Research article

Farmers' Soil Conservation Practices of Maize Production, Paklay District, Sayabouly Province, Lao PDR

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Abstract Soil degradation is a big problem on the hill slopes in the Lao PDR where maize is the main crop and intensively grown. Due to this, maize yield was lower than 3.8 ton/ha which also impacted the environment as well as farmers' incomes. Soil Conservation Practices (SCP) are important alternative methodologies for soil conservation on sloping land. The objective of this study was to examine the farmers' current soil conservation practices for maize production in Paklay district, Sayabouly province. The study employed participatory rapid appraisal (PRA) methods and data was collected through focus group discussions and semi-structured interviews from three villages (Village 1: Palay 46 households, Village 2: Boumlao-Phakeo 90 households and Village 3 Senphon 25 households, totaling 161 households). The key informant interviews were implemented through the staff of the District Agriculture and Forestry Office (DAFO) and the village headmen. The results showed that 73% of farmers practiced SCP; the major SCP practices included 100% intercropping, 60% crop residue management, 12% crop rotation, 12% conservation tillage and 3% organic fertilizer application. The use of SCP showed an increase in soil fertility, an improvement in the maize yield and soil erosion prevention on hill slopes. The majority of maize farmers who adopted SCP applied the legume intercropping method. The legume (i.e. groundnut, red bean, mungbean and black bean) were planted two weeks before the maize harvest. Crop residue was used for mulching (conserving soil moisture and soil nutrition). Furthermore, knowledge of SCP systems such as chemical use, residual crops, intercropping, mulching, tillage, and chemical soil contamination needed to be provided to farmers by staff of the DAFO.

Keywords maize, soil conservation practice, crop rotation, intercropping

INTRODUCTION

In Laos, many rural farmers have traditionally been engaged in subsistence food production. Since the middle of 1980s, the government of Laos has publicized a slow liberalization of the national economy. Shifting cultivation was replaced by the intensive cultivation of cash crops such as maize, sugarcane, cassava and rubber (Viengpasith et al., 2012). Amongst the cash crops, maize has been ranked the first in terms of volume (Phanvilay et al., 2006). Therefore, the area of maize production has increased more than 7 times from 2003 to 2010 (Thanichanon, 2012).

Sayabouly province is one of the provinces which produces the largest amount of maize as maize covers more than 98% of the total area (Lestrelin and Castella, 2011). However, over the past decade, maize production has extended into preserved forest areas. Moreover, plowing practices and increased application of pesticides, herbicides and chemical fertilizers contribute to soil degradation (e.g. soil erosion, weed outbreak, and chemical contamination) (Lestrelin et al., 2012). In addition, an increase in

the volume of maize production combined with low productivity will need more farmland and this tends to cause a change in land use and land covers.

In the 2000s, conservation agriculture had been promoted in Sayabouly province by Application Site Southern Sayabouly or Point d'Application du Sud du province de Sayabouly (PASS) and the National Programme on Agro-Ecology or Programme National Agro-Ecologie (PRONAE) in order to maintain soil fertility for sustainable agriculture in the transitional period for agriculture while controlling the negative impacts on land use. Conservation agricultural practices such as no-tillage, cover crops, crops rotation and/or crop residue management have been shown to have positive impacts on preventing soil erosion, as well as having a positive impact on soil maintenance and/or the renewal of the soils' physical, biological and chemical properties and on soil moisture (Lestrelin et al., 2012).

Therefore, one of the key factors for improving the efficiency of maize production is to increase the technical efficiency of maize farmers (Southavilay et al., 2012). Moreover, soil conservation practices are the best way to enhance maize product and sustainable land use.

OBJECTIVE

The objective of this study was to examine farmers' current soil conservation practices on maize production in Paklay district, Sayabouly province.

METHODOLOGY

Samples were selected from the famers who currently cultivate maize and the famers who had been involved in the PASS and PRONAE projects in years 2000s in Paklay district. Data collection was done through the participatory rapid appraisal (PRA) approach in 3 villages (village1: Palay, village 2: Boumlao-Phakeo and village 3: Senphon). Village headman interviews, focus group discussions and household interviews were conducted. Semi-structured interviews were conducted with a total of 161 household representatives, which was made up of 46 households from Village 1, 90 households from Village 2 and 25 households from village 3. The topics for focus group discussions and interviews included a history of farmers' traditional practices, soil management practices, cropping patterns and physical characteristics of the study areas. The total numbers of samples were calculated by Yamane (1967) as shown in Table1.

Table 1 Household interviewees in three target villages

Village	Total Household (HH)	Percentage of household (%) Cultivating maize	Household interviewed (HH)
Village 1	348	98	46
Village 2	928	95	90
Village 3	295	98	25
Total			161

Source: Field survey, 2015

RESULTS AND DISCUSSION

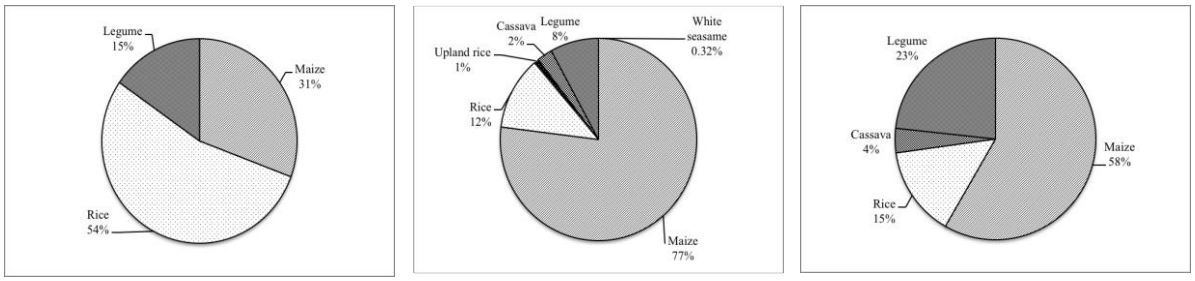
Background of Conservation Agriculture Promoted in Study Area

For intensive crops production in hill slope areas, conservation agriculture (CA) had been promoted through PRONAE (started 2001) and PASS (started 2005) in the 2000s. The concept of the projects

was direct seeding mulch-based cropping (DMC) systems. DMC systems are cropping systems that involve no-tillage and permanent plant cover on the soil. The government had set a policy to spread CA over all the country to reduce soil degradation, chemical use and improve soil fertility to help preserve the environment.

Main Crops and Soil Characteristic

Farm types: There are various crops which are grown in these areas. Rice is the main crop for household consumtion, while maize, legume and other crops are commercial crops. Farm types in all the three villages have a similar pattern because the environmental context and the livelihoods are similar in terms of the cropping areas in each village. In Village 1, maize production covered 31% of the planted area, rice covered 54% and the legume area covered 15%. In Village 2, maize production was highest at 77%, while the rice planted area was 12% and the legume planted area was 8%. For Village 3, rice covered 15% of the planted area, maize covered 58% and legume covered 23% as shown in Fig. 1.



Village1: Palay Village 2: Boumlao-Phakeo Village 3: Senphon

Fig. 1 Farm types in three villages of study area

Soil charateristics: According to the interviews with farmers, it was found that there are six different soil types in the study areas. The majority of soil types are loamy soil. This soil type is very suitable for cultivation, especially for maize production. The soil characteristics in the three villages are quite similar. Loamy soil contributes to 67%, 60% and 76% of the agricultural area in villages 1, 2 and 3 respectively. In addition, there is chalky soil at 12%, 17% and 20% for villages 1, 2 and 3 respectively.

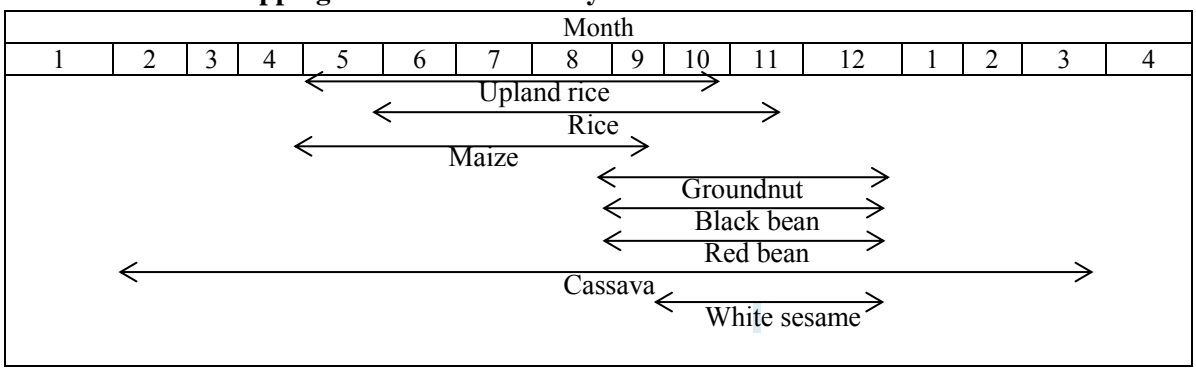
Table 2 Soil characteristics of three villages

Physical	Village 1 (n=46)		Village 2 (n=90)		Village 3 (n=25)	
Soil type	▪ Loamy	67%	▪ Loamy	60%	▪ Loamy	76%
	▪ Sandy	-	▪ Sandy	4%	▪ Sandy	-
	▪ Clay	8%	▪ Clay	1%	▪ Clay	-
	▪ Silty	14%	▪ Silty	10%	▪ Silty	-
	▪ Peaty	-	▪ Peaty	9%	▪ Peaty	4%
	▪ Chalky	12%	▪ Chalky	17%	▪ Chalky	20%

Source: Field survey, 2015

Cropping calendar: In the study areas, most of the cropping activities were concentrated during the rainy season because the area is sloping land. There were no irrigation systems for crop production in the dry season. Table 3 shows the duration of the cropping season for the three villages.

Table 3 Cropping calendar of the study areas



Source: Field survey, 2015

Famers' Practices in Maize Cultivation

Maize production systems: In the past, maize production was a traditional practice where farmers depended on indiginous knowledge. Since the government has introduced the policy of stopping slash-and-burn and shifting cultivation, the area was replaced by intensive, market-oriented agriculture. Maize became the first and most important cash crop which generally involved the use of hybrid varieties, fertilizers and pesticides, the burning of crop residues for land preparation and plowing on steep slopes, (even mechanical plowing with tractors). After a conservation agriculture project had been impremented, the maize production system has been changed to intercropping and crop rotation so the famers in the study areas mostly practice maize and legume relay intercropping. There are four kinds of legumes which include groundnut, red bean, black bean, and mungbean in this system.

Soil conservation practices: It was found that the farmers in the three villages practiced similar methods of SCP because the context of the area was also similar. In total, 73% of farmers practiced SCP. The major practice of SCP was 100% intercropping followed by 60% crop residue management, 12% crop rotation, 12% conservation tillage and 3% organic fertilizer application as shown in Table 4.

Table 4 Soil conservation practices of farmers in the study areas (N=161)

Study area	Soil conservation practices (%)		Soil conservation practices									
			Inter-cropping		Crop residue		Crop rotation		Conservation tillage		Organic fertilizer	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Palay	30	19	30	25	17	24	5	42	5	42	2	50
Boumlao-Phakeo	71	44	71	60	44	62	3	25	3	25	1	25
Senphon	17	11	17	14	10	14	4	33	4	33	1	25
Total	118	73	118	100	71	60	12	10	12	10	4	3

Source: field survey, 2015

The households interviewed were questioned about the methods of SCP that they had applied to their farmland and were asked to explain the details of each method. The current practices for SCP in the study areas had the following processes:

Intercropping: The farmers' responses showed that legumes have been used for intercropping with maize production. Legume cropping starts near the end of the rainy season because it's resistant to dry conditions and it is also a short duration crop. In practicing intercropping, farmers planted legume within one or two weeks before the maize harvest; they planted only some part of the maize area in one year and moved to other parts of the maize area for the next year. As the farmers observed, legume

intercropping could improve soil fertility. Furthermore, legume production could increase the family income.

Crop residues management: In general, crop residue management is not widely practiced yet but some farmers have used the agricultural residues for controlling soil erosion and suppressing weeds. In addition, maize residue can be bean trellis and livestock feed. There are a small number of farmers who burn crop residues after the harvest for land clearance before they plough the land to grow maize.

Conservation tillage: In the study areas, only 10% of farmers practiced conservation tillage. The condition of the areas is suitable for conservation tillage because land preparation for the high slopes must consider soil erosion. The conservation tillage methods are practiced for reducing soil erosion on the farmland and the plowing is conducted across the slope. Moreover, conservation tillage maintains soil fertility. There were farmers that do not plough or plough only some years to preserve soil fertility, decrease soil degradation and soil erosion. However, farmers are still concerned about conservation tillage as it may cause hard soil and extreme weed growth.

Crop rotation: Farmers grew legume as a part of a crop rotation program, especially groundnut. They would grow groundnut after maize, but the proportion of groundnut was less than maize. Aside from improving soil fertility, legume rotation also has the advantage of reducing soil degradation. It could also generate more income for the farmer.

Organic fertilizer: In the study area, not many farmers applied organic fertilizer in order to improve soil fertility, mainly by using manure from livestock. Organic fertilizer has not been well acknowledged and livestock production in the study area still uses traditional systems so famers do not have much manure from their livestock to apply to farmland. After the planting season, farmers let their cattle roam freely so their farmland gained manure from freely released animals. Although organic fertilizer is not enough for crop production, it can still help to improve soil fertility.

Farmers' adoption level on SCP: Depending on the number of SCP methods practiced, it was found that there were three levels of farmers' adoption of SCP, 11.80%, 33.54% and 27.95% of farmers had high, medium and low levels of adoption respectively. In addition, there were 26.71% of farmers who did not adopt any method of SCP.

Table 5 Adoption levels of farmers sampled

Adoption Category	Variable	Frequency	
		Number	Percentage
0	Non-adoption	43	26.71
1	Low adoption level	45	27.95
2	Medium adoption level	54	33.54
3	High adoption level	19	11.80
Total		161	100.00

Source: field survey, 2015

Farmers' understanding on SCP: According to focus groups discussions and semi-structured interviews, it showed that farmers understood the advantages and disadvantages of SCP methods before the adoption of SCP. In addition, the practices also showed that farmers understood soil conservation practices.

CONCLUSION

This study indicated that about 73% of farmers practiced SCP, which included the five main methods. 100% of farmers practiced SCP by intercropping, 60% by crop residue management, 12% by crop rotation, 12% by conservation tillage and 3% with organic fertilizer. Furthermore, it was found that there were three levels of farmers' adoption of SCP, 11.80%, 33.54% and 27.95% of farmers had high, medium and low levels of adoption respectively. In addition, there were 26.71% of farmers who did

not adopt any method of SCP. Moreover, farmers understood that SCP is the knowledge, perception and practice needed for soil fertility improvement. Therefore, in order to improve soil fertility, it is necessary to improve the knowledge, the perceptions, adoption levels and the practices of famers of SCP methods.

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