

Empowering Women on Bamboo Utilization and Conservation in the Lake Toba Catchment Area of the North Sumatra Province of Indonesia [†]

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[†] Presented at the 1st International Electronic Conference on Forests—Forests for a Better Future: Sustainability, Innovation, Interdisciplinarity, 15–30 November 2020; Available online: <https://iecf2020.sciforum.net>.

Abstract: Indonesia is blessed with the wonderful and beautiful Lake Toba catchment area where diverse bamboo species grow and provide socio economic benefits to the Batak community indigenous to the region. The bamboo resource, however, hasn't been sustainably managed due mainly to over-cutting while cultivation has been insignificant. This study aims to investigate the relevant interventions for achieving sustainable bamboo resource in this region. Data were derived from questionnaire surveys of 154 women and in-depth interviews with 65 respondents in Simalungun and Karo districts. In order to identify the cause of problem and strategies for sustainable management, a problem tree analysis was conducted. Findings of the study show that strengthening institutional framework, utilizing efficiently, enhancing initiatives on bamboo conservation and development, and promoting local stakeholders are identified as strategies for sustainable management. The basic notions are that achieving sustainable management is feasible only with stakeholders' support, and local communities must be provided with decent incomes by efficient utilization. Furthermore, bamboo management must be supported by promoting gender equality and empower women related to their control over bamboo plantation and harvesting, market access and other decision-making opportunities on income and expenditure. The study recognizes that there is a strong relationship between decision making authority and women empowerment.

Keywords: women; empowering; gender equality; bamboo; community livelihood

Citation: Aswandi, A.; Kholibrina, C.R. Empowering Women on Bamboo Utilization and Conservation in Lake Toba Catchment Area, the North Sumatra Province of Indonesia. *Environ. Sci. Proc.* **2021**, *3*, 47. <https://doi.org/10.3390/IECF2020-08026>

Academic Editors: Angela Lo Monaco, Cate Macinnis-Ng and Om P. Rajora

Published: 12 November 2020

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1. Introduction

Indonesia is blessed with the beautiful Lake Toba Catchment Area, consisting of approximately 110,000 hectares of lake and 280,000 hectares of land, where a diversity of bamboo species grows and provide social, cultural and economic benefits to the Batak people, indigenous to the region. Of the more than 1400 bamboo species around the world, there are at least 16 bamboo species that are utilized by local communities around Lake Toba, such as *Gigantocloa apus*, *Dendrocalamus asper*, and others.

Bamboo is one of the most valuable nontimber forest products. More than half of world's population shares in trade and subsistence utilization, with an estimated value of USD 7 billion per year [1]. Wide utilization of bamboo is support by its properties, including it being straight, strong, easy to split, cut and process with a relatively cheap price. Environmentally, bamboo is used for and rehabilitation, to reduce soil erosion, increase soil water infiltration and thereby stabilize landscapes and groundwater, and to absorb carbon dioxide [2,3]. Furthermore, bamboo is processed into modern products such as panels and boards that compete with wood products in performance [4]. The multibenefits of bamboo open the demand for this resource in line with society devel-

opment.

Bamboo management has been integrated into the Indonesian national development agenda. Both national development vision and Indonesia's forest policy provide a framework for sustainable production of nontimber forest products including bamboo resources. There is evidence that bamboo plays an important role for the socioeconomic structure of local communities around the forest. Bamboo is utilized for food, wicker, baskets, small-scale construction materials and firewood, traditionally.

Bamboo processing has become one of few money-making opportunities for women in rural areas, including the Lake Toba region. Bamboo processing is considered attractive because it doesn't need technical and financial requirements, and cash can be obtained immediately. The money earned from collecting, processing and selling bamboo is significant to household income. However, bamboo contribution to rural households, especially for women, should be considered, given male dominance in the Batak community, which still adheres to tribal norms and customs. Therefore, a gender perspective in bamboo management is required, especially to overcome the obstacles that limit women's roles, and to estimate bamboo contribution to household income.

The objectives of study are (a) to document the bamboo resources utilization by local communities in Lake Toba region; (b) to assess the potential of bamboo products to generate household income; (c) to assess gender involvement in various bamboo activities and (d) to investigate relevant interventions to achieve sustainable bamboo resources in the region.

2. Materials and Methods

2.1. Description of Study Area

The research was conducted in Simalungun and Karo districts, North Sumatra, Indonesia. Areas are located on the Lake Toba highland at an altitude of 900 to 1200 m.a.s.l. The topography is mostly sloping to steep hills with a limited flat area, and most of area is protected forests. The communities live around the forest with subsistence farming. Land productivity is mostly low; about 85% of 951 thousand populations depend on agricultural sector with a high poverty rate (20–25%) [5]. Limited options in agriculture often force people to turn to extractive forests as a source of livelihoods. Meanwhile, other sectors development such as small to medium scale businesses, tourism and derivative services are relatively low and not optimal.

2.2. Methods

This research was conducted through a household survey, key informant interview, group discussion and market surveys. The surveys were conducted on June 2019 to December 2019 in Simalungun and Karo districts. Data were derived from a questionnaire survey of 154 women and in-depth interviews with 65 respondents. The survey included socio-economic characteristics, bamboo harvesting and processing, market and price. Fourteen bamboo traders were purposively selected and interviewed for market chain identification. To identify the cause of problem and potential strategies for sustainable bamboo management, a problem tree analysis and three focus group discussions were conducted involving related stakeholders in North Sumatra.

2.3. Data Analysis

To determine factors that affect the income of rural women from bamboo, an econometric model with a multiple linear regression models was used.

$$Y = b_0 + b_i X_i \quad (1)$$

where: Y = women's income obtained from bamboo utilization; b_0 = intercept; b_i = coefficient and X_i = explanatory variable (*Age, Education, Income, Farmsize, Experience, Tspent, Pforest, Dmarket*).

3. Results and Discussion

3.1. Bamboo as Community Livelihood

The majority of respondents (69.5%) stated that bamboo was their main source of income, followed by agriculture (15.4%), paid work (10.6%) and trade (4.5%). Apart from bamboo, women in the study area exploited various another non-timber forest products such as spices, firewood and medicinal plants from the forest. The majority (40%) of respondents collect bamboo throughout the year while around 44% collect bamboo for at least six months. About 87% of respondents collect bamboo from natural forests, while 13% collect from their own gardens.

3.2. Bamboo Products

Bamboo offers a variety of products for the community. There are four bamboo species that are widely processed by the community, namely bamboo rope (*Gigantochloa apus*), bamboo betung (*Dendrocalamus asper*), and bamboo balike (*Gigantochloa pruriens*). The main products identified were baskets, winnowing trays, poles, stakes and firewood. Large basket sizes are the most widely produced in Lake Toba. The bamboo species used is rope bamboo. Bamboo stakes are preferred based-on resistant properties to termites. Dried bamboo is also collected and used as firewood.

Another species, bamboo betung is widely used for its strong properties of short segment length and being thick but flexible. It is applied for building construction, house fences or stairs. The young shoots, known as rebung, are a source of foodstuff. This bamboo has a selling value of IDR 8500/stem with an 8 m length at the village level, and prices almost double to IDR 15,000/stem in the city. In single day, each craftsman produces an average of 20 baskets of size 60 kg with a price of IDR 5000/basket.

Bamboo also produces edible shoots. In one year 10–20 shoots can be produced per clump; if there are 30 clumps in one hectare, then 3000–6000 shoots can be produced. If each shoot is valued at IDR 2500, there is an additional income IDR 7,500,000 to 15,000,000, a significant amount for farmer welfare. A basket complete with a lid is sold to a collecting agent for IDR 10,000. Most of baskets are distributed to the Karo district for oranges and vegetables containers.

3.3. Gender Perspective in Bamboo Management

Bamboo rope is the most widely used as raw material for baskets for vegetables and fruit containers. Basket-weaving has been a popular business since 1970s, where 85% of population works as craftsmen, dominated by women. Meanwhile, the men's role is bamboo harvesting and splitting it as thin as possible for the woven material. The production and marketing of bamboo products are gender sensitive. Gender inclusion tends to vary in relation to different bamboo activities (Table 1).

Table 1. Gender participation in bamboo activities.

Gender	Age	Bamboo Activities (%)		
		Harvesting	Processing	Marketing
Female	<18 years	1	8	2
	≥18 years	12	64	31
Male	<18 years	19	11	4
	≥18 years	68	17	63

Bamboo harvesting is dominated by men. But bamboo processing and marketing is carried out by both men and women, although men still dominate. Women who are members of several social organizations, such as groups, usually market bamboo products through their social involvement in the group. Men, on other hand, sell their products directly to market.

Bamboo marketing and other NTFPs in Bangladesh and Uganda are mostly done by men [6,7]. The higher male participation is due to the long distances of bamboo forests from home, and the fact that women spend most of their time taking care of their husbands, children and other family members [8]. The male dominance in marketing activities is because men are breadwinners in most Batak communities. As such, they tend to control all income-generating activities within households.

Woman often faces disadvantages that hinder their ability to engage in economic activities. As a result, they become economically dependent and politically and socially disadvantaged. In most countries, women tend to engage in lower-paying activities while men specialize in producing marketable products [8,9]. Fortunately, bamboo offers greater opportunities in an informal economy.

Economic empowerment increases women's access to economic resources and opportunities including jobs, financial, property, skills and market information. Economic empowerment has a positive impact on their social and political empowerment through increasing respect, status and self-confidence, as well as increasing decision-making power in households and communities [10,11].

3.4. Bamboo Contribution to Women's Income

Women in the study areas received income from limited sources such as agriculture (especially crop production) and bamboo (Table 2). Limited economic opportunities in the study areas prevent women from diversifying their sources of income.

Table 2. Sources and Proportions of Women's Income per month.

Sources	Income	Percentage (%)
Agriculture	1,150,500	38.36
Bamboo	1,848,450	61.64
Total	2,998,950	100.00

Bamboo utilization is a main source of income (61.64%) for women. Consistent with our findings, a study conducted in Nigeria revealed that the main household income was generated from NTFPs [12,13]. The average total income earned from selling bamboo products was IDR 1,848,000 per month. The gross margin from sales of bamboo products was 52.4%.

3.5. Determinants of Income from Bamboo

Linear regression analysis was carried out to identify the factors affecting the income derived from bamboo. Explanatory variables such as respondent's education level, experience of collecting bamboo (*Experience*), family size and time spent in forest (*Tspent*) showed a positive relationship with income derived from bamboo. However, respondent's age (*Age*), other income (*Oincome*), proximity to forest (*Pforest*) and distance to market (*Dmarket*) showed a negative relationship.

$$Y (\text{income from bamboo}) = 184.92 - 8.93 (\text{Age}) + 29.56 (\text{Education}) - 0.39 (\text{Oincome}) + 11.86 (\text{Famsize}) + 8.73 (\text{Experience}) + 387.42 (\text{Tspent}) - 196.81 (\text{Pforest}) - 192.72 (\text{Dmarket}) \quad (R^2 = 0.684) \quad (2)$$

As expected, proximity to forest negatively impacted bamboo income. Therefore, people living far from forest were less interested in bamboo activities due to higher transaction costs. In line with these findings, other studies showed that negative effect of distance to forest on bamboo income was due to increased production costs [14,15]. Time spent affected bamboo income. This means people who spend more time in forest collect more bamboo and get higher income. Other income is negatively associated with bamboo income. This indicates that if women received more income from other activities they would be less dependent on bamboo. Another important variable is distance to market,

greater distances making women reluctant to be involved in activities due to high transaction costs.

3.6. SWOT Analysis of the Bamboo Management

Interest in bamboo utilization among various stakeholders in the area (Table 3). Main interventions include involving local communities in bamboo forest management.

Table 3. Bamboo stakeholders and their roles in the study area.

Stakeholder	Roles
Local communities	They are the main recipients of bamboo resources in the area.
Industrial Research Institute	To develop high quality bamboo products for local and national markets.
Forestry Research Institute	Provides support and guidance on management of the bamboo forest.
	Building capacity of local communities on bamboo domestication and product development.
National Forestry Authority	Ensure sustainable conservation through collaborative approaches with local communities.

The bamboo subsector in the region has many strengths with which future interventions can be tailored to take advantage of the opportunities. In addition, there are several weaknesses and threats that need to be addressed in order to increase bamboo development in the study area (Table 4).

Table 4. SWOT analysis of the bamboo subsector in the study area.

Strength	Weakness
Strong indigenous knowledge about bamboo.	Excessive dependence on forests for bamboo as raw material
The presence of collaborating organizations to support bamboo interventions.	Lack of advanced technology for efficient bamboo processing.
	Limited research and access to planting material.
Opportunities	Threats
Wide range of products.	Limited access to bamboo forest.
Growing demand for products.	Removing the bamboo zone in the forest.
Wood supply is reduced.	Lack of a policy framework for production, processing and marketing
Raising awareness on bamboo utilization.	

As a multiple benefits species, bamboo is a potential NTFP for industrial raw materials, land rehabilitation and tourism in Lake Toba. Bamboo plants can be a substitute for wood, with a shorter cycle. Although bamboo utilization is still limited and uses simple technology, bamboo has convincing economic value. The development of woven bamboo handicrafts for souvenirs with attractive Batak distinctive patterns and motifs, and musical instruments such as traditional flutes, can be alternative products for diversification.

However, the bamboo population has decreased. Inaccurate harvesting for bamboo culms, which disrupts the bamboo shoots' viability, is one of main cause of population decline. Planting bamboo is also limited due to lack of community knowledge regarding proper nursery methods. The planting of various bamboo species can become a genetic resource for their future development, both for industrial raw material sources and land rehabilitation.

In socio-cultural fabric of the community, bamboo is one of things that cannot be abandoned. In various traditions, wedding ceremonies and family celebrations, bamboo raw materials become traditional tools. As a development spearhead, the community must be strengthened. The preparation activities of bamboo farming must begin by identifying some suitable and potential locations for cultivation clusters. Planning activities should be carried out in a participatory manner by taking into account gender issues and local wisdom.

Because of bamboo's adaptability to extreme environmental conditions such as low nutrient availability, high temperature, soil acidity, poor drainage, and low humidity it is

considered a rehabilitation species. The root characteristics allow this plant to maintain a hydrological system, so that it can be used as a conservation species.

3.7. Policy Implications

This study shows that bamboo products in Lake Toba region are produced based on local wisdom. The economic value can be increased through capacity-building interventions in product development by improved product quality. Market relationships need to be built to take advantage of wider markets for the local communities' benefit. The presence of various bamboo stakeholders should be a stepping stone to initiating bamboo development programs that can create jobs for local communities. This will make a major contribution to the regional economy and increase the capacity of rural communities to fight poverty.

The potential of bamboo resource is quite large, but its use is still limited for products such as woven baskets. Bamboo has a potential for industrial raw materials, land rehabilitation plants and tourism in Lake Toba. The limited cultivated bamboo species provide opportunities to increase species diversity. Planting various bamboo species can be a genetic resource for their future development, both for industrial raw materials and land rehabilitation.

The main sources of income for women in the study areas consisted of bamboo-based activities and agriculture. With these limited sources of income, bamboo plays an important role in contributing to women's income and reducing income inequality. However, the contribution of bamboo utilization for the forest, other income and distance to markets significantly affect the income earned by women. Therefore, empowering women through bamboo utilization can create significant opportunities for women in terms of increasing income and reducing income inequality.

4. Conclusions

The study findings indicate that promoting local stakeholders was one of the potential strategies for sustainable bamboo management. The basic idea is that sustainable bamboo management can only be done with the support of stakeholders, especially local communities, and considering this, local people should be provided with a decent income by using the resources efficiently. Furthermore, bamboo management must be supported by promoting gender equality and women's empowerment in their control over bamboo planting and harvesting, access to financial markets and resources, processing technology, education and training and other decision-making opportunities regarding income, savings and expenses. This study acknowledges that there is a strong relationship between decision-making authority and women's empowerment.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to there are no physical contact with respondents; no risk of discomfort or inconvenience to respondents; and respondents recruited from non-vulnerable groups.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors would like to thank Dr. Hiras Sidabutar (the Indonesian Sawmill and Woodworking Association (ISWA) for useful discussion, comments and supports in this research.

Conflicts of Interest: The authors declare no conflict of interest.

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