VETIVER GRASS IN HEDGEROW FARMING SYSTEMS ON SLOPING LANDS IN VIET NAM

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Introduction

Vetiver grass *(Vetiveria zizanioides)* is known in Vietnamese as *Huong Bai* or *Huong Lau*. In recent years it has been tested and used as a biological measure for erosion control, not only in agricultural activities, but also for road protection from landslide.

The deforestation at a rate of 11 million ha per year in the world and 100 000 ha per year in Viet Nam for crop cultivation has had a bad consequence: after a few years of cultivation, usually half of the deforested land area is degraded mostly as a result of the topsoil being washed away by water runoff.

On a global scale, vetiver grass has been widely used against erosion. It originated in the Mysore region of southern India and has been used there as green hedgerows for about 200 years. At present, vetiver grass technology (VGT) is widely applied on hundreds of thousands of hectares in 147 countries, in 106 of which it is used as hedgerows for soil and water conservation.

The technology of vetiver grass strip planting was widely applied in Thailand with good efficiency in the production of upland crops. Farming with contour planting of vetiver grass strips can increase crop yield by 20%, decrease runoff by 50% and erosion by 70%, as compared to normal farming.

In Viet Nam, since 1990 vetiver grass has been applied in research and development in some mountainous regions by the National Institute for Soils and Fertilizers. Some research results and developments have been collected to set up demonstrations on farming households' lands.

Methods of Research and Development

Along with long-term experiments, a lot of farmer-participating trials and demonstration sites were conducted with different types of hedgerow species for comparison. At harvesting time, field day trips and training courses were organized to collect the data and to evaluate the technologies the farmers want to choose, based on the effectiveness of erosion control, soil fertility, crop yield, economic return, etc.

Results of Research and Demonstration

Comparative Efficiency of Vetiver Grass Strips and Other Hedgerow Species in Hilly Soils at Phuong Linh, Thanh Ba, Phu Tho Province

The soil was under continuous cassava cultivation for ten years. The topsoil was nearly eroded; soil fertility was therefore very low, though the soil depth was considerable. The research results are presented in Table 1. Among the hedgerow species, vetiver grass has the best soil conservation effect compared with others; at the same time, the highest crop yields and economic efficiency were also obtained.

Efficiency of anti-erosive vetiver grass strips in ferralsols on clay shale at Thai Ninh, Thanj Ba, Phu Tho province

In 1996, because of new planting, the hedgerow could not develop enough for erosion control, but the amount of soil loss decreased in comparison with control treatment. In 1997 soil loss at the treatments using vetiver grass was reduced considerably. The highest anti-erosive effect was obtained

at treatment with vetiver grass combined with pineapple (Table 2). The treatment with vetiver grass hedgerows gave higher peanut seed yields as well as peanut biomass.

Table 1. Integrated results of participatory households with various hedgerow species in cassava cultivation in ferralsols on clay shales at Phuong Linh, Thanh Ba, Phu Tho province (average data 1995-1998)

Treatment	Soil loss (t/ha/yr)	Crop yield (t/ha)		Economic analysis (million VN dong/ha)			% of farmers* choosing the technology
		Cassava	Peanut	Output	Input	Net return	
1. Cassava (C.) interc. peanut (P.), no fert., no hedgerow	53.0	18.7	0.36	11.1	4.5	6.6	-
2. C. + NPK, no hedg.	54.5	21.9	-	10.9	4.1	6.8	-
3. C. +NPK + hedg. *(Tephrosia candida)*	30.7	23.1	-	11.5	4.6	6.9	-
4. C.+P.+NPK, no hedg.	43.0	17.9	0.92	13.5	5.3	8.2	25
5. C.+P.+NPK + hedg. *(Tephrosia candida)*	32.2	19.1	0.87	13.9	5.3	8.6	82
6. C.+P.+NPK+ hedg. *(Pineapple)*	23.1	20.5	0.83	14.4	5.3	9.1	96
6. C.+P.+NPK + hedg. (vetiver grass)	28.7	22.6	0.81	15.3	5.3	10.0	100

*NB: * Number of farmer participants in the evaluation of technology: 43*
- US$1 = VN dong 14 000
- Amount of yearly rainfall: 1995 – 1 273 mm
1996 – 1 494 mm
1997 – 1 670 mm

Table 2. Efficiency of erosion control of vetiver contour hedgerow farming on ferralsol on shale at the Thai Ninh site

Treatment	Soil loss (t/ha/yr)		Peanut seed yield (t/ha/2 crops)		Peanut fresh biomass (t/ha/yr)	
	1996	1997	1996	1997	1996	1997
1. Peanut (P.)+ 5 t FYM	60.7	12.5	0.65	0.63	5.8	5.6
2. P. + FYM + NP, no hedg.	48.6	11.2	0.72	1.08	6.3	7.8
3. P. + FYM + NPKCa+ hedg. (pineapple)	31.2	5.2	1.28	1.39	9.9	10.7
4. P. + FYM + NPKCa + hedg. (vetiver grass)	33.0	4.1	1.20	1.34	9.6	10.3
5. P. + FYM + NPKCa + hedg. (*Tephrosia c.)*	35.6	4.3	1.09	1.25	8.4	10.1
6. P. + FYM + NPKCa + hedg.(pineapple+vetiver)	42.2	2.7	1.16	1.24	7.4	9.1
7. P. + FYM + NPKCa natural grass strips	45.4	11.7	0.82	1.69	7.4	7.8

NB: - Soil slope: 10-12^0
- Fertilizers: 5 t FYM + 30 kg N + 45 kg P_2O_5 + 45 kg K_2O + 200 kg lime/ha
- Annual rainfall: 1996 – 1 414 mm
1997 – 2 139 mm

Effect of Vetiver Grass as Contour Hedgerow on Soil Conservation and Cassava Yield on Sandy Soil at Pho Yen, Thai Nguyen Province

Table 3. Effect of vetiver hedgerows to erosion control and crop yields on sandy soil at Pho Yen site (average data from six-farmer participatory research, 1996)

Treatment	Soil loss (t/ha/year)	Crop yields (t/ha/crop)		Economic analysis (mil.VN dong/ha)			%of farmers* choosing the technology
		Cassava	Peanut	Output	Input	Net return	
1. Cassava (C.)+ fert.	8.3	11.6	-	6.9	2.3	4.6	-
2. C.+ interc. peanut (P.) hedg. *(Tephrosia)*	4.9	12.4	0.32	9.1	2.3	6.8	59
3. C.+P.+hedgerow (vetiver grass)	6.3	12.8	0.28	9.1	2.3	6.8	40
4. C.+P.+hedgerow (vetiver+*Tephrosia)*	4.2	12.9	0.30	9.3	2.0	7.3	65

Source: Nguyen The Dang, Agroforestry College of Thai Nguyen
*NB: * Number of farmer participants in evaluating technology: 35*
- Fertilizers applied: 15 t FYM + 65 kg N + 20 kg P_2O_5 + 50 K_2O/ha

Table 4. Effect of cultivation measures to soil conservation, crop yield and economic return at the Dong Rang site (average data from 1995 to 1998)

Treatment	Soil loss (t/ha/yr)	Crop yield (t/ha/yr)		Economic analysis (mil. VN dong)			% of farmers* choosing the technology
		Cassava	T/P	Output	Input	Net return	
1. Cassava (C.) + Trao (T.) no fert., no hedgerow	27.1	11.3	1.95	7.8	5.5	2.3	2
2. C. interc. T. + NPK hedg. (vetiver grass)	6.2	13.6	2.32	9.4	6.2	3.2	18
3. C.+T.+NPK+hedg. *(Tephrosia candida)*	5.7	15.0	2.14	9.9	6.2	3.7	23
4. C.+Peanut+NPK+ hedg. (vetiver grass)	0.8	14.1	0.81	11.1	6.5	4.6	42
5. C.+Peanut+NPK+ (*Tephrosia candida)*	1.4	13.9	0.82	11.0	6.5	4.5	40

*NB: * Number of farmer participants in the evaluation of the technology: 45*
- Soil slope: 15-18^0.
- Annual rainfall: 1995 – 1 541 mm
1996 – 1 760 mm
1997 – 1 952 mm
1998 – 1 231 mm

It was the first year that this trial was conducted on sandy soil. The effect of hedgerow was not clear, but the tendency was that using vetiver grass as contour hedgerow for erosion control can decrease soil loss and get higher crop yields in comparison with control (no hedgerow). Higher efficiency was obtained in Treatment 4 with combination of vetiver grass and *Tephrosia candida* as hedgerows.

Efficiency of Vetiver Hedgerow Farming on Erosion Control, Crop Yield and Economic Return in Ferralsol on Clay Shale at the Dong Rang site, Luong Son, Hoa Binh Province

The data in Table 4 show that farming systems using vetiver grass as contour hedgerow gave better results on soil erosion control. The amount of soil loss in Treatment 2 decreased four times compared to control (Treatment 1), especially with the combined cropping systems of cassava and peanut. Because of better ground cover by crops, the soil loss decreased to less than 1 t/ha/yr (Treatment 4). At the same time, higher crop yield and higher net economic return were obtained. Thus, the farmers are interested in applying the new technology.

Table 5. Effect of alley cropping using vetiver grass as hedgerow in combination with application of fertilizer and intercropping cassava with peanut to soil conservation and crop yield (average data of two years: 1997-1998)

Treatment	Soil loss (t/ha/yr)	Crop yield (t/ha/yr)		Economic analysis (mill.VN dong)			% of farmers choosing the technology
		Cassava	Peanut	Output	Input	Net return	
1. Cassava (C), no fert. no hedgerow	4.5	10.8	-	8.2	5.7	2.5	3
2. C+Peanut (P)+NPK no hedgerow	1.8	14.9	0.74	11.2	6.6	4.6	10
3. C+P+NPK+hedge *(Tephrosia)*	0.3	14.2	0.62	10.2	6.6	3.6	55
4. C+P+NPK+hedge *(pineapple)*	0.1	14.5	0.59	10.3	6.6	3.7	47
5. C+P+NPK+hedge (vetiver grass)	0.0	14.9	0.68	10.9	6.6	4.3	58

Table 6. Efficiency of soil erosion control of alley cropping with vetiver grass as hedgerow

Treatment	Soil loss (t/ha/yr)
1. Cassava monoculture	32.2
2. Cassava + hedg. (*Tephrosia candida)*	14.2
3. Cassava + hedg. *(Flemingia congesta)*	13.4
4. Cassava + hedg. (vetiver grass)	9.7

Source: Tu Quang Hien, Agro-Forestry College of Thai Nguyen, 1997
NB: Acrisols with slope 10-15^{o}

Constraints in the Development and Techno-transfer of Vetiver Grass as Hedgerow for Erosion Control in Sloping Land Agriculture

Technology constraints

- Limited amount of vetiver tillers and seedlings
- Appropriate hedgerow distance and hedgerow management
- Vetiver grass is not a leguminous plant; thus, there is limitation in the contribution of biomass for improving soil fertility.

Funding constraints

- To establish demonstration sites on ecological zones on sloping areas.
- To assist farmers with planting material, fertilizers and other services.
- To organize training courses, workshops, field days, exchange visits, etc.

Socio-economic constraint

- It is difficult to change the habits of people, especially ethnic groups, in applying the new technologies, because of low education and poverty.

Conclusion

Vetiver grass exists in Viet Nam. It can be used as one of the species in hedgerow farming systems on sloping lands for erosion control together with *Tephrosia candida* and other hedgerow species. It can decrease soil erosion by 50-90 % and increase crop yields by 15-30 %.

There is no competition of water, nutrient and light in the vetiver hedgerow farming systems, and no negative effect in alley crops. Combination of vetiver grass and *Tephrosia candida* is best for soil conservation, increased crop production and higher economic return.

Farmers on sloping lands are interested in applying vetiver grass on their household farm to protect their soil, especially after land allocation to the farmers for long-term land-use right.

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