THE ADOPTION OF NEW TECHNOLOGIES AND THE SOCIO-ECONOMIC IMPACT OF THE NIPPON FOUNDATION CASSAVA PROJECT IN VIETNAM

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ABSTRACT

During the second phase of the Nippon Foundation project in Vietnam (1999-2003) a methodology for conducting Farmer Participatory Research (FPR) and Farmer Participatory Extension (FPE) was developed in order to benefit a large number of small cassava farmers. Through collaboration between researchers, extension workers and farmers in all activities of the project, such as the conducting of FPR trials, FPR training courses, field days, and cross-site visits, farmers have identified the most suitable new technologies for adoption in their cassava fields. Thus, at the end of 2002, about 2,717 farmers in the FPR pilot sites are planting new high-yielding varieties (KM60, KM94, KM95-3, KM98-1, KM98-5, KM98-7 and SM 937-26) on 1,244 ha. About 222 farmers have planted contour hedgerows to control soil erosion by using *Tephrosia candida*, vetiver grass, *Paspalum atratum*, pineapple or various combinations of these on 99 ha. About 689 farmers adopted intercropping cassava with peanut, black bean or maize on 42 ha; and 157 farmers are using balanced fertilizers for cassava on 26 ha. Farmers in the central part of the country have also quickly adopted the new technology of using cassava root and leaf silage for pig feeding. The number of farmers applying this technology has increased to 1,027 within two years. The total number of farmers adopting new technologies has now reached 4,812, and the economic benefit in 2002 resulting from these improved technologies has been estimated at 4,116 million VND or US$ 274,400.

Results of the second phase of the project indicate that the effects of FPR/FPE methodologies are not limited only to economic benefits for a large number of farmers, but have also had positive effects on other aspects, such as better environmental management resulting in soil and water conservation, strengthening of the capacity of researchers, extensionists and farmers in conducting strategic and applied research in crop production and animal husbandry that will overcome constraints identified at the farm level; and last but not least, it has enhanced the establishment of different types of farmers' organizations for further self-development. The experience of working together in this project will further contribute to long-term sustainable rural development in Vietnam.

INTRODUCTION

Vietnam is producing about 2 million tonnes of fresh cassava roots yearly on an area of 238,700 ha. The average yield of cassava root is 8.9 tonnes/ha. The annual cassava production of Vietnam ranks fifth in Asia and thirteenth in the world. The major cassava regions are the Northern midland and mountainous region, the North Central Coast, the South Central Coast and the Southeastern region.

During the past decade, cassava in Vietnam has changed from a traditional food crop into a commercial crop, especially in such favorable regions as the Southeastern region.

Vietnam now has about twenty-six cassava starch processing factories, and is exporting more than 200,000 tonnes of cassava per year. In other less favorable regions, cassava is both an important food crop and a feed crop for smallholder farm households.

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Cassava has the advantage that it is easy to grow and it still gives rather high yields even under poor cultivating conditions such as poor soil, lack of rainfall and low inputs. The fact remains, however, that cassava is considered a crop of the poor in many regions. Therefore, research and the transfer of new technologies, like new high-yield and high-starch varieties as well as better cultivation technologies, have received little attention. In the 21st Century, cassava appears to have great new potential but also faces new challenges. Cassava yields can be doubled as compared to the current yields by promoting extension, recommending and disseminating research results about new cassava varieties together with appropriate cultivation techniques through the Vietnam Cassava Research Network.

In order for farmers to obtain high economic benefits as well as to conserve the soil resources for more sustainable agricultural development, it is necessary for researchers to work directly with farmers, helping them to gain more knowledge and improve their ability to apply new technologies to cassava production. Vietnam's Cassava Research and Extension Network, is part of the Asian Cassava Research Network. The Vietnam Network has been collaborating with CIAT in the 2nd Phase of the Farmer Participatory Research (FPR)" project, which is financially supported by the Nippon Foundation in Tokyo, Japan.

PROJECT OBJECTIVES

The overall objective of the project is to increase the living standards of smallholder farmers and to improve the agricultural sustainability in less-favored areas of Vietnam by improving the productivity and stability of cassava-based cropping systems.

The specific objectives are:

1) To increase cassava production and maintain the soil's fertility in smallholder farms through the direct participation of farmers.
2) To identify the constraints, conduct FPR trials with farmers' evaluation and selection of the most suitable technologies.
3) To develop and disseminate new technologies that are best suited to farmers' needs and adapted to local conditions.
4) To strengthen the FPR capacity in national institutions and in a number of rural communities.

METHODOLOGIES

The 2nd Phase (1999-2003) of the project focused on the following activities:

- To use various farmer participatory methodologies such as participatory diagnosis of problems and the conducting of FPR trials in a number of pilot sites. In 2002, the project was working in a total of 25 sites in different regions of Vietnam.
- To organize training courses on FPR methodologies for extension workers and farmers.
- To organize field days (on-farm workshops), and cross-visits at the time the trials are harvested.
- To facilitate the adoption of new technologies which had been selected by farmers.
- To analyze and evaluate the results, as well as the impacts of the project on farmers' income and soil conservation, as well as the ability of researchers,

extension workers and farmers to adopt a more participatory approach in research for development.

The various steps in the process used in this project are shown in **Figure 1** and include the following activities: Participatory diagnosis→Participatory selection of potential solutions → Participatory trials→Participatory evaluation and selection of new technologies→ Participatory extention and adoption of new technologies.

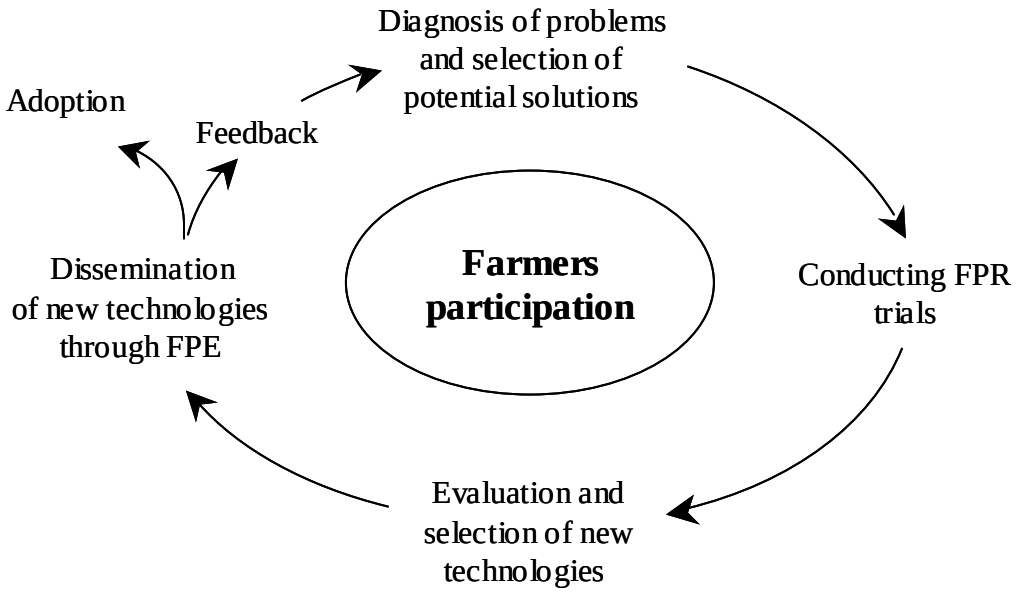

Figure 1. Steps in the farmer participatory research and extension activities.

RESULTS AND DISCUSSION

1. Identification of Constraints

By 2002, the project had conducted Rapid Rural Appraisals (RRA) with farmer participation in 25 pilot sites and farmers had determined and selected several component technologies to be tested in FPR trials. The results of these RRAs indicate that the main constraints to obtaining high cassava yields (the average yield varied from 7.0 to 16 t/ha) can be ranked in priority order as follows:

- Low fresh root yield and low starch content of the local cassava varieties.
- Serious soil erosion in many cassava producing areas.
- No or little fertilizer input; farmers are used to applying only nitrogen (N) and sometimes phosphorus (P).
- Poor cultivation technologies, such as plant spacing, planting time, weed management etc.
- Lack of knowledge about the effective use of cassava for animal feeding.

- Unstable cassava prices.
- Farmers haven not received any training in cassava technologies

2. FPR Trials

Based on the needs of farmers and the constraints identified through discussion and the use of various participatory diagnosis methodologies, seven different technology components were selected for the FPR trials (**Table 1).**

Table 1. Technology components and the number of FPR trials conducted by six collaborating institutions in Vietnam in 2002.

Technology components	Institution						
	IAS	TDUAF	HUAF	VASI	NISF	TUAF	Total
Varieties	7	4	6	9	5	16	47
Soil erosion control	4	4	5	2	8	7	30
Intercropping		4	5	6	7	9	31
Fertilization	7	4	4	3	1	5	24
Plant spacing			5		11	3	19
Weed control							0
Cassava leaf production	1		1				2
Pig feeding of cassava root and leaf silage			16				16
Total							169

The technology components that were considered most important by farmers in all pilot sites were: 1) new high-yielding cassava varieties; 2) effective soil erosion control practices; 3) intercropping; and 4) more balanced fertilization suitable for cassava. The other technology components were considered of importance mainly in certain regions. For instance, farmers in the Southeastern region were interested in trying out new methods of weed control, while the farmers in Thua Thien-Hue province wanted to try ensiling technologies of cassava leaves and roots for pig feeding. The initial studies on cassava leaf production were conducted at Thai Nguyen University of Agriculture and Forestry (TUAF) in the north and at Hung Loc Agric. Research Center of IAS in South Vietnam.

3. Training and Field Days

Training and farmer field days were important activities of the project in order to give extension workers and farmers a clearer understanding of the project's objectives and methodologies. Together they would analyze the problems, determine the type of FPR trials to find solutions that would meet the farmers' needs. Field days were organized at FPR sites at the time of harvesting the trials. The farmers participated in the harvest, scored the various treatments in each trial, and finally discussed, analyzed and selected the most appropriate technologies for the local conditions. Up to 2002, five farmer training courses had been organized in three regions of Vietnam with a total of 152 extension workers and farmers participating.

Farmer field days and cross-site visits were organized yearly by all six collaborating institutions; a total of 360 farmers and local officials participated in these activities. This was a very effective extension method, since farmers were directly involved and participated in the evaluation and the selection of those technologies that they prefered.

4. Effect of Applying New Technologies

After participating in the conducting of FPR trials, in training courses, field days and cross-visits, the farmers quickly adopted and expanded the new technologies they selected on a larger scale. At each FPR site, farmers adopted some or all of the technological components, such as new cassava varieties, intercropping, soil erosion control, both separately or combining them in certain cropping systems, such as new cassava varieties + intercropping; new cassava varieties + intercropping + fertilizing; or new cassava varieties + intercropping + soil erosion control by planting contour hedgerows. The effects of applying these new technologies during the past three years (2000-2002) are very encouraging and they have already caught the attention of both farmers and local leaders. In many areas, the leaders have reconsidered their development policies. Cassava is now being considered as a commercial crop, effectively contributing to the elimination of hunger and poverty, and to rural development and modernization through agro-industry. Van Yen district in Yen Bai province is a good example. Starting from the intercropping trials in 2001 and 2002, the area under cassava intercropped with peanut was enlarged to 6 ha in 2003. Similarly, the initial FPR variety trials were soon expanded to an area of 20 ha of new cassava varieties of high yield and starch content, such as KM60 and KM94. After the field days evaluating the results, the district and provincial officials decided to concentrate their efforts on enlarging the area of new cassava varieties; this reached a total area of 1,030 ha in 2002. Van Yen district is a good example of how cassava production suddenly expanded in North Vietnam with the adoption of new varieties and improved agronomic practices.

4.1 Adoption of soil erosion control practices

The major reason why soil erosion can be serious when cassava is grown on sloping land is that the crop is usually planted at low density (0.8-1.0 m x 0.8-1.0 m), while cassava grows slowly during the first 3-4 months; this time also coincides with the rainy season resulting in serious soil erosion on cassava land. This may be as high as 50-110 tonnes of eroded soil/ha. Therefore, soil erosion control is a very important practice, that contributes to more sustainable cassava production. One of the ways to reduce erosion is to plant hedgerows along the contours with a distance between rows of 6 to 10 m, depending on the slope. Hedgerow species tested in this project were *Tephrosia cadida,* vetiver grass, *Paspalum atratum*, *Panicum maximum* and pineapple.

Depending on their knowledge and on local conditions, farmers in each region selected the most appropriate hedgerow species. Farmers in the north generally preferred *Tephrosia candida,* farmers in the Central Coast preferred pineapple, while in the South the farmers liked vetiver grass or *Paspalum atratum*.

After three years, the number of households applying these technologies increased from 62 in 2000 to 222 in 2002 with the area using erosion control increasing from 21.1 ha to 98.8 ha. By applying soil conservation practices fresh root yields increased, ranging from 2.15 to 8.4 t/ha as compared to areas with no hedgerows; the gross income from

cassava was estimated to be about 118,158 million VND (US$ 7,8877) higher than that of areas using their traditional practices without erosion control (**Table 2**).

Table 2. Extent of adoption of erosion control practices, and their effect on cassava yield and income of farmers in Vietnam participating in the Nippon Foundation project from 2000 to 2002.

Responsible institution and year	No. of house-holds	Area (ha)	Cassava yield (t/ha)		Additional gross income (million VND)[1)]	
			Farmers' practice	Improved technique	Perha	Total
TUAF						
2000	21	4.0	17.7	20.6	1.00	4.00
2001	67	26.0	18.8	21.0	0.75	19.55
2002	88	52.0	18.8	21.0	0.75	39.10
NISF						
2000	33	14.0	11.8	11.8	0	0
2001	99	18.8	18.0	20.2	0.75	14.12
2002	96	19.9	18.0	20.2	0.75	14.97
VASI						
2000	2	0.12	25.5	30.3	1.70	0.20
2001	10	0.7	24.5	27.2	0.94	0.66
2002	14	1.0	24.5	27.2	0.94	0.94
HUAF						
2000	6	3.0	5.6	13.1	2.25	6.75
2001	12	9.7	5.2	13.6	2.52	24.44
2002	16	16.5	5.2	13.6	2.52	41.58
TDUAF						
2000	-	-	-	-	-	-
2001	6	3.3	20.0	27.0	2.03	6.70
2002	4	5.4	20.0	27.0	2.03	16.96
HARC						
2000	-	-	-	-	-	-
2001	6	1.4	19.8	22.6	0.81	1.14
2002	4	4.0	19.8	22.6	1.23	4.93
Total 2002	**222**		**12.1**			**118.16 =US$ 7,877**

[1)] Price of cassava fresh roots: VND 350/kg in the north, 300 in the Central Coast and 290 in the south in 2000/01 and VND 440 in 2001/02.

4.2 Adoption of improved fertilization practices

Since cassava can grow with few inputs, farmers generally apply only nitrogen fertilizers. Phosphorus and especially potassium are almost never applied to cassava. After three years of testing various new fertilizer technologies, only 157 households had adopted balanced fertilizer application to cassava on an area of 26.0 ha, even thought while participating in field days they had seen the remarkable difference in cassava yield between the fertilized and non-fertilized plots.

Fertilizer application to cassava doubled cassava yield in many places. The average yield increase ranged from 4.5 to 12 t/ha. The value of this increase in production

ranged from 0.55 to 5.28 million VND as compared to the farmer's traditional practice of no fertilizer application (**Table 3**).

Table 3. Extent of adoption of improved fertilization practices, and their effect on cassava yield and income of farmers in Vietnam participating in the Nippon Foundation project from 2000 to 2002.

Responsible institution and year	No. of house-holds	Area (ha)	Cassava yield (t/ha)		Additional gross income (million VND)[1)]	
			Farmer practice	Improved technique	Per ha	Total
TUAF						
2000	12	2.0	11.0	16.8	2.03	4.06
2001	42	3.5	27.7	33.7	1.80	6.30
2002*	48	5.0	27.7	33.7	1.80	9.00
NISF						
2000	33	7.0	17.2	28.5	3.20	22.40
2001	47	7.6	19.4	28.2	3.08	23.41
2002	38	7.3	19.4	28.2	3.08	22.48
VASI						
2000	3	0.15	27.1	32.5	1.89	0.28
2001	6	0.5	23.0	27.2	1.47	0.70
2002	20	2.0	23.0	27.2	1.47	2.94
HUAF						
2000	15	0.7	7.5	12.5	1.50	1.05
2001	20	1.5	10.0	15.5	1.65	2.48
2002	44	6.2	10.0	15.5	1.65	10.23
TDUAF						
2000						
2001						
2002	3	1.5	38.0	50.0	5.28	7.92
HARC						
2000	1	1.0	19.3	29.6	2.99	2.99
2001	8	2.2	33.3	35.2	0.56	1.23
2002	4	4.0	33.3	35.2	0.84	3.38
Total 2002	**157**	**26.0**				**57.42 = US$ 3,828**

[1)] Price of cassava fresh roots: VND 350/kg in the north, 300 in the Central Coast and 290 in the south in 2000/01 and VND 440 in 2001/02.

4.3 Adoption of intercropping practices

Since cassava initially grows slowly and the rows are normally spaced widely, it can be intercropped with short-duration crops like legumes. Through the FPR intercropping trials, farmers in the north and the central part of Vietnam selected intercropping with peanut, usually two rows of peanut in between rows of cassava. The use of this intercropping pattern did not decrease cassava yields, but produced an additional 0.8-1.2 tonnes of dry peanut pods/ha. Moreover, about ten tonnes of residue was returned

to the soil as green manure. In the Southeastern region, farmers preferred intercropping cassava with maize or mungbean.

Since the advantages of intercropping are remarkable, 689 households applied the intercropping technology in 2002. Cassava yields increased between 1.58 and 4.8 t/ha. The gross income/ha increased by 0.498 to 1.977 million VND. The total additional gross income from cassava and the intercrops was 142,797 million VND as compared to the farmer's traditional practice of planting cassava in monoculture (**Table 4**).

Table 4. Extent of adoption of intercropping practices, and their effect on cassava yield and income of farmers in Vietnam participating in the Nippon Foundation project from 2000 to 2002

Responsible institution and year	No. of house-holds	Area (ha)	Cassava yield (t/ha)		Additional gross income (million VND)[1)]	
			Farmer practice	Improved technique	Per ha	Total
TUAF						
2000	70	5.6	17.6	23.2	1.97	22.25
2001	82	6.7	18.8	24.4	1.98	26.65
2002	115	10.5	18.8	24.4	1.98	41.76
NISF						
2000	33	3.5	14.2	16.2	0.73	9.55
2001	34	3.7	15.8	16.9	0.38	8.74
2002	35	3.9	15.8	16.9	0.38	9.25
VASI						
2000	3	0.2	29.0	30.4	0.49	0.37
2001	64	3.0	29.4	31.9	0.88	8.62
2002	320	5.0	29.4	31.9	0.88	14.38
HUAF						
2000	20	1.5	7.1	8.8	0.50	3.75
2001	170	12.0	5.0	9.8	1.44	41.20
2002	215	18.5	5.0	9.8	1.44	63.64
TDUAF						
2000						
2001						
2002	1	1.5	36.1	40.2	1.79	5.68
HARC						
2000	1	1.0	26.6	26.6	0.29	3.29
2001	10	2.4	29.2	30.7	0.70	6.49
2002	3	3.0	29.2	30.7	0.70	8.08
Total 2002	**689**	**42.2**				**142.80 = US$ 9,520**

[1)] Price of cassava fresh roots: VND 350/kg in the north, 300 in the Central Coast and 290 in the south in 2000/01 and VND 440 in 2001/02.

4.4 Adoption of new cassava varieties

In agriculture in general, and particularly in cassava, farmers normally concern themselves only in selecting the appropriate varieties. New high-yield varieties are usually

more readily accepted than other new technologies, as adopting these other technologies normally require additional investments. By changing the variety, production can be increased without much additional investment. Moreover, higher investment for obtaining higher yield can be more easily accepted when using new varieties. If we recommend farmers to apply fertilizers to their old cassava varieties, even thought there is a remarkable increase in yield, adoption will still be slow. But it will be more readily accepted if we recommend them to apply balanced fertilizers to new cassava varieties.

Therefore, after three years of conducting the project's activities, there were at least 2,717 households growing new cassava varieties on an area of about 1,243 ha in 2002. The principal new varieties grown in each region are as follows: KM94 KM98-5 and SM937-26 in the Southeastern region; KM94, KM98-1 in the Central region; KM98-7 in Thai Nguyen; and KM94, KM60 and KM95-3 in other parts of the Northern region. By using these new varieties the fresh root yield increased between 2.9 and 24.2 t/ha. Yields in many areas doubled as compared to the local varieties. Consequently, by growing new varieties the higher yields obtained resulted in additional gross income of 3,650.07 million VND as compared to growing the local cassava varieties (**Table 5**).

4.5 Adoption of the use of cassava root and leaf silage for pig feeding.

For smallholder cassava farmers, various cassava products can be used as feed resources for pigs. Usually, there are still a lot of young cassava leaves remaining on the plant at time of root harvesting. Although cassava leaves are high in protein, one of the main constraint for using fresh cassava leaves and roots as a pig feed is the toxicity of free HCN released from the fresh roots and leaves. The use of silage technology overcomes this problem and makes it possible to effectively use these cassava leaves; moreover, it also makes it possible to store the feed for 6-12 months. Learning about this technology through training courses and field days, many households in the central part of Vietnam adopted this technology in on-farm animal feeding. Our survey indicates that in 2002 there were 1,027 households using the leaf and root silage technology for pig feeding, with the total number of pigs being 2,742. The total additional gross income resulting from using this technology was 147.54 million VND (**Table 6**).

4.6 Adoption of various new technologies and the estimated increase in gross income of farmers

Summarizing the results presented in **Tables 2** to **6**, we estimate that about 4,812 households adopted new technologies in an area of about 1,411 ha, while 2,742 pigs were fed with cassava root or leaf silage. The total additional gross income obtained was estimated at 4,115.99 million VND, equal to US$ 274,400. These are very worthy and encouraging effects of the project (**Table 7**).

5. Example of the Impact of the Nippon Foundation Project on the Livelihoods of Farmers in Tien Phong Village

In 1994, we selected Tien Phong village in Pho Yen district of Thai Nguyen province as one of the first pilot sites for implementing the first phase of the project. The RRA/PRA results showed that the fresh cassava root yield in Tien Phong village was very low, only 8.5 t/ha. The total gross income was only 3.4 million VND/ha, while the net income was 0.47 million VND/ha. After conducting the FPR trials (1994-2001), and

adopting the new technologies, cassava yields increased nearly three times, from 8.5 t/ha to 22.7 t/ha. The gross income/ha increased from 3.4 to 14.26-16.94 million VND, and the net income resulting from cassava production reached 9.9-11.78 million VND/ha (**Table 8**).

Table 5. Extent of adoption of new cassava varieties, and their effect on cassava yield and income of farmers in Vietnam participating in the Nippon Foundation project from 2000 to 2002.

Responsible institution and year	No. of house-holds	Area (ha)	Cassava yield (t/ha)		Additional gross income (million VND)[1)]	
			Farmer practice	Improved technique	Per ha	Total
TUAF						
2000	38	2.5	21.5	31.0	3.32	8.31
2001	235	46.5	21.3	29.5	2.87	132.88
2002	1,270	450.0	21.3	29.0	2.87	1,291.50
NISF						
2000	22	1.2	20.2	23.1	1.015	1.22
2001	89	3.1	20.2	23.1	1.015	3.15
2002	97	4.2	20.2	23.1	1.015	4.26
VASI						
2000	-	-				
2001	39	5	24.1	28.0	1.365	6.82
2002	68	15	24.1	28.0	1.365	20.48
HUAF						
2000	22	2.0	18.9	33.6	4.41	8.82
2001	60	9.0	15.6	34.8	5.76	51.84
2002	120	38.0	15.6	34.8	5.76	218.88
TDUAF						
2000	-	-				
2001	14	9.0	20.0	27.0	3.08	27.72
2002	12	15.5	20.0	27.0	3.08	47.74
HARC						
2000	6	2.0	19.3	43.5	7.02	14.04
2001	10	3.9	23.3	29.6	2.77	10.81
2002	70	21.0	23.3	29.6	2.77	58.21
Total 2002	**2,717**	**1,243.7**				**1,614.07 = US$ 109,405**

[1)] Price of cassava fresh roots: VND 350/kg in the north, 300 in the Central Coast and 290 in the south in 2000/01 and VND 440 in 2001/02.

CONCLUSIONS

1. Farmer participatory research and extension were found to be very effective methodologies for developing and transferring new technologies to farmers.
2. In 2002, at least 4,812 households in the 25 pilot sites of the project had adopted new technologies. It is estimated that the use of these technologies had increased farmers' income by about 4,116 million VND as compared to the farmers' traditional practices.

3. Adoption of these new technologies, not only increased cassava yields but also helped to maintain and improve the soil resources for more sustainable agricultural development, through better erosion control and soil fertility maintenance.
4. The project strengthened the capacity of farmers, extension workers and researchers in conducting strategic research and disseminating new technologies that will contribute to rural development.

Table 6. Extent of adoption of the use of cassava roots and leaves for pig feeding in three communes in central Vietnam, and their effect on the income of farmers participating in the Nippon Foundation project from 2000 to 2002.

Adopted technology and year	No of household	No. of pigs	Benefit/pig (VND)	Total gross income (million VND)
Leaf silage				
2001	28	96	86,000	8.26
2002	60	290	86,000	24.94
Root silage				
2001	759	1,896	50,000	94.80
2002	967	2,452	50,000	122.60
Total				**250.57 = US$ 9,836**

Table 7. Extent of adoption of new technologies and the estimated increase in gross income of farmers in the FPR pilot sites in Vietnam in 2002 as a result of the Nippon Foundation project.

Technology component	No. of households	Area (ha)	Increase in gross income (million VND)
New varieties	2,717	1,244	3,650.07
Intercropping	689	42	142.80
Erosion control	222	99	118.16
Balanced fertilization	157	26	57.42
Root and leaf silage for pig feeding	1,027	-[1)]	147.54
Total	**4,812**	**1,411**	**4,115.99 = US$274,400**

[1)] 2,742 pigs

Table 8. Impact of the Nippon Foundation project on the livelihoods of farmers in Tien Phong village, Pho Yen district, Thai Nguyen province in North Vietnam.

	No. of farmers	Cassava area (ha)	Cassava yield (t/ha)		Gross income (million dong/ha)	Production costs (million dong/ha)	Net income (million dong/ha)	Total net income (million dong)
			New varieties	Local variety[1)]				
1994								
Traditional	115	50	-	8.5	3.40	2.93	0.47	23.50
2000								
New varieties	25	1.31	30.9	21.5	15.46	4.36	11.10	14.54
Intercropping	37	2.59	29.3	-	18.70	5.16	13.54	35.07
Erosion control	4	0.20	24.7	-	14.59	5.46	9.13	1.83
Total	66	4.10						51.44
2001								
New varieties	89	4.70	28.5	22.7	14.26	4.36	9.90	46.53
Intecropping	40	3.38	26.2	-	16.94	5.16	11.78	39.82
Erosion control	4	0.20	-	-	-	-	-	1.83
Total	133	8.28						88.18

1) Vinh Phu

REFERENCES

Hoang Kim, Pham Van Bien, Tran Ngoc Quyen, Tran Ngoc Ngoan, Trinh Phuong Loan and K. Kawano. 2001b. Cassava breeding and varietal dissemination in Vietnam from 1975 to 2000. *In:* R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 147-160.

Howeler, R.H. 2001. The use of farmer participatory research (FPR) in the Nippon Foundation Project: Improving the sustainability of cassava-based cropping systems in Asia. *In*: R.H. Howeler and S.L.Tan (Eds.). Cassava's Potential in Asia in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 461-489.

Huang Jie, Li Kaimian, Zhang Weite, Lin Xiong and R.H. Howeler. 2001. Practices and progress in farmer participatory research in China. *In:* R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 413-423.

Lynam, J.K. and K.T. Ingram. 2001. The Nippon Foundation Project on improving the sustainability of cassava-based cropping systems in Asia – A project Evaluation Report. *In:* R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 490-516.

Nguyen Huu Hy, Nguyen The Dang and Pham Van Bien. 2001. Cassava agronomy research and adoption of improved practices in Vietnam. *In*: R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in Asia in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb 21-25, 2000. pp 216-227.

Nguyen The Dang, Tran Ngoc Ngoan, Dinh Ngoc Lan, Le Sy Loi and Thai Phien. 2001. Farmer participatory research in cassava soil management and varietal dissemination in Vietnam – Results of Phase I and Plans for Phase II of the Nippon Foundation Project. *In:* R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 383-401.

Pham Van Bien, Hoang Kim, Joel J. Wang and R.H. Howeler. 2001. Present situation of cassava production and the research and development strategy in Vietnam. *In*: R.H. Howeler and S.L. Tan (Eds.). Cassava's Potential in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp 16-24.

Wani Hadi Utomo, Suyamto and Aldon Sinaga. 2001. Implementation of farmer participatory Research (FPR) in the transfer of cassava technologies in Indonesia. *In*: R.H. Howeler and S.L.Tan (Eds.). Cassava's Potential in Asia in the 21st Century: Present Situation and Future Research and Development Needs. Proc. 6th Regional Workshop, held in Ho Chi Minh city, Vietnam. Feb. 21-25, 2000. pp. 424-435.