

## ECONOMIC ASSESSMENT OF TREE-BASED AGRICULTURE SYSTEMS IN WEST ACEH

Suseno Budidarsono<sup>1</sup> and Yuliana Cahya Wulan<sup>2</sup>

<sup>1</sup>World Agroforestry Centre (ICRAF), Jl. CIFOR, Situ Gede, Sindang Barang, P O Box 161, Bogor 16001, Indonesia; [S.Budidarsono@cgiar.org](mailto:S.Budidarsono@cgiar.org); Fax: +62-251-8625416

<sup>2</sup>The Australian National University. ACT. Canberra 0200, Australia, [yuliana.wulan@anu.edu.au](mailto:yuliana.wulan@anu.edu.au)

### Abstract

This is an assessment of tree-based agriculture practices in tsunami affected areas of West Aceh in Indonesia, emphasizing on the four major tree-crops: cocoa, rubber, coconut, and oil palm. The monitoring and data collection were part of EU funded ReGrIn project (Rebuilding Green Infrastructure with Trees People Want).

The assessment was carried out to analyze data and information for an economic assessment and development of prediction model for land use options in post-Tsunami context of West Aceh. Using two analytical tools, i.e. farm budget analysis and profitability analysis, the assessment put emphasis on cost of establishment, labor requirement, returns to land and returns to labor of the existing tree-based systems. These four important variables were used for an integrated economic-ecological impacts assessment of land use options by comparing different crops and management for optimum economic benefits to farmers.

Although there were some investment made in the study site for large scale rubber and oil palm plantations, and also hybrid coconut introduction in the past, the study found that most smallholder farmers cultivated by self supporting systems without using recommended technology. Lack of access to productivity-enhancing inputs, agricultural technologies, and market information were the most typical problems faced by farmers. However, using 2006 prices data, with 10.6% discount rate, exchange rate of Rp. 9,306 per US dollar, and using agricultural wage rate assumption of Rp. 19,638 per person day, most existing tree based systems are profitable, except coconut and rubber on peat swamps. Coconut price was very low at the time of study; and rubber cultivation on peat swamp required high labor input.

### Introduction

This assessment is part Post-Tsunami EU funded project (EU-ASIA PRO ECO II B) or EU ReGrIn Project<sup>1</sup>, specifically activity no. 3.01, entitled Economic Assessment and Developing Prediction Models for Major Land Use Options. This is an integrated assessment for economic and ecological impacts of land use options. The main objective is to understand the major tree based land use systems in West Aceh as a basis to develop prediction models for land use options and also ex-ante impact assessment of infrastructure recovery.

Rapid Rural Appraisal technique using Semi Structured Interview Guide was employed in data collection. It is combination of field observation, supporting statistical data collection, and in-depth interview with farmers, related government officials, and other key informants in September 2006. Observation and in-depth interview were carried out

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<sup>1</sup> The title of the project is "Trees, Resilience and Livelihood Recovery in the Tsunami-affected Coastal Zone of Aceh and North Sumatra (Indonesia): Rebuilding Green Infrastructure with Trees People Want (ReGrIn)

in purposively selected villages. Like other components of the Project, the study selected four sub-districts as the study sites, i.e., Arongan Lambalek, Samatiga, Johan Pahlawan and Meurebo. The study focused on four main tree-based systems in West Aceh to assess: cocoa, rubber, coconut and oil palm.

The financial and economic assessment here applies broadly farm budget analysis of the four selected tree-based systems. Three parameters will be used: (1) profitability, (2) cost of establishment and (3) labor requirements. The appropriate measure of profitability for long term investment is net present value (*NPV*), i.e., the present worth of benefit (revenues) less the present worth of the cost of tradable inputs and domestic factors of productions (Gittinger, 1992). A system is appraised as profitable if *NPV* is greater than 0. The *NPV* is an indicator for Return to Land. At the same time it is also been used to calculate return to labor as an indicator of profitability for smallholder's production incentives. It is defined as the wage rate that sets the *NPV* equal to zero. Adjusting the wage rate until *NPV* goes to zero can be used as a proxy for 'returns to labor' since this calculation converts the surplus to a wage rate. Returns to labor that exceed the average daily wage rate, indicate that individuals with their own land will prefer this activity to off-farm activities and it also justifies hiring non-family labor.

### **Conflict, Livelihood and Tsunami**

The political conflict in Aceh was partly rooted from an unequal distribution of revenues derived from natural resources extraction in the region between central government and Aceh people. On the economy, the impact was immense. During the last phase of the conflict, the people of Aceh experienced even heightened economic hardship with the worsening of the security situation. Local government was hardly operating. Investors withdrew and businesses closed down or reduced production. The economy overall was stagnant (Word Bank, 2006). The damage on the province was worsening by the earthquake and tsunami on December 2004. The tsunami killed large numbers of people, destroyed many of coastal livelihoods and the economic basis of the coastal communities. Pre-Tsunami the four natural resource sectors of agriculture, forestry, aquaculture and fishing accounted for 32 percent of regional GDP in Aceh, but employed 70 percent of the coastal, tsunami affected population. The loss of income in agriculture and fisheries alone amounts to one-third of the total losses due to the Tsunami (Mercy Crops, 2005). The western coast of Aceh was the worst hit among all areas affected by the December 26 tsunami.

### **West Aceh Regency in brief**

Administratively, the area of West Aceh is 2,927.95 km<sup>2</sup> covering 11 sub-districts and 314 villages. Topographically, it constitutes flat in northern, southern and western part and is more undulating to steep slope in the eastern part. Annual rainfall is various between 3,406.9 mm/year – 4,811.9 mm/year with total rainy day 218.5 days/year. The average annual temperature is 26.3° C and humidity is 85.5%.

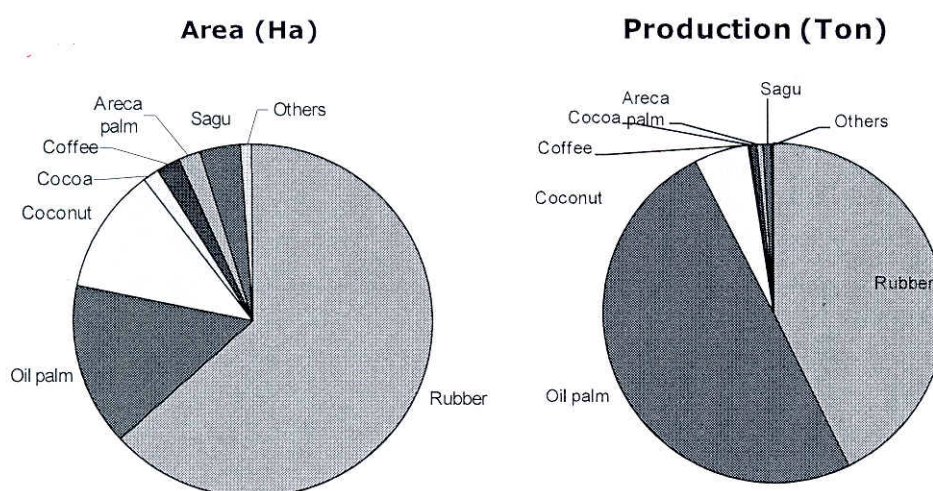
The population estimate in 2005 was 150,450 people, 15% lower than 2003 figure. Population density was 51 persons/km<sup>2</sup>. Looking at the age structure, 67.2 percent of the population were economically active population (15 – 64 years old); it is higher than national data which was 65.7 percent (BPS, 2005). In general education attainment was also low; 30.6% of the population never went to school and not completed the primary school.

Regarding transportation, although 67% of the road network has been asphalted, 31% of them were damage. Besides, road density was relatively low: 12.3 m/km<sup>2</sup> in total, and only

10.8 m/km<sup>2</sup> for asphalted road. The road network connects the urban centres within the regencies and the regency capital of Meulaboh to provincial capital of Banda Aceh and Medan (North Sumatra Province). Many settlements or villages have no proper access road.

### Tree Based Systems in West Aceh

Figure 1 describes the existing tree based system in West Aceh. Rubber based system is the largest area in the region. Oil Palm and coconut were in the second largest in term of area covered. From the production side, oil palm was the most productive. Rubber and coconut mostly operated by smallholders, while oil palm was under large scale operation. Cocoa, the newly introduced cash crops, has not been developed well in the region, but it has high potential in the future.



Source: BPS, 2005

Fig. 1: Area and production of tree crops in West Aceh, 2005

Historically, rubber plantations were established during the Dutch era and have been managed by two or even three generations. Some farmer began to cultivate rubber in 1953 and 1982. There is large scale rubber plantation was introduced by PTPN II, Medan applying Nucleus Estate and Smallholder (NES). As shown in Table 1, most farmers used un-selected seedling as planting material, the rubber systems were monoculture in nature, extensive system which is growth naturally with minimum inputs and recommended technology.

**Table 1:** Profile of Rubber Systems by Selected Village

Village	Soil	Planting material	Estimated Age (years)	Rejuvenation	Estimated Tapable Trees	Production in kg/ha/year (DRC)	Share Tapping
Gunung Kleng	Mineral	Unknown	> 60	Two times (natural)	10%	778 (<50%)	3:1
Aleu Raya	Peat	Unknown	37	Never	50%	1557 (<50%)	50:50
Suak Sigadeng	Peat	Unknown	> 60	Topping off	5%	650 (<50%)	
Paya Lumpat	Peat	Unknown	> 50	Natural Growth	<50%	1400 (60%)	60:40
Paya Lumpat	Peat	Clonal	30	Never	>60%	2250 (61%)	50:50
Seunebok Tengoh	NES	Clonal	24	Never	63%	1950 (57%)	50:50

Coconut system which is generally cultivated for 50 years in the region, is West African Tall Type. Later in 1981, hybrid coconut introduced through government project (PRPTE & SCDP). Some farmers managed their coconut plantation in monoculture system and the others mix their coconut tree with cocoa. Most of coconut plantations, at the time of study, were not well managed. The production was very high and the price were very low (Rp. 200 per unit). Table 2 below presents the condition of coconut systems in the region.

**Table 1:** Current conditions of coconut systems

Conditions	Tall Type Coconut	Hybrid Coconut
Trees/ha	179	139
Estimated Age	>50 years	24 years
Production Began	5-7th years	3rd years
Harvesting period	Every 3 months	Every 2.5 months
Productivity (estimate) (ha-1 year-1)	5000 green coconut or 1.25 ton copra	13500 green coconut or 3.3 ton copra

Oil palm is relatively new commodity in this region. It is initially cultivated in the form of nucleus estate scheme and smallholder. Some farmers began to cultivate oil palm in 1991 through World Food Program of The United Nation. Due to the conflict, many farmers abandoned their oil palm plantation (in 2001-2003). Although many of them came back in 2003, the situation was not easy for farmers to maintain their plantation without any support from the military. At the time of study the condition of smallholder oil palm plantation in general were as follow. Tree density was 140 trees per hectare; current production was ranging between 7.8 and -10.5 ton FFB/ha/year; far below the production before it was abandoned, which was 30-40 ton TBS/ha/year.

Cocoa cultivation is relatively new for farmer in the region. For security reasons many farmers cultivate cocoa in they home garden, mixed with various tree crops such as coconut, areca nut, rubber, and oil palm and fruit trees, except in Arongan Lambalek, where farmer planted cocoa in their coconut inter-rows. Many farmers know very little how to cultivate cocoa properly. General condition of the cocoa cultivation were: (1) tree density per plot ranging between 700 and 800 trees per hectare, (2) in one cocoa plot consists of two to three different species with different ages, (3) production began in 18 months to three years after its establishment, (4) productivity was 14-16 kg/tree/harvest in June to Oct, and 3-5 kg/tree/harvest in November to march. In 1990, the Agricultural Extension and Food Security Office, Agricultural Office of West Aceh Regency established nursery of fruit trees and tree crops. The seedlings were come from Medan and Lampung. Due to political conflict the nursery activities were stopped.

### **Economic Assessment of Major Tree Based Systems**

The results presented below were calculated based on 25 years farm budget analysis of the four systems. The macro-economic assumptions applied in the calculation were : (1) real interest rate is 11%, (2) exchange rate at = 9,306 IDR/ 1 US\$, (3) agricultural wage rate is Rp 20,000/person-day

#### *Profitability*

Table 3 summarizes profitability of the four tree-based agriculture practices in West Aceh. It shows that the NPV (Return to Land) of rubber on peat swamp and coconut systems have negative sign or less than 0. Those systems are not profitable by definition. Rubber

systems on peat swamp were not optimal; low productivity and need more labor compare to other system (See Table 4). While the coconut based systems, the current price of coconut and copra were very low; under the current prices (Rp. 200/unit) the system is not profitable. Looking at Return to Land, except smallholder oil palm, all tree based system provide slightly higher than the agricultural wage rate.

**Table 2: Profitability of Major Tree Crop Systems in West Aceh District (2002 = 100)**

Tree Based System	NPV (Rp '000/ha)	IRR (%)	Return to Labour (Rp/ps-day)
Rubber PTPN	1,115	11.9%	21,619
Rubber Peat	(4,522)	7.7%	12,399
Cocoa Homegarden	4,139	21.8%	23,428
Cocoa	579	16.0%	22,062
Cocoa - Coconut	2,380	14.3%	22,873
Coconut	(2,385)	3.8%	12,984
Oil Palm NES	723	12.6%	23,714
Oil Palm Smallholder	4,272	17.0%	30,561

#### *Cost of establishment and Labour Requirements*

Establishment cost to be used as cash flow constraint indicator to assess whether the investment required by the system is barrier to adoption by smallholder. Similarly to that, labor requirement indicators that used here also reflect constraint for farmers to adopt the technology of combined with the assessment of labor market. From policy makers' point of view, those figures reflects employment opportunity can be created in rural area (Tomich et al, 1998. P 69-70).

Cost of establishment is defined as all inputs used to establish the systems, whereas the term of "establishment" is defined to be number of years to positive cash flow (Vosti *etal*, 1998). Using this definition as basis of assessment, the longer a system reaches its positive cash flow, the higher cost of establishment will be.

Table 4 summarized the cost of establishment and labor requirements. All tree-based system are still affordable for farmer to incurred. In term of employment generation potential, revitalization of tree based system will certainly create employment in rural area with better return to labour.

**Table 4: Cost of establishment and Labour requirements**

Tree Based System	Cost of Establishment (Rp '000/ha)	Labour requirements	
		At establishment phase (ps-days/ha)	Operation (ps-days/ha/year)
Rubber PTPN	9,547	622	51
Rubber Peat	10,479	657	121
Cocoa Homegarden	4,758	270	46
Cocoa	5,002	217	39
Cocoa - Coconut	13,119		171
Coconut	9,911		182
Oil Palm NES	6,257	400	43
Oil Palm Smallholder	7,234	548	53

**Concluding Remarks**

Five problems of tree crop development identified in the study: (1) lack of knowledge and information on tree crop agriculture technology, (2) limited access to good planting materials of tree crop, (3) lack of agricultural extension services, (4) agricultural product processing industry has not developed and (5) farm input and marketing the outputs depend on Medan market.

Among the four main tree crop systems in West Aceh (rubber, oil palm, coconut and cocoa), rubber was the largest area covered (42.8 of the total plantation area). In term of productivity, rubber systems still need to be improved. It will have larger impact in West Aceh.

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