Extension and determinants for adoption of direct seeding mulch-based cropping systems in smallholder agriculture, LAO PDR

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Keywords: smallholders; agricultural innovation; conservation agriculture; adoption;

Introduction

Since the 1930s and the so-called Dust Bowl that affected the American Great Plains, growing concerns have been raised regarding the long term ecological and economic impacts of tillage in agriculture. As a response to these concerns, a variety of alternatives have been developed worldwide. Practices like direct seeding for instance emerged in the 1970s among soybean and wheat farmers confronted with severe soil erosion issues in southern Brazil (Bolliger et al. 2006). According to global assessments, some 106 million hectares of agricultural land would be cultivated with CA or (at least) no-till systems (Derpsch and Friedrich 2009). However, important questions have been raised concerning the potential and actual extent of CA in contexts of resource-poor smallholder agriculture (e.g. Erenstein 2003; Bolliger et al. 2006; Giller et al. 2009). This paper contributes to advance the debate by looking at the dissemination and adoption of conservation agriculture in Lao PDR where two research-development initiatives have supported experimentation and dissemination of direct seeding mulch-based cropping systems (DMC). It does so through a 4-year agroeconomic monitoring of 2,160 smallholder farmers and a coupled, statistical and qualitative approach to the farm-level determinants for adoption of CA. The study aims at examining diverse local socioeconomic and environmental situations (i.e. four districts and twenty-one villages studied) and providing robust empirical evidence on the dynamics of CA adoption in small holder agriculture.

Materials and methods

This paper presents the results of a 5-year monitoring and evaluation study conducted in twenty-one villages targeted for dissemination by research and development projects. A rapid questionnaire survey was conducted annually, from 2005 to 2008, to assess several basic farm characteristics (e.g. land tenure, land uses, incomes, farm inputs) among a random sample of 2,160 households in twenty-one target villages. A more detailed questionnaire survey, including variables like education, wealth and environmental perceptions, was then conducted in 2006 and 2008 among 462 households of four villages. On-farm monitoring data collected among members of farmer groups has also been used for characterizing the agroeconomic productivity of different DMC systems and tillage-based maize monoculture (i.e. crop yields, labour inputs, incomes and production costs). In order to get more qualitative information, a series of twenty-two semi-structured interviews was conducted in four villages selected as representatives of a gradient of environmental constraint. Southern Sayaboury province spans across three main geomorphologic zones with different characteristics in terms of slopes, erosion-risks and soil productivity: from the west (Thai border) to the east (Mekong river), a steeply sloping and erosion-prone sandstone-argillite area, a productive and moderately sloping clayey-illite schist area with basic rock intrusions, and a productive and relatively steeply sloping clayey-ferruginous schist area.

Results and Discussion

In 2008, after four years of dissemination, CA had become an important constituent of the agricultural landscapes in southern Sayaboury province (more than 1000 family for a total of 1500 ha cultivated under DMC). However, significant spatial variations could be observed as regards the numbers of farms engaged in CA and the extent of CA relative to other crop management practices. Indeed, CA covered from 1 to 40% of total rainfed area in the four different district. Four observations emerge from statistical analysis: (i) farmers engage in CA independently of their workforce, wealth, age and education level, (ii) farmers that have access to important rainfed land resources are more inclined to engage in CA, (iii) farmers that engage in CA can more easily expand their cultivated surfaces, and (iv) farmers cultivating soils with limited agricultural potential are more inclined to engage in CA.

Qualitative data show that, reduced production costs and improved labour productivity are likely to represent key incentives for the adoption of alternative cropping systems – this time, regardless of the local biophysical context. DMC presents clear benefits in terms of reduced production costs (-18% in average), increased net incomes (+12% in average) and enhanced labour productivity (+23% in average). However, interview data also suggest that environmental concern and engagement in CA can hardly be considered independently from project sensitization activities. Field demonstrations and project meetings figure relatively high among the motivations of farmers to experiment CA. As described by several interviewees, project operators can play a significant role not only in promoting solutions to environmental issues experienced locally but also in providing external assessments and raising environmental awareness. However, the extent of CA in the study area cannot be exclusively attributed to the members of the projects farmer groups. As shown by disaggregated data on adoption rates and cultivated surfaces, CA had spread beyond the farmer groups for up to 20% in Kenthao District.

More generally, in line with the assessment of Knowler and Bradshaw (2008), the study indicates that the factors influencing farmers' decision-making are highly context-specific (e.g. local land degradation and production costs issues, involvement of local elites, markets for secondary crops). Thus, the question of environmental awareness appears fundamental. Without sensitization efforts, it is likely that CA adoption in areas benefiting of productive soils will remain low until the resource base has degraded significantly. Although labour-related issues may appear unjustified in view of the agroeconomic performances of CA, an observation that emerged recurrently during interviews can provide the explanation: the absence of private operators providing technical services specific to CA. Cover crop or residue management, herbicide spraying and sowing in DMC systems require access to specific equipment and technical know-how. Thus, beyond research and farm extension, the dissemination of CA may also require a transformation of the agricultural industry itself.

References

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Figures and Tables

Table 1. Correlation coefficient matrix (Pearson): household capital assets, age and education level of the household head and relative extent of DMC in household rainfed land (2006, n=456).

	% DMC	Capital assets	Age	Education
% DMC	1	-0,078	0,004	-0,088
Capital assets	-0,078	1	0,047	0,090
Age	0,004	0,047	1	**-0,373**
Education	-0,088	0,090	**-0,373**	1

Note: Underlined values represent significant correlations (at the 0.01 level). Household capital assets were derived from household property in transportation and agricultural equipments.

Table 2. Reasons for experimenting and not experimenting CA in Nongphakbong, Houaylod, Paktom neua and Bouamlao (frequency of answers, 2008)

Experimentation (232 respondents)	
Reasons	*Freq.*
Curiosity	36%
Follows experience of neighbours	23%
Needs soil conservation issues	12%
Needs lower production costs	9%
Motivated by meetings/demonstrations	5%
Needs weed control	4%
Needs soil fertility control	3%
Confident in project experience	2%
Others	6%

Disinterest (205 respondents)	
Reasons	Freq.
Important labour charge	26%
Strenuous sowing	21%
Strenuous herbicide spraying	10%
Toxicity of the pesticides	10%
Lack of information	9%
Important production costs	5%
Non adapted to dense fallows	4%
Plots too far from road	3%
Others	12 %

Figure 1. Adoption of DMC 2005-2008 (% of household practising)