Participatory action by the community in sustainable land use management for agricultural systems on the Ban Eang watershed Saluang sub district Maeteang district, Chiang Mai province, Thailand

Chackapong Chaiwong[A] Suvimon putajanyawong[B] Phatipan Sudigoolabud[A] and Jiraporn Inthasan[A]

[A]Faculty of Agricultural Production, Maejo University, Chiang Mai, Thailand, 50290, Email chackapong@mju.ac.th
[B]Land Development Department region 6, Chiang Mai, Thailand, 50180.

Abstract
Participatory action by the community on the Ban Eang watershed in Saluang subdistrict Mae Teang district, Chiang Mai, Thailand was studied to assess soil chemical characteristics for the purpose of land use management for sustainable agriculture. This watershed has an area of about 830 ha and land uses were paddy rice, terrace paddy rice, orchard, field crop and forest. The community in Ban Eng watershed showed strong participatory action. Soils were developed from the residuum gneiss. Soil reaction was very strongly acid (pH 4.84) to strongly acid (pH 5.30) in topsoil and very strongly acid (pH 4.89) to moderately acid in subsoil (pH 5.82). Organic matter decreased with soil depth in the range of very low (0.79 g/kg) to high (56.39 g/kg). The extractable phosphorus was low (5.36 mg/kg) to moderately high (21.52 mg/kg) in topsoil and very low (0.79 mg/kg) to moderately low (8.45 mg/kg) in subsoil. Extractable potassium was high (92.5 mg/kg) to very high (178 mg/kg) in topsoil and very low (25.7 mg/kg) to moderate (97.9 mg/kg) in subsoil and extractable calcium was low (617 mg/kg) to moderate (1099 mg/kg) in topsoil and very low (54.3-91.4 mg/kg) in subsoil and magnesium was low (106 mg/kg) to moderate (289 mg/kg) in topsoil and very low (35.3 mg/kg) to low (107 mg/kg) in subsoil. The community established a programme for soil management. Dolomite and organic fertilizer were recommended to improve soil properties. Moreover, mulching, vetiver grass strips and sprinkler technique were applied in this watershed as a basis for sustainable agriculture.

Key Words
Land use management, watershed, participatory action.

Introduction
Non conservation strategies for cultivating on steep slopes were the initial cause of the problem of land degradation, soil erosion, deterioration of soil physical properties and a steady decline of soil fertility in watershed regions in tropical areas (Aneckasampant *et al.* 1992). Most areas in the watershed of northern Thailand are hilly and mountainous and subjected to shifting cultivation. Since the end of the 1970s, the rapid development of Thailand has brought into focus the need for integrated resource management as a basis for overcoming increasingly severe problems of drought and flood (Krairapanond 1998). Shifting cultivation leads to the rapid degradation of soil productivity, while soil fertility declines rapidly. The contents of soil organic matter, total N, and total P in agriculture land in watersheds were significantly lower than for forestland (Jiang 2006). The land of Ban Eang watershed has to be used to intensify crop production within rotational systems. This has led to degradation of the unfertile soil to low levels of productivity; with non-conservation cultivation techniques being, the main problem in this area. This research aims to study land use for agricultural, and soil characteristics assessed to determine management plans to ensure land use systems become sustainable through participatory action between community and researcher.

Methods
This study was carried out on the Ban Eang watershed in Saluang subdistrict Mae Teang district, Chiang Mai province, northern Thailand (between UTM 478780 N 2106881 E to 481943 N 2104563 E and 477516 N 2015485 E to 481261 N 2103650 E, 500 to 600 msl in altitude) (Figure 1 (a)) an area of about 830 ha. The results of the study are based on a questionnaire, focused group meeting discussions (Defoer 1998) to defined the context of community, problem, solution of land use, soil management, a field trip (in a succession area which has soil conservation practice and soil management) and soil science research integration. Soil samples were collected from the surface layer (about 0-20 cm depth) and subsurface layer (20-40 cm, 40-60 cm, 60-80 cm, 80-100 cm depth) with 4 replicates of each land use and about 80 subsamples (0-20 cm and 20-40 cm) were collected by the farmer for chemical soil analysis such as soil pH, organic matter, available phosphorus and extractable potassium, calcium and magnesium (USDA 1996).

Results

Community context

Ban Eang watershed has an area of about 830 ha. The surrounding landforms are hilly and undulating with a 2-50 percent slope. The population is approximately 450 people (150 families), who are farmers and non timber hunters with a career and average income is about 21,000 bath/family/year. The community in Ban Eang watershed has a leader and a committee. Buddhism is the majority religion. Soils have developed on residuum and colluvium from gneiss under a semi-humid subtropical climate. Clayloam is the texture of topsoil. The amount of clay fraction depends on soil depth. Land uses consist of paddy rice, terrace paddy rice, orchard, field crop (such as soy bean, upland rice and corn) and forest follow a topography sequence (Figure 1 (b)).

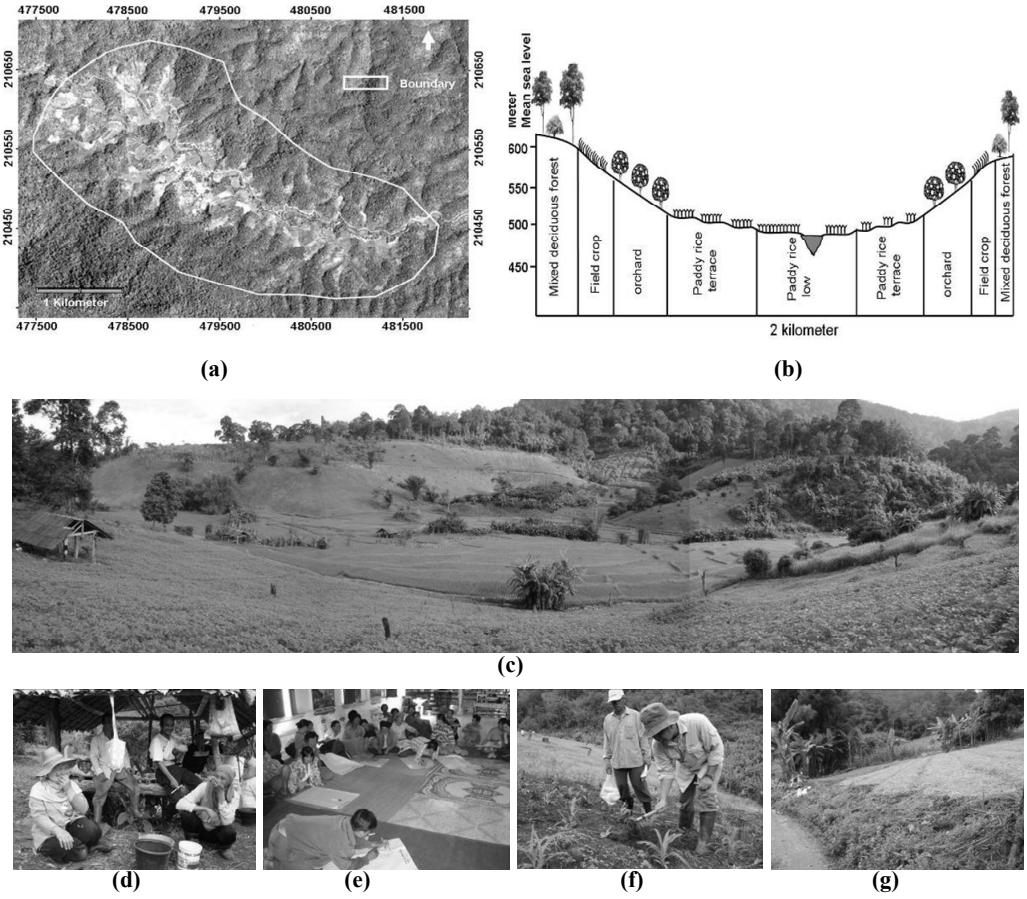

Figure 1. (a) photo aerial of study area (b) topography sequence land use (c) land use characteristic (d) farmer (e) group discussion (f) soil sampling by farmer (g) soil mulching.

Soil chemical properties

The pH values were in a range of very strongly acid to strongly acid (pH 4.84-5.30) in topsoil and a range of very strongly acid to moderately strongly acid (pH 4.89-5.82) in subsoil. Organic matter decreased with soil depth in range from 0.79-56.4 g/kg. Available phosphorus ranges from low to moderately high (5.36-21.5 mg/kg) in top soil and very low to moderately low in subsoil (0.79-8.45 mg/kg). The amount of extractable potassium ranges from high to very high (92.5-178 mg/kg) in topsoil and very low to moderate (25.7 - 97.9 mg/kg) in subsoil. The concentration of extractable calcium in topsoil showed low to moderate (617 -1099 mg/kg) and very low (54.0 -91.4 mg/kg) in subsoil while extractable magnesium as run from low to moderate (106 -289 mg/kg) in topsoil and very low to low (35.3-107 mg/kg) in subsoil (Table 1.)

Participatory action by community

From participatory approaches, the community was established in agreement and programme for soil management and conservation follow;

- The applications of dolomite for increasing soil pH, Ca and Mg
- Chemical fertilizer management following soil analysis
- Compost fertilizer for improving soil physical and chemical characteristics
- Mulching, vetiver grass strip and sprinkler water technique were used in cultivation

Table 1. Soil chemical properties at Ban Eang watershed in Saluang subdistrict Mae Teang district, Chiang Mai, Thailand.

Land use	Depth	pH		OM		P		K		Ca		Mg	
	(cm)	(H_2O)		(g/kg)		(----------mg/kg----------)							
Field	20	4.95	v.st.ac	37.43	H	5.36	L	135.29	VH	617.29	L	105.71	L
Crop*	40	4.96	v.st.ac	27.91	MH	2.61	VL	80.86	M	300.29	VL	81.00	L
	60	4.98	v.st.ac	19.60	M	1.50	VL	62.57	M	184.00	VL	75.14	L
	80	5.07	st.ac	15.31	M	1.21	VL	75.43	M	138.00	VL	76.00	L
	100	5.16	st.ac	12.28	ML	2.31	VL	63.71	M	91.43	VL	73.86	L
Orchard	20	5.28	st.ac	36.19	H	5.45	L	177.83	VH	579.67	L	154.50	M
	40	5.35	st.ac	26.73	MH	1.69	VL	63.67	M	162.67	VL	84.17	L
	60	5.24	st.ac	17.77	M	1.10	VL	67.00	M	142.17	VL	81.67	L
	80	5.28	st.ac	11.03	ML	0.92	VL	58.67	L	97.33	VL	69.17	L
	100	5.12	st.ac	8.81	L	0.79	VL	54.50	L	5.40	VL	58.67	L
Paddy	20	5.30	st.ac	48.17	VH	10.14	M	93.00	H	1012.33	M	110.67	L
rice	40	5.71	mo.ac	39.93	H	6.40	ML	77.00	M	884.33	L	93.00	L
Terrace*	60	5.55	mo.ac	24.00	M	3.95	L	52.67	L	782.67	L	98.33	L
	80	5.80	mo.ac	22.95	M	2.20	VL	63.00	M	392.00	VL	75.67	L
	100	5.82	mo.ac	13.33	ML	2.32	VL	25.67	VL	162.67	VL	35.33	VL
Paddy	20	4.84	v.st.ac	42.00	H	21.52	MH	92.50	H	858.50	L	109.00	L
Rice*	40	4.89	v.st.ac	28.31	MH	6.36	ML	50.75	L	679.25	L	63.00	L
	60	5.23	st.ac	18.48	M	5.32	L	44.25	L	590.25	L	60.00	L
	80	5.46	st.ac	13.45	ML	3.96	L	34.00	L	376.50	VL	48.75	L
	100	5.52	mo.ac	14.32	ML	2.47	VL	33.00	L	385.50	VL	49.75	L
Mixed	20	5.35	st.ac	56.39	VH	13.48	M	105.71	H	1099.14	M	289.86	M
Deciduous	40	5.38	st.ac	19.53	M	7.63	ML	97.86	H	231.14	VL	107.14	L
forest	60	5.43	st.ac	9.16	L	8.45	ML	85.86	M	72.00	VL	70.57	L
	80	5.57	mo.ac	7.17	L	8.25	ML	65.71	M	68.57	VL	69.57	L
	100	5.73	mo.ac	4.97	VL	5.56	L	37.14	L	63.57	VL	55.29	L

v.st.ac = very strongly acid, st = strongly acid, mo.ac = moderately acid, Available P, K, Ca, Mg
VH = very high, H= high, M = medium, L = low, VL = very low
* included 0-20cm, 20-40cm, collected by farmer

Conclusion

From this study, the community in Ban Eng watershed showed strong participatory involvement. Soil chemical properties in this area were reported as low to moderate levels. Hence, soil amendment application such as dolomite and organic fertilizer is recommend to improve soil chemical properties. Moreover, mulching, vetiver grass strips for soil erosion and sprinkler water technique for cultivation will be apply in the Ban Eang watershed to enable sustainable agriculture and best environmental management practices.

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