20. An Early Stage Toward Sustainable Vegetable Agroforestry Practices: Assessment Study on the Adoption Process in Nanggung

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Abstract

Agroforestry practices have received much attention in view of their role in contributing to sustainable land use as well as addressing key aspects of rural poverty. This paper approaches the issues with a focus on such areas as, Nanggung Subdistrict, a marginal forest area endowed with rich natural resources and with good access to urban areas of Jakarta. It also addresses the process of the Vegetable Agroforestry (VAF) system being introduced and responded to by the farmers. It uses a framework facilitating assessment of the early stage of the VAF adoption process. The framework is used to analyze factors possibly affecting farmers' perception on VAF technology which will lead to the decision on adopting the technology. It addresses both socioeconomic characteristics and biophysical factors. This paper ends with a discussion of the needs of maintaining the VAF adoption process in order to achieve optimal impacts.

Keywords: Vegetable agroforestry (VAF), adoption, socioeconomic characteristics.

1. Introduction

Advances in agroforestry science and practices have been made for decades in the areas where the world's greatest number of the poverty stricken are concentrated. About three-quarters of the poor people who live on less than $1 a day are found in the rural areas of developing countries (Dixon et al., 2001). Therefore, agricultural development is a key to increase poor people's income as agricultural productivity has a strong relationship with poverty.

Smallholder tree production contributes substantially to rural livelihoods and national economies, but these contributions are not adequately appreciated (Garrity, 2004). Thus, the agriculture development program which seeks to improve tree-based systems has the potential to address key aspects of rural poverty.

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An effort to improve tree-based systems is the promotion of sustainable vegetable agroforestry (VAF) systems. In VAF systems, farmers integrate vegetable cultivation in a tree-based system or vice versa. VAF offers a range of benefits from environmental sustainability to economic income for smallholder farmers.

This article examines the early adoption process of sustainable VAF systems in Nanggung subdistrict of West Java province, Indonesia. We interviewed farmers who recognized and participated in the activities related to VAF cultivation trials and market development in the study area. These activities were organized by ICRAF-IPB team under SANREM CRSP project supported by USAID.

VAF activities constituted (1) research on-farm trials, (2) market development, and (3) gender mainstreaming. The research trials explored the suitability of cultivation technology with various vegetables. The technology trials experimented on various fertilizer levels and combinations as well as feasibility production of vegetables under different tree-shades. Market development was carried out by assessing potential species of indigenous vegetables and the possibility of their production. Market agents were linked to farmers – enabling them to understand vegetable market requirements. In gender mainstreaming activities, women farmers were encouraged to participate in vegetable farming in order to improve household income.

We believe that agroforestry systems can contribute to sustainable land use as well as address key aspects of rural poverty only if they are adopted and maintained. In consequence, understanding how the VAF systems are adopted requires a clear description of the farmers' socioeconomic characteristics, technological VAF characteristics and the initiation of the adoption process.

This article presents the current status of the adoption process of VAF technology in Nanggung Subdistrict after two years of introduction using farm trials and the development approach. It elaborates on components that possibly correlate with farmers' perception of VAF technology that will lead to the adoption stage.

1.1 Nanggung: a portrayal of poverty within a natural resources-rich area

This study area of Nanggung presents a portrait describing how poverty lies in forest marginal areas which are within the reach of urban development. Its area covers 109.99 km^2 and spans from Bogor – Rangkasbitung intercity road in the North to the mountain ranges of Mount Halimun National Park in the South.

As some villages were located in the border of Mount Halimun National Park, more of the Nanggung population relied on the natural resources around the forest for their livelihood. In the mountains a gold mine operated by a state-owned company produces about 3,000 kg of gold each year.

Good access to Jakarta would normally lead to more urban effects in Nanggung. Relatively high traffic from Rangkas Bitung to Jakarta and vice versa, with crowded roads in the north of Nanggung, should enable the people of Nanggung to have easier access to markets and other urban facilities.

In regards to topography, the area constitutes uplands with gently undulating to steep landscape, with altitude ranging between 400 and 1,800 m above the sea level. Most of the population in Nanggung were engaged in agricultural activities, which utilized 7,022 ha of the arable lands and which received an annual rainfall from 3,000 to 4,000 mm

Based on the 2006 baseline study covering three sample villages Hambaro, Parakanmuncang and Sukaluyu, arable lands constituted about 63.8% of total land area. The arable lands were comprised of paddy fields, *ladang/ kebun*, community forest and the state-owned forest company of Perhutani. Housing, infrastructure and other land uses accounted for the remaining land.

Even with these endowments of rich natural resources and good access, agricultural development had not alleviated rural poverty. The baseline study found that 52% of the surveyed households were below the poverty line, and thus were categorized as poor (Wijaya et al., 2007).

2. Methodology and Framework Analysis

This research interviewed farmers who participated in the VAF research trials and development in the study area of Nanggung from early 2007 to 2008. About 71 farmers of three villages Harbaro, Parakanmuncang and Sukaluyu – were involved in the activities. A total of 71 farmers were interviewed at the end of 2008 as some technological trials ended. At that time, some farmers had participated in on-farm katuk cultivation that was carried out on their own lands.

The results of the 2006 Baseline Study were also extracted and used to describe experiences in vegetable cultivation. The sample consisted of 185 households in the same villages.

This study used a framework to analyze the current situation of components that possibly affected farmers' perception on VAF technology. The farmers' perception on VAF technology would be significant factors on their decision to adopt VAF adoption in the future. We used the participating farmers at on-farm katuk cultivation trials as indicators of farmers' perception on VAF technology.

The framework proposes socioeconomic factors associated with the perception along with the demonstrable VAF knowledge on biophysically suitable lands. Socioeconomic characteristics described by factors such as education, engagement in farmer groups as well as access to land and experiences in vegetable cultivation were collected.

Institutional factors were assessed in the context of farmers' participation which showed farmers' perception on the introduced VAF technology.

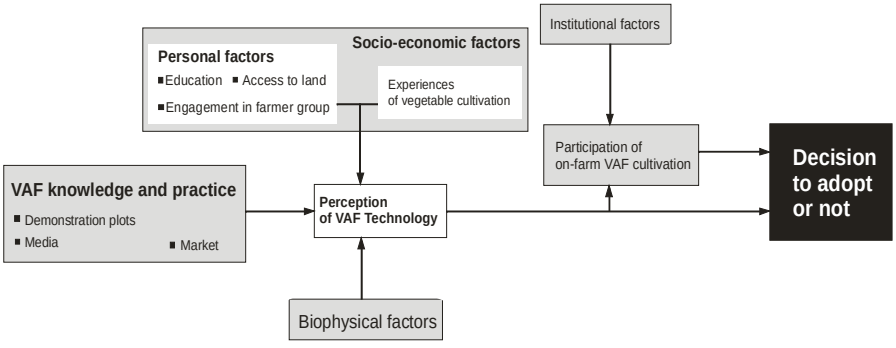

Figure 1. Framework to analyze the initial process of VAF adoption

3. Vegetable Farming Experiences

The Baseline Study found that agricultural lands of the surveyed farmers were dominated by rice fields (56%). Dryland and multi-species tree gardens accounted for 22% and 16% respectively. Table 1 shows that monoculture gardens had a share of 2.73 ha or 4%.

Table 1. Type of agriculture land found in baseline study (n=185)

Type of land	Area (ha)
Rice field	43.41
Dry land (*tegal* or *ladang*)	17.24
Monoculture garden	2.73
Multispecies tree garden	13.45
Shurb	0.05

Although the food crops occupied most lands of surveyed households, vegetables were cultivated by some farmers. Figure 2 shows the share of vegetable cultivation plots (19%) compared to non-vegetable plots.

Vegetable farmers employed various types or combinations of cultiva-

tion. Some mixed vegetables with food crops (5% of total plots managed by surveyed farmers) and some farmers combined vegetable cultivation with trees as well as with trees and food crops.

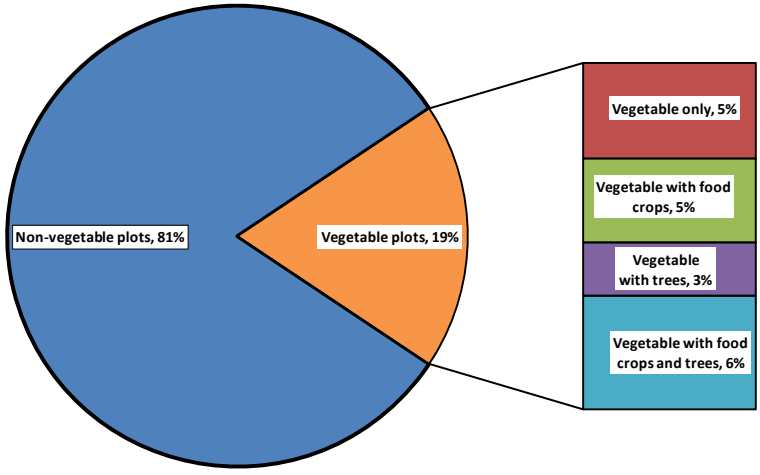

Figure 2. Vegetable farming plots found in baseline study (n=310)

In terms of vegetable plot area, vegetable farmers were controlling about 20% (15.2 ha) of total plots managed by surveyed households. As shown in Table 2, farmers who cultivated vegetables managed more than one plot with total size varying from 2.7 ha to 4.6 ha.

Table 2. Farmers managing vegetable cultivation

Type	Number of Farmers		Number of plots		Plots area	
	n	*%*	*n*	*%*	*ha*	*%*
Vegetable	14	8%	16	5%	2.7	3%
Vegetable with food crops	13	7%	14	5%	4.1	5%
Vegetable with trees	9	5%	9	3%	4.6	6%
Vegetables with food crops and trees	14	8%	19	6%	3.9	5%
subtotal	**50**	**100%**	**58**	**19%**	**15.2**	**20%**
All	**185**	**100%**	**310**	**100%**	**76.88**	**100%**

Table 3 presents vegetable farmers' landholding. There were 50 vegetable farmers (27% of total surveyed households) who managing 37% (28.71 ha) of total land area. The table also shows that plots sizes in average were 0.57 ha or bigger than the average number of all samples.

Table 3. Vegetable farmers and their lands

Type	Landholding					
	Area ha	%	Mean	Min	Max	StD
Vegetable	6.63	9	0.47	0.003	1.80	0.58
Vegetable with food crops	5.92	8	0.46	0.02	1.50	0.46
Vegetable with trees	8.48	11	0.94	0.15	2.50	0.76
Vegetable with food crops and trees	7.68	10	0.55	0.04	1.25	0.49
Subtotal	28.72	37	0.57	0.003	2.50	0.58
All	76.88	100	0.42	0.002	3.00	0.51

Overall, vegetable farmers of Nanggung were facing the domination of food crops cultivation. Farmers who cultivated vegetables also had access to one or more farms with its size as small as others.

This situation may lead to challenges and opportunities on the development of VAF systems. As to the opportunities, improving vegetable cultivation is an entry to shift from subsistence vegetable cultivation to commercial production, implying more economic benefits to farmers' households. On the other hand, the farmers' experiences in vegetable farming will support the adoption of VAF technology.

4. Personal Factors and Farmers Group Engagement

Interviewed farmers averaging about 49 years old were characterized as having low education attainment. Table 4 shows that 73% of the interviewed farmers had only attended elementary school or had a maximum of six years of education. Higher education both junior and senior was achieved by 18%.

Table 4. Socioeconomic characteristic of interviewed farmers (n=71)

Characteristic			n	%
Education level				
Never			5	7%
Elementary			52	73%
Junior			8	11%
Senior			5	7%
University			1	1%
Farmers Group member			53	74%
Sex	M		55	77%
	F		16	23%
	Average	**Min**	**Max**	**StDev**
Age	49	21	109	14
Family member	6	1	12	2.4
Productive family members*	3	1	6	1.1

Most interviewed farmers were members of farmer groups (74%). They participated in related-VAF research activities with support from their groups. The existing farmer groups facilitated communication among their members.

Table 5 indicates the distribution of interviewed farmers regarding their engagement with farmer groups. More participant farmers who were not associated with groups were found in Hambaro because the cultivation trials were concentrated in demonstration plots located in Hambaro village.

Table 5. Farmer group member of interviewed farmers by village

Village	Non-member	member	Total
Hambaro	10	21	31
Parakan Muncang	2	18	20
Sukaluyu	6	14	20
Total	**18**	**53**	**71**

The farmer group of Lestari in Parakanmuncang had established weekly meetings to gather their members, discussing current activities including new information on VAF training and research.

In the activities of on-farm trials of Katuk cultivation, both farmer groups in Parakanmuncang of Lestari and Bhakti Wanita Tani of Hambaro village had built a mechanism of rolling-seeds, which enabled their members to gain stumps from other members who had cultivated it earlier. Before cultivation, all members had agreed to allocate some stumps for other members.

5. VAF Knowledge and Practice

A series of activities intended to improve indigenous vegetable cultivation, focusing on katuk, involved farmers in targeted villages (Sukaluyu, Hambaro and Parakanmuncang) for about two years. The activities concentrated on three aspects: marketing, cultivation technology on-farm trial and gender mainstreaming.

Katuk (*Sauropus androgynous*) is one of the indigenous vegetables that have potential for commercialization. Some people of Nanggung recognized katuk as edible, as leafy plants grown as hedges at their home garden, even under the trees. Some families utilized these for daily household consumption on a small scale. Katuk is traded as daily commodities as well as other vegetables in the nearest market of Nanggung. A bigger volume of katuk is traded in Cengkareng market in West Jakarta – about 90 km from Nanggung.

VAF research activities in the study area transferred information among the people of Nanggung. Almost all interviewed farmers (99%) learned of the VAF activities from their neighborhood. They also saw the demonstration plots (92%). About 54% of the respondents had read some reading materials such as leaflets about VAF technology.

This finding highlights that social custom among the farmers where farmers preferred to consider what their neighborhoods say.

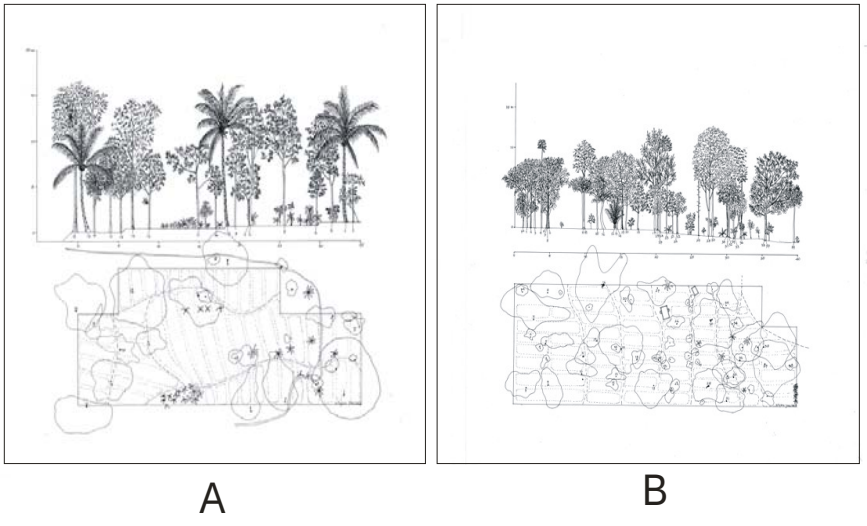

Figure 3. Profile of VAF demonstration plot of shade management trial

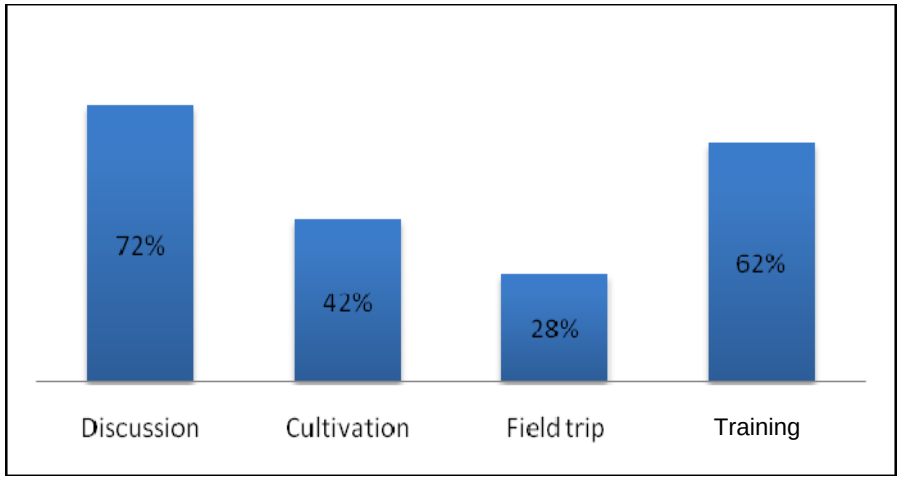

Figure 4. Farmers' participation of VAF introduction activities

Exposed demonstration plots also had a significant contribution to the farmers' perception of VAF technology. Interviewed farmers were curious as to what the researcher was doing in their villages and why some 'wild species' were planted in rows of fertilized, raised beds.

Two heads of farmers' groups admitted that their members were always concerned with what others were doing, especially in regards to new practices. They began to try out the new practices after they showed good results. One of the demonstration plots was the shade management trial. Below shows the profiles of VAF plots which were experimenting with various vegetable species with different shade levels of trees. The trial was conducted in Parakanmuncang villages.

Table 6. Financial feasibility of katuk cultivation in Ciampea Subdistrict

Item		Volume	Unit	Price (IDR)	Period			
					1st harvest	2nd harvest	3rd harvest	4th harvest
Input					60 days	45 days	45 days	45 days
1	Planting Material							
	Katuk	200,000	stump	40	8,000,000			
	Cassava	4,000	stump	25	100,000			
2	Fertilizer							
	Manure	300	sack	6,000	1,800,000			
	Urea	200	kg	1,500	300,000	300,000	300,000	300,000
	SP-36	50	kg	2,500	125,000	125,000	125,000	125,000
3	Pesticide	1	unit	47,200	632,200	632,200	632,200	632,200
Tools								
1	Hoe	3	unit	30,000	90,000			
2	Fork	4	unit	20,000	80,000			
3	Sprayer	1	unit	200,000	200,000			
4	Machete	4	unit	20,000	80,000			
Labor								
1	Preparation and planting	45	ps-day	20,000	900,000			
2	Maintenance	8.5	ps-day	20,000	170,000	170,000	170,000	170,000
Total Cost					**12,477,200**	**1,227,200**	**1,227,200**	**1,227,200**
Yield								
1	Katuk	1,800-2,000	kg	2,200	3,960,000	4,400,000	4,400,000	4,400,000
2	Cassava	2,800	kg	400			1,120,000	
Revenue					3,960,000	4,400,000	5,520,000	4,400,000
Profitability					**(8,517,200)**	**3,172,800**	**4,292,800**	**3,172,800**
BC Ratio					0.3	3.6	4.5	3.6

Farmers explored more knowledge of VAF technology by participating in various activities, such as discussion, cultivation, field trips and training (Fig. 4). Their participation indicated their eagerness to adopt VAF technology.

In the field trips, farmers were shown the feasibility of intensive katuk cultivation, which had higher economic benefits if the proper practices were used. Table 6 shows the feasibility of 5,000 m^2 katuk cultivation in Ciampea Subdistrict.

Table 6 presents the feasibility of katuk cultivation mixed with cassava. The cultivation is feasible when it reaches the fourth harvest or about six months after. Farmers will get more yields as katuk is harvestable in 4-5 years. In that time, there will be less input costs compared to the first harvest season.

In smaller land areas such in Nanggung, katuk cultivation may yield less since farmers have smaller farms. Thus, farmers will reach their break-even point longer than in the case of farmers of Ciampea.

6. Conclusions

The VAF system in Nanggung subdistrict represented by Katuk cultivation has entered the stage of early adoption. Farmers have seen the practice of VAF cultivation trials, and participated in VAF training and discussions. This interaction may contribute to the farmers' positive perception on VAF technology. Currently, with the support of their farmers' group some farmers are participating in VAF cultivation in their own lands.

The progress of VAF adoption in Nanggung was possibly affected by enabling factors:

1. Socioeconomic characteristics
2. Biophysical characteristics
3. Institutional factors such as active farmers' organization and
4. Effective presentation of VAF knowledge and practices.

Early adoption is critical and needs to be maintained since farmers apply the practices and techniques in their own lands which have unique circumstances. Proposed maintenance efforts cover at least two factors: (a) pest management and (b) fertilizer application. These factors are significant to assure yield.

If early adopters fail in their production efforts, farmers generally will not consider adopting the VAF technology. However, successful VAF cultivation will encourage the decision of more farmers to adopt VAF technology.

7. Acknowledgments

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