The Use of Vetiver for Soil Erosion Prevention in Cassava Fields in Thailand

Wilawan Vongkasem[1], Kaival Klakhaeng[1] , Watana Watananonta[2] and Reinhardt H.Howeler[3]

[1] Field Crops Promotion Division, Bureau of Agricultural Commodity Promotion and Management, Dept. of Agric. Extension (DOAE), Chatuchak, Bangkok, Thailand

[2] Field Crops Research Inst., Dept. of Agric. (DOA), Chatuchak, Bangkok, Thailand

[3] CIAT Regional Cassava Office for Asia, Dept. of Agric., Chatuchak, Bangkok, Thailand

Abstract: Cassava is a crop that induces high rates of soil erosion, especially if grown in sloping sandy soils. The joint research of the Centro Internacional de Agricultura Tropical (CIAT), the Department of Agriculture (DOA), and Kasetsart University (KU) revealed that adjustments in planting methods or planting systems could reduce soil erosion. Each method has certain advantages and disadvantages. While some methods give extra income, others need more management or higher investments; thus it is not certain whether farmers would adopt any of these methods.Therefore, CIAT in collaboration with the Department of Agricultural Extension (DOAE) and DOA initiated a project, entitled "Enhancing the Adoption of Soil Erosion Control Practices in Cassava Fields" in order to work with cassava farmers, using a Farmer Participatory Research (FPR) approach.

During the first phase (1994-98) of the project. two pilot sites were selected at Soeng Saang district of Nakhon Ratchasima province, and in Wang Sombuun district of Sra Kaew province. FPR trials on methods to reduce soil erosion were conducted for three consecutive years. After narrowing down the number of suitable options, farmers in both sites finally selected and adopted the contour strip cropping of cassava with vetiver hedgerows. They also requested further support to extend the vetiver hedgerows on a larger scale to their cassava fields. In Soeng Saang district, farmers in Sappongphot village joined together to set up a Soil Conservation Group. They planted vetiver hedgerows of a total length of 17 km in the first year (1998). Similarly, farmers in Wang Sombuun district planted vetiver hedgerows of a total length of about 10 km. During the last year of the first phase, DOAE had extended the project to two other sites in Kalasin and Chachoengsao provinces.

In the second phase of the project (1999-2003), a total of 24 villages in 17 districts in eight provinces were participating. To be able to scale up to many new sites, the project used and developed several 'Farmer Participatory Extension (FPE)' methodologies, such as cross-visits, farmer evaluation of demonstration plots, FPR trials, training courses, and field days. In addition, DOAE helped farmers in 11 sites to set up 'Cassava Development Villages', i.e. community-based self-help groups that help each other to develop better cassava production practices, and plant vetiver grass hedgerows as the most suitable system to reduce soil erosion. The activities included training, study tours, field trials, increasing production efficiency demonstration plots, and field days. The final result was that farmers in all villages adopted the vetiver-contour-strip planting method. More than 850 farmers participated in the project, and contour hedgerows of vetiver grass were grown for a total length of 130 km in their cassava fields.

Keywords: cassava, erosion, farmer participatory research, extension, Thailand, vetiver
Email contact: Vwilawan@hotmail.com

1 INTRODUCTION

Cassava can grow well even in low fertility soil and under very dry conditions. However, the rate of soil erosion in cassava fields is quite high, particularly on sloping land with sandy soils and low organic matter content. This is due to the wide spacing used in planting cassava and the slow growth rate during the first three months (Putthacharoen, 1992). Joint research of the Centro Internacional de Agricultura Tropical (CIAT), the Department of Agriculture (DOA) and Kasetsart University (KU) revealed that adjustments in planting methods or planting systems could markedly reduce soil erosion (Howeler, 1987; 1994). For instance, intercropping with some field crops, e.g. maize, groundnut, mungbean, pumpkin, watermelon; the use of chemical fertilizers, animal or green manures to stimulate initial growth and canopy formation; or contour strip cropping with some grasses, e.g. vetiver, ruzie grass, elephant grass and lemon grass. Each method has its own advantages and disadvantages. Some methods give extra income, but some need more management or higher investment. Thus, it is not clear which methods farmers might be willing to adopt.

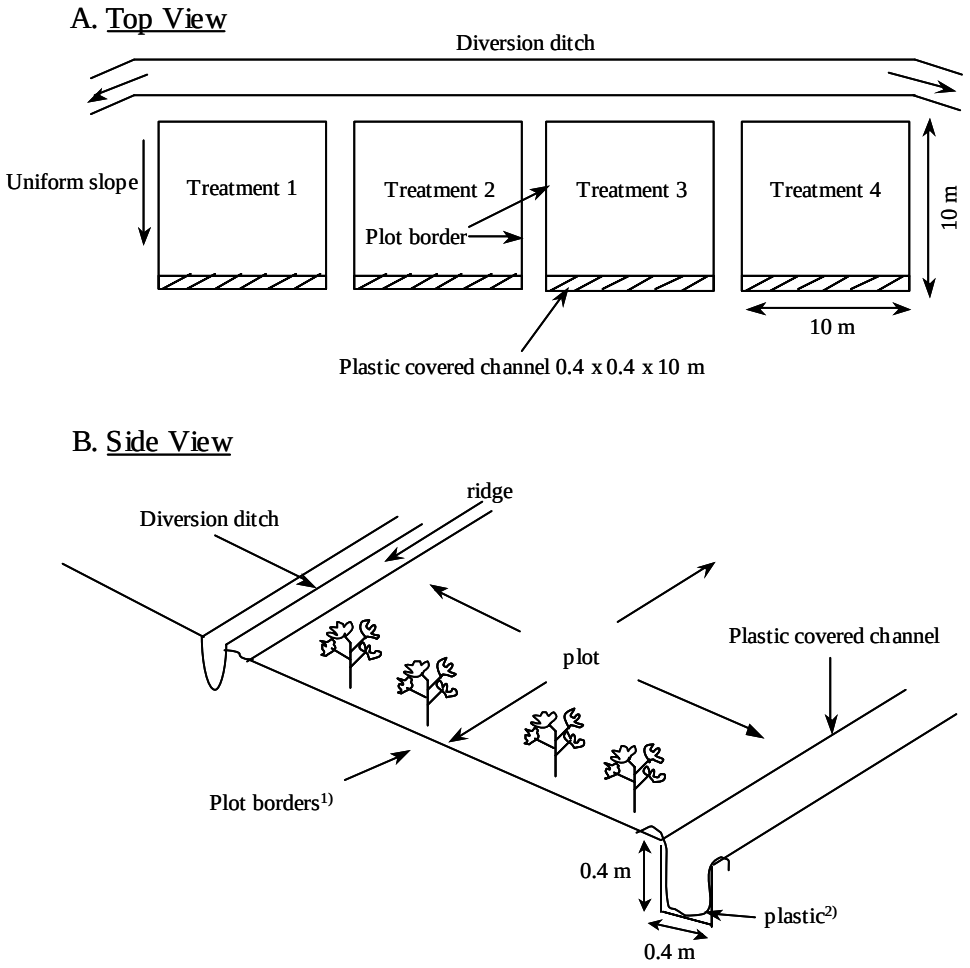
In 1993, CIAT, in cooperation with DOAE and DOA, initiated a new project entitled "Enhancing the Adoption of Soil Erosion Control Practices in Cassava Fields" which would use Farmer Participatory Research (FPR) methodologies (Vongkasem, 1998), in which farmers would test various FPR erosion control practices in simple trials on their own field. This process would increase farmers' awareness of soil erosion and its consequences. It also encouraged farmers to decide on which method of soil erosion prevention was most suitable and practical for their communities. The farmers conducted the trials by themselves with help from DOAE and DOA staff. Eventually, the farmers were the ones who selected the soil conservation method that was most suitable and efficient for their area.

The principal objectives of the project are: (i) To enhance the development and adoption by farmers of improved and sustainable cassava cropping systems and cultural practices that will reduce erosion and (ii) to scale-up the adopted methods to larger areas and to more communities.

2 PHASE I (1994-1998): IMPLEMENTATION

2.1 FPR Trials

The Dept. of Agric. Extension, in collaboration with DOA and CIAT, selected two project pilot sites, which were located in Soeng Saang district of Nakhon Ratchasima province, and in Wang Nam Yen district of Sra Kaeo province (Vongkasem *et al.*, 2000). Farmers from these pilot sites first made a study tour to observe demonstration plots, usually set out and managed by researchers; these plots showed many alternative options to maintain soil fertility and reduce erosion. Plots in these demonstrations were laid out along the contour of a uniform slope and had plastic-covered ditches along the lower side to trap eroded sediments (**Figure 1**). Farmers were asked to select some treatments that were suitable for their own areas. **Tables 1** and **2** are examples of how farmers ranked and selected the treatments. However, the farmers could also modify the treatments if they preferred; for example, in one site they replaced hedgerows of elephant grass with those of sugarcane for chewing.



[1] Plot borders were ridged up to prevent water entering from outside

[2] Soil sediment furrows were covered with plastic sheet; small holes were made in the plastic to let water seep out

Figure 1. Layout of demonstration plots, which show the effectiveness of alternative soil erosion control practices.

After two years of conducting FPR trials, farmers of both pilot sites had adopted vetiver grass hedgerows, even though the return from this treatment (in terms of cassava production and net income) was not the highest (**Table 3**). This is because farmers realized the seriousness of the soil erosion problem, and they considered which treatment was most effective in reducing erosion. The intercropping treatments generally produced more income than cassava mono-cropping and were intermediate in terms of reducing erosion. However, farmers did not have enough labor for the additional management of intercrop cultivation. In Sra Kaew province (**Table 4**) the establishment of vetiver grass barriers encountered some difficulty due to drought, and their effectiveness only became apparent after the barriers were growing well. For this reason, during the first year, the amount of soil loss from the vetiver hedgerow treatment was greater than from the ruzie grass hedgerow or contour ridging treatments. But, in the second year, the vetiver grass

hedgerows were well established so they were more effective in preventing soil erosion than other treatments

2.2 Farmer's Adaptation and Adoption

After conducting two consecutive years of FPR trials, farmers were convinced of the usefulness of vetiver hedgerows. They adopted the treatment and expanded it to a larger area in their production fields. Farmers in Nakhon Ratchasima province actually combined three treatments together: (i) using vetiver and chewing cane as contour hedgerows against erosion, (ii) intercropping with pumpkin between cassava rows, and (iii) contour ridging.

Table 1 Preference ranking by farmers of 24 treatments in the demonstration plots

Method	Ranking by farmers	
	Soeng Saang	Wang Nam Yen
1. Traditional practices	-	-
2. Closer spacing	-	-
3. No fertilizers	-	-
4. Fertilizer 15-15-15 = 25 kg/*rai**	5	-
5. Chicken manure = 250 kg/*rai*	-	-
6. Fertilizer 15-15-15 = 25 kg/*rai* + chicken manure = 250 kg/*rai*	4	-
7. No tillage	-	-
8. No tillage + plant cassava after mechanical harvesting	-	-
9. Reduced tillage, 3 discs (1x)	-	-
10. Up-down ridging	-	-
11. Contour ridging	-	-
12. Dry grass mulch	-	2
13. *Crotalaris juncea* mulch	-	-
14. *Canavalia ensiformis* mulch	-	-
15. Vetiver grass barriers	1	1
16. Elephant grass barriers	-	-
17. Ruzie grass barriers	3	4
18. Lemon grass barriers	-	3
19. *Leucaena leucocephala* barriers	-	-
20. *Flemingia macrophylla* barriers	-	-
21. Peanut intercrop	-	-
22. Mungbean intercrop	-	5
23. Maize intercrop	2	-
24. Watermelon intercrop	-	-

Table 2 Treatments selected by farmers during the study tours

Treatments selected by farmers	
Soeng Saang	Wang Nam Yen
1. Up-down ridging	1. Up-down ridging
2. Contour ridging	2. Contour ridging
3. Vetiver barriers	3. Vetiver barriers
4. Mulbery barriers	4. Peanut intercrop
5. Sugarcane barriers	5. Mungbean intercrop
6. Peanut intercrop	6. Wax gourd intercrop
7. Sweet corn intercrop	7. Ruzie grass barriers
	8. Dry grass mulch

** Rai is a Thai unit of area, equal to 1,600 m^2; 6.25 rai = 1 hectare*

Farmers in Sra Kaew province wanted to adopt the vetiver hedgerows combined with contour ridging, and tested this practice in 1 *rai*-plots. In the following year, farmers in Nakhon Ratchasima also focused their soil erosion practice only on vetiver hedgerows with contour ridging. They had learnt that the use of chewing cane hedgerows was not sustainable because they

had to replant them every 2-3 years. Furthermore, the chewing cane is not as drought tolerant as vetiver. In the case of intercropping with pumpkin, the practice required too much labor, and the pumpkin crop sometimes failed due to drought.

In the fourth year, the farmers at both sites had extended the vetiver contour hedgerows in their own cassava fields. Those successful sites were used for study-visits of farmers from new sites who joined Phase II of the project.

Table 3 Average results of FPR soil erosion control trials conducted by farmers in Soeng Saang district of Nakhon Ratchasima province, 1995/96 and 1996/97

Treatments	1995/96 Dry soil loss (t/ha)	1995/96 Cassava yield (t/ha)	1995/96 Net Income ('000 baht/ha)	1996/97 Dry soil loss (t/ha)	1996/97 Cassava yield (t/ha)	1996/97 Net income ('000 baht/ha)
1. Up-down ridging	24.80	29.80	21.75	4.30	22.30	8.05
2. Contour ridging	9.80	34.00	25.94	-	-	-
3. Vetiver hedgerows	8.50	35.20	26.78	3.85	21.80	6.24
4. Sugarcane hedgerows	11.80	32.20	34.71	4.23	22.20	11.03
5. Mulberry hedgerows	16.10	40.00	32.78	-	-	-
6. Peanut intercrop	13.30	28.90	30.69	-	-	-
7. Sweet corn intercrop	12.60	25.50	27.76	7.02	20.50	6.96
8. Pumpkin intercrop	-	-	-	5.61	21.80	9.32

Table 4. Average results of FPR soil erosion control trials conducted by farmers in Wang Nam Yen district of Sra Kaew province, 1995/96 and 1996/97

Treatments	1995/96 Dry soil loss (t/ha)	1995/96 Cassava yield (t/ha)	1995/96 Net Income ('000 baht/ha)	1996/97 Dry soil loss (t/ha)	1996/97 Cassava yield (t/ha)	1996/97 Net income ('000 baht/ha)
1. Up-down ridging	18.12	28.70	23.69	47.79	22.10	9.60
2. Contour ridging	8.22	26.90	21.28	28.27	20.70	8.17
3. Vetiver hedgerows	14.61	23.10	17.12	10.16	18.10	4.98
4. Ruzie grass barriers	4.54	31.60	30.30	-	-	-
5. Wax gourd intercrop	12.30	26.40	21.07	-	-	-
6. Peanut intercrop	14.66	16..50	21.68	-	-	-
7. Mungbean intercrop	26.22	25.50	30.88	15.53	12.60	4.66
8. Dry grass mulch	5.47	33.50	29.58	29.14	21.40	8.33

* FPR = Farmer Participatory Research

3 PHASE II (1999-2003): IMPLEMENTATION AND PROJECT EXPANSION

In Phase II, some new activities were included in order to promote the learning and understanding of soil and water conservation by many more farmers. The number of project sites also increased, while the implementation still followed the farmer participatory approach.

The implementation plan in Phase II was as follows:

- Selection of project sites
- Farmers' meeting and study tour (cross-visit)

- Evaluation of demonstration plots on increasing productivity
- Training of field staff
- Conducting of FPR trials
- Technology transfer through farmer participatory extension (FPE)
- Field days
- Media production
- Additional activities.

3.1 Selection of Project Sites

The criteria for selection of project sites are:

- Cassava is the main crop in the area where soil fertility is low and soil erosion is a serious problem.
- Farmers are eager to improve their cassava production.

After the villages were selected, their agro- and socio-economic conditions were investigated by conducting preliminary 'Rapid Rural Appraisals (RRA)', while cassava production problems were also studied.

3.2 Farmers' Meeting and Study Tour (Cross-Visit)

Farmers' meetings were held in the selected villages to discuss the objectives, principles, and procedures of the project. The detrimental effect of soil erosion was pointed out, and some solutions were presented. In addition, the improvement of soil fertility by using green manures or chemical fertilizers was also discussed. The farmers then discussed and decided for themselves whether or not they wanted to participate in the project. In case farmers were not interested, the project would look for other sites.

Farmers who wanted to participate in the project were invited to join the study tour to observe the demonstration plots on soil erosion control methods as described above. After this, farmers from the new site visited an "older" site, either Sapphongphot village, in Nakhon Ratchasima province, or the farmer group of Khong Ruam village, Sra Kaew province. Farmers in both these sites had already adopted the vetiver grass contour hedgerow system. This was an opportunity to exchange experiences between the visitors and the hosts. The concepts of establishing a village credit fund and the administration of this fund were also discussed.

At the end of the study tour, farmers were asked whether they were interested in either conducting their own FPR trials on some selected treatments of soil erosion control, or to adopt any of the observed soil erosion control practices right away. In most cases, farmers preferred to adopt the planting of vetiver hedgerows, because they had already observed the efficiency of these hedgerows for soil erosion control under real farming conditions.

3.3 Conducting FPR Trials on Increasing Productivity

In case farmers wanted to start conducting their own FPR trials, they were provided with some extra inputs, such as seeds of intercrops, seeds or tillers of hedgerow species, plastic sheets to

cover the sediment collection ditches, and they were reimbursed for the cost of digging the sediment ditches. Officials from DOA and DOAE helped farmers lay out the field trials. Alternatively, if farmers wanted to adopt the planting of vetiver grass hedgerows, they would receive the necessary vetiver slips and help in setting out contour lines from LDD.

Usually DOAE staff suggested farmers to conduct additional trials on new cassava varieties, chemical and organic fertilizers, and green manuring. These trials provided farmers with information on how to increase cassava production efficiency and also helped to attract their interest in participating in the project.

3.4 Training of Staff

Various training courses were organized by CIAT to train the project staff of the three departments, namely DOA, DOAE, and LDD. Officials from both the central and regional offices received training on the farmers' participatory development approach. Furthermore, CIAT supported the training of-trainers by having them participate in various training courses abroad.

3.5 Technology Transfer through Farmers' Participatory Extension

In order to transfer technology through farmers' participation, a budget was allocated to support 4-6 farmers' meetings annually. The topics included discussions on the problems of project implementation and the possible solutions for both project management and crop production. The local extension agents acted as the coordinators and invited experts or lecturers from outside according to the farmers' needs.

3.6 Field Days

Field days were held at three levels:

3.6.1 Village level: This was a farmers' field day organized at the time of harvest of the FPR trials. After the trial plots were harvested, all data were recorded and the results were analyzed together with the farmers. In this way, farmers learned and obtained information to make decisions about those technologies most suitable for their own conditions. They then discussed and planned for action in the following year.

3.6.2 District level: The objective of this level of field day was to disseminate the new technologies to nearby villages and sub-districts. During the field day, experienced farmers shared their knowledge with other farmers. Researchers and extensionists from DOA, DOAE, and LDD talked about ways to increase cassava production efficiency, increasing soil fertility by planting green manures, and control erosion by planting vetiver contour hedgerows. The field days took place in the project sites so that the visiting farmers would be able to study the real situation. This methodology was quite effective as the farmers were interested in duplicating the practices of soil erosion control in their own areas.

3.6.3 Provincial level: At this level, approximately 1,000-1,500 farmers and officials from nearby provinces were invited to visit the provincial field day. Reporters from newspapers and television stations were also invited in order to report the project activities through the mass media.

3.7 Media Production

In order to disseminate information about the project and its implementation to a wider audience, a video showing the use of a farmer participatory approach in development work was produced and distributed to many provincial offices and agencies. The Office of the Royal Development Projects Board also supported the project by providing the booklet series entitled "Factual Tips about Vetiver" for distribution to the farmers who participated in the project.

3.8 Additional Activities

Additional activities included:

3.8.1 Training Course for Making Handicrafts from Vetiver Leaves: The training course was aimed at offering an alternative way of generating income from vetiver leaves. Farmers from three villages: Sapphongphot and Kut Dok villages in Nakhon Ratchasima province, and Huai Suea Ten village in Kalasin province were trained. The trainers of the course were provided by the Department of Industrial Promotion.

3.8.2 Cassava Development Village: Since the year 2000, DOAE has supplemented the project's implementation by setting up so-called "Cassava Development Villages". Farmers in a few selected villages received special training to gain more knowledge and a clearer understanding about the need to conserve the soil resources while simultaneously generating higher yields and income. The planting of vetiver grass hedgerows across the slope and the planting of green manures to increase soil fertility were promoted. DOAE provided the farmers with planting material of good cassava varieties, with chemical fertilizer, and with vetiver slips on the condition that they return the value of these materials to the village-revolving fund after harvest. The rate of interest to be paid was agreed upon by the villagers. Furthermore, the members voted to elect the 'Fund Administration Committee', which comprised at least a chairman, a vice-chairman, a treasurer, and a secretary. Rules and regulations were voted on by the members.

4 FINAL RESULTS AND DISCUSSION

The results of ten years of implementation of the project "Enhancing the Adoption of Soil Erosion Control Practices in Cassava Fields" has had a great impact on the farmers' awareness of the importance of soil erosion prevention. After testing various options to reduce soil losses by erosion they selected the planting of vetiver grass hedgerows across the slopes as the most suitable and effective erosion control practice. Presently, this practice has been adopted in 24 villages located in eight provinces. Altogether, over 865 farmers participated in planting vetiver hedgerows with a total length of 130 km in cassava fields, employing a total of 1.3 million vetiver slips. Furthermore, farmers in a few villages adopted the planting of *Canavalia ensiformis* (jack bean) as a green manure. In addition, 21 "Cassava Development Villages" were established. At present, members of these farmers' groups have access to a revolving fund, which range in size from Baht 40,000 to 380,000 per group, with a total of Baht 1,475,868 to be used for the development of these community (**Table 5**). The establishment of these groups is a way to strengthen rural communities in the future. Besides, the DOAE tries to make use of the project sites

for field visits of farmers from nearby villages, sub-districts, districts and provinces in order to encourage scaling-up of the project results.

Table 5 Location of pilot sites for the project "Enhancing the Adoption of Soil Erosion Control Practices in Cassava Fields", the extent of adoption of vetiver grass hedgerows, and the status of the village revolving credit funds in 2002

Province	District	Sub-district	Village	No. of farmers	Area planted with Cassava (*rai*)	Area planted with Vetiver (plant)	Vetiver strip (km)	Villager revolving fund (baht)
Kalasin	Mueang	Phu Po Kamin	Non Sawan Kham Pla	61	306	85,500	8.6	40,000
	Nong Kung Si	Nong Bua	Kham Si	67	690	111,600	11.2	85,850
	Sahatsakhan	Non Buri	Non Sawat	63	370	86,170	8.6	75,000
		Non Nam Kliang	Huai Suea Tent Pa Kluai	42	254	128,330	12.8	114,220
	Namom	Namom	Noon Thiang	50	24.0	16,000	1.6	-
	Don Chan	Dong Phayung	Noon Kokchik	50	24.0	16,000	1.6	-
	Huay Phueng	Nikhom	Huay Fa	50	24.0	16,000	1.6	-
Kamphaeng Phet	Khanu Wara-laksaburi	Bo Tham	Si Yak Ton Sai	42	170	68,000	3.0	78,288
Kanchana-buri	Lao Khwan	Thung Krabam	Nong Kae	42	170	80,000	3.0	60,000
Chaiya-phum	Thep Sathit	Na Yang Klak	Kok Anu	42	170	68,000	4.0	86,000
Cha-cheong-sao	Sanam Chai Khet	Thung Phraya	Tha Chiwit Mai	6	45	50,000	2.0	101,080
	Tha Takiap	Khlong Takrao	Nong Yai	42	170	100,000	5.3	83,550
Prachin Buri	Na Di	Kaeng Dinso	Ang Thong	34	170	60,000	4.5	84,800
Nakhon Ratcha-sima	Dan Khun Thot	Ban Kao	Kut Dok	53	309	130,000	15.0	132,000
	Thepharak	Bueng Prue	3 , 6	26	214	80,000	11.0	54,000
	Soeng Sang*	Non Sombun	Sapphong phot	60	828	80,000	20.0	73,300
		Sa Takhian	Sa Takhian	-	30	20,000	2.0	0
	Khon Buri*	Tabaekbaan	Nong Phak Rai	27	24.0	50,000	-	0
Sra Kaew	Wang Sombun	Wang Sombun	Khlong Ruam	42	-	90,000	-	380,000
Total: 8	19	20	21	865	5,876	1,335,600	129.8	1,475,868

5 DISCUSSION

The following lessons have been learnt from the project:

1. The implementation of a project that has as its objective to conserve the soil, water, and the environment, must involve the people of the whole community, or at least, it must start with some parts of the community that participate in the project. The villagers must be aware of the seriousness of the problems that need to be solved by sharing their opinions and by making decisions together.
2. The technologies offered to the farmers must have a direct positive effect on yields and must be adapted to their way of life. For example, the adoption of vetiver hedgerows planting and intercropping with jack bean as a green manure is likely to improve soil fertility, which in turn may result in increased cassava yields.
3. The duration of a project is also another significant factor for its success, because the problem of soil erosion does not have an immediate impact on the daily life of the farmers. Thus, farmers need some time to become aware of the problem, to test several treatments and to confirm the results before they decide to adopt soil conservation practices. In this case, the project was able to continue at least ten years.
4. Agricultural extensionists need to change their role from recommending certain practices to being a facilitator, to encourage members of the community to participate in analyzing their problems and in searching for solutions. In many cases, they can act as a coordinator to seek help and knowledge from outside. Nevertheless, the needs must be identified by the community.
5. Various incentives or subsidies of some production inputs are necessary, particularly for the conducting of field trials, to provide vetiver slips and to help set out contour lines after farmers have decided to adopt the use of vetiver grass contour hedgerow planting.
6. Farmers should be given the freedom to select and modify the soil erosion prevention treatments to be tried on their own fields. For example, they can test the use of other grasses or other crops as contour hedgerows, such as sugarcane for chewing or upland rice.
7. The forming of farmers' self-help groups will provide opportunities for members of the community to express their opinions and find the best ways for future development. Support from outsiders in terms of supplying planting material, fertilizers, seeds, etc., with the condition that the users of the inputs return these to start the village revolving funds, may be a way of strengthening their development.

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Biodata

Mrs. Wilawan Vongkasem, Agriculture Scientist 7, Bureau of Agricultural Commodity Promotion and Management, Department of Agricultural Extension, received her B.S. (Agric.) from Kasetsart University in 1980. She attended several training courses on farmers' participation, such as "Participatory Research and Development" in the Philippines, and "Gender Analysis and Interest Group in Agriculture and Natural Resources Management" in Vietnam. She was responsible for the project on Management of System on Cassava for Soil Erosion Prevention under a project on "Integrated Cassava-based Cropping Systems in Asia: Farming Practices to Enhance Sustainability" which was conducted since 1994.