that conclusions drawn from this section on the seasonal pattern of household family expenditures should be considered with care, for lack of data on some expected explanatory variables on family consumption expenditures such as the monthly flow of household incomes, income elasticity with respect to each type of food and nonfood items, values and preferences of both rain-fed and irrigated farm households.

3.7 Household Credit Use

Khon Kaen farmers, like many Northeastern farmers, were found to borrow money to finance their expenditures in periods when they face a shortage of income. According to a study of wealth, income and credit in Khon Kaen [Chalamwong, 1981] conducted in the same study area, 74 percent of sample farm households borrowed (in cash or in kind) throughout the year. The average amount of borrowing per household per year was about ฿4,303. Approximately 48 percent of total farm households borrowing were found to concentrate during the period of prewet season planting (April to May). Part of this explanation is that the farmers need loans to pay for their farming as well as for the consumption needs just discussed. The same study also classified the use of borrowing funds of the farm households into three main categories: for farm and nonfarm production, for purchasing of capital assets and for family consumption expenditures. Nearly 40 percent of the loans were used for productive purposes, while 35 and 25 percent of total loans were used for purchasing capital assets and for family consumption expenditures, respectively.

With regard to the source of borrowing funds, on the average, about 45 percent of total loans were borrowed from the institutional lender, e.g., commercial bank, BAAC, cooperative, while 55 percent of loans came from farmers' friends and relatives, landlords and local merchants. Bank of Agriculture and Agricultural Cooperative (BAAC), one of the cheapest loan institutions subsidized by RTG, was the major institutional lender providing nearly 75 percent of the total institutional loan for the Khon Kaen farmers.

3.8 Models to be Developed

Ideally, because each farm household represents a unique situation, a farm household plan using linear programming procedures would be prepared for each farm household in the sample. But it is not a practical approach from either a research or extension point of view [Sektheera, 1975]. Therefore, an alternative is to develop a composite farm model having the characteristics of the average of all farm households in each farm size group to represent small, medium and large farm sizes in the rainfed and irrigated situations. To be precise, three models of rainfed farms and three models of irrigated farms will be developed to achieve the study purposes.

However, it should be borne in mind that the mix and level of activities obtained in the model solutions and the labor utilization pattern that supports them are not what one should expect to be optimum for a particular farm household. Rather, they represent the range of possibilities and their relative importance if results are aggregated to the full village level.

CHAPTER 4

THE LINEAR PROGRAMMING MODEL

Linear Programming which deals with the problem of optimum resource allocation among competing activities is used as the main analytical technique for fulfilling the objectives of the study. Details of the programming model are presented in this chapter.

4.1 General Features of the Model

A linear programming model is basically composed of these three components: objective function, resource constraints and activities. It can be expressed mathematically in the following form: [Dorfman, 1958]

Maximizing $Z = C_1X_1 + \dots\dots\dots\dots\dots\dots + C_nX_n$

Subject to restrictions

$$A_{11}X_1 + A_{12}X_2 + \dots\dots\dots\dots\dots + A_{1n}X_n \leq b_1$$

$$A_{21}X_1 + A_{22}X_2 + \dots\dots\dots\dots\dots + A_{2n}X_n \leq b_2$$

$$\vdots$$

$$A_{m1}X_1 + A_{m2}X_2 + \dots\dots\dots\dots\dots + A_{mn}X_n \leq b_n$$

$$X_i \geq 0 \quad i = 1, 2, \dots\dots\dots, n.$$

In matrix form, the model can be formulated as follows: [Heady and Candler, 1959]

Maximizing $Z = C^1X$

Subject to restriction

$$AX \leq B$$
$$X \geq 0$$

where

Z = objective function to be maximized

C = n x 1 vector of price and/or wage rate

X = N x 1 vector of activity level

A = m x n matrix of input-output coefficients

B = m x 1 vector of resource restrictions

The purpose is to solve for the level of decision variables, X_1, X_2, ...X_n, which maximizes the objective function subject to the restrictions that no X shall be negative and that the X's shall satisfy the set of resource constraints.

However, in interpreting the LP solution, the following assumptions underlying linear programming analysis should be kept in mind. A precise solution of the problem under consideration can only be obtained from the LP model if 4 assumptions can be satisfied: (1) divisibility of activities and resources; (2) additivity and linearity of the activities; (3) finiteness of alternative activities and the resource restrictions; and (4) single-value expectation i.e. resource supplies, input-output coefficients and prices are known with certainty. (See Heady and Candler, 1959, p. 17-18.)

In addition, in order to fit the problem in the linear programming scheme, it is required to assume that there is only one objective function (Z), either to be maximized or minimized on the part of entrepreneurs or farmers.

4.2 Structure of the LP Model

The structure of the model is presented in the tableaux of Figure 4.1 and 4.2 which includes activities, constraints and input-output coefficients. The structure of the LP model will be discussed as follows:

4.2.1 The Objective Function

A number of objectives or goals have been hypothesized as a motive of the decision maker (farmer), such as maximizing profit, maximizing sale after obtained some minimum profit level, survival of the firm and security [Conner, 1954; Andrew, 1976].

Also, there have been several studies designed to test those hypotheses. Such studies as those done by Yotopoulos [1968] and Hopper [1965] have generally concluded that the producers, even in the most backward areas, act as profit maximizers within some constraints. Other findings conclude that the peasant farmers seek security (DeWilde, 1967) and both security and profit maximization [Heyer, 1971; Norman, 1973] as their objectives.

According to the above evidence and the researcher's experience in conducting surveys and doing research regarding Thai farmers, one should consider combined objectives of income maximization subject to land, labor and capital availability, including the security constraint of subsistence food production (i.e. minimum rice consumption requirements to be produced by the farm household), and minimum family living expenditures. Therefore, the objective function of this model is composed of the net return obtained from farm and nonfarm enterprises, including net wage earned from off-farm work, less the cost of hired labor, cost

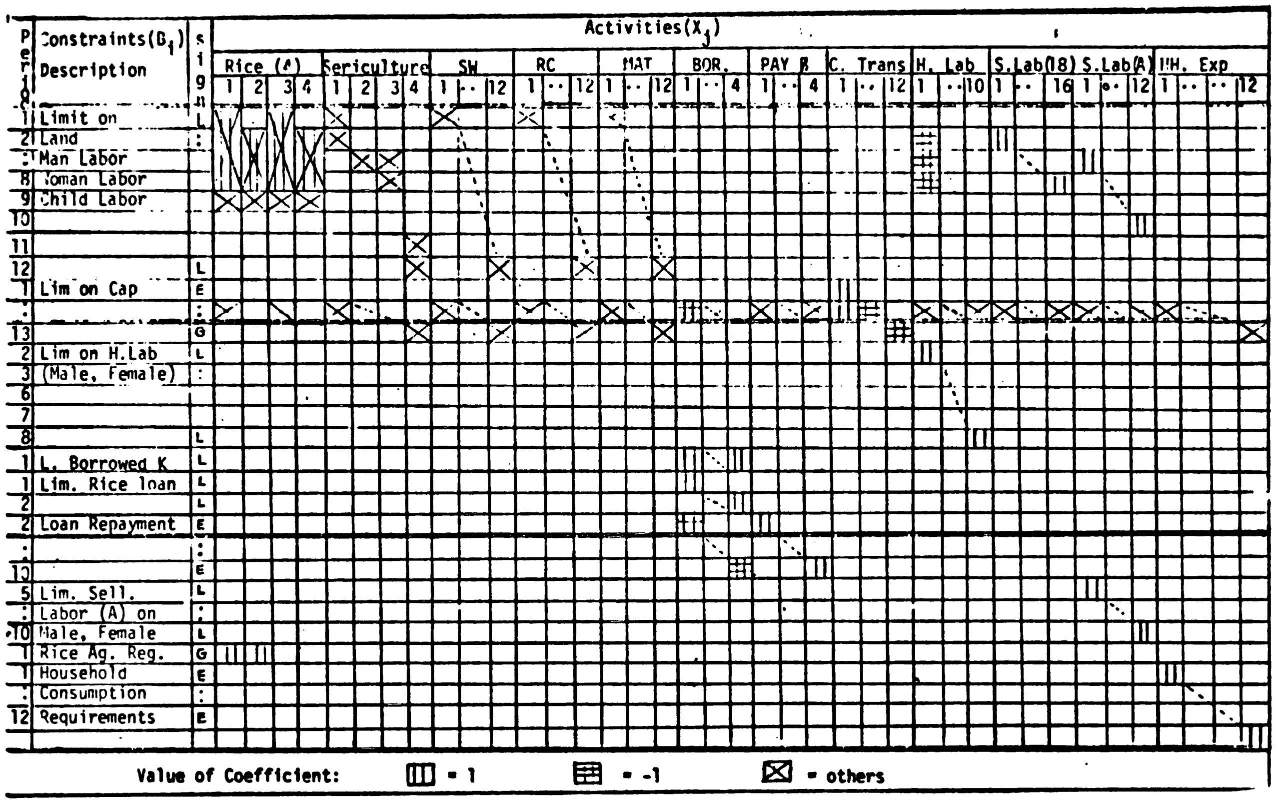


Figure 4.1 Structure of the LP Model for Rainfed Farm

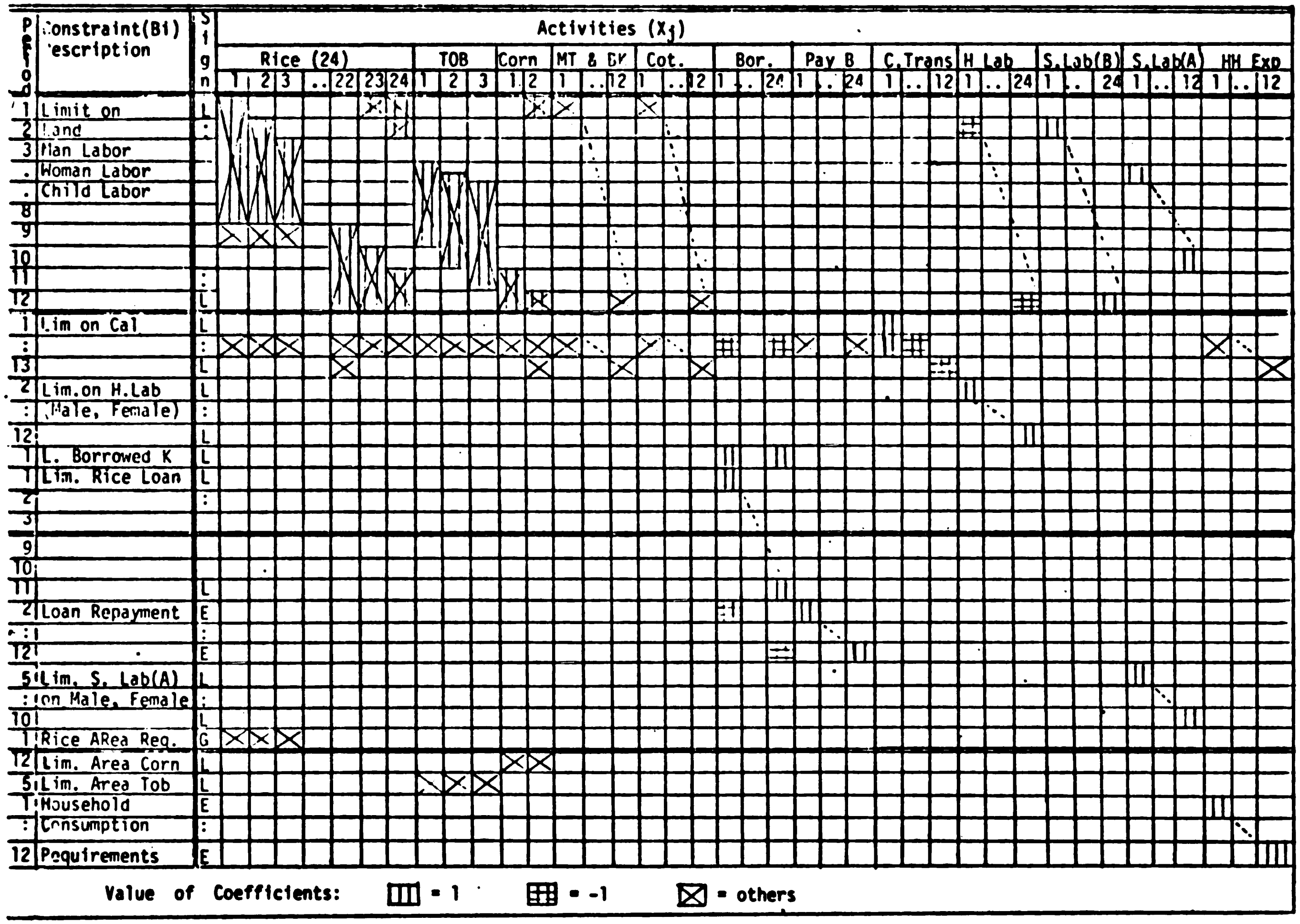


Figure 4.2 Structure of the LP Model for Irrigated Farm

of borrowed capital and household expenditures. The objective function can be summarized as the summation of the following categories:

(1) the net return to all included crop activities;

(2) plus the net return to nonfarm enterprises done by the farmer and other family members such as silk weaving, mat and basket making and others;

(3) plus the wages earned from selling out family labor in off-farm work;

(4) less the cost of labor hired;

(5) less the cost of borrow capital;

(6) less the value of household consumption requirements.

The first five categories of the objective function indicates the return to the household's land, labor and operating capital. It should be noted here that various supplementary farming enterprises and activities such as poultry, pigs and the production of fruit and vegetables produced solely for home consumption were omitted because the capital and labor inputs used to produce them as well as money obtained from their sales were accounted for "off-line" in the right-hand side and in the objective function. An adjustment was made by adding the net value (gross margin) of these supplementary enterprises to the computer results in order to get a complete picture of all farm household income.

Tables 4.1 and 4.2 present the net return (net above operating expenses excluding labor) or gross margins of the alternative enterprises included in the model. They were computed on the basis of the output, prices and production expenses reported by the households involved in a supplementary survey conducted by the researcher after the 1980 rainy season rice crop and dry season rice crop had been harvested.

Table 4.1

Gross Margin or Net Return by Enterprise of Rainfed Farm

	Starting Period	Output Per Unit	Price	Gross Return (฿)	Total Operating Cost (฿)	Net Return (฿)	Net Return to Labor ฿/Hour	Net Return to Capital (฿)
Crop: Unit		kg/rai	฿/kg	฿/rai	฿/rai	฿/rai		
Glutinous Rice	1,2.1	250	2.6	650	203.57	446.43	4.28	2.19
Nonglutinous Rice	1,2.1	250	3.2	800	205.84	594.16	5.68	2.89
Nonfarm Enterprise								
Sericulture (Silk Thread)	1,3.1,7,11	1200 Grams	฿0.5/Gram	600	127.0	473.0	2.07	3.72
Silk Weaving (Patterned Fabric)	1-12	1 Piece	฿350/Piece	350	217.1	132.9	2.99	0.61
Sticky Rice Container Making	1-12	28 Containers	฿10/ Containers	280	65.7	214.3	1.59	3.26
Mat Making	1-12	60 Mats	฿7/Mat	420	173.4	256.6	0.83	1.42

Table 4.2

Gross Margin or Net Return by Enterprise of Irrigated Farm

	Starting Period	Output Per Unit	Price	Gross Return (฿)	Total Operating Cost (฿)	Net Return (฿)	Net Return to Labor ฿/Hour	Net Return to Capital (฿)
Crop: Unit		kg/rai	฿/kg	฿/rai	฿/rai	฿/rai		
Glutinous Rice (W,B)	1,2.1,3.1	390	2.6	1,014	244.6	769.4	5.73	3.15
Glutinous Rice (W,M)	1,2.1,3.1	390	2.6	1,014	413.4	600.6	5.68	1.45
Nonglutinous Rice (W,B)	1,2.1,3.1	400	3.0	1,200	244.8	955.1	6.89	3.90
Nonglutinous Rice (W,M)	1,2.1,3.1	400	3.0	1,200	413.1	786.9	7.22	1.91
Glutinous Rice (D,B)	9,10.1,11.1	340	2.6	884	355.1	528.9	4.03	1.48
Glutinous Rice (D,M)	9,10.1,11.1	340	2.6	884	525.1	358.9	3.62	0.68
Nonglutinous Rice (D,B)	9,10.1,11.1	340	3.0	1,020	355.7	664.3	4.96	1.87
Nonglutinous Rice (D,M)	9,10.1,11.1	340	3.0	1,020	525.7	494.3	4.85	0.94
Tobacco	5,6,7	75	60.6	4,546	533.5	4,012.5	10.67	7.52
Tomato	9,10.1,11.1	2,528	1.25	3,160	471.6	2,688.4	2.86	5.70
Glutinous Corn	11.1,12.1	923 Ears	฿0.5/ear	461.5	210.7	250.8	1.59	1.19
Nonfarm Product								
Cotton Fabric	9-12.2	16 Pieces	฿57.6/Piece	921.6	347.2	574.4	2.94	1.65
Mat	1-12.2	60 Mats	฿7/Mat	420	173.4	246.6	0.82	1.42
Basket	1-12.2	2 Baskets	฿22.5/Basket	45	23.0	22.0	0.39	0.95

Note: W = Wet Season; D = Dry Season; B = Buffalo; M = Machine Tiller.

Ideally, the input-output coefficients for the model would have come directly from the Phase II survey which entailed continuous data collection over the year of study. Had this been possible, the supplementary survey would not have been needed unfortunately, although family expenses and receipts were recorded in the Phase II survey, they were not separated according to crop variety or field for crops nor were there detailed labor activities recorded. The shortcomings of collecting farm management planning data by recall interview and from a small sample are conceded. Efforts were made to validate the results by comparing with published statistical reports and with other similar ongoing studies. This was not completely satisfactory in the case of rice yields because the government publications did not distinguish between glutinous and nonglutinous rice varieties and did not report yield by growing seasons.

Input-output data for nonfarm enterprises are very sparse. Some inquiries on the economics of cottage industries were being made by other researchers in the Rural Off-Farm Employment Assessment Project at the time of this researcher's field work. Their results were different in some cases from the results presented for nonfarm enterprises in Tables 4.1 and 4.2. Their results were also based on recall interview and were not obtained from the villages of the immediate study. Consequently, the decision was made to use the answers provided by the cooperating households in the villages under study despite some disparities in the various data being collected.

There were also a methodological problem in preparing gross margins budgets for enterprises utilizing locally grown raw materials. This applies to mat making which use locally grown reeds and basket using locally grown bamboo. The cost of these raw materials could have been based on the value of labor used in gathering them. An alternative approach would be to cost them at the prices the users would estimate and would be received if sold or the amount they would be willing to pay if their collected supply was inadequate. There are difficulties with both approaches but the latter approach was chosen for this analysis. There appeared to be no reasonable way to standardize the labor used in raw material acquisition nor the source from which it was obtained. The labor reported in these budgets are the estimated requirement after the raw materials were on hand.

Tables 4.1 and 4.2 summarize the detailed enterprise budgets presented in the appendix.

The planning period for the model covers one year, beginning with the wet season and continuing for 12 months through the dry season up to the beginning of the next wet season. As in the rest of Thailand, it is traditional to think of the farming year as beginning with the coming of rains which is a requisite for working the soil. The extent and form of the dry season cropping system as well as nonfarm activities is a function of rainy season crop performance. Therefore, it is reasonable to initialize the programming at the beginning of the rainy or wet season. In addition, the year was divided into 12 planning periods, beginning with the first period in May (the beginning of wet season) to the last period in April (the ending of dry season) in order to examine how farmers allocate their resources throughout the year.

To make the model more sensitive to the problems of labor allocation during the period of land preparation, transplanting and planting rice, periods 2 and 3 for the wet season rice and periods 10 and 11 for the dry season rice were divided into two subperiods.

4.2.2 Alternative Activity Set

The alternative activities in the rainfed and irrigated farm models include the principal crop enterprises, nonfarm enterprises, labor hired in, labor hired out, household consumption expenditure, capital borrowing and repayment and necessary transfer activities. Each alternative activity is discussed as follows:

4.2.2.1 Crop Enterprises

Crop enterprises are composed of various crops typically found in the wet and dry season in the survey villages. However, to incorporate these crop enterprises in the LP model, a knowledge of the length of time needed for each crop from land preparation through threshing was required. The starting times in terms of each period are presented in Table 4.1 and 4.2. Typical for the rainfed farmer, considering two kinds of crops growing glutinous and nonglutinous rice and its two alternative starting periods, there were only four crop production activities included. In the case of the irrigated farm, there were 29 alternative crop production activities based on four different crops (glutinous and nonglutinous rice, glutinous corn and tobacco) with different varieties (long-maturing rice in the wet season and short-maturing rice in the dry season), alternative planting dates and plowing technologies (i.e., use of either draft animal or machine tillers (see Table 4.2).

The technical coefficients (Aij) for labor and capital used for each crop alternative presented in Appendix Tables 1 and 2 for the rainfed farm and Appendix Tables 7 to 17 for the irrigated farm. Labor requirements for each crop are expressed as coefficients for both male and female labor by period. The production unit of each crop is in terms of rai, thus the land requirement (Aij) is equal to 1 in each period that the crop is in the field including the time for land preparation.

4.2.2.2 Nonfarm Enterprises

Rainfed farm models include four common nonfarm enterprises, namely sericulture, silk weaving, mat making and sticky rice container making. Each alternative nonfarm enterprise, except sericulture, may be undertaken by the rainfed farm household members in each period of the year. As pointed out earlier, sericulture was commonly practiced in periods 1, 3.1, 7 and 11. The activity units of sericulture, silk weaving, sticky rice containers and mat making are 1,200 grams of silk yarn, one piece of silk fabric, 28 containers and 60 mats, respectively. For the irrigated farm models, there are only three common nonfarm enterprises of cotton weaving, mat making and basket making. Both mat and basket making could be found in each period throughout the year, while cotton weaving is restricted to periods of the dry season. The activity unit of cotton weaving, mat and basket making are one piece of cotton fabric, 60 mats and two baskets. All of these activity units for both rainfed and irrigated farms correspond to the average quantity of those particular nonfarm products recently produced and reported by the sample farm households at the time the supplemental survey took place. Labor and capital requirements (Aij) for each nonfarm enterprise were shown in Appendix Tables 3 to 6 for the rainfed farm and in Appendix Tables 18 and 19 for the irrigated farm.

4.2.2.3 Labor Hiring in Activities

Provision was made in the model for hiring labor during rice production activities to supplement family labor in critical or peak periods of labor demand. Based on evidence obtained from the survey, only adult male and female labor were hired with no child hired labor. Male and female hired labor were normally paid at the same wage rate of ฿25 per day or ฿3.13 per hour. Since labor hiring activities add to the supply of the family labor constraint, their technical coefficients (Aij) are negative. The price for hiring in labor activities are negative since they are costs which reduce the total net return.

Exchange labor was excluded from the model due to the exchange given and received having to be equalized by the family labor with a given period. Thus, they cancel out.

4.2.2.4 Labor Hiring Out Activities

In keeping with the off-farm employment information found in the survey villages as reported out earlier, the model allows the farm family members to hire out in two main off-farm work, namely agricultural field work and nonagriculture field work. The adult family members can be hired during the peak demand for workers in the periods of land preparation, transplanting and planting, harvesting and threshing rice. This means that the rainfed farm family members can be employed in periods 2 and 3, and periods 6 to 8, while the irrigated farm family members can be hired in periods 2 and 4, and periods 7 and 8 for wet season rice production and from periods 10 and 11, and periods 12, 1 and 2 for the dry season rice production. In addition, both rainfed and irrigated farm workers were allowed to hire out during the period of harvesting and hauling activities, or periods 5 to 8 for the upland crop farmers.

On the average, men and women hired labor paid equally at the wage of ฿24 per day or ฿3 per hour.

For the nonagricultural field work, the employment opportunities for farm family members were simplified beyond findings of the survey and restricted to periods 5 to 8 as these periods correspond to the activities performed in the two major off-farm nonagricultural field work of local manufacturing and construction. Other activities were excluded because of their diversity. The number of hours for family labor to hire out in this off-farm employment were calculated on the basis of the average hours reported by the farmers. Male labor was paid ฿35 a day (or ฿4.38 per hour) and female labor was paid ฿30 per day (or ฿3.75 per hour). The technical coefficients (Aij) of the labor hiring out activities are positive as they draw the labor from the family labor supply constraint. The wage earned from these activities are added to the total net return.

4.2.2.5 Capital Borrowing Activities

Provision was made in the model for the rainfed and irrigated farm households to borrow short-term production capital (not more than one year) from the BAAC which was found to be the most important loan institution for Khon Kaen farmers. This allows farm households to borrow when their initial capital or cash from the previous year is insufficient to meet production expenditures. The irrigated farm model includes 24 possible alternatives to borrow corresponding to the 24 alternatives in rice production. For the rainfed farm model there are only four alternative short-term loans corresponding to the four alternative rice production activities. It was assumed that the farmers were allowed to get the money at one time from the BAAC after obtaining bank approval of the request.

4.2.2.6 Capital Payback Activities

Capital payback activities are incorporated in the model to force farm households to pay their debts within the production year. Following the BAAC rule, each production loan has to be paid back within nine months for wet season rice and within six months for dry season rice with 1 percent interest per month starting from the beginning period of borrowing. For example, cash borrowed in period 1 has to be paid back within period 9. The Cj of payback activities carries a negative sign and reflects the amount borrowed plus interest which had to be deducted from the total net revenue.

4.2.2.7 Capital Transfer Activities

Capital transfer activities are included in the model to allow the capital which is left over after all crop and household consumption expenditures have been met at the end of one period to be transferred to the next period automatically. The transfer occurs for all periods and it is assumed cost free or Cj=0.

4.2.2.8 Household Consumption Activities

It was assumed that the farm households should maintain their customary living standard as reflected by their family consumption patterns for food and nonfood outlays. Thus, these activities were incorporated in the model to require the farm households to meet these requirements for food and nonfood in each period. The household consumption requirements (Aij) in each period by farm size group of both rainfed and irrigated farm households were computed and presented in Table 4.3.

4.2.3 Constraint Set

The following resource constraints and other restrictions of the farm households are included in the analysis, and can be seen in Table 4.4 for rainfed farms and Table 4.5 for irrigated farms by farm size group.

4.2.3.1 Land

The area of land represents the average amount of paddy land available for cultivation in the wet season which may or may not be cultivated again in the dry season. In addition, the paddy land in each period of either wet or dry seasons is assumed to be homogenous in terms of fertility. It should be mentioned here that the matter of field divisibility as well as land fragmentation as pointed out earlier is ignored in the programming analysis.

The paddy land in each period is limited to 6.13, 17.26 and 36.97 rai for the small, medium and large rainfed farm, respectively. In the case of the irrigated farm situation, the availability of paddy land for small, medium and large in each period of the wet season (periods 1 to 8) is 5.11, 14.90 and 30.97 rai, respectively. However, during the dry season (periods 9 to 12), the paddy land for medium and large farm households are limited to 11.36 and 15.61 rai due to a shortage of irrigation water supply. Since the Nam Pong Irrigation Project has a policy to conserve enough water for generating electricity during the dry season.

Table 4.3

Household Minimum Consumption Requirement by Period for Rainfed and Irrigated Farms (Baht Per Household)

	Rainfed Farm			Irrigated Farm		
Period	Small (฿)	Medium (฿)	Large (฿)	Small (฿)	Medium (฿)	Large (฿)
1	1,049	822	1,217	1,153	1,204	1,427
2	820	1,009	1,296	998	1,050	1,133
3	731	896	1,543	1,107	1,302	1,018
4	774	1,032	1,060	1,004	1,194	1,187
5	721	782	1,100	782	745	834
6	842	1,070	1,323	967	945	1,212
7	822	1,044	1,308	1,150	1,169	1,318
8	933	1,100	1,306	1,170	1,198	1,415
9	1,154	1,094	1,237	1,128	1,073	1,535
10	1,024	1,048	1,250	1,293	1,237	1,289
11	969	971	1,093	1,122	1,471	1,520
12	1,029	1,152	1,396	1,175	1,283	1,038
Total	10,868	12,020	15,129	13,049	13,870	14,926

Table 4.4

Land, Labor and Capital Constraints (RHS)
for Rainfed Farm by Farm Size Groups

Item	Farm Size Class								
	Small			Medium			Large		
Cultivated Land (rai)	6.13			17.26			36.97		
Initial Cash (baht)	500			600			1,000		
Borrowed Capital (baht)	--			5,796			15,000		
Family Labor by Sex and Age	M	F	C	M	F	C	M	F	C
Period	(Hour)			(Hour)			(Hour)		
1	208	200	96	246	220	151	280	217	64
2.1	190	120	41	157	146	20	260	150	25
2.2	190	120	41	157	146	20	260	150	25
3.1	195	132	43	205	148	21	280	170	24
3.2	195	132	43	205	148	21	280	170	24
4	260	204	103	285	239	56	320	280	84
5	265	218	72	283	260	37	310	283	40
6	320	212	80	300	260	42	443	285	48
7	300	202	82	330	274	43	450	390	55
8	270	230	104	294	257	81	310	320	90
9	201	195	97	252	230	40	286	280	50
10	220	170	99	260	238	44	270	268	56
11	254	206	99	265	210	52	210	250	60
12	266	210	130	220	210	96	214	295	110

Note: M = Adult Male; F = Adult Female; C = Child.

Table 4.5

Land, Labor and Capital Constraints (RHS) for Irrigated Farm Size Groups

Item	Farm Size Class								
	Small			Medium			Large		
Wet Season Cultivated Land	5.11			14.90			30.97		
Dry Season Cultivated Land	5.11			11.36			15.48		
Initial Cash (baht)	994			1,753			2,834		
Borrowed Capital (baht)	5,236			15,000			15,000		
Family Labor by Sex and Age	M	F	C	M	F	C	M	F	C
Period	(Hour)			(Hour)			(Hour)		
1	270	202	30	260	240	85	280	208	35
2.1	164	124	35	145	120	35	140	107	21
2.2	164	124	35	145	120	35	145	107	21
3.1	171	152	17	150	143	45	146	145	19
3.2	171	152	17	150	143	45	146	125	19
4.1	179	154	40	152	140	56	153	136	46
4.2	179	154	40	152	140	56	153	136	46
5	282	201	41	260	214	70	253	203	51
6	312	200	44	265	212	69	263	210	34
7	302	292	30	295	290	84	265	250	91
8	314	271	80	310	285	116	316	299	51
9	276	207	44	250	207	59	247	198	21
10.1	135	108	18	105	120	40	100	103	21
10.2	135	108	18	105	120	40	100	103	21
11.1	131	101	21	134	113	35	105	97	25
11.2	131	101	21	134	113	35	105	97	25
12.1	136	109	53	126	125	72	104	109	61
12.2	136	109	53	126	125	72	104	109	61

Note: M = Adult Male; F = Adult Female; C = Child.

4.2.3.2 Family Labor Supply

The availability of family labor in each period is constrained by the average family size classified into male adult, female adult (14 to 65 years of age) and child labor (7 to 13 years of age) to represent the possibility of family labor. There is evidence that they are not fully substitutable for each other in particular activities as pointed out earlier. The total hours available for male and female labor in each period was computed by assuming that an adult is available to work an 8 hour day, year round. However, family labor can be employed on farm and nonfarm enterprises as well as participation in nonincome generating activities and minor farm activities (e.g., backyard poultry, vegetable garden). Therefore, these additional activities must be reckoned in computing family labor supply. Nonincome generating activities include household domestic chores (e.g., cooking, child care, cleaning), religious and social activities and community commitment. The total hours that each family member devoted to these activities were estimated through the researcher's supplemental survey. Appendix Tables 20 to 28 and Appendix Tables 29 to 37 show the estimated amount of hours that male and female family members spent in nonincome generating activities and minor farm enterprises for each farm size group of rainfed and irrigated farms.

The time available by male and female workers for farm and off-farm employment was estimated by deducting the average hours spent in both nonincome generating activities and minor farm activities from the total hours available for each labor class. These estimates for hours available for work on-farm and off-farm activities by farm size group of rainfed and irrigated farms are presented in Tables 4.4 and 4.5 by farm size group results from the varying size of the labor force. In the case of child family labor, it was assumed that each child over seven can help the family 8 hours a day during the nonschooling periods (March 25 to April 30, first half of August and December). The number of hours available for a child to help the family were reduced to approximately 4 hours a day during the schooling time, but an 8 hour day was assumed for the weekends of this period. Based on this approach, the children's total hours available for farm work in each period for each farm size group in the rained and irrigated farm situations was computed as shown in Tables 4.4 and 4.5.

4.2.3.3 Hired Labor

Hired adult males and females were assumed to be available in the village. According to evidence obtained from the supplemental survey, four males and four females hired as laborers can be hired up to 480 hours each per month at certain periods. The farm households interviewed in the supplemental survey, especially the ones who have relatively large farms, were found to hire labor to help in the peak period of land preparation, planting, harvesting and threshing of rice. The RHS figure of 480 hours of male labor and 480 hours of female labor available for hire was computed using the assumption that each adult laborer is available to work 8 hours a day, 15 days a period, for a total of 120 hours per period.

4.2.3.4 Initial Available Capital

The availability of initial capital is the amount of cash on hand reported by the sample households at the beginning period of wet season or period 1, to be used for productive purposes and for family consumption. The average initial cash on hand of the rainfed and irrigated farm households having small, medium and large sized farms is presented in Tables 4.4 and 4.5.

4.2.3.5 Credit

Loans are available from several sources, but one of the cheapest and most important for the sample households was the Bank for Agriculture and Agricultural Cooperatives (BAAC). The interest rate charged by BAAC is 1 percent per month. Farmers can obtain short-term production loans either from BAAC or through an agricultural cooperative acting as a representative for BAAC. This production loan is made available only for rice production. The maximum amount of each short-term loan the farmer can obtain was determined by BAAC as 50 percent of the total value of rice sold (i.e., expected price times quantity of rice sold by the farmer). The quantity of rice potentially sold was equal to the expected production of rice produced deducting by the estimated amount of rice consumed by farm household members. In addition, BAAC imposed a loan limit of ฿15,000 maximum per farm family. However, according to the BAAC's rules on short-term loans, as mentioned above, the rainfed farm household with the small size farm (averaged 6.13 rai) is ineligible for a short-term loan for rice production. This is because the small rainfed farm household with 6.13 rai of paddy land can produce only rice for the family consumption and there will not be enough surplus rice to secure a production loan. The maximum loan for rice production for medium and large rainfed farms is 5,796 and 15,000 baht, respectively. For the irrigated farm, the maximum potential available loan is 5,236, 15,000, 15,000 baht for small, medium and large sized farms, respectively.

4.2.3.6 Loan Payback

In accordance with BAAC's rules on short-term loans for rice growing, a loan must be paid within nine months. For instance, loans borrowed in period 1 must be paid back by period 9, with 1 percent of interest per month. The RHS value for the payback constraint rows are equal to zero.

4.2.3.7 Household Expenditures

Each farm household is assumed to maintain a basic living standard in terms of household consumption for both food and nonfood items. The model requires that there be available in periods an amount of cash equal to the amount needed for consumption. Thus, the RHS value of these constraints is equal to 1 in each period.

4.2.3.8 Minimum Rice Consumption

The rice consumption requirement for the farm households is the average amount reported on the monthly reports as rice consumed for all purposes throughout the year. The amount of glutinous rice consumed by the households was incorporated in the model by converting to the amount of planted area needed to yield this amount of glutinous rice using a 250 kg/rai yield for rainfed rice and 390 kg/rai yield of irrigated rice. The computed area requirement for small rainfed was 8.32 rai, but since the paddy land totaled only 6.13 rai, the amount available became the minimum. The rice land requirement to produce glutinous rice was 7.76 and 9.72 rai for medium and large rainfed farms, respectively. A minimum of 5.05, 5.08 and 5.0 rai of wet season glutinous rice was required for small, medium and large irrigated farms, respectively. These requirements vary by households because of varying family size.

4.2.3.9 A Limit of Planted Area for Corn and Tobacco

The maximum planted area for glutinous corn and tobacco is limited to 0.2 rai, corresponding to the average area of corn and tobacco grown by the sample households. This is due to the constraint in the local market demand for corn and tobacco.

4.2.3.10 A Limit of Off-Farm Work

The maximum hours for farm family labor to hire out in nonagricultural field work was constrained at the level of average time reported by the sample households. Thus, the men and women workers of the farm households were allowed to hire out up to 60 and 36 hours, respectively, in each period from period 5 to 10.

CHAPTER 5

RESULTS AND ANALYSES OF OPTIMUM RAINFED FARM SYSTEMS

The programming results of the representative rainfed farm household models under conditions described in the previous chapter are discussed and presented in the following manner. First, the model results of small, medium and rainfed farms are analysed and compared to reveal the optimum allocation of labor and other household resources among farm, nonfarm enterprise and off-farm employment with the different sized farms. Consequently, it may permit an understanding of the relationship between the amount of farmland to the allocation of household family labor to farm, nonfarm enterprise and off-farm work. Secondly, the comparison of the composite farm model and actual results (obtained from the project phase II survey) are examined to assess the possibility for increased employment and income for the rainfed farm households with regard to their present situation. Finally, the shadow prices of scarce resources and excluded activities are examined to assess the potential gains in income obtainable through expansion or contraction of these limiting resources and nonbasis activities.

5.1 Optimal Solution of the Rainfed Farm Models

The optimal plan generates the maximum family net income (after deducting the family consumption and initial cash) or net for saving small, medium and large farm size for 4,223, 7,886 and 12,654 baht per household respectively (Table 5.1). The large farm had net for saving per household nearly triple that for the small farm. In absolute terms,

Table 5.1

Farm, NonFarm and Family Income of Rainfed Farms

Item	Farm Size Class		
	Small	Medium	Large
Crop Value (baht)	3,985	12,644	28,118
(-) Operating Cost	1,248	3,504	7,588
(-) Hired Labor and Interest	--	337	3,692
Net Crop Value	2,737	8,803	16,838
(+) Other Farm Income	298	337	439
Total Farm Income	3,035	9,140	17,277
(+) Net Income from Nonfarm Product	3,769	3,893	4,212
(+) Income from Off-Farm Work	8,787	7,453	7,307
Total Household Net Income	15,519	20,486	28,796
(-) Value of Family Consumption	10,868	12,020	15,142
(-) Initial Cash	500	600	1,000
Net for Saving (baht)	4,223	7,866	12,654
Adult Labor Force	2.8	3.9	4.7
Household Net Income per Worker	5,568	5,253	6,127
Farm Income as Percent of Total	19.5	44.6	60.0
Nonfarm Income as Percent of Total	24.2	19.0	14.6
Wage Income as Percent of Total	56.3	36.4	25.4
Farm Size (rai)	6.13	17.26	36.97
Household Income/rai	2,543	1,187	779
Net Crop Income/rai	447	510	456
Land Area/Worker	2.18	4.43	7.87

as well as the portion of total household net income, the value of net farm income increases with the farm size increase while the value of income earned from off-farm employment varies inversely with the farm size. This is because of a higher proportion of family labor being involved in rice production activities as the farm size increases. Value of income obtained from nonfarm enterprises as the proportion of total household net income is likewise found to decrease with the farm size.

The optimal plan for allocation of labor and other family resources to farm, nonfarm enterprise and off-farm employment for every farm size is presented in Table 5.2, 5.3 and 5.4 and is discussed as follows:

5.1.1 Crop Enterprises

The programming results for small farms suggest that the household should grow 5.23 rai of glutinous rice in period 1 (May) and .9 rai in the following period 2.1 (June) in the wet season to sustain the household minimum subsistence levels. However, even with all land area (6.13 rai) being devoted to the glutinous rice production, the small farm household still has to buy 550 kilograms of additional rice to meet the household consumption requirement. Since the small farm household with the 6.13 rai can produce only 1,530 kilograms for glutinous rice (on the basis of yield average for 250 kilograms per rai). The glutinous rice is planted in two periods to help the small farmer to have enough family labor to meet both the peak demand for his own rice production activities and to be able to engage in cottage industry and off-farm work.

Table 5.2

Optimal Farm Household Activities Pattern, Small Rainfed Farm

Activities	Month and Period														Net Return
	M	J		J		A	S	O	N	D	J	F	M	A	
	1	2.1	2.2	3.1	3.2	4	5	6	7	8	9	10	11	12	฿4223
Glutinous Rice	← GR1: 5.23 rai →														
Glutinous Rice		← GR2: 0.90 rai →													
Sericulture (100 gm)	←13.2→			←13.32→					←9.0→				←15.36→		
Silk Weaving (piece)	1	1	-	2	-	-	-	-	-	-	-	-	2	-	
Rice Container Making (container)	-	-	-	-	-	52	-	-	-	-	-	-	-	50	
Hire-in Labor: (hour) Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Off-Farm Work: Nonfield (hrs) Male	-	-	-	-	-	-	60	60	60	60	60	60	-	-	
Female	-	-	-	-	-	-	36	36	36	36	36	36	-	-	
Off-Farm Work: Field (hrs) Male	-	72	-	158	-	-	185	240	124	171	141	160	-	-	
Female	-	-	39	-	70	-	182	176	-	123	159	134	-	-	

Table 5.3

Optimal Farm Household Activities Pattern, Medium Rainfed Farm

Activities	Month and Period														Net Return
	M	J		J		A	S	O	N	D	J	F	M	A	
	1	2.1	2.2	3.1	3.2	4	5	6	7	8	9	10	11	12	฿7886
Glutinous Rice		← GR2: 7.76 rai →													
Nonglutinous Rice	← NGR1: 9.30 rai →														
Nonglutinous Rice		← NGR2: 0.20 rai →													
Sericulture (150 grams)	← 7.80 →			← 6.50 →					← 6.60 →				← 8.05 →		
Silk Weaving (piece)	4	2	-	3	-	-	-	-	-	-	-	-	3	-	
Rice Container Making (containers)	-	-	-	-	-	80	-	-	-	-	-	-	-	65	
Hire-in Labor: Male	-	71	-	-	-	-	-	-	-	-	-	-	-	-	
(hour) Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Off-Farm Work: Male	-	-	-	-	-	-	60	50	60	60	60	60	-	-	
Nonfield (hrs) Female	-	-	-	-	-	-	36	36	36	36	36	36	-	-	
Off-Farm Work: Male	-	-	-	-	-	-	161	-	70	185	192	200	-	-	
Field (hrs) Female	-	-	10	-	4	-	224	80	25	157	194	202	-	-	

Table 5.4

Optimal Farm Household Activities Pattern, Large Rainfed Farm

Activities	Month and Period														Net Income
	M	J		J		A	S	O	N	D	J	F	M	A	
	1	2.1	2.2	3.1	3.2	4	5	6	7	8	9	10	11	12	฿12,654
Glutinous Rice	← GR1: 9.72 rai →														
Nonglutinous Rice	← NGR1: 10.76 rai →														
Nonglutinous Rice		← NGR2: 16.49 rai →													
Sericulture (100 grams)	← 9.91 →			← 7.4 →									← 9.29 →		
Silk Weaving (piece)	3	2	-	3	-	-	1	-	-	-	-	-	4	-	
Rice Container Making (container)	-	-	-	-	-	81	-	-	-	-	-	-	-	95	
Hire-in Labor: Male (hour)	-	-	240	-	148	-	-	234	-	-	-	-	-	-	
Hire-in Labor: Female (hour)	-	-	-	155	-	97	-	128	-	-	-	-	-	-	
Off-Farm Work: Nonfield (hrs) Male	-	-	-	-	-	-	60	-	60	60	60	60	60	-	
Off-Farm Work: Nonfield (hrs) Female	-	-	-	-	-	-	36	-	32	36	36	36	-	-	
Off-Farm Work: Field (hrs) Male	-	-	-	-	-	-	118	-	55	188	226	210	-	-	
Off-Farm Work: Field (hrs) Female	-	-	-	-	-	-	247	-	-	248	244	242	-	-	

For the medium sized farm, the optimal plan meets the family consumption requirement with 7.76 rai of glutinous rice planted in period 2.1 (early June). The remaining 9.5 rai of land is used for nonglutinous rice production for sale. Of this amount 9.3 rai would be undertaken in period 1 (May) and the remaining .2 rai would be started at the same time as the glutinous rice (period 2.1 in June).

For the large sized farm with 36.97 rai available for crop production, the programming results recommend that 9.72 rai of land should be put to glutinous rice in period 1 (May) for family consumption reqiurements, whereas 10.76 and 16.49 rai are devoted to nonglutinous rice production in period 1 and 2.1 respectively for commercial purpose.

As for the small farm situation, the programming results for medium and large rainfed farms suggest that the farmers should split their rice production in two successive periods instead of in one period in order to minimize or avoid the problem of family labor supply shortage during the peak demand for rice production activities. These results conform to the usual way that the rainfed farmers spread their rice production over different periods.

5.1.2 Nonfarm Enterprises

It was interesting to see that the three common nonfarm enterprises found in the sample households appear besides rice in the optimal plan for every farm size class. These common enterprises are sericulture, silk weaving and sticky rice container making. The optimum solution for small and medium farms suggests that the households should practice sericulture during all four available times a year beginning in period 1 (May), 3 (July), 7 (November) and 11 (March). The optimal solution for large farms includes only three practices of sericulture a year beginning in periods 1, 3 and 11 because all of female labor in the large farm household are used up for rice production activities and nonagricultural field work in period 7 (November). Therefore, sericulture is not found in the period 7 as in the optimal plan for small and medium farms. However, according to these solutions, the household with small sized farm can produce a relatively large amount of silk yarn (5,088 grams) compared to the households with medium (2,895 grams) and large size farms (2,660 grams). This is because the larger farms utilize more female time in rice production leaving less for sericulture. Also the larger number of children in the family labor force on small farms than on medium and large farm households contribute to this result because children contribute importantly along with females in silkworm rearing or sericulture.

Silk weaving also enters the optimal plan for every farm size class. The plan recommends that the silk fabric should be woven in period 1 (June), 2.1 (the first half of June), 3.1 (the first half of July) and 11 (March) for small and medium farm households, and in period 1, 2.1, 3.1, 4 (August) and 11. All of these periods suggested by the optimal plan are the slack period for rice production activities. This recommended timing for silk weaving corresponds to the usual way that many women in the rainfed villages commonly weave silk fabric during the slack period of rice production activities. It needs to be pointed out that the greater output from silk weaving on medium and large farm household than on small farm household is because the medium and large farm households have relatively more females in the family labor force as pointed out earlier.

Sticky rice container making like sericulture and silk weaving appears in the optimal solutions for every farm size class but only for two periods--period 4 (August) and period 12 (April) which are the slack periods of rice production activities. Under the optimal plan for each farm size, the number of containers produced in the optimal plan increases with the farm size. Since the medium and large farm households have more female and male labor in the family labor force than the ones in the small farm household. This helps the medium and large farm household to take advantage from their relatively large labor force by producing more amounts of sticky rice containers.

Mat making, which has been found to be a minor cottage industry compared to the other nonfarm enterprises in the rainfed villages, as discussed earlier, is excluded from the optimal solutions for every farm size class. This is because of its relatively low return to labor compared to the sericulture, silk weaving and sticky rice container making. This conclusion is supported by Fleekenstein's study on returns to labor of selected enterprises found in the rainfed farm households [1980], indicating that mat making has a relatively low return (to labor).

According to the results discussed above, it can be concluded that it is economically possible for the rainfed farm households to combine some cottage industries with their main rice production activities.

5.1.3 Hire-In Labor

There is no hire-in labor for rice production activities in the optimal plan for small farm size because the farm household has enough of its own family labor to supply the requirements for rice production activities.

In the optimal plan for medium sized farm, only male labor is hired in for land preparation in period 2.1 (June), and the rest of rice production activities could be done by family members.

As expected, the optimal plan for the household with large sized farm includes hiring in labor for rice production activities in many periods. At the wage of 3.13 baht per hour (for both male and female work), the large farm household should hire male workers in periods 2.1 (first half of June), 3.1 (first half of July) for land preparation and in period 6 (October) for harvesting rice. In addition, female labor should be employed for transplanting and planting rice in period 2.2, 3.2 (the second half of June and July) and for harvesting rice for period 6 (October).

The above solutions show that the larger the operational farm size is the more workers are hired in. Thus it is necessary for the large farm household to hire in labor in the peak period of rice production activities in order to achieve the optimal farming system with a rice base.

According to the nature of the local labor market for field work the large farm household can obtain hire-in labor from the household with smaller sized-farms who have excess labor force. This relationship in terms of hiring in and selling out labor between the large farm household and the small farm household has been discussed earlier and it can be clearly seen in the next section where the small farm household hired out his/her family labor (both males and females) during the peak periods of rice production activities in the optimal plan for the small farm.

5.1.3 Off-Farm Work

Hiring out both male and female labor during the peak periods for rice production activities and for upland crops (kenaf, cassava, sugar cane) production activities appears in the optimal plan for the small farm household. At the wage of 3 baht per hour for field work, the small farmers are willing to hire out family labor (both males and females) in every available period throughout the year which excludes periods 1 (May), 4 (August), 11 (March) and 12 (April). During these periods, there is no demand for field work as discussed earlier. The hiring out of family labor for the small farm household in periods 2 (June), 3 (July) and 6 (October) corresponds to the time that the large farm household hires in labor for rice production activities, and in periods 5 to 10 (September to February) which corresponds to the upland farmers' demand for field workers to harvest kenaf, sugar cane and cassava. In addition, the model results for the small farm household show that both male and female family labor are hired out to manufacturing and construction at the assumed average wage of 4.38 baht per hour for male and 3.75 baht per hour for female.

For the medium farm size, only female family labor is hired out for rice farming in periods 2, 3 and 6 as all of the male family labor was used up for its own rice production activities in these periods except for period 6 having some to sell for nonfield work. Both male and female labor are hired out to upland farmers in periods 5, 7, 8, 9 and 10 which are the slack periods of rice production activities. Again, like the small farm household, the optimal plan indicates that the family labor of the medium farm household responds substantially to the off-farm work opportunities in manufacturing and construction work available from period 5 to 10 (September to February).

In the case of large farm households, as expected, there is no hiring out its family labor (both males and females) to rice farmers and construction and manufacturing during the peak periods for rice production activities (June, July and October) as all of male and female family labor were used up in those periods. But, the optimal plan shows that the large farm households like the small and medium farm households do respond to off-farm work for manufacturing and construction by hiring out the family labor during the slack periods of rice production activities.

It should be interesting that both classes of off-farm employment-agricultural field work and nonagricultural field work in construction and manufacturing offering a wage ranging from 3 to 4.48 baht (or more) per hour are very attractive not only for the small farm households but also for the medium and large farm households. This result is supported by the fact that many rainfed farm households in the study area have engaged in off-farm work as their supplementary source of family income during the slack periods of farm activities as pointed out earlier.

Moreover, the above results points out that it is economically possible for every farm size class of the rainfed farm households to engage in off-farm work on a part-time basis.

5.1.4 Capital Borrowing Activity

The need to obtain short-term loans for rice production is indicated in the optimal plan for both medium and large farm households. The medium and large farmers should borrow 2,602 and 9,317 baht respectively.

This result suggests that both of medium and large farm households have insufficient operating capital (cash) to meet their rice production expenses for the optimal plans, and they may have to borrow. Relatively, the households with large sized farm need more operating capital compared to the one with smaller farm size. It should be mentioned here again that the small farm household with an average of 6.13 rai of farmland has no borrowing capacity because not enough rice can be produced with this amount of farmland to guarantee the BAAC's short-term loan as discussed earlier.

5.1.5 Nonbasis Enterprises: Shadow Prices and Stability Coefficients

Nonbasis activities are those that do not enter the optimal solution of the model. Under the optimal plan for small, medium and large farm, mat making is the only nonfarm enterprise that never enters the solution, while silk weaving and sticky rice container making in many periods are excluded from the plan. Table 5.5 lists the excluded enterprises and their shadow prices. Shadow prices indicate the income penalties of forcing one unit of nonbasis activities into the optimal solution at the indicated interval. Therefore, the shadow prices reveal the competitive period by period of activities in the optimal solution. In principle, the lower the shadow price of a nonbasis activity for a given period, the higher is the competitive position. For example, in case of small farm household, the shadow price of sticky rice container making in period 3.2 is 0.5 per unit of 28 containers produced (or ฿0.02 per one container) this value is a net marginal cost (i.e. the excess of marginal cost over marginal revenue) indicating that the family income would be reduced by ฿0.02 if one unit (one container) was made. Thus, for small

Table 5.5

Nonbasis Enterprises and Their Shadow Price of the Rainfed Farm Household by Farm Size Class

Enterprises	Small Farm		Medium Farm		Large Farm	
	Period	Shadow Price (฿/unit)	Period	Shadow Price (฿/unit)	Period	Shadow Price (฿/unit)
Glutinous Rice (Production Unit: 1 rai)			1	0.3	2.1	0.3
Nonglutinous Rice (Production Unit: 1 rai)	1, 2.1	1.6, 2.4	--	--	--	--
Sericulture (Production Unit: 12 grams)	--	--	--	--	4	73.2
Silk Weaving (Production Unit: 1 piece)	2.2, 3.2, 4 5, 6, 7 8, 9, 10 12	0.4, 0.4, 0.2 0.4, 0.4, 10.2 0.4 0.2	2.2, 3.2, 4 5, 6, 7 8, 9, 10 12	0.5, 0.5, 0.2 0.5 0.4 0.2	2.2, 3.2 5, 6, 7 8, 9, 10 --	12.3 0.5, 6.6, 35.8 0.4 --
Rice Container Making (Production Unit: 28 containers)	1, 2.1, 2.2 3.1, 3.2, 5 6, 7, 8 9, 10, 11	43.9, 190.0, 0.5 196.6, 0.5, 190.1 190.1, 205.7, 190.1 190.1, 190.1, 3.4	1, 2.1, 2.2 3.1, 3.2, 5 6, 7, 8 9, 10, 11	3.2, 209.4, 0.5 206.9, 0.5, 145.6 291.8, 197.0, 190.1 190.1, 190.1, 3.4	1, 2.1, 2.2 3.1, 3.2, 5 6, 7, 8 9, 10, 11	2.4, 214.4, 19.5 209.4, 21.9, 201.4 220.0, 258.4, 190.7 190.1, 190.1, 3.5
Mat Making (Production Unit: 60 mats)	1 - 12	ranging from 312.1 to 388.3	1 - 12	ranging from 310.9 to 384.0	1 - 12	ranging from 305.9 to 512.3

farms, making sticky rice containers in this period is in the strongest competitive position having a near zero shadow price. The higher the shadow price the lower its competitive position in the optimal plan. For instance, again in case of small farm households, mat making in the period (12) having the largest shadow price (฿312 per 60 mats or 5.2 baht per mat), is in the weakest competitive position. This information helps explain why in every period the making of mats does not enter in the optimal solution for every farm size class. However, the shadow prices of excluded enterprises are difficult to compare across the enterprises because these excluded enterprises have no common denominator in the production unit. For instance, each production unit of mat making is based on 60 mats whereas each production unit of sticky rice container making is based on production of 25 containers. These shadow prices would indicate very clearly the ordering of excluded enterprises in terms of preference if they carried the same units.

Another approach to evaluating the LP solution is to consider its stability. This approach is interested in the question of how much the gross margins could be altered for enterprises in the optimum solution without changing that solution or the question of how much the gross margins would need to be altered for excluded enterprises in order to bring them in solution.

Table 5.6 lists the highest value of the gross margin (per unit of production) of the excluded nonfarm enterprises for which no change in the optimal plan. They are referred to as upper bound stability coefficients. The figures indicate that if the gross margin or net return (per specified unit of production) of a particular excluded nonfarm

Table 5.6

Upper Bound Stability Coefficients of Excluded
Nonfarm Enterprises, Rainfed Farm Households

Period	The Highest Value of Gross Margin of Excluded Nonenterprises								
	Silk Weaving (฿/piece)			Sticky Rice Container Making (฿/80 containers)			Mat Making (฿/60 mats)		
	S	M	L	S	M	L	S	M	L
1	--	--	--	217	218	217	602	627	625
2.1	--	--	--	404	424	429	584	602	602
2.2	133	133	145	215	215	234	585	604	674
3.1	--	--	--	411	421	424	635	631	602
3.2	133	133	145	215	215	236	684	604	604
4	133	133	--	--	--	--	583	596	631
5	133	133	133	404	410	416	584	594	759
6	133	133	140	404	506	434	584	594	584
7	143	133	169	420	411	473	626	604	584
8	133	133	133	404	404	404	584	584	584
9	133	133	133	404	404	404	584	584	609
10	133	133	133	404	404	404	584	584	584
11	--	--	--	218	218	218	609	609	609
12	133	133	133	--	--	--	560	557	553

Note: S = Small Farm Size; M = Medium Farm Size; L = Large Farm Size enterprise increases over its highest value, this particular excluded nonfarm enterprise will become viable alternative for the households and may be included in a new optimal solution. For instance, in the case of small rainfed farm households, the excluded mat making activities in period 1 (May) may become a profitable alternative for the rainfed farm household to perform in period 1 (May) if the net return of mat is higher than 602 baht per unit of 60 mats produced or 10.03 baht per mat produced. Comparing these values with the present gross margin of mat making used in the model (247 baht per 60 mats or 4.1 baht per mat, Appendix Table 6), the gross margin of mat making needs to be increased by at least twice from its current gross margin to make mat making alternative become the viable enterprise for the rainfed farm households with every farm size.

In the case of the excluded sticky rice container making, it may need to raise the gross margin from 0.5 to 97 percent of its current gross margin (214 baht per 28 containers or 7.6 baht per container, Appendix Table 5) to bring excluded sticky rice container making in certain periods into the optimal solution for every farm size class in the rainfed area. It was interesting to observe that in the case of silk weaving it may need to increase gross margin slightly, in the range of 0.07 to 8 percent from its current gross margin of 132.9 baht per piece, (Appendix Table 4) to make silk weaving in certain periods to be profitable alternative for small and medium rainfed farm households, while it needs to be increased from 0.07 to 24 percent of its current gross margin to make silk weaving become viable alternative for the large rainfed farm households in certain periods (see Table 5.6).

On the basis of these results for rainfed farms it would appear that the specified plans is very stable as regards to the basis enterprises, especially sticky rice container and mat making.

5.2 Optimal Labor Utilization Pattern

The optimal labor utilization pattern to farm (rice production activities), nonfarm enterprise and off-farm employment for small, medium and large sized farm is summarized and presented in Table 5.7, 5.8, and 5.9 respectively. The results show the optimal patterns of labor utilization by age and sex across the farm size class are seasonal and how they differ among the farm size classes.

For the small farm household optimal plan, about 12.7, 6.9 and 48.3 percent of the total available male labor are allocated to rice production activities, nonfarm enterprises (sticky rice container making) and off-farm employment respectively. This suggests that the maximum utilization of male family labor to income generating activities is about 68 percent of the total available male labor under the optimal plan based on the situation discussed in the previous chapter. It can be seen in Table 5.6 that some slack labor for males appears in periods 1, 2.2, 3.2, 11 and 12. Female family labor is fully utilized under the optimal plan in which 8.5, 48.3 and 43.2 percent of total available female labor are allocated to rice production activities, nonfarm enterprise (sericulture, silk weaving and sticky rice container making) and off-farm employment respectively. Sericulture is the most labor utilizing nonfarm enterprise included in the optimal solution as it accounts for a half of all female labor allocated to nonfarm enterprises, whereas silk weaving and sticky rice container making utilize only 27 and 21 percent. Children

Table 5.7

Optimal Pattern of Labor Utilization of Small Rainfed Farm

Period and Month	Family Labor Available (hour)			Family Labor Use as Percent of Available							Hired Labor (hour)	
				Crop		NonFarm			Off-Farm			
	M	F	C	M	F	M	F	C	M	F	M	F
1-May	208	200	96	7.4	--	--	100.0	100.0	--	--	--	--
2.1-Jun	190	120	41	62.1	--	--	100.0	--	37.9	--	--	--
2.2-Jun	190	120	41	13.9	56.5	--	11.0	--	--	32.5	--	--
3.1-Jul	195	132	43	19.0	--	--	100.0	100.0	81.0	--	--	--
3.2-Jul	195	132	43	2.3	10.4	--	36.6	100.0	--	53.0	--	--
4-Aug	260	204	103	9.3	--	45.0	100.0	25.4	--	--	--	--
5-Sep	265	218	72	7.5	--	--	--	--	92.5	100.0	--	--
6-Oct	320	212	80	6.2	--	--	--	--	93.8	100.0	--	--
7-Nov	300	202	82	38.7	49.9	--	32.3	71.2	61.3	17.8	--	--
8-Dec	270	230	104	14.4	10.0	--	20.9	--	85.6	69.1	--	--
9-Jan	201	195	97	--	--	--	--	--	100.0	100.0	--	--
10-Feb	220	170	99	--	--	--	--	--	100.0	100.0	--	--
11-Mar	254	206	99	--	--	--	100.0	100.0	--	--	--	--
12-Apr	266	210	310	--	--	42.4	100.0	19.4	--	--	--	--
Total Hour	3334	2557	1130	423	216	230	1236	380	1611	1099	--	--
Percent[1]	100.0	100.0	100.0	12.7	8.5	6.9	48.3	33.6	48.3	43.2	--	--

Note: M = Male; F = Female; C = Children

[1]Family labor use percentages computed on totals available for M, F and C respectively.

Table 5.8

Optimal Pattern of Labor Utilization of Medium Rainfed Farm

Period and Month	Family Labor Available (hour)			Family Labor Use as Percent of Available: Crop		Nonfarm			Off-Farm		Hired Labor (hour)	
	M	F	C	M	F	M	F	C	M	F	M	F
1-May	246	220	51	11.3	--	--	100.0	100.0	--	--	--	--
2.1-Jun	157	146	20	100.0	--	--	100.0	--	--	--	71	--
2.2-Jun	157	146	20	30.0	92.7	--	0.5	--	--	6.8	--	--
3.1-Jul	205	148	21	100.0	--	--	100.0	100.0	--	--	--	--
3.2-Jul	205	148	21	22.9	81.4	--	15.9	100.0	--	2.7	--	--
4-Aug	285	239	56	36.7	--	63.3	100.0	71.8	--	--	--	--
5-Sep	283	260	37	21.9	--	--	--	--	78.1	100.0	--	--
6-Oct	300	260	42	83.3	55.4	--	--	--	16.7	44.6	--	--
7-Nov	330	274	43	60.6	60.1	--	17.6	100.0	39.4	22.3	--	--
8-Dec	294	257	81	16.7	11.0	--	13.9	--	83.3	75.1	--	--
9-Jan	252	230	40	--	--	--	--	--	100.0	100.0	--	--
10-Feb	260	238	44	--	--	--	--	--	100.0	100.0	--	--
11-Mar	265	210	52	--	--	--	100.0	100.0	--	--	--	--
12-Apr	220	210	96	--	--	67.0	100.0	34.2	--	--	--	--
Total Hour	3459	2986	624	1219	603	328	1271	260	1158	1112	71	--
Percent[1]	100.0	100.0	100.0	35.2	20.2	9.5	42.6	41.7	33.5	37.2	2.1	--

Note: M = Male; F = Female; C = Children

[1]Family labor use percentages computed on totals available for M, F and C respectively.

Table 5.9

Optimal Pattern of Labor Utilization of Large Rainfed Farm

Period and Month	Family Labor (hour)			Percent of Family Labor Use For: Crop		Nonfarm			Off-Farm		Hired Labor (hour)	
	M	F	C	M	F	M	F	C	M	F	M	F
1-May	280	217	64	21.7	--	--	100.0	100.0	--	--	--	--
2.1-Jun	260	150	25	100.0	--	--	100.0	--	--	--	240	--
2.2-Jun	260	150	25	39.8	99.4	--	0.6	--	--	--	--	155
3.1-Jul	280	170	24	100.0	--	--	100.0	100.0	--	--	148	--
3.2-Jul	280	170	24	29.8	84.2	--	15.8	100.0	--	--	--	97
4-Aug	320	280	84	42.4	--	57.6	100.0	48.8	--	--	--	--
5-Sep	310	283	40	42.6	--	--	--	--	57.2	100.0	--	--
6-Oct	443	285	48	100.0	100.0	--	--	--	--	--	234	128
7-Nov	450	300	55	74.5	91.8	--	--	--	25.5	8.2	--	--
8-Dec	310	320	90	20.0	11.2	--	--	--	80.0	88.8	--	--
9-Jan	286	280	50	--	--	--	--	--	100.0	100.0	--	--
10-Feb	270	278	56	--	--	--	--	--	100.0	100.0	--	--
11-Mar	210	250	60	--	--	--	100.0	100.0	--	--	--	--
12-Apr	214	298	110	--	--	100.0	100.0	43.4	100.0	--	--	--
Total Hour	4173	3431	755	1927	881	399	1393	260	1097	1157	662	380
Percent[1]	100.0	100.0	100.0	46.2	25.7	9.7	40.6	34.4	26.3	33.7	14.9	11.1

Note: M = Male; F = Female; C = Children

[1]Percentages in terms of total available hours for M, F and C respectively.

contribute about 34 percent of their available labor to sericulture and sticky rice container making in the optimal plan. However, the labor provided by children becomes limited for nonfarm enterprise in period 1 (May), 3.1 (first half of July) and 11 (March) as all of their available labor in these particular periods were used up (Table 5.7).

In the case of the meidum farm household, the optimal labor contribution of males, females and children in rice production activities, nonfarm enterprises and off-farm work is shown in Table 5.8. Neither males and children fully utilize their labor in some periods. For instance, slack male labor appears in period 1, 2.2, 3.2, 4 and 12 as there is no opportunity for males to hire out their labor to off-farm work as pointed out earlier. In addition, a shortage of female and child labor for making sticky containers which is the only cottage industry available for males, causes a slack for male labor in those periods. Males utilize about 35, 10 and 34 percent of their available labor to rice production activities, sticky rice container making and off-farm work respectively. Even children contribute about 42 percent of their year round available labor to sericulture and to the making of sticky rice containers. All of their labor is fully utilized in many periods such as period 1 (May), 3 (July), 7 (November) and 11 (March). This points out the importance of the contribution of children to the family industries. Female labor annual available labor is fully utilized distributed with about 20, 43 and 37 percent to rice production activities, nonfarm enterprises (sericulture, silk weaving and sticky rice container making) and off-farm employment respectively. Of the few nonfarm enterprises entering the optimal plan, silk weaving is the major enterprise as it accounts for 42 percent of female labor used in these nonfarm enterprises, while sericulture and sticky rice container making equally share 29 percent of the female labor.

The optimal plan for large farms indicates some male and child labor are slack in certain periods when there are no income generating activities available as well as when there is not enough female labor to accomplish joint efforts since all female labor is used up in these periods. Males contribute about 46, 10 and 26 percent of their available labor to rice production activities, sticky rice container making and off-farm employment respectively leaving about 18 percent of their annual available labor unused.

Children also show their important role in the optimal labor utilization plan by providing about one-third of their annual available labor to sericulture and sticky rice container making. In addition, child labor appears to be very scarce in many periods, e.g. period 1, 3 and 11 as all of child labor is used up in those periods as it can be seen through Table 5.9. All of the female labor was fully utilized every period in this optimal plan. The largest proportion of female labor (40 percent) was contributed to sericulture, silk weaving and sticky rice container. Females also share about 34 and 26 percent of their labor to off-farm work and and rice production activities respectively.

Some conclusions can be summarized from the above optimal pattern of labor utilization for every farm size class. First, the contributory role of men, women and children to rice production activities, family industries and off-farm work varies widely due to the nature of the productive activities of the respective enterprises. Men play the dominant role in rice production activities as a whole and in off-farm work while the role of women and children is in family industries for the small farm household. For medium and large farm size, men are primarily occupied in rice production activities while women are engaged not only in farm production and in nonfarm enterprises but in off-farm work as well. Secondly, the allocation of male and female labor to rice production proportional to their available labor increases when the size of farm increases. Conversely, the allocation of male and female proportional to their available labor to off-farm employment increases with the farm size. The contribution of women as the proportion of their total available labor to family industries (sericulture, silk weaving and sticky rice container making) decreases with the farm size, but for men and children the results are not conclusive. Finally, the amount of hired labor (in terms of hours) appearing in the optimal plan for large and medium farms but with none in the small farm solution suggests that the demand for hire-in labor is positively related to the operational farm size as would be expected. For instance, the large farmers hired in men labor and women labor for 15 and 17 percent of their available male and female labor respectively for rice production and activities (Table 5.9). Medium farm household also hired in male labor for 71 hours or 2.1 percent of the available male labor for rice production activities, while there is neither men nor women hired labor for the small farmers (Table 5.7 and 5.8).

5.3 Shadow Price of Land and Labor

One of the important values of linear programming is that it reveals the shadow price of scarce resources and constraints. Consequently, it indicates the marginal contribution to income of the last unit of resources used in the optimum solution. Only resources which are fully exhausted have positive shadow prices. Hence, the shadow prices of resources indicate which resources are restricting and the potential gains in income obtainable through acquiring one more unit of the limiting resource. The higher the shadow price, the more limiting the resources. Shadow prices of resources also indicate the pressures to expand or contract the use of a specific resource. The shadow prices for selected resources of small, medium and large farm size are presented in Table 5. 10.

The LP results show that paddy land is fully utilized and in short supply for every farm size class as revealed by shadow prices of 320, 261 and 278 baht per rai for small, medium and large farms respectively. This suggests that the provision of land is a crucial factor for increasing the scale of operation and the level of income.

According to the study on land to rent in Khon Kaen [Chalamwong and Onchan, 1981], the land rent averages 330 baht per rai. Comparing shadow price with land rent, it would appear that the expansion of land use (by renting) for rice production for small, medium and large farmers would not be profitable under the assumed yield and prices. However, this must be a tentative conclusion because this rental rate for cropland (330 baht per rai) may not be appropriate value to be compared with the above shadow prices of land for the rainfed farms. The reported land rent was computed as an average of that reported by a sample of households including rainfed rice farms, rainfed upland crop farms and irrigated farms. Consequently, the average rent reported for all farms is not comparable to the particular types of farms used in this study.

Table 5.10

Shadow Prices of Labor of Rainfed
Farm by Farm Size Class and Period

Period	Shadow Prices Family Labor (baht/hour)								
	Male			Female			Child		
	S	M	L	S	M	L	S	M	L
1	--	--	--	3.16	3.16	3.19	0.02	0.24	0.19
2.1	3.01	3.22	3.39	3.00	3.16	3.16	--	--	--
2.2	--	--	--	3.01	3.18	3.44	--	--	--
3.1	3.00	3.22	3.31	2.99	3.16	3.16	0.51	0.28	0.17
3.2	--	--	--	3.00	3.18	3.44	0.51	0.28	0.17
4	--	--	0.01	2.99	3.11	3.16	--	--	--
5	3.00	3.08	3.18	3.00	3.08	3.18	--	--	--
6	3.00	4.61	3.31	3.00	3.08	3.31	--	--	--
7	3.00	3.08	3.18	3.21	3.08	3.97	--	0.10	--
8	3.00	3.00	3.00	3.00	3.00	3.00	--	--	--
9	3.00	3.00	3.00	3.00	3.00	3.00	--	--	--
10	3.00	3.00	3.00	3.00	3.00	3.00	--	--	--
11	--	--	--	2.99	2.99	2.99	0.26	0.26	0.26
12	--	--	0.01	2.99	2.99	2.99	--	--	--

Note: S = Small Farm; M = Medium Farm; L = Large Farm

According to the shadow prices of family labor presented in Table 5.10 female family labor appears to be limiting the most often for the various labor resources in the optimal solution as they are exhausted in every period throughout the year. For small farms, the shadow price of female labor ranges from 2.99 to 3.21 baht per hour. The period of (November) is the most critical period for female labor as revealed by the highest shadow price of female labor (3.21 baht per hour). There is a heavy demand for female labor during the period for harvesting glutinous rice leaving only a small surplus of female labor for practicing sericulture and hiring out to nonagricultural work in construction or manufacturing. For medium and large farms, the shadow price of female labor is relatively high in period 2.2 and 3.2 which are the periods with heavy demand for women labor to transplant and plant rice.

Male labor for every farm size is likewise fully utilized in many periods (Table 5.10). As would be expected, male labor is more limiting on the medium and large sized farms than on the small farm size as revealed by their large shadow prices in 2.1, 3.1, 5, 6 and 7. During these periods, male labor for both medium and large becomes most limiting in periods 2.1, 3.1 and 6. Periods 2.1 and 3.1 are the periods for land preparation and period 6 is the period for harvesting nonglutinous rice. These periods have a heavy demand for male labor and, in the case of large farms, additional workers must be hired for their rice production activities.

Table 5.10 shows the interesting result that all of the available labor from children is exhausted in many periods such as periods 1, 3.1, 3.2 and 11 for every farm size. This demonstrates the economic value of child labor in terms of their positive shadow prices and their significant role for family industries like sericulture and the production of sticky rice containers.

5.4 Comparison of Actual and Model Results

The comparison of the actual and model results will be discussed in this section. The actual results for small, medium and large farm were derived from the project Phase II surveys on the basis of the average of all sample households in each farm size class.

Ideally, the comparison of the actual and programming results would be used to test or validate the model results and to assess the possibility for the rainfed farm households to improve the families' income through the optimal solutions suggested by the programming model. However, it is difficult to compare the programming results with the actual results that were derived from the project Phase II survey due to the following problems:

(1) There is inadequate information on the actual rice production systems (varieties, technology, planting and harvesting dates) followed by the farmers available from the project Phase II survey. This makes it impossible to compare, in precise terms the optimal cropping systems recommended by the model with the one performed by the actual farmers.

(2) The estimation of family labor use for as well income obtained from the vegetable garden, poultry and livestock rearing was derived from the one short survey conducted by the researchers for use on the model. These labor use and income figures were then added to the programming results later to get a complete picture of farm enterprise

component. The accounting rules in the supplemental survey may be different from those employed in the Phase II survey.

Thus, the problem of under or over estimation of vegetable, livestock and poultry component may be expected from either of the surveys may cause a difference in the comparison of farm income and labor use in farming activities between the model and actual results as can be observed from the Table 5.11.

(3) It is difficult to diagnose differences found in the comparison between the actual and model results without the information of costs and returns of the enterprises which is not available from the projected Phase II survey.

(4) With regard to the off-farm employment component, the model simplifies the off-farm employment opportunities in commerce and services due to a lack of detail information about these types of off-farm work. But the reported actual results in Table 5.11 have already included these types of off-farm work.

With the recognization of the above comparison problems, the rough comparison between the actual and model results will be explained using the selected variables of income (by source) and labor (i.e. family labor utilization pattern to farm, nonfarm and off-farm activities by age and sex) which is available from the Phase II survey. Table 5.11 indicates that the composition of family net income by source obtained from the programming model and actuals have similar patterns. Both results suggest that the net income from farm enterprise as a proportion of household income increases as the farm size increases, while net income from nonfarm enterprises and off-farm employment are inversely related to the size of farm. Consequently the programming

Table 5.11

Comparison of Actual and Model Results of the Rainfed Farms

Item	Small Farm		Medium Farm		Large Farm	
	Actual	Model	Actual	Model	Actual	Model
Income (baht)						
Farm	4,233	3,035	7,686	9,140	8,778	17,277
	(26.6)	(19.5)	(41.7)	(44.6)	(44.0)	(60.0)
Nonfarm	3,350	3,769	3,793	3,893	3,704	4,212
	(21.0)	(24.2)	(20.6)	(19.0)	(18.6)	(14.6)
Off-farm	8,351	8,787	6,939	7,453	7,482	7,307
	(52.4)	(56.3)	(37.7)	(36.4)	(37.5)	(25.4)
Total	15,934	15,591	18,418	20,486	19,964	28,796
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Labor Utilization (Hour)						
Farm						
Male	1,290	1,259	1,854	2,042	2,411	2.516
	(48.1)	(40.0)	(62.6)	(57.9)	(70.4)	(62.7)
Female	853	600	1,053	1,118	1,459	1,458
	(38.7)	(20.5)	(45.4)	(31.9)	(51.2)	(36.4)
Child	583	477	323	250	494	548
	(59.9)	(55.0)	(59.8)	(49.0)	(74.1)	(67.8)
Nonfarm						
Male	479	230	332	328	583	399
	(17.9)	(7.4)	(11.2)	(9.3)	(17.0)	(10.0)
Female	813	1,236	836	1,271	981	1,393
	(36.9)	(42.0)	(36.0)	(36.3)	(34.5)	(34.8)
Child	319	380	217	260	173	260
	(40.1)	(44.3)	(40.2)	(51.0)	(25.9)	(32.2)
Off-Farm						
Male	911	1,611	779	1,158	431	1,097
	(34.0)	(52.0)	(26.2)	(32.8)	(12.6)	(27.3)
Female	537	1,099	431	1,112	407	1,157
	(24.4)	(37.5)	(18.6)	(31.8)	(14.3)	(28.8)
All Activities						
Male	2,680	3,100	2,965	3,528	3,425	4,012
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Female	2,203	2,936	2,320	3,501	2,847	4,008
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Child	974	857	540	510	667	808
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: Figures in parentheses are column percent figures.

solution are consistent with the actual results with regard to the relationship between the size of farm and net income by source.

Again, the allocation of family labor to farm, nonfarm enterprises and off-farm work as a proportion of total available labor in the model has a similar pattern to that found in the actual farm. That is, the share of female and male labor to farm enterprises proportional to their available labor varies directly with the size of the farm while the share of male and female labor to both nonfarm enterprises and off-farm employment proportional to their available labor decreased when the size of farm increases. But, the contribution of children to farm and nonfarm enterprises as suggested in the model is inconclusive and slightly different to the actual farms.

CHAPTER 6

RESULTS OF THE IRRIGATED FARM MODELS

The programming results for small, medium and large irrigated farms will now be presented in the same manner as the previous chapter. The optimal farm household organization with maximum household income will be discussed first by farm size, followed by a presentation of the optimal pattern of family labor utilization to farm, nonfarm enterprise and off-farm employment. The marginal value product or shadow prices of land, labor and capital resource will be interpreted. Finally, the model results will be compared to the actual results by farm size class.

6.1 Optimal Solution of the Irrigated Farms

The maximum annual family net income (after deducting the value of family consumption on food and nonfood items and household initial cash in hand) or net for saving (or for investment) in the optimal plan is 8,869, 14,479 and 21,491 baht per household for small, medium and large farms, respectively (Table 6.1). Looking at the composition of income generated in the optimal plans, the share of farm income in absolute term as well as in proportion to total household income increases when the size of farm increases. Conversely, the income from nonfarm enterprises as well as from off-farm employment decreases with the farm size. The general conclusion is that as the farm becomes smaller, the farm household tends to rely more heavily on income from family industires and off-farm work.

Table 6.1

Farm, Nonfarm, Off-Farm and Family Income of Irrigated Farms by Farm Size

Item	Farm Size Class: Small	Medium	Large
Crop Value (Baht)	10,605	29,283	52,092
(-) Operating Cost	3,085	7,788	13,191
(-) Hired Labor	--	1,587	7,272
Net Crop Value	7,520	19,908	31,630
(+) Other Farm Income	1,855	1,667	2,307
Total Farm Income	9,375	21,575	33,937
(+) Net Income from Nonfarm Product	1,591	1,231	542
(+) Income From Off-Farm Work	11,949	7,311	4,791
Total Household Income	22,915	30,117	39,270
(-) Value of Family Consumption	13,052	13,884	14,945
(-) Initial Cash	994	1,754	2,834
Net for Saving	8,869	14,479	21,491
Adult Labor Force	4.9	4.9	4.4
Household Income/Worker	4,677	6,146	8,925
Farm Income as Percent of Total	40.9	71.6	86.4
Nonfarm Income as Percent of Total	6.9	4.1	1.4
Off-Farm Income as Percent of Total	52.2	24.3	12.2
Farm Size (Rai)	5.39	15.45	32.36
Household Income/Rai	4,252	1,949	1,214
Net Crop Income/Rai	1,395	1,289	977
Land Area Per Worker	1.1	3.15	7.35

The optimal solutions for irrigated farms by farm size are presented in Tables 6.2 to 6.4. The enterprises and activities included in the optimal plans will now be discussed.

6.1.1 Crop Enterprise

The programming solutions suggest a very simple cropping pattern for the small farm compared to the ones appearing in the optimal solutions for medium and large farms. Most of the farmland for a small farm household is devoted to glutinous rice production in the wet season to meet minimum subsistence levels, leaving only a small area of land (0.06 rai) for growing tobacco for sale. But the small farm households use all available land (5.11 rai) for nonglutinous production in the dry season. To be precise, the small farm household should grow 5.05 rai of glutinous rice in period 2.1 (June) for family consumption and use 0.06 rai for tobacco production in period 5 and 5.11 rai for the dry season nonglutinous rice for sale in period 10.1.

However, the optimal cropping pattern differs slightly from the present mix of crops for small farms growing only rice, as tobacco was included in the optimal plan because it has relatively high returns to land.

There is a slightly different cropping pattern appearing in the optimal plan for medium and large farms. The optimal solutions suggest both medium and large farmers should grow wet season glutinous rice for a minimum area of land to meet the family consumption requirement. The rest of the land for medium farms should grow tobacco, corn and non-glutinous rice for sale, while the rest of the farmland for large farms should grow only tobacco and nonglutinous rice. Both wet and dry season nonglutinous rice are suggested to be planted in the different

Table 6.2

Optimal Plan for Small Irrigated Farms

Enterprise	M 1	J 2.1	2.2	3.1	J 3.2	A 4.1	4.2	S 5	O 6	N 7	D 8	J 9	F 10.1	10.2	M 11.1	11.2	A 12.2	12.2	Net Income ฿8869
		← GR2(W,B):5.05 rai →																	
								← TOB1:0.06 rai →											
Crops	→												← NGR2(D,B):5.11 rai —						
Cotton Weaving (Piece)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	9	9	
Basket Making (Basket)	6	-	-	-	4	-	6	-	-	-	-	-	-	-	-	4	-	6	
Mat Making (Mat)	18	21	-	10	-	23	-	-	-	-	-	-	-	-	-	-	-	-	
Hire-In Labor Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hire-In Labor Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonfield Work (Hrs.)[a] Male	-	-	-	-	-	-	-	60	60	60	60	60	30	30	-	-	-	-	
Nonfield Work (Hrs.)[a] Female	-	-	-	-	-	-	-	36	36	36	36	36	18	18	-	-	-	-	
Field Work (Hrs.)[b] Male	-	146	164	28	-	159	-	208	237	139	224	212	87	105	19	-	82	-	
Field Work (Hrs.)[b] Female	-	-	124	-	50	-	154	165	163	142	204	168	90	90	-	28	-	-	

Note: W = wet season; D = dry season; B = buffalo - cultivated; GR = glutinous rice; NGR = nonglutinous rice.

[a]Off-farm employment in construction and manufacturing.

[b]Off-farm employment in agricultural field work.

Table 6.3

Optimal Plan for Medium Irrigated Farms

Enterprise		Month and Period																	Net Income
		M	J		J		A		S	O	N	D	J	F		M		A	
Enterprise		1	2.1	2.2	3.1	3.2	4.1	4.2	5	6	7	8	9	10.1	10.2	11.1	11.2	12.1	12.2	฿ 14479
			←GR2(W,B):5.08 rai→																
			←NGR2(W,B):2.01 rai→																
					←NGR3(W,B): 7.6 rai→														
									←TOB1:0.2 rai→										
														←NGR2(D,B):8.12 rai→					
															←NGR3(D,B):8.23 rai→				
Crops		←Corn2:0.2 rai→																	
Cotton Weaving (Piece)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	9	5	
Basket Making (Basket)		1	-	-	-	2	-	2	-	-	-	-	-	-	-	-	1	-	3	
Mat Making (Mat)		11	21	-	26	-	33	-	-	-	-	-	-	-	-	-	-	-	-	
Hire-In Labor	Male	-	-	-	103	-	120	-	-	-	-	-	-	-	-	135	-	102	-	
	Female	-	-	-	-	-	-	14	-	-	-	4	-	-	-	-	51	-	-	
Nonfield Work (Hrs.)[a]	Male	-	-	-	-	-	-	-	60	60	60	16	60	30	30	-	-	-	-	
	Female	-	-	-	-	-	-	-	36	36	36	-	36	18	18	-	-	-	-	
Field Work (Hrs.)[b]	Male	-	112	71	-	-	-	-	137	151	94	-	176	47	75	-	-	-	-	
	Female	-	-	43	-	-	-	-	177	174	130	-	160	102	102	-	-	-	-	

Note: GR = glutinous rice; NGR = nonglutinous rice; W = wet season; D = dry season; B = buffalo - cultivated; T = tractor cultivated.

[a]Off-farm employment in construction and manufacturing.

[b]Off-farm employment in agricultural field work.

Table 6.4

Optimal Plan for Large Irrigated Farms

Enterprise	M 1	J 2.1	2.2	J 3.1	3.2	A 4.1	4.2	S 5	O 6	N 7	D 8	J 9	F 10.1	10.2	M 11.1	11.2	A 12.1	12.2	Net Income ฿21491
Crops																			
Cotton Weaving (Piece)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Basket Making (Basket)	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	1	-	1	
Mat Making (Mat)	15	12	-	11	-	27	-	-	-	-	-	-	-	-	-	-	-	-	
Hire-In Labor Male	-	240	105	240	-	240	-	-	-	-	360	-	32	-	189	-	240	-	
Hire-In Labor Female	-	-	240	-	70	-	72	-	-	-	358	-	-	-	-	38	-	-	
Nonfield Work (Hrs.)[a] Male	-	-	-	-	-	-	-	60	60	47	-	60	-	30	-	-	-	-	
Nonfield Work (Hrs.)[a] Female	-	-	-	-	-	-	-	36	36	36	-	36	18	18	-	-	-	-	
Field Work (Hrs.)[b] Male	-	-	-	-	-	-	-	74	96	-	-	165	-	31	-	-	-	-	
Field Work (Hrs.)[b] Female	-	-	-	-	-	-	-	167	174	56	-	149	64	21	-	-	-	-	

Crops (shown as arrows spanning the periods):

GR2(W,B):7.24 rai

NGR1(W,B):10.79 rai

NGR2(W,B):2.42 rai

NGR3(W,B):0.0 rai

ToB3:0.2 rai

NGR3(W,T):0.43 rai

NGR1(D,B):3.17 rai

NGR2(D,B):6.71 rai

NGR3(D,B):5.15 rai

NGR3(D,M):0.23 rai

Note: GR = glutinous rice; NGR = nonglutinous rice; W = wet season; D = dry season; B = buffalo - cultivated; T = tractor - cultivated.

[a]Off-farm employment in construction and manufacturing.

[b]Off-farm employment in agricultural field work.

periods for both medium and large farms even though there might be a problem of family labor shortage and a need to hire-in labor. But the large farmer appears to spread out nonglutinous rice production in many more alternative periods than the medium farm household. It is interesting that the optimal solution recommends that the large farmer should grow some tractor-cultivated nonglutinous rice in both seasons besides buffalo-cultivated rice, while the optimal plan for small and medium farms includes only the traditional rice production with buffalo-plowing. This suggests that it may be necessary for the large farm household having a relatively small labor force to employ more labor-saving technology for its commercial rice production like renting two-wheel tractor for land preparation even if it is more expensive than renting buffalo. However, the optimum solution for the large farm (containing only tobacco and rice) is a slightly different cropping pattern from the present mix of crops (with rice, tobacco and corn) found in the sample households.

6.1.2 Nonfarm Enterprises

All three common cottage industries (i.e., cotton weaving, mat and basket making) found in the sample irrigated households enter the optimal plan in many periods for every farm size. Cotton weaving which was commonly performed by women during the dry season is recommended for periods 11.1, 12.1 and 12.2 for small and medium farms and only the two periods of 11.1 and 12.1 for the large farm. All female labor of the large farm was used up for rice production activities in period 12.2. For every farm size, mat making is proposed during the slack periods of rice production activities in the wet season (e.g., periods 1, 2.1, 3.1 and 4.1), but not for any period of the dry season because it generates relatively less income compared with cotton weaving. Basket making, which is the only one family industry performed by men alone, appears in many slack periods of rice production activities in both the wet and dry season for the optimal plan for every farm size. In absolute terms, the optimal solutions indicate that small and medium farm households can produce more fabric, mats and bamboo baskets than possible for the large farm household, as both the small and the medium farms have relatively more excess family labor compared to the large farm household. Thus, the small and medium farm households can allocate their excess family labor to these family industries during the slack periods of rice production activities. This result suggests that it is economically possible to improve household income through a combination of farm and nonfarm enterprises or cottage industries, especially for the farm household with excess family labor relative to its operational farm size.

6.1.3 Hire-In Labor

The programming solutions of both medium and large farms include hiring in both male and female labor at 3.13 baht per hour in the periods having a peak demand for labor in rice planting and harvesting. There is no need for the small farm household to hire in any male or female labor for the rice production activities as it has a large family labor force related to its cropland area. In comparison, the large farm household needs to hire in more labor than the medium farms in order to satisfy the optimal cropping pattern. Tables 6.3 and 6.4 indicate that in total about 460 hours of male labor and 69 hours of female labor are hired by the medium farm household, and 1,646 hours of male labor and 778 hours of female labor are hired in by the large farm household. These results show that when the area of land to crops become larger, there is more need to hire in labor, especially for rice production activities. This type of relationship may help to understand that the local market for field workers is established and functions in a way such that the large farm household having a relatively small labor force needs additional labor during the peak periods of rice production activities and thus has to search for labor from and offer payment to the small farm households having excess labor relative to the cropping requirements. In addition, the rice production sector can absorb substantial local employment especially in the irrigated area where rice can be grown in both wet and dry seasons.

6.1.4 Off-Farm Work

The optimal off-farm employment pattern differs by farm size. For the small farm, the household responds to all available off-farm employment in field work and in construction or manufacturing even in the peak periods of rice production activities. Since the small farm household has more than enough family labor for the rice production activities, it has surplus labor to hire out. The households on medium-sized farms hires out substantial family labor to both field work and nonfield work according to the LP solution. But unlike small farms, these households have only a few hours of male labor and have no female labor to hire out in construction or manufacturing in period 8 which is the peak period for harvesting wet season rice. Moreover, there is no family labor either male or female available for other rice farmers to hire during period 8 (December) of the wet season and periods 11 and 12 (March and April) of the dry season because all of its family labor was used up in these periods for harvesting wet season rice (period 8) and for land preparation and planting for dry season rice (periods 11 and 12). For the large farm household, family labor is also hired out to upland farmers and to nonfield work (construction and manufacturing). But it has no labor to hire out during the peak period of wet and dry season rice production activities since all of the family labor was used up and instead has to hire in additional labor during the peak periods of rice production activities as pointed out earlier. These results indicate that the small farm household nominates to hire out family labor as opportunities become available throughout the year, especially to local rice farmers who have relatively large-sized farms. The major supply of local hired labor for rice production is thus expected to come from the small farm household. This suggests that when the farm becomes larger, the opportunity for family labor to be hired by other rice farmers is decreased. However, programming solutions for every farm size also suggests that it is economically possible for the farm households even in the irrigated area to work in off-farm employment on a part-time basis in addition to their farming and family industries under the given assumptions of the model. In addition, both classes of off-farm employment (i.e., agricultural field work and the work in manufacturing or construction) offering a wage ranging from 24 baht to 35 baht (or more) per day (or 3 baht to 4.38 baht per hour) are attractive to male and female labor, especially for the small farm household to hire out. These two classes of off-farm employment are highly competitive with the family industries (cotton weaving, basket and mat making).

6.1.5 Borrowed Capital

The programming solution results show that no capital was borrowed for every farm size of irrigated farms. This suggests that, under the assumptions of the model, the operating capital of the farm household is not a limiting resource. This implies that the irrigated farm households could be self-financed because according to the LP results, they could have cash from all sources to meet the operating expenses of rice production and their household needs. This result supports Sektheera's results from her analysis of irrigated farming systems (1979) indicating that capital availability was not a major limiting resource as no capital was borrowed for any representative farm or case farm.

6.1.6 Nonbasis Enterprises: Shadow Prices & Stability Coefficients

Some alternative crop enterprises (glutinous and nonglutinous rice, glutinous corn and tobacco) and cottage industries (cotton weaving, mat and basket making) are excluded from the optimal plan in some periods for every farm size because these excluded enterprises are relatively less profitable compared to the other enterprises included in the plan. This can be seen from Table 6.5 which lists the enterprises that were excluded in certain periods and their shadow prices. With the exception of tobacco for small farm size, buffalo-cultivated nonglutinous rice is the most competitive crop for wet and dry seasons for both small and medium farms. This means that for given prices and yields and with more available resources, buffalo-cultivated nonglutinous rice has the highest potential return compared to the other excluded crops for the small and medium farms. For the large farm, as all alternatives of buffalo-cultivated nonglutinous rice for wet and dry seasons have already entered the optimal plan, buffalo-cultivated glutinous and nonglutinous rice become the most economically desirable crop for the farmer in wet and dry seasons, respectively, compared to the other excluded crops which have relatively large shadow prices.

Table 6.5

Shadow Prices for Nonbasis Enterprises on Irrigated Farms by Farm Size Class

Enterprise	Small Farm		Medium Farm		Large Farm	
	Period	Shadow Price (฿/rai)	Period	Shadow Price (฿/rai)	Period	Shadow Price (฿/rai)
Glutinous Rice (W,B)	1,3.1	80,75	1,3.1	3,2	1,3.1	2,0.5
Glutinous Rice (W,T)	1,2.1,3.1	162,118,118	1,3.1,3.1	106,116,118	1,2.1,3.1	28,32,18
Nonglutinous Rice (W,B)	1,2.1,3.1	3.4,1.2,1.2	1	0.1	--	--
Nonglutinous Rice (W,T)	1,2.1,3.1	54,9,9	1,2.1,3.1	109,117,110	4,2.1	38,37
Glutinous Rice (D3)	9,10.1,11.1	70,143,117	9,10.1,11.1	75,154,78	9,10.1,11.1	71,174,224
Glutinous Rice (D,T)	9,10.1,11.1	212,227,83	9,10.1,11.1	219,233,158	9,10.1,11.1	144,253,139
Nonglutinous Rice (D,B)	9,11.1	65,46,46	1	0.1	--	--
Nonglutinous (D,T)	9,10.1,11.1	70,143,117	9,10.1,11.1	115,100,100	9,10.1	72,100
Tobacco	6,7	0.09	6,7	28	5,6	150,254
Glutinous Corn	12.1,1	504	12.1	636	12.1,1	1,052,156
Cotton Weaving	9,10.1	11.0	9,10.1,10.2	11.0	9,10.1,10.2	11.0
(Unite: one piece)	10.2,11.2	11.0	11.2	36.4	11.2,12.2	36.4
Mat Making	2.2,3.2,4.2	337	2.2,3.2,4.2	337,362,337	2.2,3.2,4.2	509,363,363
(Unit: 60 mats)	5 to 12.2	ranging from 337 to 362	5 to 12.2	ranging from 337 to 362	5 to 12.2	ranging from 337 to 363
	2.1 to 3.1		2.1,2.2,3.1	145,145,197	2.1,2.2,3.1	362,152,444
Basket Making	4.1	145	4.1,12.1	145	4.1,12.1	447,1,092
(Unit: 2 baskets)	5 to 11.1		5 to 11.1	ranging from 145 to 639	5 to 11.1	ranging from 145-634
	12.1					

Note: W = wet season; D = dry season; B = buffalo-cultivated; T = tractor-cultivated.

Among the excluded cottage industries for every farm size, cotton weaving shows the strongest competitive position compared to the excluded mat making in the dry season. This suggests that mat making is less economically desirable than cotton weaving for the irrigated farms during the dry season under the given price and production technology. Thus, mat making is never included in the optimal plan for the irrigated farms.

If compared with the shadow prices of excluded basket making--the only available family industry, performed by men, across the farm size class--the shadow prices of excluded mat making for medium and large farms are larger than those for the small farms in many periods. This suggests that the excluded basket making is likely to be preferred by the small farm over medium and large farms if the excluded basket making were forced in the optimal solution by some means. The income penalties of forcing one unit of basket making for medium and large farm households is higher than for small farm households.

Table 6.6 shows the upper bound stability coefficients or the highest value of the gross margin (per unit of production) of the excluded nonfarm enterprises for which there was no change in the optimal plan. Comparing the upper bound stability coefficients of the excluded cotton weaving with its present gross margin of 575 baht per 16 pieces of cotton fabric (Appendix Table 18) it may need to raise the gross margin from 1.9 to 6.3 percent of the current gross margin to bring excluded cotton weaving in certain periods into the optimal solution for every farm size class. For basket making, the gross margin of basket making needs to be increased at least 659 percent of its current gross margin (22 baht per 2 baskets, Appendix Table 19) to make excluded basket making become a viable alternative for the small irrigated farm households,

Table 6.6

Upper Bound Stability Coefficients of Excluded
Nonfarm Enterprises, Irrigated Farm Households

	The Highest Value of Gross Margin of Excluded Nonfarm Enterprises								
	Cotton Weaving (฿/16 Pieces)			Basket Making (฿/2 Baskets)			Mat Making (฿/60 Mats)		
Period	S	M	L	S	M	L	S	M	L
1	--	--	--	--	--	--	--	--	--
2.1	--	--	--	167	167	212	--	--	--
2.2	--	--	--	167	167	174	584	584	584
3.1	--	--	--	167	219	443	--	--	--
3.2	--	--	--	--	--	--	584	609	609
4.1	--	--	--	167	167	453	--	--	--
4.2	--	--	--	--	--	--	584	584	609
5	--	--	--	167	167	167	584	584	584
6	--	--	--	167	167	167	584	584	584
7	--	--	--	167	167	249	584	584	584
8	--	--	--	168	249	174	584	609	609
9	586	586	586	167	167	167	584	584	584
10.1	586	586	586	167	181	174	584	584	584
10.2	586	586	611	167	167	167	573	573	573
11.1	--	--	--	167	174	174	573	573	573
11.2	586	611	611	--	--	--	584	584	609
12.1	--	--	--	167	174	174	584	609	609
12.2	--	--	611	--	--	--	573	573	609

Note: S = small farm size; M = medium farm size; L = large farm size.

while it needs to be increased substantially; in the range of 659 to 1,959 percent from its present gross margin to make basket making in certain periods to be profitable alternatives for medium and large irrigated farm households.

In the case of excluded mat making, it may need to raise the gross margin from 132 to 147 percent of its present gross margin of 247 baht per 60 mats (Appendix Table 6) to bring excluded mat making in certain periods into the optimal solution for every farm size class in the irrigated area.

6.2 Optimal Labor Utilization Pattern

The optimal labor utilization pattern for each farm size class of the irrigated farms suggested by the programming solutions is summarized and presented in Tables 6.7 to 6.9. It should be mentioned here that the figures in terms of the percentage of family labor use for crop, nonfarm enterprise and off-farm employment may not add up to 100 in some periods due to some unused labor hours.

For the small farm, male labor is fully utilized by allocating 23 percent of the available labor to crop production, 19 percent to nonfarm enterprise (mat and basket making) and 58 percent to off-farm employment. Females spent about 11 percent of their available labor for crop production, 20 percent for mat making and cotton weaving and 54 percent for off-farm employment, leaving about 15 percent of labor unemployed (Table 6.7). These slack labor periods for females occur in periods 1 (May), 2.1 (first half of June), 3.1 (first half of July) and 4.1 (first half of August) because no children are available to help females in weaving mats in these periods. Although only 19 percent of available child

Table 6.7

Optimal Pattern of Labor Utilization of Small Irrigated Farms

	Family Labor Available (Hrs.)			Percent of Available Family Labor Used For							Percent Utilization	
				Crop		Nonfarm			Off-Farm			
Period	M	F	C	M	F	M	F	C	M	F	M	F
1	270	202	30	43.5	60.5	56.6	28.3	100.0	--	--	100	88.8
2.1	164	124	35	11.0	--	--	53.6	100.0	89.0	--	100	53.6
2.2	164	124	35	--	--	--	--	--	100.0	100.0	100	100.0
3.1	186	152	17	84.9	7.0	--	21.3	100.0	15.1	--	100	28.3
3.2	186	152	17	34.4	67.1	65.6	--	--	--	32.9	100	100.0
4.1	179	154	40	11.1	--	--	49.3	100.0	88.9	--	100	49.3
4.2	179	154	40	7.8	--	92.2	--	--	--	100.0	100	100.0
5	282	201	41	5.0	--	--	--	--	95.0	100.0	100	100.0
6	312	200	44	4.8	0.5	--	--	--	95.2	99.5	100	100.0
7	302	292	30	34.1	39.0	--	--	--	65.9	61.0	100	100.0
8	314	271	80	9.6	11.4	--	--	--	90.4	88.6	100	100.0
9	276	207	44	1.4	1.4	--	--	--	98.6	98.6	100	100.0
10.1	135	108	18	13.3	--	--	--	--	86.7	100.0	100	100.0
10.2	135	108	18	--	--	--	--	--	100.0	100.0	100	100.0
11.1	181	131	21	89.5	14.3	--	85.7	--	10.5	--	100	100.0
11.2	181	131	21	35.6	78.6	64.4	--	--	--	21.4	100	100.0
12.1	161	109	58	49.1	--	--	100.0	--	50.9	--	100	100.0
Total Hours	3,768	2,829	647	868.0	315.0	730.0	574.0	122.0	2,170.0	1,594.0	5,768	2,483.0
Percent[a]	100	100	100	23.0	10.8	19.4	19.6	18.9	57.6	54.4	100	84.8

Note: M = males; F = females; C = children.

[a]Percent of total labor hours available, respectively.

Table 6.8

Optimal Pattern of Labor Utilization of Medium Irrigated Farms

	Family Labor Available (Hrs.)			Percent of Available Family Labor Used For							Hired Labor (Hrs.)	
				Crop		Nonfarm			Off-Farm			
Period	M	F	C	M	F	M	F	C	M	F	M	F
1	260	240	85	95.3	84.9	4.7	15.1	22.5	--	--	--	--
2.1	145	120	35	22.8	2.0	--	55.4	100.0	77.2	--	--	--
2.2	145	120	35	51.0	64.2	--	--	--	49.0	35.8	--	--
3.1	150	143	45	100.0	26.6	--	60.0	100.0	--	--	103	--
3.2	150	143	45	57.4	100.0	42.6	--	--	--	--	--	--
4.1	152	140	56	100.0	--	--	76.0	100.0	--	--	120	--
4.2	152	140	56	52.4	100.0	47.6	--	--	--	--	--	14
5	260	214	70	0.5	--	--	--	--	75.8	99.5	--	--
6	265	212	69	20.4	0.9	--	--	--	79.6	99.1	--	--
7	295	290	84	47.7	42.8	--	--	--	52.2	57.2	--	--
8	310	285	116	94.8	100.0	--	--	--	5.2	--	--	4
9	250	207	59	5.6	5.3	--	--	--	94.4	94.7	--	--
10.1	105	120	40	26.7	--	--	--	--	73.3	100.0	--	--
10.2	105	120	40	--	--	--	--	--	100.0	100.0	--	--
11.1	134	113	35	100.0	26.6	--	73.4	--	--	--	135	--
11.2	134	113	35	75.1	100.0	24.9	--	--	--	--	--	51
12.1	126	125	72	100.0	36.6	--	66.4	--	--	--	102	--
12.2	126	125	72	31.7	52.2	68.3	47.8	--	--	--	--	--
Total Hours	3,264	2,970	1,049	1,832.0	1,246.0	262.0	551.0	155.0	1,179.0	1,068.0	460	69
Percent[a]	100.0	100.0	100.0	55.9	42.0	8.0	18.6	14.8	36.1	36.0	14.1	2.3

Note: M = males; F = females; C = children.

[a]Percent of total hours available, respectively.

Table 6.9

Optimal Pattern of Labor Utilization of Large Irrigated Farms

Period	Family Labor Available (Hrs.)			Percent of Available Family Labor Used For: Crop		Nonfarm			Off-Farm		Hired Labor (Hrs.)	
	M	F	C	M	F	M	F	C	M	F	M	F
1	280	208	35	100.0	77.2	--	22.8	71.4	--	--	--	--
2.1	140	107	21	100.0	20.3	--	37.3	100.0	--	--	240	--
2.2	140	107	21	100.0	100.0	--	--	--	--	--	105	240
3.1	146	125	19	100.0	15.4	--	28.8	100.0	--	--	240	--
3.2	146	125	19	79.1	100.0	20.9	--	--	--	--	--	70
4.1	153	136	46	100.0	--	--	64.2	100.0	--	--	240	--
4.2	153	136	46	72.8	100.0	27.2	--	--	--	--	--	72
5	253	203	48	47.1	--	--	--	--	52.9	100.0	--	--
6	263	210	52	40.7	--	--	--	--	59.3	100.0	--	--
7	265	250	34	82.3	63.2	--	--	--	17.7	36.8	--	--
8	316	299	91	100.0	100.0	--	--	--	--	--	360	358
9	247	198	51	8.9	6.6	--	--	--	91.1	93.4	--	--
10.1	100	103	21	100.0	20.4	--	--	--	--	79.6	82	--
10.2	100	105	21	39.0	62.1	--	--	--	61.0	37.9	--	--
11.1	105	97	25	100.0	36.6	--	63.4	--	--	--	189	--
11.2	105	97	25	78.9	100.0	21.1	--	--	--	--	--	38
12.1	104	109	61	100.0	86.6	--	13.4	--	--	--	240	--
12.2	104	109	61	62.6	100.0	37.4	--	--	--	--	--	--
Total Hours	3,120	2,722	697	2,367.0	1,490.0	130.0	287.0	111.0	623.0	811.0	1,646	788
Percent[a]	100.0	100.0	100.0	75.9	54.7	4.2	10.5	15.9	19.9	29.8	52.8	28.9

Note: M = males; F = females; C = children.

[a]Percent of total hours available, respectively.

labor are utilized under the optimal plan, children have shown their important contribution for mat making in periods 2.1, 3.1 and 4.1.

For the medium farm, the optimal plan indicates that all men are fully employed by sharing 56, 8 and 36 percent of their available labor to crop production (rice, tobacco and corn), cottage industry (basket making) and off-farm employment, respectively (Table 6.8). Females are nearly fully employed under this plan as only 105 hours or less than 4 percent of their available labor being unused. Again, this slack is due to a shortage of children's time to participate in mat making in periods 2.1, 3.1 and 4.1. Females are computed to allocate 42 percent of their available labor for crop production, 19 and 36 percent for family industries (cotton weaving and mat making) and off-farm employment, respectively. Children's contribution to mat making appears in periods 2.1, 3.1 and 4.1 during the wet season when all of their labor is fully used. Under this optimal plan, the medium farm households may need to hire in 460 hours of male labor (or 14 percent of their available male labor) and 69 hours of female labor (or 2 percent of their available female labor) for rice production activities.

In the case of large irrigated farms, the programming results recomment to allocate more than half of female and male family labor to rice, and tobacco production. To follow this plan, all males are fully employed by allocating 76, 7 and 17 percent of their labor to crop production, family industry and off-farm employment, respectively. Only 5 percent of the labor of females is unused because 55 percent of female labor is devoted to crop production and 10 and 30 percent are also allocated to cottage industry and off-farm work, respectively (Table 6.9). Again, children in the large farm household labor force participate significantly in mat making activities during periods 2.1, 3.1 and 4.1 when all of their available labor are used up in these periods. The optimal plan for the large farm also suggests that a substantial number of hours of labor should be hired in for rice production activities. Table 6.8 indicates that about 1,646 hours of male labor (or 52.8 percent of available male family labor) and 778 hours of female labor (or 29 percent of available female family labor) are hired in by the large farm households.

These conclusions are summarized from the above optimal utilization pattern for each farm size:

(1) When the operational size of irrigated farms become larger, the share of adult labor proportional to their available labor for crop production increases substantially. The need to supplement farming enterprise with nonfarm/off-farm employment diminishes.

(2) Conversely, the portion of family labor allocated to either cottage industries or off-farm employment decreases when the farm size increases. For small farms, the family industries as well as off-farm employment become an even more important source for providing income and employment to the family members.

(3) Hire-in labor becomes increasingly important for the large farm households if they are to fully utilize their farmland. This may imply that the local employment for farm households, especially the ones who have relatively large labor forces, can be generated through the rice production sector in particular to irrigated areas where intensive rice production is permitted at least twice a year.

(4) Children are important for the family industry of mat making in many periods during the wet season, as all of their labor is used up and becomes the most limiting resource in these certain periods.

(5) It is economically possible for the farm households even in the intensive agriculture area to combine some viable alternative of cottage industries and part-time off-farm employment, e.g., local agricultural field work and construction with the farming business.

6.3 Shadow Prices of Land and Labor

The shadow prices of the land and family labor obtained from the linear programming model are discussed in this section.

As available land in wet and dry seasons for each farm size are fully utilized, its shadow price can be obtained from the programming results. Paddy land appears to be one of the most limiting resources in both wet and dry seasons for every farm size of the irrigated farms, especially for the small farm as it has relatively high shadow prices of land compared to medium and large farms. For the small farm, the shadow price of wet season land and dry season land is 889 baht and 332 baht per rai, respectively. The shadow price of land is about 536 and 297 baht per rai in wet and dry seasons for the medium farm, while the large farm has a shadow price of wet season land of 195 baht per rai and 125 baht per rai for the dry season land. The relatively high shadow price of cropland for the small farm household compared to the ones for medium and large sized farm households may imply that the expansion of farm size (farmland) would be more beneficial for the small farm household than for the medium and large farm households.

Table 6.10 shows the shadow price of family labor by age and sex for each farm size. In the case of small farms, the shadow price of male labor ranges from 0.4 baht to 3.0 baht per hour, while ranging from 2.9 baht to 3 baht per hour for female labor. In comparison, on the basis of the shadow prices, both male and female labor for medium and large

Table 6.10

The Shadow Prices of Selected Resources of Irrigated Farms by Farm Size Class

Resource	Small Farm		Medium Farm		Large Farm	
	Period	Shadow Price (฿/Unit)	Period	Shadow Price (฿/Unit)	Period	Shadow Price (฿/Unit)
Male Labor	1,2.1,2.2	0.4,3.0,3.0	1,2.1,2.2	0.4,3.0,3.0	1,2.1,2.2	0.4,6.9,3.1
	3.1,3.2,4.1	3.0,0.4,3.0	3.1,3.2,4.1	3.1,0.4,3.1	3.1,3.2,4.1	8.4,0.4,8.9
	4.2, 5, 6	0.4,3.0,3.0	4.2, 5, 6	0.4,3.0,3.0	4.2, 5, 6	0.4,3.0,3.0
	7-12.2	3.0	7, 8,9	3.0,4.5,3.0	7, 8,9	4.5,11.8,3.0
			10.1,10.2,11.1	3.3,3.0,3.1	10.1,10.2,11.1	3.1,3.0,3.1
			11.2,12.1,12.2	0.4,6.7,0.4	11.2,12.1,12.2	0.4,20.1,0.4
Female Labor	2.2,3.2,4.2	3.0	1,2.2,3.2	1.3,3.0,3.0	1,2.2,3.2	1.3,3.9,3.1
	5-10.2	3.0	4.2, 5, 6	3.1,3.0,3.0	4.2, 5, 6	3.1,3.0,3.0
	11.1,11.2	2.9,3.0	7, 8, 9	3.0,3.1,3.0	7, 8, 9	3.0,3.1,3.0
	12.1,12.2	2.9	10.1,10.2,11.1	3.0,3.0,2.9	10.1,10.2,11.1	3.0,3.0,2.9
			11.1,12.1,12.2	3.1,2.9,2.9	11.1,12.1,12.2	3.1,2.9,3.1
Child Labor	1,2.1	3.0	2.1	2.4	2.1	2.4
	5-10.2	3.0	3.1,4.1	2.4	3.1,4.1	2.4
	11.1,11.2	2.9,3.0				
	12.1,12.2	2.9				

farms are more often limiting resources compared to the small farm, especially during the peak periods of rice production activities such as period 8 (harvesting wet season rice) and period 12.1 (planting dry season rice). For the labor of children, all available time is exhausted in periods 2.1, 3.1, 4.1 with a shadow price of 2.4 baht per hour being revealed for every farm size. This shadow price gives insight into the economic value of children's labor, an area on which little research has been done.

6.4 Comparison of Actual and Model Results

The main focus of this study is on the income and employment of the rural farm households. Thus, two key variables of household income earned by source and labor allocation to farm, nonfarm enterprise and off-farm are chosen for the comparison of actual and programming results. The actual results for household income and labor utilization are obtained from the project Phase II survey on the average basis of baht per sample household for income variables.

The comparison of both results by farm size class are summarized and presented in Table 6.11. It should be kept in mind that the reported farm income includes the objective function value from the model plus other farm income from selling vegetable, fruit and poultry, activities which were deliberately excluded from the model specification.

For the small irrigated farm, both model and actual results show a relatively large portion of family net income coming from farm and off-farm employment. But, the model indicates a substantially higher portion of family net income from cottage industries and a slightly higher portion of family income from off-farm employment than the actual results. The model results suggest that the small farm household should allocate

Table 6.11

Comparison of Actual and Model Results of Irrigated Farms

Item		Small Farm		Medium Farm		Large Farm	
		Actual	Model	Actual	Model	Actual	Model
Net Income (Baht):							
Farm		9,535 (54.7)	9,375 (40.9)	18,941 (75.6)	21,575 (71.6)	25,047 (84.2)	33,937 (86.4)
Nonfarm		68 (0.4)	1,591 (6.9)	56 (0.2)	1,231 (4.1)	313 (1.0)	542 (1.4)
Off-Farm		7,842 (44.9)	11,949 (52.2)	6,041 (24.1)	7,311 (24.3)	4,398 (14.8)	4,791 (12.2)
Total Income		17,445 (100.0)	22,915 (100.0)	25,038 (100.0)	30,117 (100.0)	29,758 (100.0)	39,270 (100.0)
Labor Utilization (Hour):							
Farm	Male	1,543 (53.4)	1,918 (39.8)	1,805 (74.0)	2,680 (65.0)	2,168 (87.6)	3,204 (81.0)
	Female	1,540 (59.6)	1,906 (46.8)	1,590 (59.5)	2,350 (59.2)	1,714 (64.4)	2,579 (70.1)
	Child	466 (83.6)	380 (75.7)	723 (85.0)	874 (84.9)	541 (89.4)	696 (86.3)
Non-farm	Male	95 (3.3)	730 (15.2)	244 (10.0)	262 (6.4)	160 (6.5)	130 (3.3)
	Female	151 (5.8)	574 (14.1)	405 (15.2)	551 (13.9)	537 (20.2)	287 (7.8)
	Child	91 (16.4)	122 (24.3)	128 (15.0)	155 (15.1)	64 (10.6)	111 (13.7)
Off-Farm	Male	1,253 (43.3)	2,170 (47.0)	390 (16.0)	1,170 (28.6)	147 (5.9)	623 (15.7)
	Female	891 (34.5)	1,594 (39.1)	676 (25.3)	1,068 (26.9)	410 (15.4)	811 (22.1)
Total Labor Use	Male	2,981 (100.0)	4,818 (100.0)	2,439 (100.0)	4,142 (100.0)	2,475 (100.0)	3,957 (100.0)
	Female	2,582 (100.0)	4,074 (100.0)	2,657 (100.0)	3,969 (100.0)	2,661 (100.0)	3,677 (100.0)
	Child	557 (100.0)	502 (100.0)	851 (100.0)	1,029 (100.0)	605 (100.0)	807 (100.0)

Note: Figures in parentheses are a percentage.

proportionately more family labor to cottage industries and off-farm employment than the actual situation.

Both actual and programming results for medium farms show the largest share of family net income being provided by farm enterprises while the income from off-farm employment proportional to family income is second only to the farm income. These model results are consistent in general with the actual results in that the farm households devote a large portion of family labor to farm enterprises, but also allocate some of the family labor to cottage industries and off-farm employment for supplemental income earnings.

The labor utilization pattern which appears in the programming solutions are similar to actual results on the basis of the rankings according to family labor use. Next to the farm enterprises, off-farm employment provided the largest share of family labor use. But, the programming results suggest a lower proportion of male family labor being spent on cottage industires and a higher proportion in off-farm employment. This means that the actual medium-sized farmer should allocate more male labor from basket making to off-farm work in agricultural field work and construction or manufacturing as basket making contributes relatively less to family income.

For the large farms, likewise, the model provided results expressed as proportional composition of income which were similar to the actual farm results having farm income as the largest portion of family income. In addition, the model results also suggest that to the extent possible, the sample farm household should shift more male and female labor from cottage industries to off-farm work during the periods which off-farm employment opportunities are available.

In general, the model results seem to be able to reflect the way that the actual farm households behave in earning family income from different sources and in the way family labor and other resources are allocated to farm, cottage industries and off-farm employment. The model results also show some possible alternatives for households on irrigated farms to improve their family income and employment by some reallocation of labor to farm, cottage industries and off-farm employment.

These comparisons have been cognizant of the difficulties for making comparisons explained in Chapter 5. For this reason, the conclusions have been expressed in rather general terms.

CHAPTER 7

SIMULATION ANALYSIS: EFFECT OF CHANGES IN ALTERNATIVE FARM, NONFARM ENTERPRISES AND OFF-FARM EMPLOYMENT ON HOUSEHOLD INCOME AND EMPLOYMENT

The optimum organizations for rainfed and irrigated farm households with size differences were discussed and presented in Chapters 5 and 6 in order to assess the economic consequences from combining farm, nonfarm enterprises and off-farm employment under the given constraint sets and conditions facing the sample households. Further analysis will be pursued in this chapter by simulating situations which vary from the base model presented in the previous chapters in order to trace out the effect of alternative nonfarm enterprises and off-farm work opportunities, including alternative crop enterprises during the dry season (i.e., for irrigated farms) on household income and employment in the rainfed and irrigated areas.

Since the base models evaluated the farm size as a dependent variable, this analysis will consider only the medium sized irrigated farms. By definition, this farm size class represents 50 percent of sample farms in both rainfed and irrigated areas.

The several assumed situations to be examined for medium farm size in both areas are as follows:

(1) Change assumptions regarding off-farm employment opportunities and wages.

(a) Assume no off-farm employment opportunities.

(b) Assume off-farm employment opportunities are expanded throughout the dry season periods.

(c) Assume wages are increased by 10 and 30 percent above those used in the base model.

(2) Change assumptions regarding some nonfarm enterprise alternatives to permit year-round availability of sericulture in the rainfed area and year-round cotton weaving in the irrigated area.

(3) Variation in the main crop yield (rice) due to the uncertainty condition faced in the rainfed area.

(4) Fully irrigated situation with one new alternative cash crop of tomato in dry season for the irrigated farms.

7.1 Simulation Analysis for the Rainfed Farms

7.1.1 Situation I: Eliminate Off-Farm Employment Opportunities

Even the assumed off-farm employment opportunities are relative more profitable than many nonfarm enterprises found in the villages, but in reality, the opportunity to work off-farm especially in construction or manufacturing may be limited for many farm household members because of the employers' skill education or physical requirements. The extreme situation without off-farm employment opportunities is examined to see how farm and nonfarm enterprises interact under this circumstance with all other assumptions held fixed.

It can be seen clearly from Table 7.1 that without off-farm employment opportunities, the rainfed farm households' family net income for saving (or investment) decreases by 46.4 percent from the base model. The absence of off-farm employment opportunities has no effect on the composition of crop mix because all available land was fully utilized

Table 7.1

Results of a Change in Off-Farm Employment Opportunities for the Rainfed Farms

	Base Model	No Off-Farm Situation I	%	More Off-Farm Situation II	%
Net Income Source: (baht)					
Farm	9,140	9,140	-	9,140	-
Nonfarm	3,893	7,698	+ 97.7	2,940	-24.5
Off-Farm	7,453	-	*	10,084	+35.3
Total	20,486	16,838	- 17.8	22,164	+ 8.2
Net for Saving[1]	7,866	4,218	- 46.4	9,544	+21.3
Labor Use: (hour)					
Farm					
Male	2,042	2,042	-	2,042	-
Female	1,118	1,118	-	1,118	-
Nonfarm					
Male	328	1,145	+249.1	172	-47.6
Female	1,271	2,383	+ 87.5	952	-25.1
Child	260	482	+ 85.4	228	-12.3
Off-Farm					
Male	1,158	-	*	1,643	+47.6
Female	1,112	-	*	1,431	+28.7
Hired Labor					
Male	71	71	-	71	-
Female	-	-	-	-	-
Slack Labor					
Male	872	1,095	+ 31.7	424	-51.4
Female	-	-	-	-	-
Child	362	143	- 60.5	396	+ 9.4
Borrowed Capital (baht)	2,603	2,645	+ 1.6	2,603	-

Note: % = percentage change from the base model.

[1]Excluding the value of family consumption and initial cash on hand.

for the rainy season in the base models. It would force the family members to be more fully employed in cottage industry activities to compensate for the lost income from off-farm employment.

The amount of silk fabric and sticky rice containers produced was increased by 33 and 275 percent respectively from the base model, while the production of silk yarn (from sericulture) remain unchanged as all of child labor was already exhausted in the periods that sericulture is practiced. Mat making is less competitive than the other cottage industries and it still does not appear in the new optimal solutions. Under this assumed situation without off-farm employment opportunities, the rainfed farm households would allocate more male, female and child labor to sticky rice container making and more females to silk weaving. Despite the lack of off-farm employment opportunities the available hours of females are still fully employed and children employment increases by 6.1 percent from the base model, because the time of females can be employed by the silk weaving industry and sticky rice container making whereas childrens labor can be employed by sticky rice container making. However, the male employment situation is worse under this assumed situation because the slack of male labor (unemployment) increases by 25 percent from the base model. In addition, the absence of off-farm employment opportunities causes the rainfed farmers to borrow little more capital (cash) from BAAC (only 2 percent) than the base model due to the ability of rainfed farm households to earn additional income from cottage industry.

In short, the above results demonstrate that if the rainfed farm households were to lose all off-farm employment opportunities, their family net income for saving drops substantially, to an extent which cannot be compensated through more family labor involvement in cottage industry like silk weaving and sticky rice container making. It was observed that, employment for men was reduced without the off-farm employment opportunities because men are assumed not to avail themselves for employment opportunities in cottage industry due to the nature of this endeavor as found in the rainfed area.

7.1.2 Situation II: More Off-Farm Employment Opportunities

During recent years the Thai government has funded and implemented a program offering rural employment in the dry season (January to April) with a wage averaging nearly the same as that assumed for construction and manufacturing in the base model. In addition, some new agricultural processing industries such as a paper pulp mill has been promoted and established in Khon Kaen near the study area. This paper pulp mill plans to operate at least from September to the end of the dry season (April) and expects to offer a wage equal to other agricultural processing industries. Thus, it is reasonable and interesting to project the consequence of the government funded program as well as the pulp mill on the rainfed farm household income and employment by allowing the rainfed farm households to have more opportunities to hire out their family labor in manufacturing or government funded program than in the base model for two additional periods of March and April. For the lower-wage off-farm employment in agricultural field work, the rainfed farm households are also allowed to hire out their family to the irrigated rice farmers during the dry season. To be precise, the rainfed families are provided more opportunities to hire out their labor to rice farmers in March (period 11) and April (period 12) in addition to the ones assumed in the base model. The consequence of this assumed situation on household income and employment are presented in Table 7.1. Under this assumed situation, the family net income for saving increased by 21 percent from the base model. These additional off-farm employment opportunities leave the crop mix unchanged compared to the base model. The result is a reduction in the use of family labor for cottage industry (silk weaving and sticky rice container making) during the March-April period when off-farm employment would increase. The share of male and female labor to off-farm farm employment increase by 48 and 29 percent from the base model respectively. From an employment viewpoint, men are better off under this assumed situation because their slack labor (unemployment) decreased by almost half from the base model, while unused labor of children increased by 9 percent from the base model. Again, females are still fully employed in this situation.

One can conclude from this result that any kind of government funded program as well as manufacturing offering wages of 35 baht per day (or 4.48 baht per hour) for males and 30 baht per day (or 3.75 baht per hour) for females is sufficient to generate substantial local employment, especially for men during the dry season in the rainfed area. This supports the researcher's observation that many rural households in the rainfed areas of the northeast region are very responsive to the current government funded program offering rural employment in the dry season. However, this kind of program aiming for an improvement in rural employment may result in a reduction in the output for products like silk fabric and sticky rice containers in the rainfed area of the Northeast.

7.1.3 Situation III: Variation in Wage

A change in the assumption regarding wages used in the base model for rainfed farms is examined under this section. According to personal interviews with some owners of agricultural processing factory in Khon Kaen and the rainfed farmers who hired in labor, the wage paid to the workers has tended to increase every year due to a rapid rise in the cost of living (or inflation). In addition, a change in minimum wage law imposed by the government caused many manufacturing owners to pay higher wage to the workers. Thus, an assumed situation with an arbitrary increase in wages by 10 and 30 percent from those used in the base model is an experiment to project its consequences on household income and employment of the rainfed farms.

When wages increase by 10 and 30 percent from the base model, family net income for saving increases 26 and 52 percent of the base model respectively (Table 7.2). Despite the assumed wage increases by 30 percent from the base model, the cropping pattern for the rainfed farmers remains unchanged from the base model. But an increased wage causes a production of silk yarn (sericulture) in July and November to become relatively less profitable for both the plus 10 percent and plus 30 percent levels compared with the off-farm employment for the rainfed farm household in these periods. Consequently, the farm households switch their family labor from sericulture to off-farm employment (in agricultural field work) in July and November. This can be seen through the new allocation of family labor in which women hire out more hours of their labor to off-farm employment by 9.4 percent from the base model (Table 7.2). The production of silk yarn thus reduced by 45 percent from the base model. Under this assumed situation, male

Table 7.2

Results of Variation in
Wages for the Rainfed Farms

	Base Model	Wage Rage Up 10%		Wage Rate Up 20%	
		Situation III	%	Situation III	%
Net Income Source: (baht)					
Farm	9,140	9,140	-	9,140	-
Nonfarm	3,893	3,366	-13.5	3,598	- 7.6
Off-Farm	7,453	9,988	+34.0	11,808	+34.0
Total	20,486	22,494	+ 9.8	24,546	+19.8
Net for Saving[1]	7,866	9,874	+25.5	11,926	+51.6
Labor Use: (baht)					
Farm					
Male	2,042	2,042	-	2,042	-
Female	1,118	1,118	-	1,118	-
Nonfarm					
Male	328	240	-26.8	240	-26.8
Female	1,271	1,166	- 8.3	1,166	- 8.3
Child	260	183	-29.6	183	-29.6
Off-Farm					
Male	1,158	1,158	-	1,158	-
Female	1,112	1,217	+ 9.4	1,217	+ 9.4
Hired Labor					
Male	71	71	-	71	-
Female	-	-	-	-	-
Slack Labor					
Male	872	842	- 3.0	842	- 3.0
Female	-	-	-	-	-
Borrowed Capital (baht)	2,603	2,407	- 7.5	2,407	- 7.5

Note: % = percentage change from the base model.

[1]Exclude the value of family consumption and initial cash on hand.

employment has benefited indirectly from the wage-increase situation as it increased (i.e., slack male labor decrease) by 3 percent from the base model. More male labor would be employed in sticky rice container making activities in August while some female labor in this month have given up the practice of sericulture (in July to August) in favor of a higher wages in the off-farm employment opportunity.

However, even though the rainfed farm households seem to have a higher net income under the assumed situation with increased wage, any policy attempting to raise wages for rural workers like a minimum wage law should take account possible adverse consequences on cottage industries like sericulture and the related industry of silk-weaving. The silk weaving industry may face a short run shortage of supply of silk yarn in this area which is the main raw material for this industry and, in turn, disturb the textile industries depending on a reliable supply of silk fabric.

7.1.4 Situation IV: Two Additional Production Periods for Sericulture

The base model allowed the rainfed farm to practice sericulture for only 4 times across the year due to a bind on the supply of mulberry leaf as mentioned earlier. But it is possible for the households to practice sericulture for maximum of 6 times across the year if they could produce enough mulberry leaf for feeding silk worms. This problem has been realized by the Royal Thai government and thus many programs and much research have been promoted and conducted to overcome the problem in the Northeast region because sericulture is one of the rural industries strongly supported by the government for improving rural household income in this region. For instance, several agricultural research efforts for finding a new high-yielding variety of mulberry tree have been conducted at local experiment stations under the Ministry of Agriculture and by Khon Kaen University. It would have high potential for the rainfed farm households to be able to fully practice sericulture for 6 times across the year. Some hope is being provided by the current government program on sericulture.

Thus, it is appropriate to examine the situation by providing over the base model two additional production periods for sericulture to be practiced in period 5 (September) and period 9 (January). Under this assumed situation, the two new alternatives of sericulture are included in the optimal solution. This result suggests that it is feasible for the rainfed farm households to practice sericulture for the maximum of 6 times across the year if the mulberry problem is resolved. Adding two sericulture production periods in the farm plan can generate nearly 2 percent more household net income for saving than the base model (Table 7.3). Most increased net income comes from the production and sale of 572 grams of silk yarn in period 5 (September) and 619 grams in period 9 (January). The optimum cropping pattern under the new situation remains unchanged from the base model. Two additional alternatives for sericulture entering in the new optimal solutions causes the farm household to switch more family labor (female) from off-farm employment in agricultural field work to sericulture (in periods 5 and 9). Consequently, the income from wages dropped by 6 percent from the base model (Table 7.3). This assumed situation may not help to increase female employment as all of their assumed labor available for productive activities were already fully employed. Neither female nor male employment changes from the base model. Since all of the assumed

Table 7.3

Results of a Change in Nonfarm Enterprises

	Base Model	More Sericulture Situation IV	More Sericulture %	Without Silk Weaving Situation V	Without Silk Weaving %
Net Income Source: (baht)					
Farm	9,140	9,140	-	9,140	-
Nonfarm	3,893	4,489	+15.3	3,057	-21.5
Off-Farm	7,453	7,000	- 6.1	7,453	-
Total	20,486	20,629	+ 0.7	19,650	- 4.1
Net for Saving[1]	7,866	8,009	+ 1.8	7,030	-10.6
Labor Use: (hour)					
Farm					
Male	2,042	2,042	-	2,042	-
Female	1,118	1,118	-	1,118	-
Nonfarm					
Male	328	328	-	594	+81.0
Female	1,271	1,422	+11.9	1,083	-14.8
Child	260	337	+29.6	236	+ 9.2
Off-Farm					
Male	1,158	1,158	-	1,158	-
Female	1,112	961	-13.6	1,112	-
Hired Labor					
Male	71	71	-	71	-
Female	-	-	-	-	-
Slack Labor					
Male	872	872	-	488	-44.0
Female	-	-	-	188	+188.0
Child	362	286	-21.0	337	+ 7.2
Borrowed Capital (baht)	2,603	2,603	-	3,324	+27.7

Note: % = percentage change from the base model.

[1]Excluding the value of family consumption and initial cash on hand.

female labor available for productive work was already used up in the base model and whereas males cannot take advantage from sericulture which is commonly practiced by women and children.

This assumed situation points out that there is room for additional cottage industries like sericulture to improve the household income in the rainfed area if production bottlenecks are removed.

7.1.5 Situation V: No Silk Weaving Enterprise

The previous analysis of the base model (in Chapter 5) revealed that silk weaving was a profitable cottage industry for rainfed farm households. However, in practice, there is a skill involved in the silk weaving enterprise required for grading silk thread, designing the pattern warping and finally weaving (Suphanchaimat, 1981). Taking into account this skill constraint, it is desirable to trace out the impact of a skills barrier on the silk weaving enterprise. The model therefore stimulates this extreme situation having no silk weaving enterprise for the rainfed farms. Under this assumed situation, the rainfed farm households would have a reduction in the family net income for saving by 11 percent from the base model (Table 7.3). Consequently, it causes the rainfed farmers to borrow operating capital from BAAC by 28 percent more than the base model. Moreover, female unemployment which never occurred in the previous base model results, becomes apparent because silk weaving can be performed by women alone. Without silk weaving, it is interesting that mat making enterprise which never appeared in the base model results, as discussed earlier, becomes an economically viable alternative enterprise for the rainfed farmers to perform in a certain period (e.g. June). The new optimal solutions shows no change in the optimal crop mix. The production of silk yarn remains unchanged. Whereas the production of sticky rice containers increases substantially from the base model. When the matter of family employment by age and sex is examined under this assumed situation without silk weaving enterprise, despite women employment being worse off, men and children employment increase by 44 and 7 percent from the base model results respectively.

1.7.6 Situation VI: Variation in Crop Yield

To enable the programming analysis in the study to go beyond the static point of view, some risk and uncertainty situations which are expected to be faced by the rainfed farmers are considered in this section. Variation in the crop yield has been experienced by many Thai rainfed farmers because of uncertain or erratic weather and climatic conditions e.g. severe rainstorm or drought. For instance, a severe rainstorm hit the northeast region in Thailand and caused flooding on some rainfed areas including the study area in Khon Kaen Province. It damaged rice in the lowland fields which in turn caused a drop in production of rice of the rainfed farmers.

The basic model assumed normal rice yields. For this experiment, the main crop yield (rice) was assumed to decrease by 10 and 20 percent from the normal level (250 kgs per rai) used in the base model, while other things were held constant. The projected consequences of crop yield variation in terms of household income and labor utilization can be seen in Table 7.4 Reduction in crop yield results in a drop in family net income for saving from the base model results as expected because of a substantial decrease in crop income. It was interesting

Table 7.4

Results for Crop Yield
Variation for the Rainfed Farms

	Base Model	Crop Yield Down 10%		Crop Yield Down 20%	
		Situa-tion	%	Situa-tion	%
Net Income Source: (baht)					
Farm	9,140	7,755	-15.1	6,376	-30.2
Nonfarm	3,893	3,893	-	3,893	-
Off-Farm	7,453	7,453	-	7,453	-
Total	20,486	19,101	- 7.3	17,722	-13.5
Net for Saving[1]	7,866	6,481	-17.6	5,102	-35.1
Labor Use: (hour)					
Farm					
Male	2,042	2,042	-	2,042	-
Female	1,118	1,118	-	1,118	-
Nonfarm					
Male	328	328	-	328	-
Female	1,271	1,271	-	1,271	-
Child	260	260	-	260	-
Off-Farm					
Male	1,158	1,158	-	1,158	-
Female	1,112	1,112	-	1,112	-
Hired Labor					
Male	71	71	-	71	-
Female	-	-	-	-	-
Slack Labor					
Male	872	872	-	872	-
Female	-	-	-	-	-
Child	362	362	-	362	-
Borrow Capital (baht)	2,603	2,550	- 2.0	2,550	- 2.0

Note: % = percentage change from the base model.

[1]Excluding the value of family consumption and initial cash on hand.

to observe that despite a drop in crop yield (rice) by 20 percent below the normal level, the optimal pattern of enterprise mix with crop (rice, tobacco, corn), cottage industry (sericulture, silk weaving and sticky rice container making) and off-farm employment remains unchanged from the base model results. This result demonstrates that it is possible for the rainfed farmers to achieve the feasible solution with some family net income for saving under the assumed uncertain situation with a crop yield from 10 to 20 percent below the normal level. In other words, the rainfed farmers can survive and stay in the farm business with some net income for saving even if their main crop yield were dropped by 20 percent from the normal level. This is because the supplemental income from cottage industry as well as from off-farm employment helps the rainfed farms to carry the losses resulting from a drop in the main crop yield. In addition, under this assumed situation the rainfed farmers are able to pay back the BAAC's short-term loan. Thus the BAAC's credit policy to the rainfed farmers may not be risky even under a situation causing a drop in few farmers' crop yield by 20 percent from the normal level. However, this and any further conclusions drawn from this result should keep in mind the other assumption contained in the model.

7.2 Simulation Analysis for the Irrigated Farms

7.2.1 Situation I: Without Off-Farm Employment Opportunities

If off-farm employment opportunities are withdrawn, the irrigated farm households would have their family net income for saving reduced by 33 percent from the base model results. Even with an increase in the income from nonfarm enterprises it does not compensate for the loss in income from the off-farm work (Table 7.5). This demonstrates the importance of off-farm employment to farm household income even in the intensive agriculture area. The absence of off-farm employment opportunities cause irrigated farmers to spread out their wet and dry season rice into 3 periods (periods 1, 2.1, 3.1 for wet season rice and periods 9, 10.1 and 11.1 for dry season rice) instead of 2 periods while the rest of crops grown (tobacco and glutinous corn) are still the same as in the base model. Under this assumed situation, the production of all 3 cottage industries (basket making, mat making, cotton weaving) substantially increase from the base model because the irrigated farmers would have to engage their family labor in the available cottage industry to compensate for the absence of off-farm employment opportunities. However, it was observed that despite the absence of off-farm employment opportunities both male and female employment in total do not change from the base model results as their labor can be used for cottage industry during the period without off-farm employment opportunities. Children employment is utilized more fully under this assumed situation as children are able to contribute more labor to the family industries like mat making.

7.2.2 Situation II: More Off-Farm Employment Opportunities

Like the rainfed farming situation, it was assumed that the irrigated farm households have more opportunities than the base model to hire out their family labor during the dry season (i.e. two additional periods of March and April). Under this assumed situation, the irrigated farm households are little better off because their family net income for saving slightly increases by 1.7 percent from the base model

Table 7.5

Results of a Change in Off-Farm Employment Opportunities for the Irrigated Farms

	Base Model	Without Off-Farm Situation I	%	More Off-Farm Situation II	%
Net Income Source: (baht)					
Farm	21,575	21,575	-	21,575	-
Nonfarm	1,231	3,763	+205.7	1,018	-17.3
Off-Farm	7,311	-	*	7,776	± 6.4
Total	30,117	25,338	- 15.9	30,369	+ 0.8
Net for Saving[1]	14,479	9,701	- 33.0	14,731	+ 1.7
Labor Use: (hour)					
Farm					
Male	2,680	2,680	-	2,680	-
Female	2,350	2,350	-	2,350	-
Nonfarm					
Male	262	1,441	+450.0	202	-22.9
Female	551	1,453	+163.7	317	-42.5
Child	155	412	+165.8	155	-
Off-Farm					
Male	1,179	-	*	1,239	+ 5.1
Female	1,068	-	*	1,122	+ 5.1
Hired Labor					
Male	460	350	- 23.9	460	-
Female	69	78	+ 13.0	69	-
Slack Labor					
Male	-	-	-	-	-
Female	105	105	-	105	-
Child	892	635	- 28.8	892	-

Note: % = percentage from the basic model.

[1]Excluding the value of family consumption and initial cash on hand.

(Table 7.5). Increase in off-farm employment opportunities (in March and April) has no effect on the optimal cropping pattern, but it causes a drop in the production of cotton fabric and bamboo baskets since the households shift their family labor from cotton weaving and basket making activities to off-farm employment (in March and April). The production of cotton fabric decreases by 22 percent from the basic model whereas the production of basket reduces by 24 percent. Introducing more off-farm employment opportunities offering a wage of 3.75 baht per hour for females and of 4.38 baht per hour for male labor may cause the cottage industry found in the irrigated area to become less economically desirable for the irrigated farm households and thus, the production of the cottage industry would be expected to decrease substantially.

7.2.3 Situation III: Variation in Wages

Wages used in the basic model for the irrigated farms were assumed to be increased by 10 and 30 percent under this situation. When wages are increased by 10 percent, it is expected that the family net income for saving will improve by 5.1 percent from the base model (Table 7.6). Part of this increased income is obtained from additional off-farm work. A wage increase of 10 percent does not change the optimal pattern of enterprise mix for the irrigated farm households.

However, if wages are permitted to rise to a level of 30 percent above those assumed in the base model, it may cause the production of glutinous corn to become less profitable while the other crop enterprise of rice and tobacco would still be attractive for the irrigated farmers. The households thus switch their family labor from glutinous corn production activities to off-farm work (Table 7.6). According to a limit

Table 7.6

Results of Variation in
Wages for the Irrigated Farms

	Base Model	Wage Rate Up 10% Situation III	%	Wage Rate Up 30% Situation III	%
Net Income Source: (baht)					
Farm	21,575	21,575	-	21,525	- 0.2
Nonfarm	1,231	1,231	-	1,249	+ 1.5
Off-Farm	7,311	8,042	+ 9.9	9,504	+30.0
Total	30,117	30,848	+ 2.4	32,278	+ 7.2
Net for Saving[1]	14,479	15,210	+ 5.1	16,640	+14.9
Labor Use: (hour)					
Farm					
Male	2,680	2,680	-	2,661	- 0.7
Female	2,350	2,350	-	2,332	- 0.7
Nonfarm					
Male	262	262	-	274	+ 4.6
Female	551	551	-	560	+ 1.6
Child	155	155	-	159	+ 3.2
Off-Farm					
Male	1,179	1,179	-	1,186	+ 0.6
Female	1,068	1,068	-	1,109	+ 3.8
Hired Labor					
Male	460	460	-	457	- 0.6
Female	69	69	-	109	+57.9
Slack Labor					
Male	-	-	-	-	-
Female	105	105	-	114	+ 8.5
Child	892	892	-	888	- 0.4

Note: % = percentage change from the basic model.

[1]Excluding the value of family consumption and initial cash on hand.

of off-farm employment opportunities as pointed out earlier, an increase in wage (even by 30%) does not change the level of the household employment.

On the basis of the above results, it may be concluded that increased wage (even by 30% from the base model) may effect slightly the minor crop production activities like glutinous corn, but has no impact on the cottage industry performed by the irrigated farm households. This is because the main crop production of rice and tobacco are still highly profitable for the farmers compared to the off-farm work. In addition, most of the cottage industries are less competitive to both classes of off-farm employment as discussed earlier. Thus, an increase in off-farm employment wage is expected to cause no change in the production of products from the family industry. But the irrigated farm households who have excess labor force would be expected to take advantage of the situation with increased wage in off-farm employment, consequently obtaining more income from hiring out their labor to this off-farm work.

7.2.4 Situation IV: Year Round Availability of Alternative Non-Farm Enterprises

This assumed situation allows the family labor, especially females to have more opportunities to engage in some viable nonfarm enterprises like cotton weaving not only in the dry season as usual but also in the wet season. The new optimal solutions suggest that the cotton weaving should be operated in periods, 1 (May), 2.1 (first half of June), 3.1 (first half of July) and 4.1 (first half of August) for the wet season and periods, 11.1, 12.1 and 12.2 for the dry season. Under this situation, the new optimal solution indicates that it is possible for the irrigated farm households to increase their family net income for saving by 5.7 percent from two base model (Table 7.7) if cotton weaving could be promoted year round rather in the dry season only. Up to this point, one may question why the farm households usually weave cotton fabric in dry season only. Part of the explanation is the problem of a limit on local market demand for cotton fabric especially in the wet season. In other words, the demand for cotton fabric is seasonal and local as pointed out earlier. There is more demand for cotton fabric in dry season as many households have more spare time in that period to prepare mattress, pillow cases, blankets, etc. for the next winter season. All of these are made from cotton fabric. However, if there was a demand for cotton fabric during the wet season, family labor would respond dramatically to engage in cotton weaving activities during this period as well. Introducing cotton weaving activities during this period can improve female employment since cotton weaving can be operated by women alone. Women are more fully employed under this assumed situation. In fact, all of their available labor is fully employed (i.e. there is no women slack labor). Under this situation, mat making activities as well as the production of glutinous corn became less economically desirable for the irrigated farm households and they were replaced by cotton weaving activities. In short, marketing considerations aside, this result implies that cotton weaving may be a promising cottage industry for the irrigated farm households to improve their family income and women employment.

Table 7.7

Results of a Change in Nonfarm Enterprise and Fully Irrigated Situation

	Base Model	More Cotton Weaving Situation IV	More Cotton Weaving %	Fully Irrigated Situation V	Fully Irrigated %
Net Income Source: (baht)					
Farm	21,575	21,525	- 0.2	24,514	+ 13.6
Nonfarm	1,231	2,091	+69.9	636	- 48.3
Off-Farm	7,311	7,332	+ 0.3	6,228	- 14.8
Total	30,117	30,948	+ 2.8	31,378	+ 4.2
Net for Saving[1]	14,479	15,310	+ 5.7	15,740	+ 8.7
Labor Use: (hour)					
Farm					
Male	2,680	2,661	- 0.7	2,944	+ 9.6
Female	2,350	2,332	- 0.7	2,696	+ 14.7
Nonfarm					
Male	262	274	+ 4.6	177	- 32.4
Female	551	674	+22.3	377	- 31.6
Child	155	-	*	155	-
Off-Farm					
Male	1,179	1,186	+ 0.5	1,000	- 15.2
Female	1,068	1,068	-	886	- 17.0
Hired Labor					
Male	460	460	-	596	+ 29.6
Female	69	69	-	268	+228.4
Slack Labor					
Male	-	-	-	-	-
Female	105	-	-	115	+ 9.5
Child	892	1,047	+ 17.4	775	- 13.1

Note: % = percentage change from the basic model.

[1]Excluding the value of family consumption and initial cash on hand.

7.2.5 Situation V: Fully Irrigated Situation

The base model for irrigated farms discussed in Chapter 6 represented a partially irrigated situation which caused the farm households to leave some of their paddy land idle during the dry season. Thus, this situation assumes a fully irrigated situation that allows the farmers to fully utilize paddy land in the dry season. Moreover, tomatoes, a new dry season crop enterprise is proposed, with two alternative planting periods of January (period 9) and February (period 10). The budget for this enterprise is presented in Appendix Table 17. Based on the assumption, the new optimal solution is shown in Table 7.8. It indicates that the family new income for saving increases to 15,740 baht (or by 8.7 percent from the base model). Part of this increased income is generated from the new crop mix appearing in the solution. This optimal pattern of crop mix differs from the one entering in the base model. Under this assumed situation the new alternative cash crop of tomato and tractor-cultivated nonglutinous rice are included in the new optimal plan, whereas the production of glutinous corn is excluded. This situation allows the irrigated farmers to have a more intensive cropping system, but it may be necessary for the farmers to employ labor-saving technology for their commercial rice production i.e. renting two-wheel tractor. The fully irrigated situation causes the farm households to reallocate their labor by switching their family labor from the cottage industry to new intensive cropping activities as it can be seen in Table 7.6. Consequently, the production of cotton fabric and basket decreases by 79.4 and 32 percent respectively from the base model. However, to achieve this optimal intensive cropping system, the farm households have to hire more labor (both male and

Table 7.8

Optimal Farm Household Activities Pattern for the Irrigated Farms with Fully Irrigated Situation

Enterprise	M	J		J		A		S	O	N	D	J	F		M		A	
	1	2.1	2.2	3.1	3.2	4.1	4.2	5	6	7	8	9	10.1	10.2	11.1	11.2	12.1	12.2
Crops		←GR2(W,B):5.08 rai→																
		←NGR2(W,B):1.68 rai→																
				←NGR3(W,B):7.94 rai→														
									←TOB1:0.2 rai→									
	→												←TOM2:0.86 rai					
												←NGR1(D,B):0.86 rai→						
	→												←NGR2(D,B):5.01 rai					
	→														←NGR3(D,B):5.96 rai			
	→														←NGR3(D,T):2.19 rai			
Cotton Weaving (Piece)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
Basket Making (Basket)	-	-	3	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
Mat Making (Mat)	20	21	-	26	-	33	-	-	-	-	-	-	-	-	-	-	-	-
Hire-in Labor Male	-	-	42	92	-	129	-	-	-	-	-	-	-	-	93	-	240	-
Hire-in Labor Female	-	-	75	-	-	-	20	-	-	-	4	-	-	-	-	30	9	130
Non-Agr. Field Work[1] (hr) Male	-	-	-	-	-	-	-	60	60	60	15	60	30	30	-	-	-	-
Non-Agr. Field Work (hr) Female	-	-	-	-	-	-	-	36	36	36	-	36	18	18	-	-	-	-
Agr. Field Work[2] (hr) Male	-	121	-	-	-	-	-	136	151	94	-	147	-	35	-	-	-	-
Agr. Field Work (hr) Female	-	-	7	-	-	-	-	177	174	130	-	129	52	37	-	-	-	-

Note: W = Wet Season; D = Dry Season; B = Buffalo; T = Tractor; GR = Glutinous Rice; NGR = Nonglutinous Rice; TOB = Tobacco; TOM = Tomato

[1]Off-farm employment in construction and manufacturing.

[2]Off-Farm employment in agricultural field work.

females). The above results demonstrate that it is possible for the irrigated farmers to increase their family income through a more intensive farming system especially in the dry season if a year round supply of irrigation water could be provided.

CHAPTER 8

SUMMARY AND CONCLUSIONS

The primary objective of this study was to appraise alternative uses of family resources for farm and nonfarm enterprises and their impacts on production, employment and income of rural farm households in Khon Kaen Province. The study attempted to go beyond previous farm management studies in Thailand having focused only on organization and operation of farm activities while failing to provide detail on farm household nonfarm and off-farm activities and their relationship to farm activities. In addition to farming activities family industry and off-farm employment were studied for their contribution to family income and their share of total labor utilization. A farm level model was developed to assess the effect of cottage industry and off-farm employment on family resource use, farm organization and household income. The results of this study should contribute to a better understanding of rural farm households' employment behavior and provide some of the information currently needed by the RTG policy maker for better decision and action regarding rural employment policy.

The main objectives of this study are as follows:

(1) To examine the nature, extent and composition of farm, nonfarm and off-farm activities and their relationships in order to:

(a) Identify the kinds of and combinations of income generating activities in the rural study area.

(b) Compare rainfed with irrigated farms with regard to cropping patterns, off-farm employment and the nonfarm activities.

(c) Describe the seasonal profile of total hours worked each month by family members in alternative employment opportunities.

(d) Assess the relative importance of different farm, nonfarm enterprises and off-farm work with regard to labor absorption and income generation and to compare their relative farms of different sizes.

(2) To develop analytical models to represent the irrigated and rainfed farm household situations found in Khon Kaen villages. These models, then, were used to analyze the optimum allocation of the family labor and other household resources among farm and nonfarm enterprises, and off-farm work opportunities consistent with the constraints of initial farm and family resources, including family subsistence constraints.

(3) To use the model developed to evaluate the effect of alternative nonfarm enterprises and off-farm work opportunities, and wage change on enterprise combinations, employment and income earned.

(4) To evaluate the possible effect of alternative farm enterprises, especially during the dry season, on enterprise combinations, employment, resource use and income earned.

(5) To propose possible policies and programs to assist in improved household income and to stimulate employment of members of farm household in farm and nonfarm enterprise and off-farm work.

The first step taken to fulfill the study objectives was to describe in detail the household resource endowment and their constraints.

On the basis of the household descriptive analysis, a poly-period linear programming model was developed for representative farm households within different farm size groups (small, medium and large) of the rainfed and irrigated agriculture situation in Khon Kaen in order to specify optimal resource allocation for the farm household. The model contained the usual farm enterprises e.g., glutinous and nonglutinous, tobacco and corn, consistent with the major enterprises actually found in the study area. In addition, major nonfarm enterprises and off-farm work opportunities were included in detail to test the complementarity and competitiveness of farm, nonfarm enterprises and off-farm employment. The model specified an objective function to maximize net farm household income subject to land, labor, capital, subsistence needs and other constraints. The planning period for the model covered one year, beginning with the wet season and continuing for 12 months through the dry season up to the beginning of the next wet season. The results then demonstrated the optimum combination of farm, nonfarm enterprises and off-farm work to maximize annual family net income. Simulation analyses with some assumed situations varying from the initial model were performed to obtain insights into how government policies and programs might be used to increase rural household income and employment through a change in some alternative nonfarm enterprises and off-farm work opportunities, including alternative crop enterprises during the dry season.

8.1 Summary of the Descriptive Analysis

8.1.1 Land Use and Farm Size

The land area operated by individual farm household ranged from 5 rai to 52 rai with a mean of 19.88 rai in the sample rainfed villages, and ranged from 3.0 rai to 45.8 rai with a mean of 17.26 rai in the sample irrigated villages. According to the definition of farm size used in this study, for the rainfed farm households there were 10 small farms with a mean of 6.33 rai of land area, 19 medium farms with a mean of 17.77 rai, and 10 large farms with a mean of 37.46 rai. For the irrigated farm households, there were 10 small farms with a mean of 5.39 rai, 18 medium farms with a mean of 15.45 rai and 10 large farms with a mean of 32.36 rai. The level of tenancy was very low for rainfed and irrigated farms. Most of the rental agreements were with relatives and were commonly in kind in terms of a crop-share arrangement (about 40 percent of the harvested crop). Most of the land operated by rainfed and irrigated farmers was used for growing glutinous and nonglutinous rice.

Glutinous rice which is customarily the staple food for people in the Northeast was grown for family consumption but if there is excess it will be sold on the market. It is thus necessary for the households to grow enough rice for their family consumption for it is a disgrace to have to buy rice. Nonglutinous rice is consistently produced for commercial purposes. Small areas of vegetables were also grown, sometimes with supplemental water from swamps or shallow wells in the rainfed area. The orchard of the rainfed farm households was mostly for the growing of mulberry leaves to support their family industry of sericulture or silk worm rearing which is common in this area. For the irrigated farms where a double cropping of rice was normally found, some cash crop like tobacco and glutinous corn were also grown besides vegetables, but in a very small limited area due to their local limited market. It was observed that most of sample households of the rainfed farms use water buffalo to plow their paddy land whereas on irrigated farms the land preparation was performed by either water buffalo or a small machine tiller (two-wheel tractor) in both wet and dry seasons.

8.1.2 Family Composition and Labor Force

Within the rainfed farm households, the average size of household family member increased with the size of farm. The households on large farms had a larger family size (7.1 person per family) than for medium farm households (5.7 persons per family) and for small farm households (5.6 persons per family). But this relationship between the family size and the size of farm operated did not appear to hold for irrigated farm households all farm size groups were found to have about the same number of persons per family. The average number of persons per family was 5.5 for small farms, 5.2 for medium farms and 5.3 for large farm size. The size of the family labor force also varied among the farm size groups and between the rainfed and irrigated farm households. Family labor force was classified as adult male, adult female (14 to 65 years old) and children (7 to 13 years old). For the rainfed farms, on the average, about 4 persons or 71 percent were in the labor force for the small farms, whereas the households with medium sized farm and large-sized farm had 5.7 persons or 80 percent and 5.6 persons or 79 percent of their family members in the labor force, respectively.

In the case of irrigated farms, the small and medium farm households had about 4.9 persons or 89 percent of their family members in the labor force, which is slightly larger than the family labor force of the large farm households having 4.4 persons or 83 percent of the family members in the labor force. For every farm size class of the rainfed farm households, on the average, there were more adult males than adult females in the family labor force, but the amount of child labor varied little among the farm size classes. However, the irrigated farm households averaged more females than males in their labor force for every farm size class. No causal relationship was implied here.

8.1.3 Land-Labor Relationship

For the rainfed farm households, the ratio of land to labor force increased with farm size whether computed on the basis of number in the family labor force or on the basis of adults in the family. The land-labor ratio was 3.0, 4.5 and 7.9 rai per adult for the small, medium and large farm size, respectively. This suggests that the labor may be in excess supply on small farms and in short supply on the large farms as far as meeting crop labor requirements are concerned. Indeed, the indication of excess labor on small farms and labor shortage on large farms was even more pronounced on irrigated farms where the land per adult worker is 4.2, 4.1 and 8.8 rai for the small, medium and large farm, respectively.

8.1.4 Family Income Sources and Farm Size

In the case of rainfed farms, farm enterprises provided the primary source of family net income for the medium and large size farm, while the most important sources of family income for small farm size was off-farm work. Farm income sources accounted for 44, 42 and 27 percent of the total family net income for the large, medium and small farms, respectively. This demonstrated that the net farm income proportional to total net income was positively related to the operational size of farm. This would be explained in part by the fact that the major contributor to net farm income was rice production which was largely dependent on the amount of farmland. Thus, the household operating the larger farm was able to earn more income from farm enterprises than those operating smaller farms. Nonfarm enterprises (or cottage industry) generated a significant amount of net income for every farm size class in the rainfed area. The small and medium farm size were able to earn up to 21 percent of their total net income from cottage industry whereas the large farm households earned 19 percent of their total net income on the average. Off-farm work also made a significant contribution to the family net income for most of the rainfed farm households, especially the small farm size group. It provided 52 percent of the total family net income for the small farm household, while the medium and large farm households obtained 38 and 37 percent of their total family net income respectively from off-farm work. Again income obtained from off-farm work as well as farm income on the basis of a percentage of gross family income, seemed to show a close relationship to the farm size, but in the opposite manner. This was as one would expect because families on small tracts of land in the rainfed area, would find it difficult to utilize as much labor for farm production activities as was possible on the larger farms.

As expected the average family net income per household of the irrigated farm households was higher than the one of the rainfed farm households, since rice which was the major income earner can be grown twice a year in the irrigated area. Farm enterprise was the most important source of family net earning for all farm size classes of the irrigated farm. It provides 55, 76 and 84 percent of family net income for the small, medium and large farm households. Off-farm employment also played a significant role in generating income for farm families even in the irrigated area. It provided 45, 24 and 15 percent of total family net income for the small, medium and large farm households, respectively. Nonfarm enterprise provides some supplementary net income to families even on the irrigated farms, but in relative terms represented only 0.4, 0.2 and 1.4 percent of the total family net income for small, medium and large farm size, respectively.

8.1.5 Nonfarm Enterprises

There were four cottage industries of silk weaving, sericulture, sticky rice container and mat making found in the sample rainfed farm households, and 3 nonfarm enterprises of cotton weaving, basket and mat making in the sample irrigated farm households. In relative terms, silk weaving, sericulture and the making of rice containers were the dominant family industries for the rainfed farm households with more than a half of the total households engaged in them. Cotton weaving appeared to dominate the other two nonfarm enterprises, mat and basket making for the irrigated farms with 50 percent of the total households performing this enterprise.

8.1.6 Off-Farm Employment

Hiring out farm labor to work in the crop field (rice and upland crops) was the most common off-farm employment opportunity found in both rainfed and irrigated farms, especially for the farm household which has a large labor force relative to their farmland. On the average, for agricultural field work, wages paid to male and female labor was approximately equal, ranging from 2.8 to 3.5 baht per hour. To work as wage labor for many rainfed and irrigated farm households to the time of the major manufacturing and construction activities took place was evident. On the average, for these kinds of off-farm work, male labor was paid 4.36 baht per hour (or 35 baht per day) and female labor was paid 3.75 baht per hour (or 30 baht per day).

8.1.7 Distribution of Family Labor to Farm, Nonfarm and Off-Farm Activities

The major findings of the family labor utilization to farm, nonfarm and off-farm activities were as follows:

(1) For all sample households, the important role of farm work as the percent of total family labor use increased with the size of the operational farm. In other words, there was more farm work to be accomplished on the large farms requiring the households with large farm size to devote more of their labor in farming than the households with smaller sized farm.

(2) When the matter of water availability was examined (rainfed farms vs. irrigated farms), the relative share of family labor in farm work for the irrigated farms was higher than for the rainfed farms.

(3) On the average of all sample households, farm work was dominated by adult males relative to adult females and children. Even on the basis of the average hours per person, the male adult involvement in farm work still increased with farm size and was higher on irrigated farms than on rainfed farms.

(4) The share of nonfarm work (cottage industry) proportional to the total family labor use for the rainfed farms was larger than for the irrigated farms because the farming activities were limited for rainfed farm households and income must be supplemented by engaging more in many varieties of cottage industry. It was also revealed that women in both rainfed and irrigated farm households play the dominant role in cottage industry.

(5) Children in both rainfed and irrigated areas demonstrated their certain role in cottage industry by sharing nearly 16 percent of total family labor worked in nonfarm activities. However, the role of children in nonfarm employment activities cannot be explained adequately from the data provided in this study. In the cultural setting of rural Thailand children are expected to develop basic skills and to avoid idleness whether or not their employment is regarded as profitable from a monetary standpoint. The role of women in development has received increased attention in recent years. The role of children may also be an area for more attention in research.

(6) The contribution of off-farm work proportional to total family labor use decreased as farm size increased for the total sample households as well as for both rainfed and irrigated farm households.

(7) About the same protion of both men and women time was allocated to off-farm work on the average of all households but varied markedly among farm types and farm sizes. As farm size increases, the share of one's time spent in off-farm work decreased for both males and females, and for both rainfed and irrigated farms. This demonstrated that farm labor needs to be first priority even when off-farm employment may exist.

(8) For all farms, the CV (coefficient of variation--the ratio of the standard deviation of the monthly average to the annual average of family labor use) was 0.30, 0.20, 0.24 and 0.17 for farm work, farm work plus nonfarm employment, farm work plus off-farm work, and the total labor utilization distribution, respectively. This suggested that off-farm employment contributed less to smoothing monthly labor use fluctuation than did the nonfarm (cottage industry type) employment. In comparison, the CV of 0.19 for farm work on irrigated farms was less than the CV of 0.21 for employment from all sources on rainfed farms. This demonstrated one of the advantages of irrigation to open opportunities for a more uniform (less erratic) use of family labor than was possible on rainfed farms.

8.1.8 Household Consumption Patterns

The value of food expenditure proportional to the total expenditures for the rainfed farm household was higher than for the irrigated farm households because the rainfed farm households had relatively lower income than the irrigated farm households and would be expected to spend a large portion of their income on basic or staple food. The value of food expenditure proportional to the total expenditures for both rainfed and irrigated farms likewise decreased as farm size increased. Family nonfood expenditures in both relative and absolute terms were lower for the rainfed than the irrigated farm and were positively correlated with farm size.

The descriptive analysis of farm household in both rainfed and irrigated areas in Khon Kaen Province have helped to provide improved insight into how rural village farmers utilize their resources. One finding of this study with regard to cottage industry or nonfarm enterprise indicates evidently that cottage industry has been previously understated in its contribution to rural farm households in terms of income generating activity as well as their contribution to rural household self-employment. Cottage industry as well as some types of off-farm employment are a part of farm household's way of life along with farming even in the areas of more intensive farming systems with better irrigation. The role of men, women and children were found to differ among the type of enterprise and among activities performed within enterprise and also by the farming situation (i.e., rainfed or irrigated). For instance, silk weaving and sericulture found in the rainfed village are dominated by women, cotton weaving and basket making found in the irrigated village are dominated by women and men, respectively. These kind of findings may be very useful in the design of rural development policies or programs aiming to alleviate rural poverty and employment.

8.2 Summary and Implications of the LP Results

8.2.1 The Programming Result for the Rainfed Farms

The major findings of this part of the study may be summarized as follows:

(1) The composition of enterprise mix for rice, sericulture, silk weaving, sticky rice container making and off-farm work always appears in the optimal solutions for every farm size class. On the economic side, these results demonstrate the potential for rainfed farm households to combine farm, family industry and off-farm employment to

attain maximum annual family net income under existing family resource constraints including average subsistence and living expenditure requirements.

(2) Regarding farm enterprise combinations, to attain the optimal cropping systems with full utilization of land, the rainfed farmers should produce glutinous rice up to the minimum level for family consumption needs and devote the rest of the land for commercial nonglutinous rice production splitting the planting into two periods in order to avoid or minimize a problem of a shortage in supply of labor.

(3) Land was fully utilized and became one of the most limiting resources especially for the small farm households. On the basis of the highest shadow price of land for the small farmers compared to the medium and large farmers, the higher value of additional land for small farmers was demonstrated.

(4) All available female labor for every farm size was fully employed and thus became a more limiting resource than male and child labor. This may reveal the significant contribution of rural women work to household income generating activities, in addition to the well known role of women in various nonincome generating activities, e.g. chores and child rearing.

(5) No hired workers were employed on the small farm households since their family labor was adequate to meet all farming activity requirements. Only a few men days of labor were hired-in on the medium farm households. The programming results also suggest that it may be necessary for the large farm household to hire in many hours of both male and female labor especially during the peak periods of rice

production activities in order to meet the labor demand for the optimal cropping system.

(6) Mat making is always excluded from the optimal base plan for every farm size class of the rainfed farms because of its low level of income generated compared to other nonfarm enterprises under the given price and current technology. However, mat making became an economically desirable activity for the rainfed farmers in a certain period as it appeared in the new optimum solution assuming no silk weaving activities. This solution points out that mat making may become a viable alternative activity for the rainfed farm households if there is no skilled family labor to perform silk weaving activities.

(7) The results from the simulation analysis allowing two additional production periods for sericulture to be practiced demonstrate that it is feasible for the rainfed farm households to practice sericulture for the maximum of 6 times across the year if the mulberry production constraint is resolved. This implies that there is still room for additional cottage industries like sericulture to improve the household income in the rainfed area if production bottlenecks are removed.

(8) In the optimum solutions, every farm size class of the rainfed farm households, had some members (both males and females) with off-farm work. It would be economically desirable for the rainfed family members to work off-farm on a part-time basis if employment opportunities exist. Without these off-farm employment opportunities, the rainfed farm household would be worse off because their family net income would decline substantially as can be seen through the simulation analysis with no off-farm employment opportunities. This result conforms to the fact

that many rural farm households have been engaged in off-farm work as their supplemental source of family income during the slack periods of farming activities.

(9) According to the results obtained from the simulation analysis with changed assumptions regarding off-farm employment opportunities, the important contribution of off-farm employment to family income and employment becomes very evident. Without both classes of the assumed off-farm employment opportunities, the rainfed farm household income and employment (especially men) would be much lower. Conversely, with the assumption of more off-farm employment opportunities, the rainfed farm households would be better off as their family net income and the employment of their male labor would increase substantially. These results also suggested that rainfed family labor enthusiastically respond to off-farm work offering a wage ranging from 24 to 35 baht per day (or more).

(10) The effect of an increase in wage rates as a means to improve household income for rainfed farm households was examined. The programming solutions with assumed wage rate increase by 10 and 30 percent above the base model, demonstrated a substantial increase in household income. But increasing off-farm employment wages may cause a substantial short-run drop in the production of cottage industry especially sericulture because the households will switch their family labor from cottage industry to off-farm employment work.

(11) Without silk weaving activities, the rainfed farm households appear to be worse off, as their family net income falls below levels obtained in the base model. In addition, female unemployment which never occurred in the base model before became apparent in the situation

of no silk weaving activities. More operating capital was also borrowed from the BAAC for rice production.

(12) Despite a drop of 20 percent in the average crop yield of rice from the normal level reported by the rainfed farmers, the programming solutions demonstrate that the rainfed farms would still be able to obtain enough family net income for saving (through the same optimal pattern of enterprise mix as found in the base model) to pay back all short-term loans to BAAC. This result may be against the conservative view of commercial bankers who usually claim that to give loans to rainfed farms is very risky. Their position may be based more on the variability of income on rainfed farms than on the income level.

8.2.2 The Programming Results for the Irrigated Farms

Highlights of the programming results and implications for the irrigated farms in relation to existing conditions and constraints are as follows:

(1) The enterprise combination of glutinous rice, nonglutinous rice, tobacco, cotton weaving, basket and mat making, and part-time off-farm work always enter the optimal solutions for every farm size class. These results demonstrate the possibility for the irrigated farmers to combine farm, and nonfarm enterprises, including off-farm work to achieve maximum net family income under existing family resource constraints with subsistence and living expenditure requirements. The composition of enterprise mix suggested by the programming models are not far away from the one that the sample farm households usually do for income earning by engaging their family labor to farm (e.g.,

glutinous and nonglutinous rice and tobacco), nonfarm enterprises (mat making, cotton weaving and basket making) and off-farm work.

(2) All three common crops of glutinous rice, nonglutinous rice and tobacco are included in the optimal cropping pattern for every farm size class. However, in addition to these common crops, glutinous corn appears only in the optimal cropping system for the medium sized farm. Unlike the small and medium sized farms, the programming solutions suggest that it may be necessary for the large sized farm households to employ labor-saving technology, e.g., two-wheel tractor for commercial rice production.

(3) The programming solutions show the results that no capital was borrowed for the irrigated farmers with every farm size class. Under the given assumption of the models, the capital of the farm household is not a limiting resource, thus the marginal value product (MVP) of borrowed capital was equal to zero. This may suggest that the irrigated farm households could be self-financed as they have enough capital (cash) for spending on operating expenditures of rice production, plus the family consumption expenses.

(4) All wet season land was fully utilized for every farm size class. All available land was also fully utilized by small farmers in the dry season. However, for both medium and large farms, the available land was only partially used in the dry season because of inadequate irrigation water supply. Land was a more limiting resource for the small farmers as reflected by its highest MVP of land compared to the medium and large sized farms. Each additional unit of land at the margin allocates more value to the small farmers than would be the case for the larger size farms.

(5) Unlike the solutions for rainfed farming situation, male labor was exhausted, whereas some small amount of female and a large amount of child labor was unused in the optimal solutions for the irrigated farmers with every farm size. Because irrigation permits more cropping activities and since cropping activities utilize male labor, irrigated farms will utilize male labor more fully than is to be found on rainfed farms. Furthermore, only one family industry of basket making found in the irrigated villages can be performed by men alone. For females, their opportunities to engage in cottage industry of cotton weaving was assumed limited only in the dry season and also limited by the shortage of child labor in some periods for making mats, as pointed out earlier.

(6) The programming results suggest that it is necessary for both medium and large farm households to hire in both male and female workers for commercial rice production activities during the peak periods. While no hire-in labor is recommended in the optimal cropping pattern for the small farmers.

(7) Off-farm work by male and female family labor always enter the optimal solutions for every size class in many periods. These results point out that even under the well established crop intensification in the irrigated area, there is still room for family labor to engage in off-farm work. On the other hand, it is possible for male and female family labor to work off-farm on a part-time basis.

(8) It is economically possible to increase farm household income earned as well as family employment through intensification of cropping system with better irrigation system in the dry season as can be clearly seen in the new optimal solution of the simulated situation assuming

full irrigation water supply in the dry season plus the new alternative crop of tomato.

(9) For the irrigated farm households, the possibility for improvement of household income and the employment of family labor especially for women through the expansion of a viable family industry like cotton weaving was very evident as can be seen through the simulation analysis of an assumed situation with year around cotton weaving activities.

(10) Without assumed off-farm employment opportunities, even the irrigated farm households would be worse off as their family income and the women employment substantially dropped.

Inversely, both family income and employment for women are increased with more assumed off-farm employment opportunities.

8.3 Areas for Further Research

Suggested areas for further research are based on the shortcomings and perceived weakness of the study and on the potential for extending the study in the future for improved rural development policy in Thailand.

The shortcomings are addressed by consideration of three major concerns: (1) the data for enterprise analysis; (2) the scope of the study; and (3) methodological issues.

Even though the Rural Off-Farm Employment Assessment Project was carefully designed to meet its objectives and despite the abundance of high quality data regarding rural employment phenomenon, it did not supply the input-output coefficients by enterprise customarily required in linear programming analysis. The labor inputs activities by technology employed for each enterprise are very essential. Failure to provide them was not an oversight in the project design. To have done so would have added substantially to the cost and complexity of the data gathering and analysis procedures. No research undertaken can be all things to all interested groups. Consequently, the researcher attempted to fill this gap with a one-time interview-based survey of a limited sample. Refinement over time of the input-output coefficients for enterprises especially the nonfarm enterprises, will surely improve the value of the results whether they confirm or revise the findings of this research.

With regard to the scope of the research one may conclude that the findings may have limited applicability for broad development policy. The "representative" households are based on a limited number of villages and those villages were not selected by randomizing procedures. To make the scope manageable, villages in upland farming areas were excluded recognizing that some nonfarm enterprises (such as mat making) are more prevalent there than in the rainfed and irrigated farm households in this study. Consequently, the representative farms of this study may be representative of only a limited domain in Khon Kaen Province. This study was more concerned with examining differences in employment behavior as effected by the availability of irrigation water and by the size of the farm than it was in designing the analysis to produce results necessarily representative of a large geographic area. It is hoped, however, that the results obtained can be used to understand more clearly farming situations in Northeast Thailand that may be similar to those encountered in this study..

The scope of the study was also somewhat delimiting with regard to the number of potentially viable alternative enterprises for the farm, nonfarm and off-farm employment aspects of the villages under study. Only the most common farm crops and nonfarm enterprises were considered, livestock relationships to the cropping system and to family consumption behavior were overly simplified by treating them as "given," and the wide range of off-farm employment opportunities that are seemingly available in the area were restricted to only hired wages in agricultural work and a selected additional category of off-farm employment. How much was lost by these simplification procedures is not known. It is a matter worthy of further exploration.

There is need for adaptive research to identify additional potential crops for both rainfed and irrigated farms in the rainy season and for irrigated farms in the dry season. More information is needed on the economics of individual nonfarm enterprises to learn the determinations of success or failure and to be able diagnosis the potential for improvements in the production (including technology) and in marketing practise. The potential for new product development in the area is another area needing further study. Furthermore, this study has suggested the need for more information on the local labor market especially the interactions between nonfarm firms/households and the farming sector. Without these further studies, the present findings must be taken as preliminary.

Further research possibilities come to mind on the methodological side. For example, what are implications of modelling the representative household by preparing a composite average of all selected farms? The average will reveal a greater variety of enterprises than would be expected on the typical farm. The mathematics of linear programming may exclude an enterprise may be prevalent in the village under study. This does not necessarily mean that the households engaged in the enterprise are behaving irrationally. It is more likely that the averages used to specify input-output coefficients and resource constraints are very unlike those to be found on the farm where in the enterprise is practiced. It is possible that the linear programming approach will generate improved results if more behavioral features explaining "why farmers do what they do" can be incorporated in the analysis rather than averaging all households or even modelling selected case households with consideration of only the customary constraints of land, labor and consumption requirements. More research is needed in this area.

The underlying assumptions and the usual static nature of linear programming provides a basis for common criticism of the method. Nevertheless, with care in model specification, reliable data and good judgement in the selection of propositions to be evaluated, it is a very powerable tool for analyzing firm-household relationships. There is the opportunity to further exploit the methodology in Thailand in the problem area of this study. For example, in addition to the suggestions offered above for improving the results from a household perspective, there may be merit in redefining the problem as a village or community phenomenon. In this way, basic intra-community labor utilization issues would be addressed and the focus on "why villages do what they do" should prove both useful and interesting.

In summary, this study is just one additional step on the path of research on rural employment in Northeast Thailand. It is a companion to the other studies already undertaken and also contemplated as part of a common project. Despite its shortcomings, it is offered as a modest contribution in the form of tentative conclusions and some possible avenues for further research to an area of considerable concern to the Royal Thai Government.

APPENDIX

Appendix Table 1

Enterprise Budget of Glutinous Rice of
Rainfed Farm Household, Khon Kaen Province

Enterprise:	Glutinous Rice	Unit of Production:	1 rai
Variety:	San Pa Tong (Long Maturing Rice)	Season:	Wet Season
Power Use:	Draft Animal	Output:	25 tang (250 kg)
Price:	₿26/tang	Gross Value:	₿650.00

Operating Cost	Qty.	Price	Value (₿)	
Seed	6.70 kg	₿2.50/kg	16.7	
Fertilizer	5.56 kg	₿4.50/kg	25.02	
Pesticide & Herbicide			4.96	
Transportation			22.84	
Power Hired			134.00	
Total				₿203.57
Gross Margin:				₿445.43

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	2.96	--	--
	2.1	LP	26.01	--	--
	2.2	PT	1.04	15.18	--
	3	CC	3.20	--	--
	4	CC	4.08	--	--
	5	CC	3.20	--	--
	6	CC	3.20	--	--
	7	HT&HL	19.00	16.38	--
	8	TSH	6.31	3.66	--
	Total		69.01	35.22	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TSH = Threshing

Appendix Table 2

Enterprise Budget of Nonglutinous Rice of
Rainfed Farm Household, Khon Kaen Province

Enterprise:	Nonglutinous Rice	Unit of Production:	1 rai
Variety:	Mae Loop (Long Maturing Rice)	Season:	Wet Season
Power Use:	Draft Animal	Output:	25 tang (250 kg)
Price	฿32/tang	Gross Value:	฿800.00

Operating Cost				
Seed	6.51 kg	฿3.00/kg	19.53	
Fertilizer	5.45 kg	฿4.50/kg	24.52	
Pesticide & Herbicide			4.95	
Transportation			22.84	
Power Hired			134.00	
Total				฿205.84
Gross Margin:				฿594.16

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	2.98	--	--
	2.1	LP	26.01	--	--
	2.2	PT	1.06	14.56	--
	3	CC	3.20	--	--
	4	CC	4.05	--	--
	5	CC	3.20	--	--
	6	HT&HL	23.72	16.17	--
	7	TSH	5.51	4.0	--
	Total		69.73	34.73	--

Note: N = Nursery LP = Land Preparation PT = Planting
CC = Crop Care HT = Harvesting HL = Hauling
TSH = Threshing

Appendix Table 3

Enterprise Budget of Sericulture of
Rainfed Farm Household, Khon Kaen Province

Enterprise:	Sericulture	Unit of Production: 1200 grams	
Variety:	Native Variety		
Product:	Silk Yarn	Price: ฿50/100 grams	
		Gross Value: ฿600	

Operating Cost	Qty.	Price	Value (฿)
Eggs	5 beds	฿4/bed	20.0
Mulberry Leaves 107 kg		฿1.0/kg	107.0
Total			127.0
Gross Margin:			473.0

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	Feeding	--	87.12	77.52
	2	Processing	--	64.20	--
		Total	--	151.32	77.52

Note: The production process of Sericulture can be complete within two periods. The first period includes feeding and other activities involved in silk worm raising while successive period includes silk thread processing such as boiling cocoon, reeling, and spinning.

Appendix Table 4

Enterprise Budget of Silk Weaving of
Rainfed Farm Household, Khon Kaen Province

Enterprise:	Silk Weaving		Unit of Production: 1 piece		
Product:	Patterned Fabric (1.05 x 1m)		Price: ฿350/piece		
			Gross Value: ฿350		
Operating Cost			Value (฿)		
Silk Yarn			190.67		
Dye			20.08		
Plastic Thread			2.57		
Transportation			3.71		
Total					217.03
Gross Margin:					132.97

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	Year Round	Whole*	--	44.44	--

*Whole = deguming + spinning + reeling + wrapping + dyeing + unwrapping + bobbin + winding + setting up loom and weaving.

Appendix Table 5

Enterprise Budget of Sticky Rice Container Making of the Rainfed Farm Households in Khon Kaen

Enterprise: Stick Rice Container Making			Unit of Production: 28 containers		
Product: Sticky Rice Container			Price: ฿10 per container Gross Value: ฿280.0		
Operating Cost			Value (฿)		
Bamboo			20.16		
Plastic String			2.24		
Ruttan			12.32		
Toddy Palm (fiber from palm frond)			10.00		
Wood			7.22		
Nail			9.81		
Transportation			3.92		
Total					฿65.66
Gross Margin:					฿214.34
Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	Year Round	Whole*	63.2	71.6	14.1

*Whole = bamboo processing (cutting, splitting, smoothing) + weaving + assembling.

Appendix Table 6

Enterprise Budget of Mat Making of Rainfed and Irrigated Farm Households in Khon Kaen

Enterprise:	Mat Making			Unit of Production: 60 mats	
Product:	Reed Mat (1.5 x 2 meters)			Price: ฿7.00 per mat	
				Gross Value: ฿420	
Operating Cost				Value (฿)	
Reed				63.6	
Plastic String				83.4	
Dye				13.8	
Transportation Cost				12.6	
Total					฿173.4
Gross Margin:					฿246.6
Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	Year Round	Whole*	-	194.64	102.38

*Whole = cutting + slicing + drying + dyeing + weaving. This is the labor requirement after reeds have been acquired.

Appendix Table 7

Enterprise Budget of Glutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Glutinous Rice		Unit of Production: 1 rai	
Variety: Pan Pa Tong (Long Maturing Rice)		Season: Wet Season	
Power Use: Draft Animal		Output: 39 tang (390 kg)	
Price: ฿26 per tang		Gross Value: ฿1,014.0	
Operating Cost	Qty.	Price	Value (฿)
Seed	6.2 kg	฿2.6	15.91
Fertilizer	2.19 kg	฿4.07	8.94
Pesticide & Herbicide			8.21
Transportation			26.54
Power Hired			185.00
Total			฿244.60
Gross Margin:			฿769.40

Labor Cost:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	3.6	--	--
	2.1	LP	31.29	2.11	--
	2.2	PT	12.39	20.17	--
	3	CC	3.93	--	--
	4	CC	2.72	--	--
	5	CC	2.72	--	--
	6	CC	2.72	--	--
	7	HT&HL	19.77	21.80	--
	8	TH	5.56	5.47	--
	Total		84.70	49.55	

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 8

Enterprise Budget of Glutinous Rice of
the Irrigated Farm Households in Khon Kaen

Enterprise: Glutnious Rice — Unit of Production: 1 rai
Variety: San Pa Tong (Long Maturing Rice) — Season: Wet Season
Power Use: Machine Tiller — Output: 39 tang (390 kg)
Price: ฿26 per tang — Gross Value: ฿1,014.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	6.29 kg	฿2.6/kg	16.35	
Pesticide & Herbicide			7.33	
Power Hired			26.54	
			355.00	
Total				฿413.43
Gross Margin:				฿600.57

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	3.62	--	--
	2.1	LP	14.07	--	--
	2.2	PT	1.39	20.17	--
	3	CC	4.64	--	--
	4	CC	2.72	--	--
	5	CC	2.72	--	--
	6	CC	2.72	--	--
	7	HT&HL	21.01	21.52	--
	8	TH	5.57	5.56	--
	Total		58.46	47.25	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 9

Enterprise Budget of Nonglutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Nonglutinous Rice | Unit of Production: 1 rai
Variety: Mae Loop (Long Maturing Rice) | Season: Wet Season
Power: Draft Animal | Output: 40 tang (400 kg)
Price: ฿30 per tang | Gross Value: ฿1,200.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	4.57 kg	฿3.00/kg	13.71	
Fertilizer	2.67 kg	฿4.07	10.86	
Pesticide & Herbicide			8.44	
Transportation			26.79	
Power Hired			185.00	
Total				฿244.80
Gross Margin:				฿955.20

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	3.67	--	--
	2.1	LP	32.00	2.01	--
	2.2	PT	11.20	20.18	--
	3	CC	4.10	--	--
	4	CC	3.07	--	--
	5	CC	3.07	--	--
	6	CC	3.07	--	--
	7	CC	3.07	--	--
	8	HT&HL &TH	26.85	26.17	--
	Total		90.10	48.36	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 10

Enterprise Budget of Tobacco of
the Irrigated Farm Households in Khon Kaen

Enterprise: Tobacco			Unit of Production: 1 rai		
Variety: Local			Season: Wet Season		
Power: Draft Animal			Output: 75 kg		
Price: ฿60.55/kg			Gross Value: ฿4,541.25		
Operating Cost		Qty.	Price	Value (฿)	
Seed				87.63	
Fertilizer				217.57	
Pesticide & Herbicide				128.29	
Power Hired				100.00	
Total					฿ 533.49
Gross Margin:					฿4,007.76

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	5	N	11.04	3.12	--
	6	LP&PT	15.57	9.19	--
	7	CC	57.29	64.54	--
	8	CC	39.65	48.95	--
	9	HT&PC	67.89	55.31	--
	Total		191.44	181.11	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; PC = Processing

Appendix Table 11

Enterprise Budget of Nonglutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Nonglutinous Rice			Unit of Production: 1 rai		
Variety: Mae Loop (Long Maturing Rice)			Season: Wet Season		
Power Use: Machine Tiller			Output: 40 tang (400 kg)		
Price: ฿30 per tang			Gross Value: ฿1,200.00		
Operating Cost		Qty.	Price	Value (฿)	
Seed		4.60 kg	฿3.00/kg	13.80	
Fertilizer		2.62 kg	฿4.07/kg	10.74	
Pesticide & Herbicide				6.77	
Transportation				26.79	
Total					฿413.10
Gross Margin:					฿786.90

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	1	N	3.6	--	--
	2.1	LP	14.07	--	--
	2.2	PT	1.73	20.18	--
	3	CC	4.07	--	--
	4	CC	3.07	--	--
	5	CC	3.07	--	--
	6	CC	3.07	--	--
	7	CC	3.07	--	--
	8	HT&HL	26.86	26.18	--
	Total		62.61	46.36	--

Note: N = Nursery LP = Land Preparation PT = Planting
CC = Crop Care HT = Harvesting HL = Hauling
TH = Threshing

Appendix Table 12

Enterprise Budget of Nonglutinous Rice of
the Irrigated Farm Households in Khon Kaen

Enterprise: Nonglutinous Rice | Unit of Production: 1 rai
Variety: RD 7 (Short Maturing Rice) | Season: Dry Season
Power Use: Draft Animal | Output: 34 tang (340 kg)
Price: ฿30 per tang | Gross Value: ฿1,020.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	4.95 kg	฿3.00/kg	14.85	
Fertilizer	21.33 kg	฿5.00/kg	106.65	
Pesticide & Herbicide			23.37	
Transportation			26.86	
Power Hired			185.00	
Total				฿355.73
Gross Margin:				฿664.27

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	9	N	3.50	--	--
	10.1	LP	31.68	3.64	--
	10.2	PT	12.39	20.18	--
	11	CC	15.50	--	--
	12	HT&HL &TH	22.99	23.93	--
	Total		86.06	47.75	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 13

Enterprise Budget of Glutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Glutnious Rice	Unit of Production: 1 rai
Variety: RD (Short Maturing Rice)	Season: Dry Season
Power Use: Machine Tiller	Output: 34 tang (340 kg)
Price: ฿26 per tang	Gross Value: ฿884.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	5.36 kg	฿2.60	13.93	
Fertilizer	21.37 kg	฿5.00	106.85	
Pesticide & Herbicide			23.41	
Transportation			25.86	
Power Hired			355.00	
Total				฿525.05
Gross Margin:				฿358.95

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	9	N	3.52	--	--
	10.1	LP	14.04	--	--
	10.2	PT	1.39	20.17	--
	11	CC	13.19	--	--
	12	HT&HL	17.33	17.12	--
	1	TH	5.10	5.27	--
	Total		56.60	42.56	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 14

Enterprise Budget of Glutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Glutinous Rice	Unit of Production: 1 rai
Variety: RD (Short Maturing Rice)	Season: Dry Season
Power Use: Draft Animal	Output: 34 tang (340 kg)
Price: ฿26 per tang	Gross Value: ฿884.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	5.36 kg	฿2.6/kg	13.93	
Fertilizer	21.37 kg	฿5.0/kg	106.85	
Pesticide & Herbicide			23.41	
Transportation			25.86	
Power Hired			185.00	
Total				฿355.05
Gross Margin:				฿528.95

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	9	N	3.52	--	--
	10.1	LP	32.03	3.04	--
	10.2	PT	12.39	20.17	--
	11	CC	15.19	--	--
	12	HT&HL	17.33	17.12	--
	1	TH	5.10	5.27	--
	Total		85.56	45.60	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 15

Enterprise Budget of Nonglutinous Rice of the Irrigated Farm Households in Khon Kaen

Enterprise: Nonglutinous Rice	Unit of Production: 1 rai
Variety: RD 7 (Short Maturing Rice)	Season: Dry Season
Power Use: Machinery Tiller	Output: 34 tang (340 kg)
Price: ฿30 per tang	Gross Value: ฿1,020.00

Operating Cost	Qty.	Price	Value (฿)	
Seed	4.95 kg	฿3.00/kg	14.85	
Fertilizer	21.33 kg	฿5.00/kg	106.65	
Pesticide & Herbicide			23.37	
Transportation			25.86	
Power Hired			355.00	
Total				฿525.73
Gross Margin:				฿494.27

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	9	N	3.5	--	--
	10.1	LP	14.07	--	--
	10.2	PT	1.73	20.18	--
	11	CC	15.50	--	--
	12	HT&HL &TH	22.99	23.93	--
	Total		57.79	44.11	--

Note: N = Nursery; LP = Land Preparation; PT = Planting; CC = Crop Care; HT = Harvesting; HL = Hauling; TH = Threshing

Appendix Table 16

Enterprise Budget of Glutinous Corn of the Irrigated Farm Households in Khon Kaen

Enterprise: Glutinous Corn	Unit of Production: 1 rai
Variety: Local	Season: Dry Season
Power Use: Draft Animal	Output: 923 ears
Price: ฿0.50/ear	Gross Value: ฿461.50

Operating Cost	Qty.	Price	Value (฿)	
Seed	2.26 kt	฿20.0/kg	45.20	
Fertilizer			52.00	
Pesticide & Herbicide			13.50	
Power Hired			100.00	
Total				฿210.70
Gross Margin:				฿250.80

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	11	LP&PT	53.90	45.50	--
	12	CC	39.17	19.64	--
	1	HT	6.67	25.06	--
	Total		99.74	90.20	--

Note: LP = Land Preparation PT = Planting
CC = Crop Care HT = Harvesting

Appendix Table 17

Enterprise Budget of Tomato of the Irrigated Farm Households in Khon Kaen

Enterprise: Tomato	Unit of Production: 1 rai
Variety: Roma (VF 134)	Season: Dry Season
Power Use: -	Output: 2,528 kg
Price: ฿1.25 per kg	Gross Value: ฿3,160.00

Operating Cost	Qty.	Price	Value (฿)	
Seed			100.00	
Fertilizer			217.42	
Pesticide & Herbicide			84.22	
Transportation			--	
Power Hired			--	
Total				฿ 471.65
Gross Margin:				฿2,688.36

Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	8	N&LP& F&I	31.04	35.6	18.12
	9	PT&F&I &CC	68.01	109.09	32.79
	10	F&CC&I	60.22	97.74	30.38
	11	CC&I&HT	112.76	210.85	29.63
	12	I&HT	32.11	63.46	7.64
	Total		304.14	516.74	118.56

Note: N = Nursery; LP = Land Preparation; F = Fertilizing; PT = Planting; I = Irrigation; CC = Crop Care; HT = Harvesting

Source: "Input Suppliers for the Modern Fruit and Vegetable Processors," A Case Study, Rural Off-Farm Employment Assessment Project, Bangkok, Thailand.

Appendix Table 18

Enterprise Budget of Cotton Weaving of the Irrigated Farm Households in Khon Kaen

Enterprise: Cotton Weaving			Unit of Production: 16 pieces		
Product: Cotton Fabric (1.0 x 1.5 meters)			Price: ฿57.61 per piece		
			Gross Value: ฿921.76		
Operating Cost		Qty.	Price	Value (฿)	
Cotton Yarn				324.32	
Dye				22.88	
Total					฿347.20
Gross Margin:					฿574.56
Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	9,10.1,10.2 11.1,12.1,12.2	Whole*	--	195.4	--

*Whole = warp preparation + reeling cotton yarn + degumming and dyeing + patterning + weaving.

Appendix Table 19

Enterprise Budget of Basket Making of
the Irrigated Farm Households in Khon Kaen

Enterprise: Basket Making			Unit of Production: 2 baskets		
Product: Bamboo Basket			Price: ฿22.50 per basket		
			Gross Value: ฿45.00		
Operating Cost		Qty.	Price	Value (฿)	
Bamboo				19.0	
Ruttan				4.0	
Total					฿23.00
Gross Margin					฿22.00
Labor Input:	Period	Task	Male (hrs.)	Female (hrs.)	Child (hrs.)
	Year Round	Whole*	55.5	--	--

*Whole = cutting + splitting + smoothing + weaving.

Appendix Table 20

Computation of Maximum Available Hours of Adult Males for Income Generating Activities of the Small Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (1.7 Adults)	422	408	422	422	408	422	408	422	422	381	422	408
B. Nonincome Generating Activities:	114	20	20	90	103	20	20	80	107	74	93	100
Domestic Work	20	12	12	20	20	12	12	20	20	20	20	20
Religious and Social	75	8	8	54	62	8	8	50	75	36	59	70
Others	19	--	--	16	21	--	--	10	12	18	14	10
C. Minor Agricultural Activities	100	8	12	72	62	102	108	54	114	87	75	42
D. Maximum Available Hours (D=A-B-C)	208	380	390	260	265	320	300	270	201	220	254	266

Appendix Table 21

Computation of the Maximum Available Hours of Adult Females for Income Generating Activities of the Small Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (1.2 Adults)	298	288	298	298	288	298	288	298	298	268	298	288
B. Nonincome Generating Activities:	53	36	28	50	50	36	60	50	54	54	53	48
Domestic Work	45	28	28	45	45	28	45	42	45	45	45	45
Religious and Social	8	8	--	5	5	8	8	8	9	9	8	3
Others	--	--	--	--	--	--	7	--	--	--	--	--
C. Minor Agricultural Activities	45	12	6	44	20	50	26	18	49	45	39	30
D. Maximum Available Hours (D=A-B-C)	200	240	264	204	218	212	202	230	195	170	206	210

Appendix Table 22

Computation of Maximum Available Hours of Children for Income Generating Activities of the Small Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (1.1 Children)	180	176	186	224	176	180	176	224	180	167	194	264
B. Nonincome Generating Activities:	60	60	60	60	60	60	60	60	60	60	60	60
Domestic Work	60	60	60	60	60	60	60	60	60	60	60	60
Religious and Social	--	--	--	--	--	--	--	--	--	--	--	--
Others	--	--	--	--	--	--	--	--	--	--	--	--
C. Minor Agricultural Activities	24	34	40	61	44	40	34	60	23	8	35	74
D. Maximum Available Hours (D=A-B-C)	96	82	86	103	72	80	82	104	97	99	99	130

Appendix Table 23

Computation of the Maximum Available Hours of Adult Males for Income Generating Activities of the Medium Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (2.26 Adults)	560	542	560	560	542	560	542	560	560	506	560	542
B. Nonincome Generating Activities:	239	191	135	228	230	128	119	171	193	192	223	263
Domestic Work	35	35	30	30	35	30	30	30	35	35	35	35
Religious and Social	148	125	97	149	149	80	71	125	142	123	158	160
Others	56	36	8	44	40	18	18	16	16	34	30	68
C. Minor Agricultural Activities	75	37	15	47	29	132	93	95	115	54	72	59
D. Maximum Available Hours (D=A-B-C)	246	314	410	285	283	300	330	294	252	260	265	220

Appendix Table 24

Computation of the Maximum Available Hours of Adult Females for Income Generating Activities of the Medium Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (1.73 Adults)	429	415	429	429	415	429	415	429	429	388	429	415
B. Nonincome Generating Activities:	145	102	110	163	113	114	111	96	145	102	161	180
Domestic Work	75	70	70	75	75	70	70	70	75	75	75	75
Religious and Social	62	32	32	68	28	36	33	20	46	19	70	70
Others	18	--	8	20	10	8	8	6	24	8	16	35
C. Minor Agricultural Activities	64	23	23	27	42	45	30	76	54	48	58	25
D. Maximum Available Hours (D=A-B-C)	220	290	296	239	260	260	274	257	230	238	210	210

Appendix Table 25

Computation of the Maximum Available Hours of Children for Income Generating Activities of the Medium Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (0.5 Children)	82	80	82	102	80	82	80	102	82	76	88	120
B. Nonincome Generating Activities:	16	16	16	16	16	16	16	16	16	16	16	16
Domestic Work	16	16	16	16	16	16	16	16	16	16	16	16
Religious and Social	--	--	--	--	--	--	--	--	--	--	--	--
Others	--	--	--	--	--	--	--	--	--	--	--	--
C. Minor Agricultural Activities	15	24	24	30	27	24	21	5	36	16	20	8
D. Maximum Available Hours (D=A-B-C)	51	40	42	56	37	42	43	81	40	44	52	96

Appendix Table 26

Computation of the Maximum Available Hours of Adult Males for Income Generating Activities of the Large Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (2.3 Adults)	570	552	570	570	552	570	552	570	570	515	570	552
B. Nonincome Generating Activities:	249	18	10	200	189	81	53	206	279	189	312	298
Domestic Work	30	10	--	30	30	30	30	30	30	30	30	30
Religious and Social	158	8	10	119	126	43	23	152	177	116	193	198
Others	61	--	--	61	33	8	--	24	72	43	89	70
C. Minor Agricultural Activities	41	14	--	50	53	46	49	54	65	44	48	40
D. Maximum Available Hours (D=A-B-C)	280	520	560	320	310	443	450	310	226	270	210	214

Appendix Table 27

Computation of the Maximum Available Hours of Adult Females for Income Generating Activities of the Large Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (2.4 Adults)	595	576	595	595	576	595	576	595	596	538	595	576
B. Nonincome Generating Activities:	325	228	227	271	235	262	223	227	257	207	297	250
Domestic Work	85	75	75	85	85	75	75	75	85	85	85	85
Religious and Social	198	137	136	162	130	171	130	132	148	106	162	141
Others	52	16	16	24	20	16	18	20	24	16	40	24
C. Minor Agricultural Activities	53	48	28	44	58	48	53	48	58	53	48	28
D. Maximum Available Hours (D=A-B-C)	217	300	340	280	283	285	300	320	280	278	250	298

Appendix Table 28

Computation of the Maximum Available Hours of Children for Income Generating Activities of the Large Rainfed Farms

Unit: Hours Per Household

Item	Month and Period											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A. Total Hours (0.9 Children)	148	144	148	184	144	148	144	184	148	137	158	216
B. Nonincome Generating Activities:	50	50	50	50	50	50	50	50	50	50	50	50
Domestic Work	50	50	50	50	50	50	50	50	50	50	50	50
Religious and Social	--	--	--	--	--	--	--	--	--	--	--	--
Others	--	--	--	--	--	--	--	--	--	--	--	--
C. Minor Agricultural Activities	34	44	50	50	54	50	55	44	48	31	48	56
D. Maximum Available Hours (D=A-B-C)	64	50	48	84	40	48	44	90	50	56	60	110

Appendix Table 29

Computation of Maximum Hours Available by Adult Males for Major Income Generating Activities of Small Irrigated Farm

Item	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
	Month and Period											
A. Total Hours (2.0 Adult)	496	480	496	480	496	480	496	496	496	448	496	480
B. Non-Income Generating Activities: (hour)	139	95	97	71	63	58	97	72	139	104	133	129
Domestic Work	23	23	23	23	23	23	23	23	23	23	23	23
Religious & Social	96	60	60	34	30	27	60	37	96	62	96	92
Other	20	12	14	14	10	8	14	12	20	24	14	14
C. Minor Agr. Activities	87	57	57	67	135	126	81	110	81	69	101	79
D. Maximum Hours Available (D = A - B - C)	270	328	342	358	282	312	302	314	276	270	262	272

Appendix Table 30

Computation of Maximum Hours Available by Adult Females for Major Income Generating Activities of Small Irrigated Farm

Item	Month and Period											
	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (2.3 adult)	570	552	570	570	552	570	552	570	570	515	570	552
B. Non-Income Generating Activities: (hour)	217	190	152	173	186	181	139	157	191	193	187	227
Domestic Work	86	86	86	86	86	86	86	86	86	86	86	86
Religious + Social	97	70	50	71	94	63	45	63	71	91	79	117
Other	34	34	16	16	16	32	8	8	34	16	22	24
C. Minor Agr. Activities	151	114	114	89	165	189	121	142	172	106	121	107
D. Maximum Hours Available (D = A - B - C)	202	248	304	308	201	200	292	271	207	216	262	218

Appendix Table 31

Computation of Maximum Hours Available by Child Labor for Major Income Generating Activities of Small Irrigated Farm

Item	Month and Period											
	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (o.6 children)	98	96	98	122	96	98	96	122	98	91	106	144
B. Non-Income Generating												
Activities: (hour)	22	22	22	22	22	22	22	22	22	22	22	22
Domestic Work	22	22	22	22	22	22	22	22	22	22	22	22
Religious + Social	---	---	---	---	---	---	---	---	---	---	---	---
Other	---	---	---	---	---	---	---	---	---	---	---	---
C. Minor Agr. Activities	76	2	40	20	33	32	44	20	32	33	42	6
D. Maximum Hours Available (D = A - B - C)	30	70	34	80	41	44	30	80	44	36	42	116

Appendix Table 32

Computation of Maximum Hours Available by Adult Males for Major Income Generating Activities of Medium Irrigated Farm

Item	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
	Month and Periods											
A. Total Hours (1.8 Adult)	439	429	439	439	429	439	429	439	439	396	439	429
B. Non-Income Generating Activities: (Hour)	95	99	100	88	62	71	69	66	97	101	102	114
Domestic Work	25	25	25	25	25	25	25	25	25	25	25	25
Religious + Social	45	58	65	41	29	46	44	41	58	62	67	69
Other	25	16	10	12	8	10	--	--	14	14	10	20
C. Minor Agr. Activities	84	40	39	47	107	103	65	63	92	85	69	63
D. Maximum Hours Available (D = A - B - C)	260	290	300	304	260	265	295	310	250	210	268	252

Appendix Table 33

Computation of Maximum Hours Available by Female Adults for Major Income Generating Activities of Medium Irrigated Farm

Item	Month and Period											
	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (2.1 Adult)	521	504	521	521	504	521	504	521	521	470	521	505
B. Non-Income Generating Activities: (Hour)	180	186	159	172	171	174	138	149	174	146	215	196
Domestic Work	86	86	86	86	86	86	86	86	86	86	86	86
Religious + Social	54	70	60	70	60	60	46	55	68	46	85	85
Other	40	30	13	16	25	28	16	8	20	14	44	25
C. Minor Agr. Activities	101	78	76	69	119	135	76	87	140	84	80	59
D. Maximum Hours Available (D = A - B - C)	240	240	286	280	214	212	290	285	207	240	226	250

Appendix Table 34

Computation of Maximum Hours Available by Child Labor for Major Income Generating Activities of Medium Irrigated Farm

Item	Month and Period											
	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (1.1 Children)	180	176	180	224	176	180	176	224	180	167	194	264
B. Non-Income Generating Activities: (hour)	30	30	30	30	30	30	30	30	30	30	30	30
Domestic Work	30	30	30	30	30	30	30	30	30	30	30	30
Religious and Social	---	---	---	---	---	---	---	---	---	---	---	---
Other	---	---	---	---	---	---	---	---	---	---	---	---
C. Minor Agr. Activities	65	46	60	82	76	81	62	70	91	57	94	90
D. Maximum Hours Available (D = A - B - C)	85	70	90	112	70	69	84	116	59	80	70	144

Appendix Table 35

Computation of Maximum Hours Available by Adult Males for Major Income Generating Activities of Large Irrigated Farm

Item	Month and Period											
	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (1.7 Adult)	422	408	422	422	408	422	408	422	422	381	422	408
B. Non-Income Generating Activities: (hour)	95	90	93	75	60	61	72	58	84	92	121	109
Domestic Work	23	23	23	23	23	23	23	23	23	23	23	23
Religious + Social	54	57	62	38	25	18	36	27	49	51	78	72
Other	18	10	8	14	12	20	13	8	12	18	20	12
C. Minor Agr. Activities	74	38	37	41	95	98	71	48	91	89	91	91
D. Maximum Hours Available (D = A - B - C)	280	280	292	306	253	263	265	316	247	200	210	208

Appendix Table 36

Computation of Maximum Hours Available by Adult Females for Major Income Generating Activities of Large Irrigated Farm

Item	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (2.0 Adult)	496	480	496	496	480	496	480	496	496	448	496	480
B. Non-Income Generating Activities: (hour)	171	173	188	157	162	166	138	127	196	160	199	192
Domestic Work	86	86	86	86	86	86	86	86	86	86	86	86
Religious + Social	63	67	82	41	52	58	40	31	86	62	91	80
Other	22	20	20	30	24	22	12	10	24	12	22	26
C. Minor Agr. Activities	117	93	58	67	115	120	92	70	102	82	103	70
D. Maximum Hours Available (D = A - B - C)	208	214	250	272	203	210	250	299	198	206	194	218

Appendix Table 37

Computation of Maximum Hours Available by Child Labor for Major Income Generating Activities of Large Irrigated Farm

Item	May 1	Jun 2	Jul 3	Aug 4	Sep 5	Oct 6	Nov 7	Dec 8	Jan 9	Feb 10	Mar 11	Apr 12
A. Total Hours (0.7 Children)	115	112	115	143	112	115	112	143	115	106	123	168
B. Non-Income Generating Activities: (hour)	24	24	24	24	24	24	24	24	24	24	24	24
Domestic Work	24	24	24	24	24	24	24	24	24	24	24	24
Religious + Social	---	---	---	---	---	---	---	---	---	---	---	---
Other	---	---	---	---	---	---	---	---	---	---	---	---
C. Minor Agr. Activities	56	46	53	27	40	40	54	28	40	40	49	22
D. Maximum Hours Available (D = A - B - C)	35	42	38	92	48	51	34	91	51	42	50	122

Month and Period

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