FARMER PARTICIPATORY RESEARCH ACTIVITIES IN THE NIPPON FOUNDATION CASSAVA PROJECT IN THAILAND

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ABSTRACT

Complete canopy closure in a cassava crop takes a rather long time, especially when farmers do not apply fertilizers. This may lead to serious soil erosion when the crop is grown on slopes and result in a decline in soil fertility. Although nutrient extraction and removal by cassava tends to be less compared with many other crops, soil losses due to erosion may be higher because of the wide plant spacing used and the crop's slow initial development. Past research has shown that fertilizer application, reduced tillage, contour ridging, mulching, intercropping and the planting of contour hedgerows can greatly reduce erosion. Nevertheless, farmers seldom adopt soil conservation practices, mainly because the recommended practices are not suitable for the local conditions, they may be too costly or require too much labor, or they may be ineffective. Moreover, farmers are often not aware of the amount of soil, water and nutrients lost by erosion.

The farmer participatory research (FPR) methodology used in this project, conducted in more than 20 pilot sites in Thailand, indicate that farmers are very capable of making their own decisions, and they are willing to adopt new technologies, such as new cassava varieties, improved fertilization, use of animal or green manure, and herbicides, especially when the use of these practices lead to a higher net income. The FPR trials also showed farmers that the planting of contour hedgerows of vetiver grass, or other grasses or legumes, was very effective in reducing erosion. The use of a farmer participatory approach was very effective in developing more suitable varieties and production practices, which farmers could readily adopt and then disseminate to other farmers in neighboring communities.

The project showed that when farmers are directly involved in the development of new technologies, by planning and implementing their own trials on their own fields, this will greatly enhance the adoption and dissemination of improved technologies, which is likely to improve the farmers' living standards. This is of fundamental importance.

INTRODUCTION

In 2000, cassava (*Manihot esculenta* Crantz) was grown in Thailand in about 1.13 million hectares, the national average yield was about 16.25 t/ha, and total production was 18.75 million tonnes of fresh roots. These roots are being used for the production of about 4.66 million tonnes of dry cassava chips, pellets and starch, mainly for export, with a values of US$ 693.52 million.

Most cassava is grown by smallholders on upland areas with poor soil and low or unpredictable rainfall. In the Northeastern and the Eastern regions, cassava is grown on gentle slopes but soil erosion can be very serious. Most poor farmers do not apply fertilizers to cassava and this may lead to a decline in soil fertility, which in turn causes low yield. Past research by Kasetsart University has shown that cassava cultivation may cause twice

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as much soil erosion as the cultivation of mungbean, and three times as much as that caused by maize, sorghum and peanut (Putthacharoen, 1993; Putthacharoen *et al*.,1998).

Research on erosion control practices have shown that soil losses due to erosion can be markedly reduced by simple agronomic practices combined with soil conservation practices. This includes agronomic practices such as minimum or zero tillage, mulching, contour ridging, intercropping, fertilizer and/or manure application, and planting at higher density; and soil conservation practices such as terracing, hillside ditches and planting contour hedgerows of grasses or legumes. But these practices are seldom adopted by farmers because they may not have been appropriate for the specific circumstances of the farmers, either from an agronomic or socio-economic standpoint (Howeler, 2001).

Since 1994, the Centro Internacional de Agricutura Tropical (CIAT), the Department of Agriculture (DOA), the Department of Agricultural Extension (DOAE), the Land Development Department (LDD), Kasetsart University (KU) and the Thai Tapioca Development Institute (TTDI) have collaborated in the Nippon Foundation supported project entitled "Integrated Cassava-based Cropping Systems in Asia: Farming Practices to Enhance Sustainability". This project uses a farmer participatory research and extension approach. The farmers involved in the project were encouraged to develop technologies by themselves by conducting farmer participatory research (FPR) trials on their own fields. This enabled them to develop the most effective practices for their own conditions and disseminate these selected practices to farmers in neighboring communities.

MATERIAL AND METHODS

Project Sites

Phase 1: 1994-1998 (5 years):

To implement the project, cassava growing areas were selected that had at least 5% slope and where the farmers and local extension personnel were enthusiastic and willing to collaborate. Rapid Rural Appraisals (RRA) were conducted in each area to obtain baseline information and to select the most suitable pilot sites (Howeler, 2001; Vongkasem *et al*., 1998). The project initially worked in only two sites (villages), one in Soeng Saang district of Nakhon Ratchasima province, and one in Wang Nam Yen district in Sra Kaew province. In 1998 this was extended to another two sites, one in Sahatsakhan district of Kalasin province and one in Sanaam Chaikhet district of Chachoengsao province.

Phase 2: 1999-2003 (5 years):

During the 2nd phase the project expanded rapidly to include over 20 sites in the following six provinces:

1. Nakhon Ratchasima province in the lower Northeast region
2. Kalasin province in the upper Northeast region
3. Prachinburi province in the Eastern region
4. Chachoengsao province in the Eastern region
5. Chaiyaphuum province in the lower Northeast region
6. Kanchanaburi province in the Western region

Collaborating Organizations:

During the 2nd phase the following institutions collaborated in the project:

1. Field Crops Research Institute of DOA
2. Rice and Field Crops Promotion Division of DOAE
3. Soil and Water Conservation Division of LDD
4. Kasetsart University (KU)
5. Thai Tapioca Development Institute (TTDI)
6. The Centro Internacional de Agricultura Tropical (CIAT)

Activities

1. Selection of project areas

The criteria of selection were the same as in Phase 1. Each year the project expanded to 1-2 new provinces by selecting appropriate pilot sites in one or more districts.

2. Training

Field staff of new sites were trained in cassava production practices and FPR and RRA methodologies.

3. Farmers meetings

Farmers from the new sites that were interested in participating in the project participated in a one-day training course with the objective of: 1. increasing the farmers' knowledge and understanding of soil conservation in cassava growing areas; 2. to discuss with farmers how to conduct, with help of researchers and extensionists, FPR trials on their own fields. These farmers then visited demonstration plots with various management practices to reduce soil erosion. Farmers were asked to score the various soil erosion control treatments, considering their likely effect on soil loss by erosion, cassava yield and net income. Farmers then selected the most suitable 4-5 soil erosion control treatments to try in FPR trials on their own fields.

4. Demonstration plots

Each year demonstration plots were established by DOA, KU, or TTDI at their research stations. These demonstrations had a large (18-24) number of treatments, including the application of chemical fertilizers or manures, green manures, closer plant spacing, intercropping with different crops and contour hedgerows of different grasses or legumes. These treatments tended to reduce soil erosion and gave farmers some ideas about alternative ways of solving erosion problems. The demonstration plots were laid out along the contour of a uniform slope; ditches were dug along the lower ends of each plot and covered with plastic to catch the soil sediments eroded from each plot. Farmers from new sites visited these demonstration plots, scored the treatments and selected those they would like to try out in FPR erosion control trials on their own fields.

5. FPR trials

After farmers decided to conduct FPR trials, researchers and extensionists helped them to decide on the best treatments, provided the necessary materials and helped them to set out the trials. During the crop season, researchers and extensionists visited the trials 1-2 times to discuss with the farmers and solve any problems.

At time of harvest, collaborating farmers and project staff harvested all the trials in the pilot site, recorded all data and calculated average results of each type of trial. Data on soil loss from every treatment was also presented to the participating farmers and others interested. The meeting then discussed the results of each trial and selected again the best treatments for next year's trials (Howeler, 2001; Watana *et al*., 2002).

6. Scaling-up and adoption

After two years of conducting FPR trials, farmers had usually selected the most suitable treatments to try out in larger size plots (approximately 1,500-3,000 m^2) on their fields. Project staff tried to help them; for instance, in setting out contour lines to plant hedgerows for erosion control, or to obtain seed or vegetative planting material of the selected hedgerow species, intercrops or new cassava varieties.

RESULTS AND DISCUSSION

Farmer Participatory Research in the Second Phase

1. Demonstration plots

Demonstration plots were laid out at TTDI's Research and Development Center to show the effect of many alternative treatments on soil losses due to erosion, on cassava and intercrop yields and on net income. Farmers from new sites were asked to discuss and score the effectiveness of each treatment. The results indicate that farmers from different sites have different preferences, depending on the local bio-physical and socio-economic conditions, as well as on their traditional practices. Farmers usually selected 3-4 treatments that they would like to test in FPR trials on their own fields in comparison with their traditional practices.

2. FPR trials

2.1 Chayaphuum province

During the first year, 24 farmers in Khook Anu village in Naayaang Klak subdistrict of Thep Satith district were conducting FPR trials on various topics, such as soil erosion control, varieties, application of chemical fertilizers and chicken manure, planting of green manures and weed control. **Tables 1** to **6** show the average results of these trials. **Table 1** shows that farmers selected Kasetsart 50 and Rayong 5 in spite of their lower yields in the trial, because the starch and chip factories who buy the roots pay a lower price for Rayong 72, because of a generally lower starch content. Among soil erosion control practices, farmers selected vetiver grass hedgerows and contour plowing as the most suitable (**Table 2**). Especially vetiver grass hedgerows are now widely adopted in their village. **Table 3** shows that farmers preferred the use of jack bean (*Canavalia ensiformis*) as a green manure, to be plowed in the soil at 45 days after planting, after which cassava is planted immediately. Results of four FPR fertilizer trials indicate that cassava yields increased markedly with application of chemical fertilizers and chicken manure (**Table 4**) or urea (**Table 5**). Farmers preferred to apply chemical fertilizers at a rate of 156 kg/ha of 15-15-15 as this gave a rather high yield at a low cost. Application of Glyphosate following hand weeding was considered the best treatment to control weeds (**Table 6**).

2.2 Kanchanaburi province

In Nong Kae village of Thung Krabam subdistrict in Law Khwan district, 42 farmers conducted FPR trials. They conducted the same type of trials as those in Chaiyaphuum province. As a result of these FPR trials, farmers adopted vetiver grass hedgerows to control erosion (**Table 7**) and started to scale-up this year. Application of 12.5 t/ha of chicken manure resulted in the highest yield of 36.1 t/ha and a net income of $366.11 (**Table 8**). Farmers ranked the tested varieties in the order of Rayong 72, Kasetsart 50 and Rayong 5 (**Table 9**). This village has a similar climate as the Northeastern region, which is quite suitable for planting Rayong 72.

Table 1. Results of two FPR variety trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphuum province in 2001/02.

	Cassava yield (t/ha)			Starch content (%)			Farmers' preference
Varieties	A[1)]	B[1)]	Av.	A	B	Av.	ranking
Kasetsart 50	19.65	13.62	16.63	<10	18	<14.0	3
Rayong 72	17.50	31.31	24.40	18	28	23.0	1 [2)]
Rayong 5	20.03	22.82	21.42	17	19	18.0	2

[1)] A = Mr. Lun; B = Mr. Chanthong

[2)] Although Rayong 72 had clearly the highest yield and starch content in these trials, farmers will continue to grow Kasetsart 50 and Rayong 5, because owners of chipping yards give a price discount for Rayong 72, claiming a low starch content.

Table 2. Average results of two FPR erosion control trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphuum province, in 2001/02.

	Dry soil loss	Yield (t/ha)		Starch content	Gross income	Production costs	Net income	Farmers' preference
Treatments	(t/ha)	Cassava	Intercrop	(%)	(US$/ha)			(%)
1. Farmers' practice	13.99	12.61	-	20.3	300.2	272.3	27.9	0
2. Contour plowing	10.16	8.41	-	20.0	200.2	272.3	-72.1	100
3. Up/down plowing	31.10	12.34	-	18.3	293.8	272.3	21.5	0
4. Mungbean intercrop	10.30	8.70	0.306	24.0	352.8	316.9	35.9	82
5. Vetiver grass hedgerows	8.03	13.02	-	22.3	310.0	287.1	22.9	100
6. Lemon grass hedgerows	4.53	15.94	-	21.0	379.5	287.1	92.4	0[2]

[1)] Prices: cassava US$ 23.81/tonne fresh roots
mungbean 0.47/kg dry grain
1US$ = 42 baht

[2)] Although lemon grass hedgerows produced the highest net income and lowest soil loss, farmers do not like this grass as it can not tolerate drought, it is difficult to find enough planting material and it is difficult to sell in large quantities.

Table 3. Average results of six FPR green manure trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphuum province in 2001/02.

	Cassava yield	Starch content	Gross income[2)]	Production costs	Net income	Farmers' preference
Green manures[1)]	(t/ha)	(%)	(US $/ha)			(%)
1. No green manure	26.14	26.3	703.3	272.3	431.0	0
2. *Crotalaria juncea*	29.87	29.4	839.2	328.0	511.2	0
3. mungbean	29.60	27.9	817.6	331.9	485.7	0
4. *Canavalia ensiformis*	30.24	30.0	864.0	302.1	561.9	100

[1)] no fertilizers were applied; green manures were planted at the same time as cassava and were weeded out by hoe at 2 MAP; farmers suggest to plant green manures either before cassava and incorporate before cassava planting, or plant GM as an intercrop at 1-1½ MAP and weed out at 2 MAP the green manure.

[2)] Prices: cassava US$ 28.57/tonne fresh roots at 30% starch

Table 4. Average results of four FPR fertilizer trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphuum province in 2001/02.

Fertilizer treatments	Cassava yield (t/ha)	Gross income[1)]	Production costs (US$/ha)	Net income	Farmers' preference (%)
1. No fertilizers or manures	20.48	585.2	272.3	312.9	0
2. 156 kg/ha of 15-15-15	27.08	773.8	302.1	471.7	52
3. 312 kg/ha of 15-15-15	29.44	841.1	331.9	509.2	19
4. 1.56 t/ha of chicken manure (CM)	28.12	803.3	302.8	500.5	19[2)]
5. 1.56 t/ha CM+156 kg/ha 15-15-15	28.32	809.0	332.6	476.4	10[2)]

[1)] Prices: cassava US $ 28.57/tonne fresh roots at 30% starch
chicken manure 0.019/kg
15-15-15 fertilizers 0.190/kg

[2)] Chicken manure is difficult to find in the area

Table 5. Average results of five FPR fertilizer trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphum province in 2001/02.

Fertilizer treatments	Cassava yield (t/ha)	Starch content (%)	Gross Income[1)]	Production costs (US $/ha)	Net income	Farmers' preference (%)
1. No fertilizers or manures	21.4	25.4	563.5	272.3	205.7	
2. 156 kg/ha of 15-15-15	27.0	28.8	686.4	302.0	384.4	
3. 312 kg/ha of 15-15-15	29.4	25.9	701.6	331.8	369.8	
4. 156 kg/ha of 15-15-15+ 156 kg/ha of urea	33.0	29.0	786.6	328.1	458.5	
5. 312 kg/ha of 15-15-15+ 156 kg/ha of urea	24.9	27.2	657.3	357.8	299.5	

[1)] Prices: cassava US$ 23.84/tonne fresh roots at 30% starch
15-15-15 fertilizer 0.19/kg
urea 0.16/kg
1US $ = 42 baht

Table 6. Average results of four FPR weed control trials conducted by farmers in Khook Anu village, Naayang Klak subdistrict, Thep Sathit district of Chayaphuum province in 2001/02.

Weed control treatments	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs (US $/ha)	Net income	Farmers' preference (%)
1. Hand weeding (HW)	24.65	29.2	691.6	272.3	419.3	
2. HW+Glyphosate 1.5 cc/liter	29.95	28.2	827.1	290.2	536.9	
3. HW+Glyphosate 3.0 cc/liter	29.35	28.7	817.6	308.0	509.6	

[1)] Prices: cassava US$ 28.46/tonne at 30% starch with US$ 0.50 reduction for every 1% reduction in starch content.

Table 7. Average results of two FPR erosion control trials conducted by farmers in Nong Kae village, Thung Krabam subdistrict Law Khwan district, Kanchanaburi province of Thailand in 2001/02.

Treatments	Dry soil loss (t/ha)	Cassava yield (t/ha)	Starch content (%)	Gross[1)] Income	Production costs	Net income
				(US $/ha)		
Up/down ridging	1.13	14.9	19.9	298.8	372.0	-146.4
Contour ridging	0.38	20.0	20.0	475.5	378.5	97.0
Vetiver grass hedgerows	1.10	19.2	21.2	455.9	373.0	82.9
Sugarcane hedgerows	3.71	24.2	20.2	583.0	417.3	165.7
Sweet corn intercropping	3.30	22.2	19.3	587.1	451.1	136.0

[1)] Prices: cassava US $ 23.84/tonne
sweet corn 0.02/cob
sugarcane 0.04/stem
harvesting 2.85/t
transportation 2.85/t
1US $ = 42 baht

Table 8. Average results of three FPR fertilizer and chicken manure trials conducted by farmers in Nong Kae village, Thung Krabam subdistrict of Law Khwan district, Kanchanaburi province of Thailand in 2001/02.

Fertilizer treatments	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs	Net income	Farmers' preference (%)
			(US $/ha)			
1. No fertilizer	20.9	20.8	498.2	384.2	114.0	
2. 156.2 kg/ha of 13-13-21	18.6	20.0	442.8	403.2	39.6	
3. 312.4 kg/ha of 13-13-21	24.3	20.0	577.9	466.1	143.4	
4. 312.0 kg/ha of 15-15-15	21.4	22.0	509.5	449.6	59.9	
5. 3.12 t/ha of chicken manure	18.4	16.7	438.0	377.6	60.4	
6. 6.24 t/ha of chicken manure	23.1	21.5	550.0	405.8	144.2	
7. 9.36 t/ha of chicken manure	22.9	17.0	546.4	412.2	134.2	
8. 12.48 t/ha of chicken manure	36.1	23.0	860.7	494.6	366.1	
9. Apply fertilizer according to soil analysis	29.8	24.6	709.5	497.4	212.1	

[1)] Prices: cassava US $ 23.84/tonne fresh roots
13-13-21 fertilizer 0.20/kg
chicken manure 0.03/kg

Table 9. Results of a FPR variety trial conducted by a farmer in Nong Kae village, Thung Krabam subdistrict of Law Khwan district, Kanchanaburi province of Thailand in 2001/02.

Varieties	Cassava yield (t/ha)	Starch content (%)	Gross income	Production costs[1)]	Net income	Farmers' ranking
			(US $/ha)			
Kasetsart 50	25.4	21.7	604.7	409.9	194.8	2
Rayong 5	29.6	14.0	705.3	433.8	271.5	3
Rayong 72	30.2	17.0	720.2	437.2	283.0	1

[1)] Price: cassava US$ 23.81/tonne fresh roots at 30% starch.

2.3 Nakhon Ratchasima province

During the 2nd phase of the project, 53 farmers in Khut Dook village, Baan Kaw subdistrict of Daan Khun Thot district, conducted FPR trials. The trials were similar to those conducted by farmers in Kanchanaburi province. After conducting trials for two years farmers adopted Rayong 90 which gave the highest root yield and net income (**Table 10**); this is different from Chayaphuum and Kanchanaburi provinces. Farmers selected the use of 312.4 kg/ha of 16-16-8 fertilizers because it gave the highest fresh root yield; this was followed by pelleted chicken manure **(Table 11)**. With respect to weed control, application of Glyphosate resulted in higher yields and net income than the hand weeding control (**Table 12**).

Table 10. Results of a FPR variety trial conducted by farmers in Kut Dook village, Baan Kaw subdistrict of Daan Khun Thot district, Nakhon Ratchasima province of Thailand in 2001/02.

Varieties	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs[2)]	Net income
			(US $/ha)		
Kasetsart 50	29.6	26.5	705.6	433.8	271.8
Rayong 5	28.3	26.5	674.2	426.4	247.8
Rayong 90	32.7	26.0	779.0	451.5	327.5
Rayong 72	28.4	23.2	676.6	427.0	249.6

[1)] Prices: cassava US $ 23.84/tonne fresh roots

[2)] Production costs are based on data from the office of Agricultural Economic in 2000.

Table 11. Results of a FPR fertilizer trial conducted by farmers in Kut Dook village, Baan Kaw subdistrict of Daan Khun Thot district, Nakhon Ratchasima province of Thailand in 2001/02.

Fertilizer treatments	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs	Net income
				(US$/ha)	
1. No fertilizers	15.3	19.0	363.3	319.0	44.3
2. 312.5 kg/ha of 16-20-0	26.3	22.6	627.0	408.9	218.1
3. 312.5 kg/ha of 15-15-15	20.0	21.0	476.1	385.0	91.1
4. 312.5 kg/ha of 16-16-8	30.8	22.9	733.3	437.4	295.9
5. 312.5 kg/ha of 15-7-18	23.3	23.0	553.8	411.3	142.5
6. 6.25 t/ha of rice husks	20.6	18.6	490.4	376.4	114.0
7. 6.25 t/ha of cattle manure	23.8	19.0	566.6	496.5	70.1
8. 2.5 t/ha of duck manure + rice hulls	24.4	20.8	580.9	455.4	125.5
9. 2.5 t/ha of chicken manure + rice hulls	20.8	23.5	496.1	434.8	61.3
10. 625 kg/ha of pelleted chicken manure	26.6	22.2	633.3	405.4	227.9
11. 625 kg/ha of organic fertilizers	25.9	23.2	617.1	411.8	205.3

[1)] Prices: cassava: US $ 23.81/tonne fresh roots
chicken manure: 0.03/kg

2.4 Prachinburi province

In Aang Thong and Khao Khaat villages in Kaeng Dinso subdistrict of Naadii district, 34 farmers conducted FPR trials. Based on the results of these FPR trials farmers preferred Rayong 72 as it was easy to take care of, followed by two breeding lines, as well

as Kasetsart 50 and Rayong 5 (**Table 13**). From the FPR fertilizer trials, they preferred the use of 156 kg/ha of 15-7-18 over that of 15-15-15 as this produced the highest yield. However, no fertilizer application resulted in the highest net income (**Table 14**).

Table 12. Results of a FPR weed control trial conducted by a farmer in Kut Dook village, Baan Kaw subdistrict of Daan Khun Thot district, Nakhon Ratchasima province of Thailand in 2001/02.

Weeding treatments	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs	Net income
			(US $/ha)		
1. Hand weeding	27.4	19.2	653.2	421.3	231.9
2. Glyphosate herbicide	30.7	21.6	731.3	455.4	275.9

[1)] Prices: cassava: US $ 23.84 /tonne fresh roots.

Table 13. Average results of four FPR variety trials conducted by farmers in Kaeng Dinso subdistrict of Naadi district, Prachinburi province of Thailand in 2000/01.

Varieties	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Production costs[2)]	Net income	Farmers' ranking
			(US $/ha)			
1. Rayong 1	7.44	17.5	124.0	180.8	-56.0	6
2. Rayong 5	10.65	22.3	201.8	193.0	8.8	5
3. Rayong 72	16.27	20.3	292.8	214.5	78.3	1
4. Kasetsart 50	12.91	20.7	234.8	201.7	33.1	4
5. CMR 36-55-166	14.06	23.4	273.8	206.0	67.8	2
6. CMR 37-18-89	14.19	22.8	272.3	206.5	65.8	3

[1)] Price: cassava: US $ 22.90/tonne fresh roots at 30% starch with US $ 0.50 reduction for every 1% reduction in starch content

[2)] Production costs: US$ 152.5/ha plus US$ 3.80/tonne for harvest and transport

1 US $ = 42 baht

Table 14. Average results of four FPR fertilizer trials conducted by farmers in Kaeng Dinso subdistrict of Naadi district, Prachinburi province of Thailand in 2000/01.

Fertilizer treatments	Cassava yield (t/ha)	Starch content (%)	Gross income[1)]	Fertilizer cost[1)]	Production costs[2)]	Net income	Farmers' ranking
			(US $/ha)				
1. No fertilizers	8.60	21.9	161.3	0	140.6	20.7	4
2. 156 kg/ha of 15-15-15	8.79	21.4	162.8	33.4	186.0	-20.7	3
3. 312 kg/ha of 15-15-15	7.10	22.7	135.9	66.9	213.0	-77.1	5
4. 156 kg/ha of 15-7-18	9.36	23.1	180.9	29.7	185.6	-4.7	1
5. 312 kg/ha of 15-7-18	9.21	22.6	175.8	59.5	213.6	-37.8	2

[1)] Prices: cassava US $ 22.80 /tonne fresh roots at 30% starch
15-15-15 0.214 /kg
15-7-18 0.191 /kg

[2)] Production costs: US$152.5/ha plus US$3.80/tonne for harvest and transport; 1US$ = 42 baht

Table 15 shows that in 2002 a total of 386 farmers participated in the project, conducting 72 FPR trials in nine pilot sites in six provinces.

Table 15. Number and area (in rai) of FPR trials conducted by farmers in various pilot sites of the Nippon Foundation project in Thailand in 2002.

					Types of FPR trials						
Province	District	Subdistrict	Village[1)]	No. of farmers	Varie-ties	Org. manures	Chem. fertil.	Chem.+org. manures	Herbi-cides	Green manures	Inter-crops
Nakhon Ratchasima	Daan Khun Thot	Baan Kaw	Khut Dook	53	1/3	1/2	1/2	-	-	-	1/2
	Thephaarak	Bueng Prue	Village 3 and 6	-	-	-	-	-	-	-	-
	Soeng Saang	Noon Sombuun	Sapphong Phoot	-	-	-	-	-	-	-	-
		Sra Takhian	Sra Takhian	-	-	-	-	-	-	-	-
	Khonburi	Tabaekbaan	Nong Phak Rai	27	1/2	1/2	1/2	-	-	-	1/5
Prachinburi	Naadii	Kaeng Dinso	Aang Thong Khaw Khaat	34	1/5	-	-	-	1/5	-	-
Kalasin	Mueang	Phuu Po	Noon Sawan	-	-	-	-	-	-	-	-
		Khamin	Khamplaafaa	-	-	-	-	-	-	-	-
	Nong Kungsri	Nong Bua	Khamsri	-	-	-	-	-	-	-	-
	Sahatsakhan	Noonburi	Noon Sawaat	-	-	-	-	-	-	-	-
		Noon Namkliang	Huay Suea Ten Paa Kluay	-	-	-	-	-	-	-	-
	Naamon	Naamon	Noon Thiang*	50	4/4	-	3/3	2/2	-	3/3	-
	Don Chaan	Dong Phayung	Noon Kokchik*	50	4/4	-	4/4	-	-	3/3	-
	Huay Phueng	Nikhom	Huay Faa*	50	4/4	-	4/4	-	-	3/3	-
Chachoengsao	Sanaam Chaikhet	Thung Phrayaa	Thaa Chiwit Mai	-	-	-	-	-	-	-	-
	Thaa Takiab	Khlong Takraw	Nong Yai	-	-	-	-	-	-	-	-
Kamphaengphet	Khanuwaralakburi	Bo Tham	Siiyaek-Ton Thoo	30	-	-	1/5	5/10	-	-	1/5
Chaiyaphuum	Thep Sathit	Naayaang Klak	Khook Anu	50	2/3	-	2/2	-	4/4	-	3/6
Kanchanaburi	Law Khwan	Thung Krabam	Nong Kae	42	2/2	2/2	2/2	-	-	2/2	2/2
Sra Kaew	Wang Sombuun	Wang Sombuun	Khlong Ruam	-	-	-	-	-	-	-	-
Total: 6	**9**	**9**	**9**	**386**	**19/27**	**4/6**	**18/19**	**7/12**	**5/9**	**11/11**	**8/20**

[1)] * = initiated in 2002

[2)] Total = 72 FPR trials; 1 ha = 6.25 rai

CONCLUSIONS

The farmer participatory research approach allows farmers to make their own decisions. They are enthusiastic to test and select the most suitable varieties and cultural practices. They not only selected vetiver grass hedgerows as the best way to control soil erosion but they also increased their cassava yields and net income by selecting the most suitable variety, such as Rayong 5, Rayong 90, Rayong 72 and Kasetsart 50. Besides those, they selected the most suitable cultural practices, such as the use of green manure, chicken manure, chemical fertilizers and weed control for their own conditions. The use of more sustainable cassava production practices is likely to improve the farmers' living standard in the near future

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