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

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Abstract: Indonesia is blessed with wonderful and beautiful Lake Toba catchment area where diversity bamboo species grow and provide socio- economic benefits to Bataknese community, indigenous to 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 on 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 cause of problem and strategies for sustainable management, a problem tree analysis were conducted. Findings of study shows 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 income by efficiently 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 strong relationship between decision making authority and women empowerment.

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

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 diversity of bamboo species grows and provides social, cultural and economic benefits to the Batak people, the indigenous of region. 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 *Gigantoclhoa apus*, *Dendrocalamus asper*, and others.

Bamboo is one of the most valuable non-timber 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 the properties, including straight, strong, easy to split, cut and process with relatively cheap price. Environmentally, bamboo also used to land rehabilitation, reduce soil erosion, increase soil water infiltration thereby stabilizing landscapes and groundwater and 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 multi-benefits of bamboo open the demand for this resource in line with society development.

Bamboo management has been integrated into Indonesian national development agenda. Both national development vision and Indonesia's forest policy provide a framework for sustainable production of non-timber forest products including bamboo resources. There are evidences that bamboo play important role for socio-economic 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 in Lake Toba region. Bamboo processing is considered attractive because it doesn't need technical and financial requirements, whereas 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 the men dominance in Batak community, who still adhere 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 estimating bamboo contribution to household income.

The objective of study are (a) to document the bamboo resources utilization by local communities in Lake Toba region; (b) to assess the potential of bamboo product 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 Lake Toba highland on altitude of 900 to 1200 m.a.s.l. The topography is mostly sloping to steep hills with a limited flat area which 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 medium scale businesses, tourism and derivative services is relatively low and not optimal.

2.2. Methods

This research was conducted through household survey, key informant interview, group discussion and market surveys. The surveys conducted on June 2019 to December 2019 in Simalungun and Karo districs. 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's 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 rural women income from bamboo, an econometric model with multiple linear regression models is used.

$$Y = bo + bi\ Xi \quad (1)$$

where: Y = women income obtained from bamboo utilization; *þo* = intercept; *þi* = coefficient and; Xi = 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 study area exploited various another NTFPs such as spices, firewood, and medicinal plants from forest. The majority (40%) of respondents collect bamboo throughout the year while around 44% collects bamboo for at least 6 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 community. There are four bamboo species that are widely processed by 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 regarding the strong properties, short segment length, 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 8,500/stem with 8 m length at village level; and prices almost double, IDR 15,000/stem in the city. In single day each craftsman produces an average of 20 baskets size 60 kg with a price of IDR 5,000/basket.

Bamboo also produce edible shoot. In one year 10-20 shoots can be produced per clump, if there are 30 clumps in one hectare, then 3,000-6,000 shoots can be produced. If each shoot is valued at IDR 2,500, there is an additional income IDR 7,500,000 to 15,000,000, a significant amount for of farmer welfare. A basket complete with a lid is sold to a collecting agent for IDR 10,000. Most of baskets are distributed to Karo district for oranges and vegetables container.

3.3. Gender Perspective in Bamboo Management

Bamboo rope is the most widely used as raw material of basket for vegetables and fruit containers. The basket-weaving have been popular business since 1970s, where 85% of population works as craftsmen which dominated by women. Meanwhile, men's role is bamboo harvesting and splitting as thin as possible for woven material. The production and marketing of bamboo product is 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 group. Men on other hand sell their products directly in market.

The bamboo marketing and other NTFPs in Bangladesh and Uganda were mostly done by men [6, 7]. The higher of male participation due to long distances bamboo forest from home, and fact that women spend most of her time taking care of her husband, children, and other family members [8].

The men dominance in marketing activities is because men are breadwinners in most Batak communities. As such, they tend to control all income-generating activities within household.

Woman often faces disadvantages that hinder their ability to engage in economic activities. As a result, they become economically dependent, 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 offer greater opportunities in informal economy.

Economic empowerment increases women's access to economic resources and opportunities including jobs, financial, property, skills and market information. Economic empowerment have 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

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

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

As expected, *proximity to forest* negatively impacted bamboo income. Therefore, people living far from forest are less interested in bamboo activities due to higher transaction costs. In line with these findings, another studies show that negative effect of distance to forest on bamboo income is due to increased production costs [14, 15]. *Time spent* affected bamboo income, this means people who spend more time in forest collect more bamboo get higher income. *Other income* is negatively associated with bamboo income. This indicates that if women received more other activities income, they would be less dependent on bamboo. Another important variable is distance to market, greater distances make 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 sub-sector in the region has many strengths with which future interventions can be tailored to take advantage 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 an alternative to product diversification.

However, bamboo population has been decreased. Inaccurate harvesting for bamboo culms which disrupt the bamboo shoots viability is one of main cause of population declining. The 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 of community, bamboo becomes one of things that cannot be abandoned; in traditional and wedding ceremonies, family celebrations, even bamboo raw materials become traditional tools. As development spearhead, the community must be strengthened; farmer group preparation begins by identifying potential location for cultivation cluster. Planning activities are carried out in a participatory manner by taking into account gender issues and local wisdom.

The bamboo adaptability to extreme environmental conditions such as low nutrient availability, high temperature, soil acidity, poor drainage, and low humidity are considered for 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 improve product quality. Market relationships need to be built to take advantage of wider market for 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 is a potential for industrial raw materials, land rehabilitation plants and

tourism in Lake Toba. The limited cultivated bamboo species provide opportunities for efforts 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 women is influenced by several factors. The time spent collecting bamboo, proximity to 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 promoting local stakeholders identified as some 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 in this consideration, 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, expenses, etc. This study acknowledges that there is a strong relationship between decision-making authority and women's empowerment.

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