Peanut production systems in a rain-fed subsistence-oriented agroecosystem in a riverine village in the Dry Zone of Myanmar

Moe Swe Yee[1*], A. Terry Rambo[2] and Suchint Simaraks[3]

Abstract: Peanuts are the second most important crop after rice in Myanmar. They are produced mainly in the Dry Zone. Multiple cropping and double cropping are typical for the Dry Zone because single cropping is not safe for the farmers facing the meager and unreliable rainfall on limited land. This paper describes the peanut production systems in a typical riverine village in the Dry Zone. Naung Pin Win village was purposively selected as a study site and a stratified random sample of 30 households representing different types of landholding was selected. Both quantitative and qualitative data were collected, using group interviews of the village committee and farmers, semi-structured interviews, direct observation and participation. Agriculture in the village is rainfed with seasonal flooding. Only some households raise rice but all households raise peanuts in either the wet or dry seasons. Peanuts are grown as a source of cooking oil for home consumption and are the major cash crop for all households. Peanut residues are also the main feed for cattle and are a source of cash income for households that do not own large livestock. There are four different types of peanut production systems: 1) Rainy season peanuts in the dryland, 2) Dry season peanuts in the dryland, 3) Dry season peanuts after rice in the wetland, 4) Dry season peanuts in the alluvial land. Each system has different cultivation practices, requires different inputs, and provides different benefits. Dry season production on alluvial lands gives the highest yields at the lowest input cost and plays an especially important role in the livelihoods of landless households.

Keywords: cropping systems, rainfed agriculture, multiple cropping, cost-benefit analysis, semi-arid zone, peasant agriculture

Introduction

The Dry Zone of Myanmar is a large semi-arid region with a monsoonal climate (Myanmar National Report, 2004) that has many agroecological conditions similar to those in Northeast Thailand. Most agriculture is rainfed and productivity of rice, the staple crop, is generally low and insufficient to meet the consumption needs of subsistence farmers (Htoo, 2007). Consequently, farmers must grow other crops (e.g., peanuts, pulses, cotton, bananas, toddy palms) and raise livestock in order to support themselves.

Peanuts are an especially important crop for rain-fed subsistence farmers in the Dry Zone. They are a source of cooking oil and food for home consumption, the oil cake and stover are used as livestock feed, and any surplus can be sold for cash (Phyo, 2008). In this article we describe the different types of production systems employed in peanut production in Naung Pin Win Village, which is located on the west bank of the Chindwin River in Saigaing Division (**Figure 1**). For each system, we describe cultivation practices, varieties planted, inputs and outputs, processing, consumption, storage, and sale, and analyze the costs and benefits of the different peanut production systems to the farmers.

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Materials and Methods

This paper is based on field research conducted by the first author in Naung Pin Win village from the last week of March to the first week of June 2008. Data sources included both primary and secondary data. Secondary data was collected from the annual report, offices of Settlement and Land Record Department, Myanmar Agriculture Service in township and the office of Village Peace and Development Council in the village. Primary data were collected in the village using semi-structured interviews with key informants, participation observation and group interviews. Thirty agricultural households, evenly divided among small landholders, big landholders, and landless, were randomly selected for detailed household interviews covering household history, family structure, occupations and economic status, crop production systems and management practices relating specifically to varieties, cultural practices, problems and constraints. Detailed data on quantities and cash values of all inputs and outputs in peanut production systems were also collected as part of these household interviews. Respondents answered questions about inputs and outputs using local measures but these have been converted to standard international scientific units for purposes of cost-benefit analysis (**Table 1**).

Observation was also heavily used in this research to get the detailed information related to farmers' activities in peanut production system and their livelihood. The first author lived in the village and observed the behavior of villagers on a daily basis, including participating with them in many activities relating to production of peanuts.

Table 1 Units used for input-output and cost-benefit analysis.

	Local measure	Equivalent international unit (kg)	Value (kyat)
Peanut seed	Basket	26	230,000
Manure	Cart load	250	2,000
Chemical fertilizer	Bag	50	25,000
Stover	Cart load	504	24,700

The study site

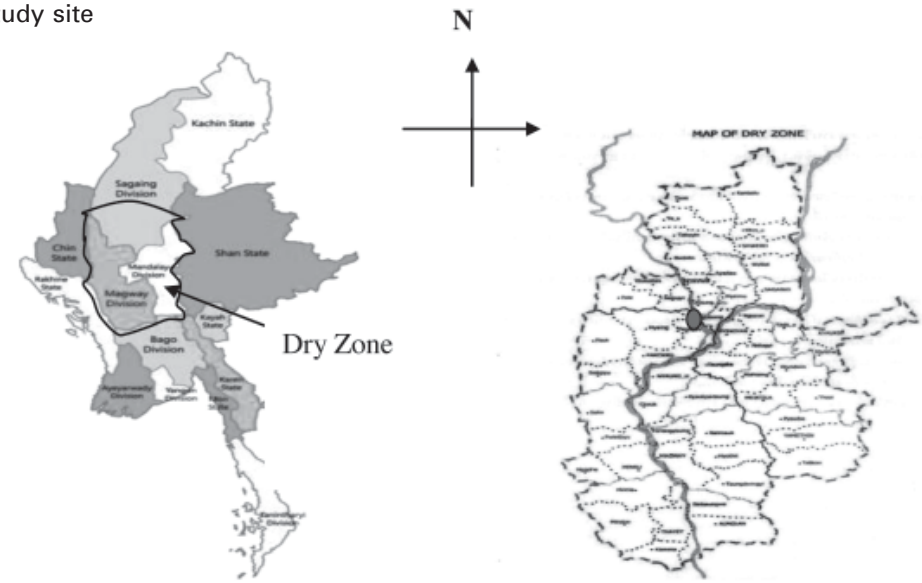


Figure 1 Map of the Dry Zone regions and location of study site.
Source: burmaexports.com

Results

The Dry Zone which is composed of Magway, Mandalay and Sagaing Divisions, is located in the central part of the Myanmar. The study village, Naung Pin Win, is situated in the administrative area of Kani Township, Monywa District, Sagaing Division (**Figure 1**). It is situated 58 kilometers away from Monywa City and 2 km from Kani Township. The village lies on the west bank of the Chindwin River and is next to the road from Kani Township to Monywa City.

Naung Pin Win village was established more than 60 years ago, before the independence of the country (Office of Village Peace and Development Council, 2008). Although the village started with 10 or 15 households, today it has 110 households, of which 104 are agricultural households. It has a total population of 739 persons (June, 2008) with an average density of 609 persons/km^2 and a nutritional density of 6 persons/ha.

The total land area of the village is 122 hectares, of which the agricultural land is 114 ha and the settlement area about 8 ha (Settlement and Land Record Department, 2008) but the total land holding of individual households is greater than this because some of the households also own dryland plots that are situated in other villages. There are three main types of land: wetland (*Le*-land), dryland (*Ya*-land), and alluvial land (*Kaing-Kyung*) (SLRD, 2003). Wetland is used for growing rice in the rainy season and other crops in the dry season. Dryland is used for growing cash crops, especially peanuts, in the rainy season. Alluvial land in the riverbed is submerged in the wet season and only available for cultivation of peanuts in the dry season. Except for a small amount of irrigation of dry season crops using tube wells, all crops are rain-fed.

The village has a monsoonal climate with distinct wet and dry seasons. Annual average rainfall is only 785mm (Weather report, 2008) with high variability from year to year and uneven distribution within each year. It generally rains when pre-monsoon cycles from the west come in. Sometimes, cyclones from the east also blow into this area and it eventually rains throughout the region from late May or nearly June until late September or early October (Myanmar National Report, 2008). The heavy rain is usually received in July and August but a dry spell occurs when dry desiccating winds blow from the south. **Figure 2** shows the bimodal rainfall pattern in Kani Township.

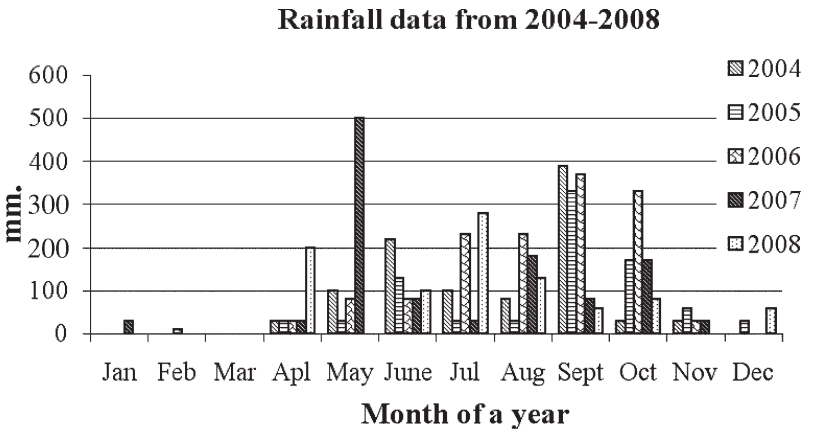


Figure 2 Monthly rainfall in Kani township. (2004- 2008).
Source: Kani Township weather station (2009)

The village is quite isolated and has only limited access to external markets. The road connecting the village to the city was only built in 2002-2003. Before that, the river was used for transportation. To reach neighboring villages and Kani Township, they use bicycles, motorcycles, and for transportation of some commodities they use bullock carts. When they go to the Monywa city to sell their produce or buy needed production inputs, they can travel either by motorbus or motorboat.

The village economy is based on agriculture and almost all people are farmers. Farm households produce food crops for home consumption as well as for sale to earn cash income. Almost all households also raise some livestock, both as food and as a source of cash income. Some households have members doing other livelihood activities (e.g., government staff, working abroad) but the other family members never give up doing agriculture. In most cases, farm work is done using only family labor, but hired labor is commonly used during peak seasons like seed sowing and harvesting of the crops. The agricultural households can be divided into three types based on size of land holding and ownership of livestock (**Table 2**).

Big farmers are the most numerous type of household, accounting for 50 percent of all agricultural households. They all possess at least 1 hectare of dryland, either within the village or in other villages; some big farmers, but not all, also possess some wetland used for growing rice. Small farmers (21 % of households) own less than one hectare, all wetland. Landless farmers (29 %) own no land but all households are able to cultivate a small area of alluvial land assigned to them by the village committee in the dry season.

Crops

Several dryland crops, including pigeon pea, cotton, sesame and peanut, are grown in the rainy season. In the dry season, peanut, chick pea, black gram, sunflower and pulses can be grown. In the wetland area, they grow rice in rainy season. Rice is grown for home consumption but the rice land area is relatively small and the yield is insufficient to support a family. If sufficient soil moisture is available for a second crop, the farmers grow peanut, black gram, wheat and onion as double cropping after rice. If they have sandy dry land, they grow bananas, which are the second most important crop for all households. There are many toddy palm trees, which were planted by former generations. All crops are grown on a small scale, are primarily for consumption although they are sometime sold when in surplus.

Cropping patterns

The village has three types of land with several different associated soil types. **Figure 3** shows the cropping calendar of households based on type of their land holding, soil types and season.

Table 2 Holdings of land and livestock of different types of households.

Types of household	Size of farm plots (ha)			Livestock ownership (head)		
	Dry land	Wet land	Alluvial land	Cattle	Chickens	Pigs
Small farmers (22 HHs) < 1 ha	-	0.5-1	0.25	-	1-5	-
Big farmers (52 HHs) 1-5 ha	1-5	0.5-1	0.25	2-4	1-5	-
Landless (30 HHs)	-	-	0.25	-	5-10	1-5

Livestock

Draft animals provide the main energy source for farm activities. Most large landholding households raise at least two cattle for farm activities. Landless and poor farmers do not keep cattle. Most households raise chickens, mostly to sell for cash, although they are sometime consumed on social occasions. Poor families raise pigs to sell as a way to earn extra income. . However, raising animals in this village is not on a large-scale commercial basis.

Peanut production systems

Four different types of peanut production systems are employed by farmers in this village:

1. Rainy season peanuts in the dryland
2. Dry season peanuts in the dryland
3. Dry season peanuts after rice in the wetland
4. Dry season peanuts in the alluvial land.

Each of these systems uses different types of land, employs different cultivation methods, requires different inputs and gives different outputs, and provides different benefits to the farmers.

Land preparation

For rainy and dry season peanut production in the dryland fields and wetland paddy fields, the land is plowed at least 3 or 4 times with animal power before the field is seeded. For dry season peanuts in alluvial land, only a single plowing is usually needed because soil structure is easy to till and seeding is also done at the same time.

Peanut varieties

The farmers plant the same two varieties of peanut in both seasons and all types of land (**Table 3**).

The *Spain* variety was first adopted sixty years ago and is still grown in the village until today. The farmers say that this variety is most adaptable for their agroecosystem and livelihood system. Although the *Khatoat* variety gives higher yield than the *Spain*, the yield is not stable. The main factor is that the *Spain* is a short duration variety so it takes less moisture than the *Khatoat*. The *Khatoat* variety needs more moisture and fertilizer than the *Spain*. They

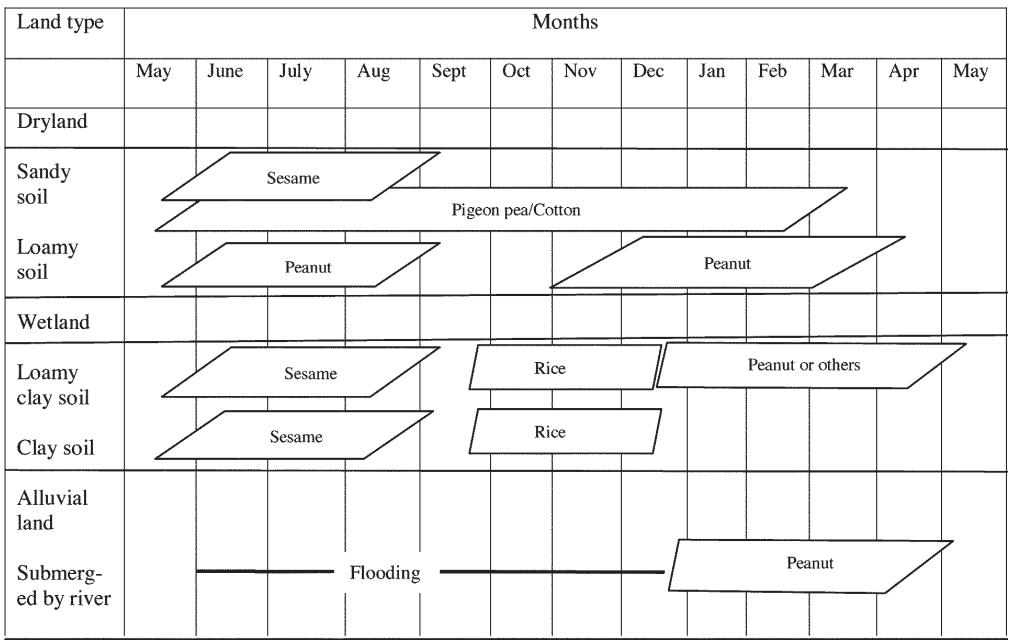


Figure 3 Cropping calendar of Naung Pin Win village.

Table 3 Characteristics of peanut varieties grown in Naung Pin Win village.

Variety	Duration	Color	Yield (in baskets)	Seed size	Eating quality	Oil content
Spain	120 Days	Deep pink	35-50	Small	Good	Good
Khatoat	135 Days	Pink	50-60	Big	Medium	Good

observed that the *Spain* variety gives stable yield, good oil content and is the most adaptable variety for their agroclimatological conditions. Therefore most of the farmers in the village use the *Spain* variety.

Production inputs and outputs

All tillage operations are done using only human and animal power. All adult numbers of farm households are involved in doing farm work. Land preparation for both dryland and wetland fields takes much more time and labor than for fields on alluvial land. The farmers that own their own cattle use them to plow the fields; otherwise they need to pay a cattle owner to plow for them. Peanut seeds saved from the rainy season crop are planted in the dry season because these are fresh and have a good rate of germination. The seeding rate is different in different seasons. For the dry season, the seeding rate is higher than the rainy season. That is because in rainy season peanut production, weeding is done using an animal drawn harrow. Therefore, farmers use a lower seeding rate and wider spacing between plants in order to allow the use of this implement for weeding. In the dry season, weeding is done by hand with a small hoe; this permits planting with a higher seeding rate and narrower spacing. Cow dung is the main source of fertilizer for wetland and dryland fields and farmers only use small amounts of chemical fertilizers such as phosphorus. Only small quantities of foliar fertilizer are used in alluvial fields. Pesticides are also used on a very small scale. Family labor and exchange labor are commonly used. Planting, harvesting and threshing are done mostly with family labor. Hired labor can also be used easily because the workers are paid with peanuts. **Table 4** shows the inputs and outputs involved in peanut production on different types of land.

Harvesting, threshing, shelling and storage

Harevsting, threshing, and shelling are all done by hand. For harvesting, they pull the peanut plant from the soil. If the soil is dry and compact, they first use small hoe to loosen the soil around the plants. Threshing is done by pulling the pods from the plants by hand. Shelling by hand is done with a simple cracking tool made from a toddy palm branch. The village women do this work in their leisure time as a group. After harvest, peanuts are stored in barns next to the farmers' houses. When they want to store peanut seeds for a long time, the unshelled peanuts are kept in the barn. If, however, they only want to store them for a short time, they shell the peanuts but keep the nuts together with the shells in a bag or basket. This method prevents the discoloration of seed and loss of oil content.

Processing, home consumption, and marketing of peanuts

After shelling, the farmers select some of the matured seeds to save for planting the next crop while most of the seeds are consumed by the households. Even though some households produce only a small quantity of peanuts, they try to keep all the peanuts they grow for making cooking oil for their home consumption. When they need oil, farmers take shelled peanut to one of the oil mills in the village. They pay

Table 4 Inputs and outputs in peanut production on different types of land (1 ha).

Land type	Activities	Inputs				Outputs		
		Animal power (cow days)	Human labor (person days)	Seed (kg)	Manure (kg)	Fertilizer (kg, liter)	Stover (kg)	Seed (kg)
Dryland (Rainy season)	Land preparation	67	67	131	3250	143	732	2500
	Weeding	5	30					
	Plant protection		8					
	Harvesting, threshing		125					
	Total	72	230	131	3250	143kg	732	2500
Dryland (Dry season)	Land preparation	67	67	183	3250	280	993	2500
	Weeding	5	30					
	Plant protection		8					
	Harvesting, threshing		130					
	Total	72	235	183	3250	280kg	993	2500
Wetland (Dry season)	Land preparation	73	73	183	3250	280	993	2500
	Weeding		35					
	Plant protection		8					
	Harvesting, threshing		130					
	Total	73	246	183	3250	280kg	993	2500
Alluvial land (Dry season)	Land preparation	20	20	131	0		1097	2500
	Weeding		30					
Plant protection			8			7.5		
Harvesting, threshing			125					
	Total	20	183	131	0	7.5 liters	1097	2500

Table 5 Costs and benefits (in Kyat) of peanut production systems on 1 hectare of different land types in different seasons.

	Dryland Rainy season	Wetland Dry season	Alluvial Dry season	Land Dry season
Inputs				
Cattle	72,000	72,000	73,000	20,000
Seed	150,000	210,000	210,000	150,000
Manure, chemicals	51,500	51,500	82,000	26,250
Labor	230,000	235,000	246,000	183,000
Total inputs	503,500	568,500	611,000	379,250
Outputs				
Peanut	840,000	1,140,000	1,140,000	1,260,000
Stover	123,500	123,500	123,500	123,500
Total outputs	963,500	1,263,500	1,263,500	1,383,500
Ratio of inputs/outputs	1:1.9	1:2.2	1:2.0	1:3.6

Note: Exchange rate (in 2009), 1 US dollar = 1000 kyats, 1 baht = 27 kyats.

the mill owner a small fee to press peanut seeds for peanut oil. Most of the households also sell the oil cakes to the mill owner, except for a few large farmers who use peanut cake as a feed supplement for their cattle. The fee for pressing peanut seeds to get the oil is small because the mill owner gets the profit by selling oil cake which is a valuable livestock feed that can be sold for a good price in the market in Monywa city, but is not sold inside the village. Their main goal in growing peanut is to be self sufficient for home consumption. In addition to making cooking oil, the villagers also consume boiled peanut, fried peanut, peanut sprout, and make traditional peanut snacks for social, cultural and religious activities. When the big farmers have surplus production of peanuts, they save the peanuts and sell them only when they need the money. The market for peanut oil in the village is not large so if any families have surplus oil they take it to Kani market to sell for cash.

Costs and benefits of peanut production

Costs and benefits differ among the different types of peanut production systems, depending on land type, soil type and season. **Table 5** presents a cost-benefit analysis of different types of peanut production. All inputs and outputs are shown in kyat.

Dry season peanut production on alluvial land has the most favorable input/output ratio of any of the production systems. Input costs are low because the soft fertile soil is easy to cultivate and requires minimal fertilization while yields are high because the supply of nutrients and soil moisture are adequate for the needs of the crop. Rainy season peanut production in dryland fields gives the lowest returns because of erratic rainfall. But this crop it is extremely important because it supplies the fresh seeds needed for dry season peanut production. Dry season production in dryland fields gives the same yield as dry season production in wetland fields but requires somewhat lower inputs so is marginally more profitable.

Discussion

In this village, the majority of people directly depend upon agriculture for their survival. The farmers in the village have adapted their agricultural practices to different land and soil types, erratic rainfall and seasonal flooding. They practice multiple cropping to

meet household needs for food and cash income.

The farmers produce peanuts in different seasons and on different land types (dryland, wetland and alluvial land). Human labor and animal power are utilized for most of the tillage operations. The close integration between peanut growing and livestock is beneficial for both plants and animals and increases the overall productivity of the agroecosystem (Fakoya 2002). Cattle provide draft power for cultivating the peanuts while the livestock feed on otherwise unusable parts of plants and crop by-products. In the case of this village, peanut stover is the most important feed for cattle. Seed cake left after pressing from the peanuts is also fed to pigs and chickens. At the same time, the peanut crop utilizes livestock manure as a source of nutrients. In this village, cow dung is the important source of nutrients to maintain crop productivity and to supplement chemical fertilizers. A mixture of cow dung and household wastes is the best organic fertilizer for their farm. Therefore, raising of crops (peanut) and livestock (cattle) are highly complementary activities within the village farming system.

Yields of peanut in this village in the dry season are somewhat higher than of average of 954kg/ha for the Sagaing division of the Dry Zone, but lower than the national average of 1,312kg/ha for Myanmar (compared to 1,517kg/ha in Thailand) (FAO, 2003). Due to the shortfall of edible oil production in Myanmar, several million tons of palm oil are imported annually to fulfill the local requirement (MOAI, 2001) so the government is attempting to implement a plan to increase both the yield per hectare and the total sown area of oil crops. In Naung Pin Win village, however, the farmers still use traditional technology and varieties. Little or no use is made of mechanization, irrigation, and chemical fertilizer in growing peanuts. The farmers in this village have a detailed knowledge of managing peanut production in different types of land and different seasons. Weed control is done manually or mechanically depending upon soil type and extent of weed infestation. For peanut production in the dryland area, the farmers use wider spacing with a lower seed rate. They use harrows for weeding because less soil moisture condition and soil structure is compact in the dryland. In the wetland peanut production, narrow spacing with a higher seed rate is used because the soil is less compact and moisture is suitable for hand weeding.

Peanut cultivation affects several emergent properties of the agroecosystem notably productivity and equitability. Most of the land is suitable for peanut production and has relatively high productivity. Dry season peanut production on alluvial lands has the highest yield of almost 1,100 kg of shelled peanuts/ha, which is close to the national planning target of 1,210kg per hectare (MAS, 2008). This production system is also the one that is the most economically beneficial for all households. Peanut growing on alluvial lands also contributes to equitability within the village since all agricultural households, including landless ones, receive an equal share of this land to cultivate. Peanuts from this land provide for the home consumption needs of the landless households while they can sell any surplus to meet cash needs. Peanut production in the alluvial land also enhances solidarity and autonomy (Rambo, 1985) because a share of each household's harvest is contributed to the community for development projects and to support Buddhist festivals. Autonomy is enhanced because peanuts are mostly produced using locally available resources and production is sufficient to meet local needs.

Conclusions

The production of dry season peanuts on dryland, wet land, and alluvial land fields makes an important contribution to the livelihoods of all agricultural

households in the village. The first benefit is to provide sufficient cooking oil for home consumption. Secondly, peanut residues are the main feed for cattle and a source of cash income for landless and small farmers who sell stover to large landholders for feeding cattle. They also sell peanut oil cake to gain extra income. Thirdly, surplus peanuts can be sold to provide for other household expenditures. Peanut plays an important role in supplying food for people and feed for cattle, household income as well as for their social, cultural, religious and development activities. Peanut production systems in this village are beneficial for all households (especially important for landless households). Their land, natural resources and peanut varieties they use, give quite high productivity, even though the farmers still employ traditional agricultural practices. Further research is needed to find out if introduction of suitable modern varieties and production technology can result in increased productivity in the face of the many environmental and economic constraints faced by the village farmers.

Acknowledgements

This paper is based on research done by the first author as part of her masters degree program in Systems Agriculture in the Faculty of Agriculture of Khon Kaen University. Her study was supported by the FAO (OPEC Project, Myanmar). Special thanks are given to the chairman of the Village Peace and Development Council and his staff, the managers of Myanmar Cotton and Sericulture Department and Settlement and Land Record Department, and all of the farmers in the village for their cooperation and advice throughout the research. Dr. Viriya Limpinuntana has provided useful guidance in the course of this research.

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