Forest Farmer Groups' Perception and Behavior in relation to Climate Change Mitigation

Indartik[1], Mega Lugina[2], Mirna Aulia Pribadi[3], Ari Wibowo[4]
{indartik32@yahoo.co.id, mega_lugina@yahoo.com, auliamirna@gmail.com}

Center for Research and Development of Socio-Economic Policy and Climate Change[1,2,3]

Abstract. Forest Management Units (FMUs) plays important roles in Indonesia's commitment to mitigate climate change, especially in the land-based sector. Forest land in FMU is managed by FMU managers and communities around the forest. The study aims to identify people's perceptions and behavior around the RPH Mangunan related to climate change mitigation. Data collection methods are household surveys of KPH land users, in-depth interviews with key stakeholders, and focus group discussion. The data analysis method used is descriptive analysis. The result shows that forest farmers groups understood forests' ecological function. However, the level of community understanding regarding forest as carbon sinks and storage was still limited. Forest farmer group members are willing to be involved in protecting the forest. Forest farmer group members are still interested in carrying out agroforestry activities within the KPH area. Still, with the development of tourism, there has been a shift in agroforestry activities to ecotourism.

Keywords: perception, behavior, forest farmer group, RPH Mangunan, climate change mitigation

1. Introduction

Climate change is a global phenomenon that causes various negative impacts on life earth. Therefore it is crucial to carry out efforts to control and mitigate climate change immediately. Indonesia has a substantial commitment to efforts to mitigate the effects of climate change. This commitment is reflected in Indonesia's emission reduction targets listed in the National Determined Contribution (NDC) document. The Indonesian NDC document states that Indonesia targets reducing emissions by 29% on its own efforts and 41% with international supports.

Forestry, as a land-based sector, is expected to contribute significantly to reduce emissions. Therefore, Indonesia's Government has designated the forestry sector as the sector targeted to contribute to the highest emission reduction in

meeting the Indonesia NDC target [1]. With Indonesia's commitment to mitigating climate change in the land-based sector, KPH, as the site-level unit management, plays important roles. KPH land management is not only carried out alone but also involves communities around the forests, which are members of the forest farmer groups. Thus, in implementing climate change mitigation programs, the community also plays an essential role in determining the program's success and the substance itself.

Communities' role in the success of climate change mitigation program in KPH is essential because the community has dual roles, as the subject/actor of the program, which is an extension of KPH, and at the same time also as the object receiving impacts on the implementation of the program. People acquire local knowledge in dealing with climate diversity based on real experiences. This experience can be used to anticipate environmental changes, including natural disasters [2]. The community is the initial stakeholder and is the one who able to recognize, identify, and prioritize the steps needed for the shake of their environment [3].

The success of climate change mitigation cannot be separated from the community's active participation at the site level. Community participation will be carried out if they have a correct and comprehensive understanding and perception of climate change. Also, the community understands what steps should be taken in the future for their environment. By identifying people's perceptions, an appropriate community empowerment scheme can be formulated [4]. In the climate change context, public perceptions are also fundamental regarding adaptation strategies, especially for community groups, with a high-level dependency on nature and forests [5].

Therefore, it is necessary to ensure that the community has a correct understanding of climate change to contribute positively and by climate change mitigation in FMUs. Identification of community perceptions is needed to determine the extent of community understanding of climate change mitigation and how these perceptions affect community attitudes and behavior in managing KPH land. This study aims to identify the perceptions and behavior of the community around RPH Mangunan regarding climate change mitigation.

2. Method

2.1. Location

The study was conducted at KPH Yogyakarta in July-August 2018. The research location was focused on the area of RPH Mangunan, which represents the protected forest of KPH Yogyakarta.

2.2. Materials

Data collection methods are household surveys of KPH land users, in-depth interviews with key stakeholders, and focus group discussion (FGD), which was attended by stakeholders involved in KPH land management. The number of household respondents representing KPH land users was 33 people. Sampling was carried out using the purposive sampling method, which is a sampling technique by determining specific criteria [6]. According to Robinson (2014), purposive sampling is a deliberate selection of informants based on their ability to explain specific themes, concepts, or phenomena [7].

FGDs were conducted two times: the first FGD participants are farmers groups who use KPH land, while the second FGD as attended by all stakeholders involved in KPH land management, including government, private sectors, cooperatives, and farmer group representatives. The first FGD was conducted to formulate with forest farmer groups in what form of tourism development they want to, which is an accordance with rules/regulations imposed in the protection forest. The second FGD which invited not only farmers, but also representative KPH, Provincial Forestry Office, and Notowono Cooperative. In this FGD, we discussed what form of KPH land utilization to be developed by considering livelihood gained by farmers and the applied regulations for protection forest management.

2.3. Logical Framework

Community perception of KPH land utilization will generate motivation, which is needed to trigger the community to determine their behavior **(Figure 1)**. According to Fielmand (1999), perception is a productive process to motivate and understand a real situation [8]. Based on McDonald (2012), perception is a personal perspective that becomes a trigger to take actions. Perception is influenced by

information and experiences that enable someone to have opinions based on the socio-cultural aspect [9]. In this study, what is meant by farmer perception is the opinion of farmers on the KPH area and the views of farmers on the existence of forests and their function in climate change mitigation.

This perception forms farmers' motivation to fulfill their daily needs, which some of them are attained from forests. The fulfillment of daily needs can be done through farming cultivation or agroforestry and nature-based tourism. The motivation affects farmers' behavior in utilizing forest land, whether for agroforestry system or nature-based ecotourism and what kind of model applied, which is biophysically appropriate and the terms of KPH land use. The producer behavior theory approaches farmers' behavior in this study in economics. According to van Meerhaeghe (1986), the theory of producer behavior explains how producers try to produce optimal production by regulating the most efficient production factors[10]. In this study, as producers, in utilizing the KPH land, farmers will choose the most profitable activities for farmers.
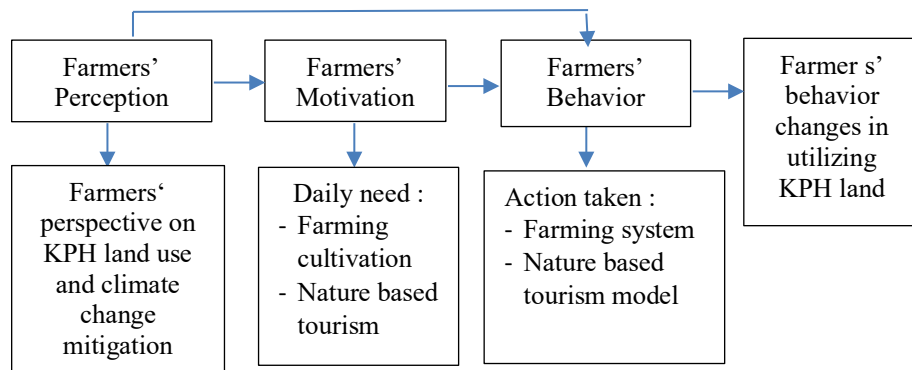

Figure 1. The logical framework of study

2.4. Data Analysis

The data analysis method used is descriptive analysis, an analysis that describes a phenomenon by identifying patterns in the data to answer who, what, where, when, and to what extent [11]. Furthermore, Loeb et al. (2017) also stated that the descriptive analysis could identify previously unrecognized social phenomena and

lead to causal understanding and the mechanisms behind cause-and-effect relationships [11].

3. Result and Discussions

3.1 Description of Study Site

Yogyakarta Forest Management Unit (KPH) was promulgated through SK. 439/Menhut-II/2007 on 13 December 2007, which was subsequently amended by Minister of Forestry Decree No. 721/Menhut-II/2011, covering an area of 15.724,50 ha is divided into Production forest amounted to 13.411,70 ha and protection forest covering an area of 2.312,80 ha **(Figure 2)**. The working area of KPH Yogyakarta is spread over three regencies, namely Kulon Progo, Bantul, and Gunung Kidul Regencies.

KPH Yogyakarta is a technical implementation unit (UPTD) under the Yogyakarta Special Province Forestry and Plantation Office. The Forest area under KPH Yogyakarta is divide into five Forest Area (known as BDH) and 25 Forest Management Resort (RPH). The five BDH are Karangmojo, Paliyan, Panggang, Playen, and Kulonprogo-Bantul. The study focuses on RPH Mangunan, which is located in BDH Kulon Progo-Bantul. The entire RPH Mangunan area is a protected forest with predominantly pine trees.
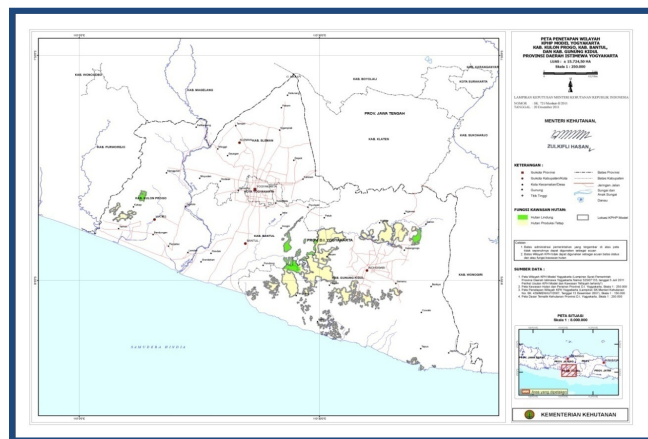

Figure 2. Working Area of KPH Yogyakarta (source : Balai KPH Yogyakarta, 2013[12])

3.2 Respondent Characteristics

Most of the respondents are the community around RPH Mangunan, such as the community in Muntuk Village, who use the KPH land for intercropping (tumpangsari) and other activities. Intercropping has been carried out since the 1970s and switched to galangal after trees grew around the year 2007. In addition to intercropping, the community also began to grow mulberry for silkworm feed, use KPH land to raise honey bee, and manage ecotourism in KPH. Each activity is accommodated in different farmer groups: galangal farmer group under KTH Becici Asri and KTH Ngudi Lestari, mulberry groups under KTH Margo Sutro, bee raising group under KTH Sekar Sari, and tour operator vary depending on tourist attractions managed such as Puncak Becici, Pinus Sari, Pinus Asri, Bukit Pengger, Lintang Sewu, and Pintu Langit Dahromo.

The characteristics of respondents in each activity group were slightly different. Respondents who still cultivate galangal have an older age than other activity groups, with primary education and most of the main livelihoods of farmers - however, this group control more extensive land.

The tour operator is mostly managed by young people in a relatively young age group, with higher education and most of the primary jobs are not as farmers. These tour operators' initiator is usually the second generation of intercropping farmer groups **(Table 1)**. The average number of family members is four persons.

Table 1. Respondents Characteristics of KPH Land Users

Respondents Characteristics	Pattern				
	Mulberry	Galangal	Honey Bee Raiser	Tour Operator	Total
Average Age	44	61	48	38	50
% respondents with elementary background	50.0	100.0	23.1	12.5	54.5
% respondents whose main job is farmer	50.0	83.3	50.0	25.0	60.6
Average number of family members	4	4	4	3	4

3.3 Perception of KPH Land Users on Forests and Climate Change Mitigation

Forests have an essential role in climate change mitigation. According to Locatelli, Evans, Wardell, Andrade, & Vignola (2011), three activities in the forestry sector to mitigate climate change according to IPCC LULUCF category are (1) afforestation, i.e., converting previously non-forested land to forest land; (2) reforestation, i.e., converting land that is not currently forested into forest land; (3) preventing deforestation, i.e., preventing the conversion of forest land to non-forested land [13]. In order to prevent deforestation, that is, people encroach of forests or carry out illegal logging activities in the forest area; KPH Yogyakarta grants permission to people who are members of the forest farmer groups to use the KPH area in the form of agroforestry or the development of tourism activities or other economic activities that do not damage forests.

According to S. Lestari & Premono (2014), agroforestry has a vital role in developing the community and the surrounding environment [14]. Furthermore, Oyebade, Aiyeloja, & Ekeke (2010) stated that agroforestry provides higher land productivity, economic benefits, and more significant and sustainable social benefits [15]. These social benefits include ecological and economic interactions in agroforestry systems that are very significant for environmental management because they can solve degradation and other problems related to climate change. Communities in rural areas are unaware of the role of agroforestry in climate mitigation action.

Community perception is critical to be identified to measure their participation in a program or policy, especially related to climate change. Suhesti & Hadinoto (2019) state that perception has a significant impact on the participation of KTH members in government programs related to critical land rehabilitation [16].

Any implemented program will experience obstacles in its implementation if the community does not have a correct understanding and tends to choose activities that are counterproductive [17]. If a community has a poor understanding, there is a need to conduct training on climate change issues to enhance the adaptive capacity of communities and, in turn improve their livelihood [18].

Forest farmer group members who become respondents in the study understand the function of forest outside a provider of wood, including flood prevention, landslide prevention, clean water producer, and water source **(Figure 3)**. People already understand the ecological and economic functions of forests. The study of Hudiyani et al. (2017) in Wonogiri district shows that farmers' perceptions of the

benefits of agroforestry-patterned community forests are high [19 Farmers feel that community forests have provided many benefits, especially ecological and economic benefits. A study of Dewi (2011) shows that based on farmers' perception, the benefit of ecology and social of community forests in Sumedang District West Java are high [20]. Paletto et al. (2012) stated that people in Trentino region (northeast of the Italian Alps) feel that the environmental value of the forest is higher than its economic value. They consider that the environmental function of protected forests is more important than timber production and tourism activities [21]. Meanwhile, according to the people in the buffer zone of Mount Halimun Salak National Park, the primary use of forest resources is related to water sources, timber for building materials, and firewood [22].

Regarding forest as carbon sequestration and storage, 58% said they already knew the function of the forest as carbon sequestration and storage. However, when explored further, farmers' understanding is still limited to trees absorb CO_2 or smoke from vehicles. They do not understand how trees absorb CO_2 and store carbon. Furthermore, farmers do not understand when a tree being cut down; it will release carbon.
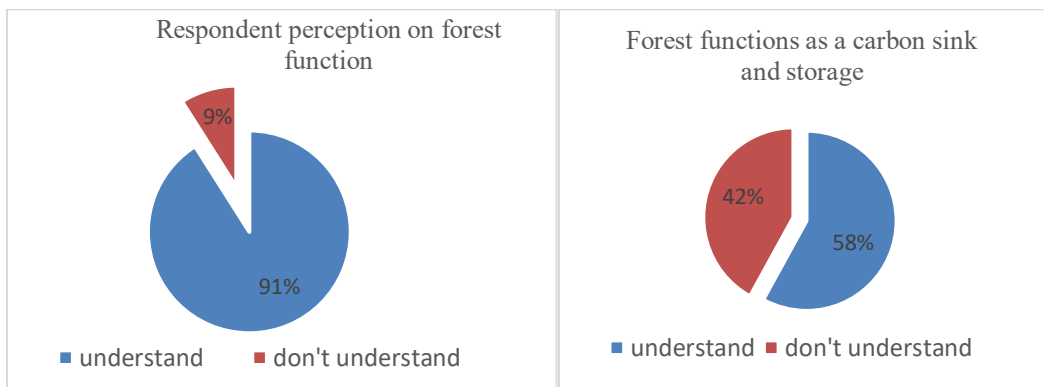

Figure 3. Respondent Perception on Forests and Roles of Forests

Almost all respondents are willing to involve in protecting the forest **(Figure 4)**. Preserving the forest includes rehabilitation activities, namely planting, replanting, and forest protection activities (patrol), including not cutting down trees in KPH Yogyakarta. These activities are one of the roles of forest farmer groups in protecting forests and an alternative in mitigating climate change.

Respondents also stated that using the KPH area for activities such as agroforestry and ecotourism contributed to household income. Agroforestry activities with galangal planting patterns, according to respondents, have contributed to household income by 36%. However, agroforestry activities with mulberry and honey bee cropping patterns have not produced results yet as they are still being pioneered. Activities from ecotourism have contributed relatively higher, which is around 70% of household income. This is due to the fact that in the research location, especially in RPH Mangunan, ecotourism has developed and produced relatively large results.
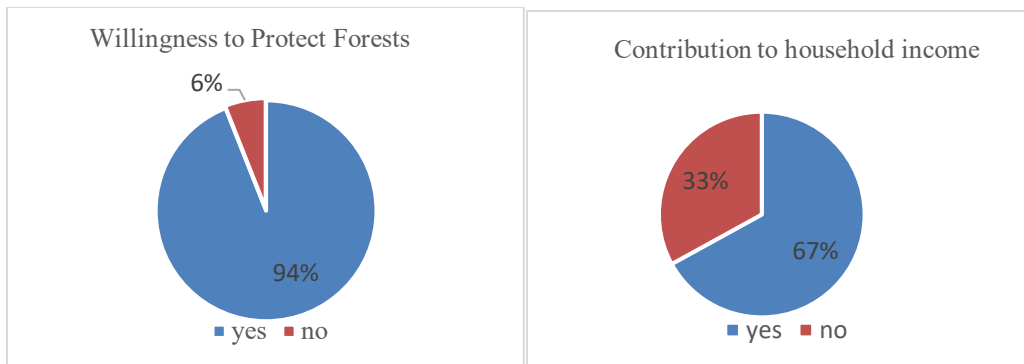

Figure 4. Willingness to Protect Forests and Contribution to Household Income

In an effort to increase forest benefits both ecologically and economically, support from the government is needed. Government support can be in the form of forestry extension agents, tree seedlings, business capital, and market access. According to Padillah et al. (2018), the level of farmers' perceptions of the role of extension workers in Tabir District Jambi Province is quite good. Extension workers have played a sufficient role in government programs to increase the production of certain commodities [23]. According to Virianita et al. (2019), farmers thought that government support as an essential need, support primarily in the form of business capital, marketing access, guaranteed market prices, and transportation infrastructure [24].

3.4 Behaviour of KPH Land Use on Protection Forest Management

In the use of the Mangunan protection forest, the community around the forest is incorporated in forest farmer groups or tour operator under the guidance of KPH. The community engagement aims to create jobs, increase the income of surrounding communities [12]. The community uses KPH land by planting herbs "empon-empon," grass, and crops. The community obliged to maintain stands around the intercrops. With the growing sense of community ownership of the KPH's existence, the community participates in protecting and preserving KPH areas.

Forest farmer groups that facilitate activities in RPH Mangunan include KTH Becici Asri, Ngudi Lestari, Margo Sutero, Sekar Sari, and tour operators such as Puncak Becici, Pinus Sari, Pinus Asri, Bukit Pengger, Lintang Sewu, and Pintu Langit Dahromo. KTH Becici Asri was established in 2004, followed by KTH Ngudi Lestari in 2005, with 20 members in each group. Both Becici Asri and Ngudi Lestari utilize RPH Mangunan land to plant galangal under tree stands. KTH Sekar Sari was formed in 2018 with a membership of around 16 persons, focusing on the development of honey bees. KTH Margo Sutero was established around 2015 with about 20 members and developed mulberry plants for silkworm feed. Tour operators were established in the year 2015-2017 with a varied number of members each.

Most of respondents took part in the activities of farmer groups in RPH Mangunan so that they could have activities or could work on the RPH Mangunan area. Thus activity is expected to generate additional income for the family. In addition, they also want to gain knowledge and experience so that they can increase their capacity together with other members.

There are rules or agreements within the farmer groups that are mutually agreed upon **(Table 2)**. According to most respondents, these agreements were written (67%) and followed the existing government regulations. The rules that are followed include not destroying wood stands and have to replant dead woody plants. In addition, a schedule of community service in groups is also arranged. Sanctions are given to members who break the agreement, especially for members of the mulberry and tour operators, as they have routine activities every day. For the mulberry group, they have to take care of silkworms every day, and tour operators must be available to give service to visitors every day too. If members do not take part in voluntary work, they will be fined as much as Rp. 15,000.00.

However, if members ask for a permit for other needs, they can replace working on another day.

Table 2. Respondent Perception on Farmer Group Institution (%)

% Respondent	Pattern				
	Mulberry	Galangal	Honey bee	Tour Operator	Total
The existence of rule/regulation	100.0	91.7	100.0	100.0	97.0
The existence of written agreement	50.0	66.7	100.0	62.5	66.7
The existence of sanctions for those who break the agreement	100.0	33.3	0.0	100.0	63.6
The existence of role models	50.0	75.0	75.0	100.0	81.8
Role models must become group leaders	0.0	58.3	50.0	12.5	36.4

Initiators of forest farmer groups are often role models of the surrounding community. According to respondents, the role models are the head of RPH Mangunan, group leaders, and community leaders. Role models are not always the group leaders unless the initiators are the one who mobilizes a farmer group. The election of both heads of forest farmer groups and tour operators was carried out through a discussion process.

In managing RPH Mangunan protected forests, forest farmer groups hold a regular meeting once a month. According to respondents from the three groups (mulberry, galangal, and tour operators), they usually discuss work plans during the meetings; for example, the mulberry group plans time to nurture, fertilizing, and replant/sowing plants. The honey bee and tour operators also discussed problems in fields, such as water supply problems for crops and tourism activities **(Figure 5)**.
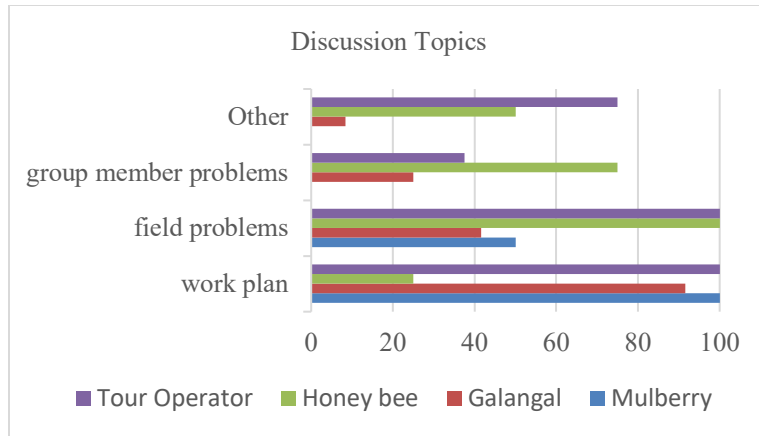
Figure 5. Topics Discussed During Regular Meetings

The next problems to be discussed by the honey bee group members are conflicts between members and the progress of their group. They also discussed on members' social gathering and increasing human resources capacity. Based on a study carried out by Ruhimat (2017), the institutional capacity of farmer groups is one of the essential factors in the development of agroforestry farming [25]. Efforts to increase institutional capacity are carried out by increasing the dynamics of farmer groups and the participation of members in each farmer group activity.
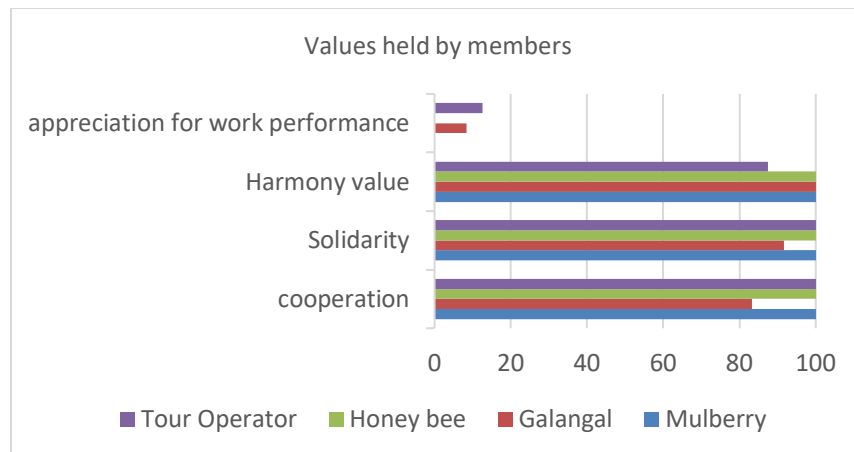

Figure 6. Values held by members in Forest Farmer Groups and Tour Operators

In managing the KPH area, farmer group members work together to achieve the group's goals; for example, within a tour operator, its members work together to build photo spots, repair roads, planting trees, and maintain cleanliness. Group members also stated that they got along well with each other, felt similar and shared. However, until now, there has been a lack of appreciation for the satisfactory performance of group members **(Figure 6)**.

According to respondents, access given by KPH to manage protected forest contribute to their welfare. The income derived from the land-use activity is used to meet daily needs. Even though the mulberry and honey bee farmers have not yet generated income, they still hope that these activities provide good results in the future through the development of educational tourism. Besides, community involvement in the forests is also in the context of preserving the forests. The community help protect forests from fire and illegal logging. Community involvement is undoubtedly beneficial for KPH to keep the forest sustainable, indirectly maintaining carbon stocks and increasing carbon sequestration, contributing to climate change mitigation. The study of Mamuko et al. (2016) conducted in Menado shows that people have a high perception of forests and their functions [26]. They are willing to participate in maintaining and conserving natural resources to maintain land productivity.

Ecotourism activities in RPH Mangunan have changed farmers' interest in agroforestry activities **(Figure 7)**. The certainty of income obtained from ecotourism activities is the main attraction for farmers to switch to nature tourism.
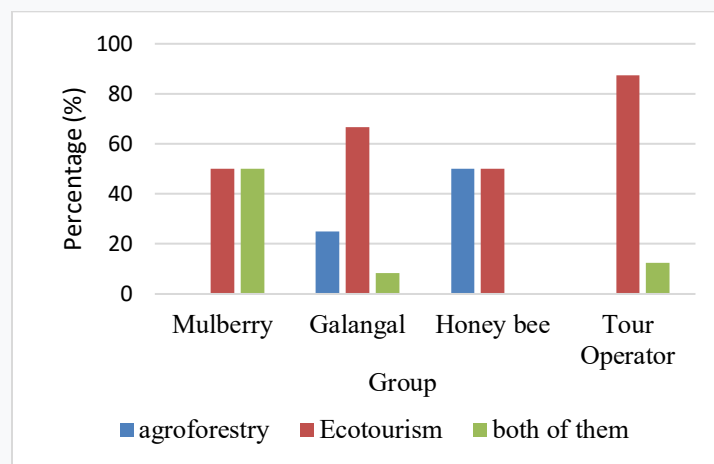

Figure 7. Respondents' Interest in Agroforestry and Ecotourism Activities

Compared with the income from galangal agroforestry, a tour operator's income is higher, reaching an average of Rp.9,000,000.00 / year **(Table 3)**. Also, ecotourism management activities do not require more energy than agroforestry activities

Table 1. Comparison of Revenue from Galangal and Tourism Activities in RPH Mangunan

	Pattern	
	Galangal	Tour Operator
Revenue (Rp./year)	2,610,667	9,000,000
Cost (Rp./year)	275,833	-
Net Income (Rp./year)	2,334,833	9,000,000

However, there are still respondents who still choose agroforestry activities and choose to stay involved in both activities. The options are the opportunities to include agroforestry activities in the development of ecotourism. Based on the results of the FGD, the pattern that allows both activities to accomplish simultaneously is agroforestry-based ecotourism. Agroforestry itself is a multi-functional land-use system that has the potential to absorb and store carbon, conserve biodiversity, break the wind, produce food, provide non-timber forest products, wood for firewood, and wood for construction [27].

The agroforestry system also increases the resilience of smallholders in facing climate change with the variety of agricultural and forestry products that can be produced, environmental services that have implications for agricultural and forestry products as well as for the environmental and significant income for households [28]. Compared to farmers who depend on conventional farming, agroforestry farmers are more economically resilient [28].

In addition, agroforestry is a system that can combine the goals of climate change adaptation and mitigation by synergizing adaptation and mitigation activities [29]. Besides having higher carbon stock compared to conventional agriculture systems and pasture, agroforestry systems reduce emission through fire avoidance [30]. Soto-Pinto et al. (2010) identified that the carbon density in tropical climate zones is higher than that of temperate and low climate zones [30].

Incorporating agroforestry activities into ecotourism is a middle way between economic activities, agriculture, and environmental conservation efforts. This is in

line with Abbas et al. (2017), which states that agroforestry is seen as a win-win solution in agricultural development and environmental sustainability efforts [27].

4. Conclusions and Recommendation

Respondents are communities around RPH Mangunan who use the KPH area for intercropping activities through forest farmer groups. These groups are divided into the galangal group, the mulberry group, the honey bee group, and the tour operator. The characteristics of respondents in the three farmer groups are different from the tour operator. Respondents in three farmer groups have older age; education is mostly elementary school and has the main livelihood as farmers. The tour operator, managed mainly by people in a relatively young age group, with higher education, and most of the primary jobs are not farmers.

Members of forest farmer groups who were respondents in the study understood forests' ecological function; however, the level of community understanding regarding forests as carbon sequesters and stores was still limited. Forest farmer group members are willing to be involved in protecting the forest, which is carried out in the form of rehabilitation activities, forest protection (patrols), and not destroying forests such as cutting trees in RPH Mangunan KPH Yogyakarta. These activities are one of the roles of farmer groups in mitigating climate change.

Farmers' behavior in managing forest area can be reflected in their behavior in forest farmer groups. Some rules or agreements are mutually agreed upon within the farmer group, such as not destroying stands of wood, replanting, and consensus for community service within the group. There are sanctions or fines if group members violate the agreement. They also have a schedule for regular meetings to discuss the group's problem, mostly work plans and issues in the field. Values such as cooperation between members, the amount of harmony, and the feeling of the same fate, and responsibility are also shared by the farmer groups' members. They also feel that they have received economic benefits from RPH Mangunan, although some have not received additional income.

There is a shift in community interest from agroforestry activities to ecotourism because of higher income and less energy required in ecotourism. However, some respondents still choose to do agroforestry and also choose to stay involved in both activities. This is an opportunity to include agroforestry activities in the

development of ecotourism. Therefore, ecotourism, which is integrated with agroforestry models, is proposed to be developed to mitigate climate change.

Acknowledgments

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