Soil quality, management practices and sustainability of pineapple farms in Cavite, Philippines: Part 2. Management practices and sustainability assessment

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ABSTRACT

The management practices and sustainability of pineapple farms in Cavite, Philippines, were assessed. Most farmers are plowing and harrowing their land 3-4 times a year. Single row planting is predominant (95 %) as well as pineapple monocropping (67 %). Only 7.5 % of the farmers are practicing any soil and water conservation measures. More than half of the farmers are applying nitrogen fertiliser above the recommended rate, representing a waste of valuable farm resource that could also lead to nutrient pollution problems. The Framework for Evaluating Sustainable Land Management was used to assess the sustainability of each farm in terms of productivity, security, protection, economic viability, and social acceptability. Results showed that the pineapple farming systems are weak with respect to the security and protection pillars of sustainability due to the lack of long-term incorporation of crop residues and the general absence of on-farm soil and water conservation measures. These are the issues which should be addressed by agricultural extension programs to ensure the environmental sustainability of pineapple farming in the province.

Key words: Sustainability assessment, pineapple farming.

INTRODUCTION

In a preceding paper, soil quality indicators of selected pineapple farms in Cavite were measured and evaluated with respect to soil quality standards, and fertiliser recommendations were tailored to suit each farm (Guinto & Inciong, submitted). In this paper, we attempt to use soil quality indicators and soil management practices as components of farming systems sustainability coupled with farm-level socio-economic data as exemplified in the Framework for Evaluating Suitable Land Management (FESLM) approach where soil qualities and other factors affecting productivity, economic viability, social acceptability, security and protection are used to predict the sustainability of farming (Smyth & Dumanski, 1993). The FESLM is based on the definition of sustainable land management as a system that combines technologies, policies, and activities aimed at integrating socio-economic principles with environmental concerns so as to maintain or enhance production and services simultaneously; reduce the level of production risk; protect the potential of natural resources; be economically viable, and be socially acceptable (Dumanski & Smyth, 1994). The FESLM approach consists of a logical analysis procedure for guiding the evaluation of land use sustainability. The three main stages are: (1) identification of the purpose of evaluation, specifically land use systems and management practices; (2) definition of the analysis process which consists of evaluation factors, diagnostic criteria, indicators and thresholds to be utilized; and (3) an assessment endpoint that identifies the sustainability status of the land use system under evaluation. Learning about these parameters can help us maintain and/or improve farming systems sustainability. It is important to note, however, that soil qualities are only one component of the many factors affecting productivity and, subsequently, sustainability (Ringrose-Voase *et al.*, 1997). The objectives of this paper were to: (1) document and assess the fertilisation and soil management practices of pineapple farmers in Cavite; and (2) assess sustainability of the pineapple farms using the FESLM approach of the International Board for Soil Resources and Management (IBSRAM).

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MATERIALS AND METHODS

Data on socio-economics and management technologies of farmers were obtained from a Bureau of Agricultural Research, Department of Agriculture-funded research project on the socio-economic impact assessment of pineapple technology in Southern Tagalog and Bicol Regions by Dr. Alice T. Valerio of the College of Economics and Development Studies, Cavite State University (Valerio, 2002). During the interviews, a survey questionnaire was used to ask farmers about their farm management practices (including soil management practices) and to obtain socio-economic data (e.g. land tenure, years engaged in farming, etc.). Details of the survey questionnaire are provided in Inciong (2004). A total of 38 pineapple farmers from Indang, Silang, Alfonso and Tagaytay City participated in the interview.

Sustainability of pineapple farms was assessed using the Decision Support System for Evaluating Sustainable Land Management in Sloping Lands of South-East Asia Version 1.1 (Alpha-Test Version) Software (Rais *et al*., 1997; IBSRAM, 2000). In this software, the five pillars of the international Framework for Evaluating Sustainable Land Management (FESLM) (Smyth & Dumanski, 1993) were used. These include productivity (e.g. yield, soil organic matter and nutrients), security (e.g. long-term trends in rainfall and variability), protection (e.g. soil erosion), economic viability (e.g. benefit-cost ratio, on-farm and off-farm income, labor availability), and social acceptability (e.g. land tenure, access to extension services). The SLM indicators along five FESLM pillars have been transformed into several user-friendly questions. For each question, one of the multiple choice answers can be selected. Some examples of the questions pertain to land holding size (less, than 1 ha, 1 to 2 ha, more than 2 ha); annual cropping intensity (2 to 3 crops with conservation measures, 2 to 3 crops without conservation measures, one crop with conservation measures, one crop without conservation measures); land tenure (full ownership, long term user rights, no official land title). The relevant answers for the farm being evaluated were input into the DSS-SLM system. Based on the information for a specific farm, DSS-SLM provides an assessment of the sustainability status of the farm as influenced by land management practices by the farmer. The sustainability status for each of the FESLM pillars namely productivity, security, protection, economic viability and social acceptability is provided as one of the four following possible scenarios: Score=1: land management practices meet sustainability requirements; Score=2: land management practices are marginally above the threshold for sustainability; Score=3: land management practices are marginally below the threshold for sustainability; and Score=4: land management practices do not meet sustainability requirements. Full details of the assessment technique are provided in Rais *et al.* (1997, 2000).

RESULTS AND DISCUSSION

Management practices of pineapple farmers

The management practices of the pineapple farmers in the four municipalities of Cavite are shown in Table 1. Most of the farmers are plowing and harrowing their land 3-4 times a year. Single row planting is predominant (95 %). Multi-cropping is practiced by the farmers although mono-cropping is more dominant (67 %). Only 7.5 percent of the farmers are practicing any form of soil and water conservation measures. This is most likely because majority of the farmers (65 %) are tenants while the rest (35 %) are owners. Lack of awareness on the importance of conserving valuable topsoil could also be one reason. Soil and water conservation measures practiced by those few farmers include mulching using coconut fronds and pineapple residues, and planting strips of Napier grass (*Pennisetum purpureum)* at the edges of their farms.

Fifty-five percent of the farmers are applying nitrogen fertiliser above 300 kg N/ha, which is well above the recommended rate of 250 kg N/ha. Only 1 farmer (3 %) applies phosphorus fertiliser on his farm. Application of fertiliser nitrogen above the recommended rate is counter-productive because excessive nitrogen does not benefit the plant at all, represents a waste of valuable farm resource, and could cause nutrient pollution via nitrate leaching or sediment runoff leading to eutrophication of streams and rivers.

Correlations between management practices and soil quality were computed but no significant relationships were found (data not presented). Similar results were obtained by Ringrose-Voase *et al.* (1997) who indicated that the reason for the low correlations is that

Table 1. Management practices of pineapple farmers in upland Cavite.

Management practice	Frequency	Number of farmers	Percentage
Plowing			
	1-2	11	29
	3-4	20	53
	5-6	7	18
Harrowing	0	1	3
	1-2	15	39
	3-4	18	47
	5-6	4	11
Planting system	Single row	38	95
	Double row	2	5
Cropping system	Mono-cropping	27	67
	Multi-cropping	13	33
Soil and water conservation techniques	Presence	3	8
	Absence	37	92
Planting density (plants per hectare)	10000-20000	21	55
	21000-30000	16	42
	>30000	1	3
Kg N/ha applied	<100 kg	1	3
	100-300 kg	16	42
	>300 kg	21	55
Kg P_2O_5/ha applied	None	37	97
	100-200 kg	1	3

soil qualities and management practices are only one component of the many factors affecting productivity.

Sustainability assessment of the pineapple farms

Sustainability of farms was assessed using the five pillars of the Framework for Evaluating Sustainable Land Management (FESLM) using IBSRAM's DSS-SLM software. These include: productivity, economic viability, social acceptability, security, and protection. It should be noted that the version of DSS-SLM software used in this research contains only a diagnostic module which identify sustainability status of the farm for each FESLM pillar. The prognosis or prediction aspect of DSS-SLM is still under development (IBSRAM, 2000). Nevertheless, the diagnostic module in itself is already useful in highlighting the weak spots of a particular farm in order to improve its sustainability in the future.

Regardless of town, all of the farms are marginally above the threshold for sustainability using the productivity criterion (Score=2, see Table 2). Productivity rating was not affected by the low value of N, since farmers are applying nitrogen fertilizers to boost their yield. The average yield of most of the farms is less than 25 percent of the average yield of the community (21 t/ha according to the Bureau of Agricultural Statistics (BAS), 2003).

Using the economic viability criterion, 82 % of the farms are marginally above the threshold for sustainability and only 16 % met the sustainability criterion.

All of the farms have direct access to main roads, making transportation of harvested pineapple fruits easy, and agricultural inputs are available as required. Farmers are either owners or tenants with long-term user rights. Also, health and educational facilities are adequate, making pineapple farming socially acceptable. Thus, about 60 % of the farms are marginally above the threshold while near 40 % of the sites met the sustainability threshold.

The security criterion has three indicators: average annual rainfall, drought frequency and the amount of biomass or crop residues plowed back to the land. All farms have sufficient rainfall and drought occurrence

Table 2. Number and percentage of farms belonging to a particular sustainability score by FESLM pillar category.

FESLM pillar	Score*	Number of farms	Percentage
Productivity	1	0	0
	2	38	100
	3	0	0
	4	0	0
Economic viability	1	6	16
	2	31	82
	3	0	0
	4	1	2
Social acceptability	1	15	39.5
	2	23	60.5
	3	0	0
	4	0	0
Security	1	0	0
	2	0	0
	3	0	0
	4	38	100
Protection	1	3	7.9
	2	14	36.8
	3	18	47.4
	4	3	7.9

*1 = meets sustainability; 2 = marginally above the threshold for sustainability; 3 = marginally below the threshold for sustainability; 4 = does not meet sustainability criterion

is not frequent, but the amount of crop residues incorporated back to the soil on a long -term basis is low. This is regarded as critical by DSS-SLM making all of the farms not sustainable using the security criterion of the FESLM (Score=4).

Almost half of the farms (47 %) are marginally below the protection criterion. Most farmers are not doing any erosion control practices and most of them are engaged in monocropping which makes the soil more prone to erosion and nutrient loss. About 37 % of the farms, however, are marginally above the protection criterion.

Table 3 shows the mean sustainability assessment scores of the four pineapple growing municipalities of Cavite by FESLM pillar. For productivity and economic viability, all of the municipalities were marginally above the sustainability threshold. For social acceptability, Silang met the sustainability threshold while the rest of the municipalities were marginally above the sustainability threshold. As explained earlier, all municipalities scored poorly with respect to the security pillar. For the protection pillar, Alfonso and Silang fared better than Indang and Tagaytay (Score of 2 vs. 3).

Table 3. Mean sustainability assessment scores of the four pineapple growing municipalities of Cavite using the five pillars of FESLM.

Town	Number of farms	FESLM Pillar				
		Productivity	Economic viability	Social acceptability	Security	Protection
Indang	9	2*	2	2	4	3
Alfonso	9	2	2	2	4	2
Tagaytay	10	2	2	2	4	3
Silang	10	2	2	1	4	2
All farms**	38	2	2	1.7	4	2.8

*1= meets sustainability; 2 = marginally above the threshold for sustainability; 3 = marginally below the threshold for sustainability; 4 = does not meet sustainability criterion
**For all farms, the value of each FESLM pillar is a weighted average.

CONCLUSION

The use of soil quality indicators and soil management practices together with socio-economic data using the FESLM approach is useful in assessing the sustainability of pineapple farms in Cavite. The evaluation revealed that pineapple farming systems of the province are weak with respect to the security and protection pillars of sustainability due to the lack of long-term incorporation of crop residues and the general absence of on-farm soil and water conservation measures. Extension efforts by the Department of Agriculture and Cavite State University need to raise farmers' awareness on these issues to ensure that pineapple crops are grown in an environmentally sustainable manner into the future.

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