CHAPTER 3

RESEARCH METHODOLOGY

This section describes research method, which was separately carried out in two parts, the household survey and the field experiment.

3.1 Household survey

3.1.1 Site selection

Xieng Ngeun district was selected for the survey. The district is located about 30 km south of Luang Prabang municipality. The reason that Xieng Ngeun district was selected to represent the Luang Prabang area is that, first, the district has high proportion of upland rice areas (over 80% of district rice area is upland rice). Second, Xieng Ngeun district is one of 11 districts of Luang Prabang province that has been given special attention by the provincial authorities towards its forest protection, improving quality of life in shifting cultivation areas through environmentally sound development. Therefore, at the moment Xieng Ngeun district has several projects and institutions that are important to the development of upland agriculture, for example, the Northern Agroforestry Training Center, Northern Upland Crop Research Center, and the Shifting Cultivation Project.

3.1.2 Data collection

The survey was carried out in April 1998 using formal questionnaires. A total of 13 villages were selected with the help of the Xieng Ngeun Agriculture Service, in which 50 households were randomly selected for interviewing. The survey questionnaires focused largely on upland farming related issues such as cropping systems, production constraints and management, and socio-economic issues. Additional data were collected from publications and other related institutions.

3.1.3 Data analysis

The data from the survey was checked for normality. Descriptive analysis was used to qualify and quantify the significant relationships between selected variables.

3.2 Field experiment

3.2.1 Experimental site

The experiment was carried out in Mae Hia Research Station, Chiang Mai University. The Station is located at 18° 45'N latitude and 98° 55'E longitude, 330 m altitude. The average annual rainfall is 1,200 mm, which concentrates from May to September. Average temperature during cropping periods is 22 °C.

The soil of the area is Satuk soil series, a member of Oxic Paleustults (Virlsilp and Suksawat, 1991), with the chemical properties showing in the Table 3.1.

Table 3.1 Selected soil chemical properties of Mae Hia Research Station

Parameters	Depth (cm)	
	0-20	20-40
pH	6.40	6.16
Total N (%)	0.08	0.06
Available P (ppm)	7.75	3.67
Available K (ppm)	88.97	48.49
CEC (meq/100 g)	6.60	7.34

(Source: field samples)

3.2.2 Experimental design

The field experiment was a Randomized Complete Block Design (RCBD), with 4 replications. There were 8 treatments (Table 3.2), which included 2 monocropping (rice and pigeon pea, 3 strip cropping, 3 row intercropping, and 3 spatial arrangements in which the ratio of rice to pigeon pea, based on the percentage of the plot area, was 50:50, 75:25, and 25:75.

Table 3.2 Description of treatments tested.

Treatment	Cropping systems	Spatial arrangements in 54 m^2 (6m x 9m)
1.	Monocropping	Sole rice (100%RI)
2.	Monocropping	Sole pigeon pea (100%PP)
3.	Strip cropping	50%RI:50%PP, 18 rows of RI:6 rows of PP
4.	Strip cropping	75%RI:25%PP, 27 rows of RI:3 rows of PP
5.	Strip cropping	25%RI:75%PP, 9 rows of RI:9 rows of PP
6.	Row intercropping	50%RI:50%PP, 18 rows of RI:6 rows of PP
7.	Row intercropping	75%RI:25%PP, 27 rows of RI:3 rows of PP
8.	Row intercropping	25%RI:75%PP, 9 rows of RI:9 rows of PP

3.2.3 Crop management

The planting distance between rows and hills was 25x25 cm for rice, and 75x 25 cm for pigeon pea. The experiment was replanted on June 18, 1998. Rice was dibbled using dibble sticks, placing 10-20 seeds in each hole. Pigeon pea were also dibbled on the same day, placing 6-10 seeds per hole. Pigeon pea was thinned to 2 plants per hill, 20 days after planting.

The local rice variety, Chao How, and local pigeon pea variety, with growth duration of 145 days for rice and 295 days for pigeon pea, were used. During the growing period, the crops were kept weed free, regularly provided with water, and protected from pest damage, especially birds during flowering to ripening stage.

3.2.4 Data collection

During the growing season, rice and pigeon pea growth stages and performance was observed. Above ground biomass was measured 3 times for rice, and 4 times for pigeon pea. The above ground biomass and grain yield were estimated at 14% moisture.

3.2.5 Data analysis

The Analysis of Variance (ANOVA) was used to quantify the statistical significant difference among the treatments tested. The Land Equivalent Ratio (LER) was used to evaluate the productivity of intercropping treatments against sole crop treatments.

LER is the most frequently used measurement to evaluate effectiveness of an intercrop (Ofori and Stern, 1987; Trenbath, 1976; Vandermeer, 1989). It is an index of combined yield, which provides a quantitative evaluation of the yield advantage due to intercropping (Willey, 1979).

LER is defined as the total land area required under sole cropping to give the yields obtained in the intercropping mixture (eq. 3.1). Hiebsch and McCollum define Land Equivalent Ratio as:

$$LER = \frac{Yi\,1}{Ym\,1} + \frac{Yi\,2}{Ym\,2} \qquad\qquad (eq.\ 3.1)$$

Where,

Ym1 and Ym2 = sole crop yields of the component crop 1 and 2, respectively.

Yi1 and Yi2 = intercrop yields of the component crop 1 and 2, respectively.

When LER is equal or less than 1, there is no advantage to intercropping in comparison to sole cropping. When LER is greater than 1, a larger area of land is needed to produce the same yield in sole crop than with an intercropping mixture.

3.2.6 Economic analysis

Economic analysis, such as cash return per unit area or per unit of input, is often used to compare different intercropping systems. However, economic analyses of input-output relationships may not be very useful for subsistence farmers where the prices of inputs and outputs fluctuate highly, and the farmers practice intercropping or farm for their own consumption, or when the introduced intercrop has no market value (Gupta and O'toole, 1986). Therefore, economic analysis was not quantified in this study.