The impact of pine forest management on the surrounding community in Malang Forest Management Unit

Y Adalina and R Sawitri

Forest Research and Development Center, Jl. Gn Batu No 5 Bogor, West Java, Indonesia

Email: yelinadalina@yahoo.com; sawitri_reny@yahoo.com

Abstract. Pine forest used by the community surrounding forest to improve the community's economy through Community Forest Management Program established by Perum Perhutani with division of arable land and plantation of species vegetation. This study aims to: (1) determine the diversity of plants in pine forest; (2) to analyze socioeconomic of the land user farmers, and (3) to recognize the optimization of land use and the diversity of cultivated vegetables. The research was conducted at the Junggo Forest Resort Production, Forest Management Unit Malang, East Java, Indonesia. The survey method was carried out through a plant inventory with total of 23 plots. Farmers were interviewed from 30 respondents through a structured questionnaire and the data were analyzed descriptively qualitatively. There were five species of stands found at tree canopy level namely Eucalyptus alba, Albizia sp, Toona sureni, Persea americana, and Pinus merkusii species with the highest. Various vegetables that combined in 2-3 species, implementing an agroforestry system. The average of land user’s income is IDR 4,500,000 - IDR 6,000,000 per 4 months of the harvest season. The implementation of Community Forest Management Program under pine stands would provide benefits for improving welfare of communities around the forest.

1. Introduction

Indonesia is a country with the third largest tropical forest globally and is one of the seven mega biodiversity countries [1]. The total forest area is 120.6 million ha, or about 63% of the total land area of Indonesia, consisting of 44.7 million ha of primary forest, 37.8 million ha of secondary forest, 3.4 million ha of plantation forest, and scrub covering an area of 34.7 million ha [2]. Part of plantation forest was pine forest that managed by Perum Perhutani. The Minister of Environment and Forestry gave a mandate to Perum Perhutani to manage state forests as plantation forest, for example the area of pine (Pinus merkusii) forest in Java Island is ca. 600,000 ha [3].

Perhutani in Forest Management Unit (KPH: Kesatuan Pengelolaan Hutan) Malang empowers communities surrounding the forest to do agroforestry systems at pine stands through Community Based Forest Resouces Management (PHBM: Pengelolaan Hutan Berbasis Masyarakat) program. Since 2001, the PHBM program is a step forward from Perhutani collaborates with other parties in managing forest resources. PHBM program activities include preparing management plans, utilization of forest resources, protection, and nature conservation to get mutually beneficial relationship and to create sustainable forest management [3,4].

Plantation forest management such as Perhutani aims to get optimal benefits for both the company and the communities surrounding forest through the optimization of land use at pine stands by implementing the agroforestry systems. In Perum Perhutani KPH Malang, management forest and
communities surrounding forest planted the arable land with many vegetation in certained square areas. The success story of PHBM program will be supported by active participation of communities in reserving forest areas. Community participation in the forest management is implemented to get many benefits, such as to increase income and availability food in certain area [5]. Besides that, PHBM program can become a solution to reduce conflicts between managers and communities surrounding forests [6] and help in conserving the forest ecosystem including water resources [7]. Nurrochmat and Hasan [8] stated that the sustainability of natural resource is closely related to the human activities that use them wisely. Natural resources including forest resources should be managed in an ecosystem oriented manner [9].

Interaction between the community and the forest cannot be separated. Therefore, PHBM program established by Perum Perhutani is proposed as one of the efforts for improving the economy of communities surrounding the pine forest. The Community Forest Management System impacts increasing the income of farmers surrounding production forests [10]. The active participation of the people around the forest is an essential condition for the sustainability of forest development itself. The implementation of corporate social responsibility implemented by Perum Perhutani through PHBM is realized in the form of land use with an intercropping system. This study aims to determine the diversity of plants in pine forest, to analyze socioeconomic of the land user farmers, and to recognize the optimization of land use and the diversity of cultivated vegetables. Moreover, from this research, we will know optimalization of land use and the kinds of vegetables that harvested every four months. It is hoped that this program is to create a community surrounding an independent and prosperous forest area.

2. Methods

2.1. Study site

The study was conducted in Sumbergondo Village, administratively located in the Junggo Forest Pemangkuan Resort (RPH), Singosari Forest Management Unit (BKPH), Kepanjen Forest Section (BH), Forest Management Unit (KPH) Malang, East Java, Indonesia. Perum Perhutani KPH Malang manages 88,848 ha of forest area. It is a permanent production forest area (HP) located in the Brantas watershed with the primary vegetation Pinus merkusii and mixed jungles with sufficient standing growth. The study site was located in Bumiaji District, Batu City, at 112°34'54" - 112°31"48" E and 7°45'35" -7°50'31"S, 1,240 - 1,300 m above sea level. The average temperature was 21.5°C, with an average humidity of 86%, a wind speed of 10.73 km/hour, and an average rainfall of 875-3000 mm per year. The average rainfall intensity over the past ten years was 14.78 mm/day. The land is generally hilly, undulating, and can be categorized as plain topography. The slope range is between 8-25%. Based on the Soil and Agroclimate Research Center [11] the type of soil in the study site area is the association of yellowish-brown andosols to black, sandy, and slightly rocky, which is sensitive to erosion, including fertile soil types.

Sumbergondo Village covers an area of 573 ha and consisting of 35 ha of rice fields, 17 ha of housing/plots, 103 ha of land, 367 ha of forest area, and others of 8 ha. The population of Sumbergondo Village is 3,899 people, and almost 90% of the people earn their living as farmers or farm laborers. The forest area in Sumbergondo Village was divided into two categories, viz. production forest (415 ha) and protected forest (46.50 ha).
2.2. Vegetation analysis
We observed 23 plots (± 9200 m² or 0.1% of total area ± 96,000 m²) of the permanent production forest (HP) located at blocks 53, 54 and 56. Plant height and diameter were recorded for each species collected. Vegetation analysis was performed at each level of stands which classified as seedlings (2 x 2 m²); stake sapling (5 x 5 m²); poles (10 x 10 m²) and trees (20 x 20 m²) [12]. Vegetation data were analyzed to determine the Importance Value Index (IVI) based on species relative density, relative dominance, and relative frequency based on the formula [12]:

\[
\text{Density (K)} = \frac{\sum \text{individu}}{\text{sample plot area}}
\]

\[
\text{Relative density (KR)} = \frac{\text{absolute density of each type} \times 100}{\text{total absolute density of all types}}
\]

\[
\text{Dominance (D)} = \frac{\sum \text{basic area}}{\text{sample plot area}}
\]

\[
\text{Relative dominance (DR)} = \frac{\text{absolute dominance of each type} \times 100}{\text{total absolute dominance}}
\]

\[
\text{Frequency (F)} = \frac{\sum \text{sampling point of one sample}}{\sum \text{sample plot area}}
\]

\[
\text{Relative frequency (FR)} = \frac{\text{absolute dominance of each type} \times 100}{\text{total absolute frequency}}
\]

Important value index (IVI) for pole and tree-level

\[
\text{IVI} = \text{Relative density} + \text{Relative dominance} + \text{Relative frequency}
\]

Important value index (IVI) for seedlings and saplings

\[
\text{IVI} = \text{Relative density} + \text{Relative frequency}
\]

2.3. Land use analysis
We conducted this study by surveying, observing, and interviewing the selected respondents (members of PHBM program) using questionnaires or in-depth interviews. The village was chosen purposively, based on the land use of Pinus merkussi forest area. This land use was cultivated through agroforestry system with species of agricultural plants, fruits, and herbs.
The respondent was random selected from the head of the household residing in the research village, which got arable land in the forest treasury managed by Perum Perhutani through PHBM. The number of respondents interviewed was 30 respondents, 10% of all members of PHBM. In-depth interviews were conducted with other stakeholders involved in forest area management, including community leaders, the staff of Perum Perhutani, and key persons.

2.4. Socioeconomic analysis
The data was analyzed descriptively. The questionnaire data included age, formal education, non-formal education, number of dependents, income level, length of stay, and arable land of under pine forest that managed for agriculture.

3. Results and Discussion

3.1. Vegetation analysis
*Pinus merkusii* company-class plantation forests contained many tree and fruit species such as mahogany (*Swietenia mahagoni*), gmelina (*Gmelina arborea*), eucalyptus (*Eucalyptus alba*), suren (*Toona sureni*), silk tree (*Albizia* sp.), jackfruit (*Artocarpus heterophyllus*), avocado (*Persea americana*), persimmons (*Diospyros feet*), mango (*Mangifera indica*), oranges (*Citrus* sp.), bananas and coffee (*Coffea* sp.). Various types of fruit trees in this area are planted by the community around the forest, to utilized their fruit. While mahogany, gmelina, eucalyptus, and suren plants grow naturally. The advantage of pine trees compared to other tree species is their fast-growing and various uses [13], It’s that pine forest could also have socially, economically, and ecologically beneficial. From the ecological aspects of forest ecosystems, they have the function and role in supporting the sustainability of the ecosystem. From the economic aspects, they can be one source of income for forest communities. From the socio aspects, people are involved in the utilization of forest resources [14].

Subsequently, the species of plants cultivated in the intercropping pattern were horticulture, medicinal plant, fodder, ornamental plant, and vegetables. The medicinal plants included elephant grass (*Pennisetum purpureum*), (*Musa* sp.), ginger (*Zingiber officinale*), pandanus (*Pandanus amaryllifolius*), taro (*Colocasia esculenta*), cassywa (*Manihot esculenta*), and *Diplazium esculentum*. Various species of ornamental plants were included such as krisan flowers (*Chrysanthemum*), peacock flowers (*Aster* sp.), dwarf umbrella tree (*Schefflera arboricolasyn*), anthurium (*Anthurium andraeanum*), roses (*Rosa* sp.), and ballon plant (*Platycodon grandifloras*). Species of vegetable plants grown under the *P. merkusii* were eggplant (*Solanum melongena*), cabbage (*Brassica oleracea var. capitata*), chilies (*Capsicum frutescens*), mustard greens (*Brassica chinensis* var. parachinensis), broccoli (*Brassica oleraceavar. italic*), carrots (*Daucu scarota*), and mustard greens (*Brassica chinensis* var. parachinensis). As farmers, so community surrounding the forest used and managed the land areas under pine stands to plan vegetables with agroforestry systems [15]. Agroforestry systems are a form of sustainable land use that has good prospects for increasing farmer income and forest sustainability [16].

The Importance Value Index (IVI) calculation shows that there are five species of plants at the tree level grown in the plot-53, 54, and 56 in the Junggo Resort, viz avocado (*Persea americana*), eucalyptus (*Eucalyptus alba*), pine (*P. merkusii*), silk tree (*Albizia* sp.), and suren tree (*Toonasureni*). Putri et al. [17] stated that forest stands and tree composition structure show an influence on habitat and plant diversity. Based on the IVI data, silk tree dominated species with IVI 16, 31% and a relative density of 6.09 %, and the lowest density of 1 tree/ha found was avocado species. Pine stands in agroforestry had average diameter of 29.75 cm, average tree height of 12.67 m, these affected the light inside forest to fotosyntesis intercropping plants.

The density value of a species indicated the number of individual species concerned in a specified unit area, so the density value was a description of the number of species at the study site [18]. This following its function as a monoculture managed production forest areas where *P. merkusii* trees are the main staple of forest vegetation, following Gunawan et al. [19] that the magnitude of IVI shows the level of the role of the species concerned in the ecosystem.
There were five species of plants at the pole level consisting of avocado (*Persea americana*), coffee (*Coffea sp.*), pine (*Pinus merkusii*), silk tree (*Albizia sp.*), and suren tree (*Toona sureni*). These showed that the species of plants have adaptability in the forest areas [19].

The sapling level, the vegetation consisted of avocado (*Persea sp.*), Coffee (*Coffea sp.*), banana (*Musa sp.*), pine (*Pinus merkusii*), and mango (*Mangifera indica*). The highest IVI analysis results at the sapling level are coffee plants (*Coffea sp.*) IVI of 94.29% with a density of 18 individuals/ha. This sapling level shows that the coffee plant (*Coffea sp.*) has high adaptability than other species. By the statement of Destaranti et al. [20] that the high value of IVI means that a type is dominant and has better adaptability than other species.

The undergrown is a plant community formed by the stratification of plants growing under a forest stands, including grasses, herbs, and shrubs [21]. Total of 36 species of undergrown were recorded at FMU Malang. They consisted of 15 species of plants cultivated by the community and as many as 11 wild species of grass, herbs, and bush.

Species of plants cultivated by the community include ginger, pandanus, taro, ferns, elephant grass, ornamental plants (anthurium, hortensia flowers, and roses), vegetable plants (cauliflower, spinach, rempi, radishe, pandan, tumbaran, lamuran, grunting grass and wedusan (table 2). The study results differed from the results of the Sekarini [22] study in which there were 54 species of bottom plants in pine plants in 1984 and 38 species in 1993 pine plants in KPH Malang.

### Table 1. Important Value Index of vegetation species at Junggo Resort, KPH Malang.

| Growth Rate Classification | Species of Plants | K(Ind/ha) | KR(%) | FR(%) | F | DR (%) | IVI |
|---------------------------|-------------------|----------|-------|-------|---|--------|-----|
| Tree level                | *Persea americana* | 1        | 0.42  | 3.45  | 0.04 | 0.25  | 4.12|
|                           | *Eucalyptus alba*  | 8        | 3.33  | 10.35 | 0.13 | 2.46  | 16.14|
|                           | *Pinus merkusii*   | 214      | 89.17 | 72.42 | 0.91 | 89.63 | 251.21|
|                           | *Albizia sp.*      | 8        | 3.33  | 6.89  | 0.09 | 6.09  | 16.31|
|                           | *Toona sureni*     | 9        | 3.75  | 6.89  | 0.09 | 1.57  | 12.22|
| Total                     |                   | 240      | 100   | 100   | 1.26 | 100   | 300 |
| Pole level                | *Persea americana* | 3        | 4.76  | 13.13 | 0.09 | 3.75  | 21.85|
|                           | *Coffea sp.*       | 2        | 3.17  | 6.67  | 0.04 | 3.64  | 13.48|
|                           | *Pinus merkusii*   | 36       | 57.14 | 46.67 | 0.30 | 56.32 | 160.13|
|                           | *Albizia sp.*      | 2        | 3.18  | 6.67  | 0.04 | 3.35  | 13.19|
|                           | *Toona sureni*     | 20       | 31.75 | 26.66 | 0.17 | 32.94 | 91.35|
| Total                     |                   | 63       | 100   | 100   | 0.64 | 100   | 300 |
| Sapling level             | *Persea americana* | 5        | 14.29 | 14.29 | 0.09 | -     | 28.7 |
|                           | *Musa parasiadiaca*| 2        | 5.71  | 7.14  | 0.04 | -     | 12.86|
|                           | *Coffea sp.*       | 18       | 51.43 | 42.86 | 0.26 | -     | 94.29|
|                           | *Pinus merkusii*   | 9        | 25.71 | 28.57 | 0.17 | -     | 54.28|
|                           | *Mangifera indica* | 1        | 2.86  | 7.14  | 0.04 | -     | 10.00|
| Total                     |                   | 35       | 100   | 100   | 0.60 | -     | 200 |

Note: KR = Relative density; DR = Relative dominance; R = Frequency; FR = Relative frequency; IVI = Important value index

The vegetation analysis resulted six species of cultivated plants, namely radish (*Raphanus sativus*), carrots (*Daucus carota*), pakis sayur (*Diplazium esculentum*), elephant grass (*Pennisetum purpureum*), pandan (*Pandanus amaryllifolius*) and taro (*Colocasia esculenta*). The most dominant undergrown at the study site research location was the creeping woods orrel (*Oxalis corniculata*) with an IVI value of 26.89%. This type of *Oxalis corniculata* grows well because the pine forest in the study location is classified as a forest with a less dense canopy. Pine trees have the character of a sparse canopy and needles that allow light to penetrate the forest floor [23].
Undergrown plants provide some benefits for the environment [24]. The existence of undervegetation on the forest floor can function as a barrier to the rainwater blows so that rain does not directly hit the soil surface and surface runoff so that it will minimize erosion [25, 26].

The diversity of undergrowth can be influenced by canopy cover found around the scrub. The older the age of pine stands, the smaller the number of undergrown species [21,27]. Environmental conditions such as sunlight and shade are factors that influence plants’ growth under the stand [28]. The Value of the IVI indicated the magnitude of the influence of these species in a plant community [29].

### 3.2. Land use of Pinus merkussi forest

Forest management of Perum Perhutani in the research location jointed with community forest management. This management system aims to achieve sustainability of forest functions and benefits by optimally and proportionately combining economic, ecology, and social aspects. Forest management, together with the community, gives access to the community surrounding forest and stakeholders for their respective roles and functions to manage forests in a participatory manner without changing the forest's status and purpose [30]. Thus, the community can actively participate in managing the woods, so that a sense of ownership and a sense of responsibility for the existence and sustainability of the wood would be grown.

The Community Forest Management System (PHBM) Perum Perhutani KPH Malang participates directly and indirectly in the socio-economic development of the community. An indirect contribution is Perum Perhutani to the community through intercropping activities, while the direct input consists of labor absorption in non-timber utilization, namely tapping pine resin.

The Community Forest Management System (PHBM) activities carried out by the Sumbergondo Village community to increase household economic income by using forest land through intercropping activities. The community gave the wisdom to cultivate the forest land by planting in between the staple crops following the community's ability and actively taking care of the forest area. Forests managed under the PHBM system have very high benefits for people's lives. Forests cannot be separated from forest village communities lives, soo the community must manage and protect the wood.

The results of [31] showed that many forest village community use forest land in the fertile FMU region of Malang to cultivate crops. Societies have long used the area as intensive agricultural land for vegetables, various types of flowers, bananas, corn, coffee, and ginger. A total of 359 farmers are working on the ground in the area managed by Perhutani Public Corporation.

In a year, farmers get two harvests during the rainy season for eight months, while in the dry season

### Table 2. Important index value of plant species at seedling level.

| No. | Species                        | K (Ind/ha) | KR (%) | F | FR (%) | IVI (%) |
|-----|--------------------------------|------------|--------|---|--------|--------|
| 1   | Pakis sayur (Diplazium esculentum) | 16         | 0.7    | 0.13 | 2.91   | 3.61   |
| 2   | Elephant grass (Pennisetum purpureum) | 30         | 1.31   | 0.08 | 1.94   | 3.26   |
| 3   | Pandan (Pandanus amaryllifolius)    | 8          | 0.35   | 0.09 | 1.94   | 2.29   |
| 4   | Taro (Colocasia esculenta)         | 2          | 0.09   | 0.09 | 1.94   | 2.03   |
| 5   | Carrots (Daucus carota)            | 150        | 6.55   | 0.04 | 0.97   | 7.52   |
| 6   | Radishe (Raphanus sativuss)        | 150        | 6.55   | 0.04 | 0.97   | 7.52   |
| 7   | Rempi (Oxalis corniculata)         | 460        | 20.09  | 0.30 | 6.79   | 26.89  |
| 8   | Wedusan (Ageratum conyzoides)      | 140        | 6.12   | 0.43 | 9.71   | 15.82  |
| 9   | Lulangan (Eleusineindica)          | 205        | 8.96   | 0.30 | 7.79   | 15.75  |
| 10  | Pakis berbulu (Cibotium barometz)  | 120        | 5.24   | 0.35 | 7.77   | 13.01  |
| 11  | Grinting grass (Panicum munitum)   | 200        | 8.74   | 0.09 | 1.94   | 10.68  |
| 12  | Tumbaran (Spinifex littoralis)     | 80         | 3.49   | 0.30 | 6.79   | 10.29  |
| 13  | Lamuran (Polytrias amaura)         | 132        | 5.77   | 0.17 | 3.88   | 9.95   |
for four months, they cannot work on arable land because there is no water source. To manage their land, the majority of respondents rely on rain fed water.

The study showed that as many as 16 respondents or 53.33% worked on an area of 0.1 ha by planting one species of vegetable, namely carrot. Some people planted three species of crop plants, in total 13 respondents or 43.33% (Table 3). Respondents who planted one species of crop plant were land user who lack of capital for production costs, such as fertilizer, pest and crop seeds.

Table 3. Respondents' income from farming located at the pine forest of Perum Perhutani KPH (Forest Management Unit) of Malang, East Java.

| No | Characteristic                                      | Classifications | Number of Respondents | Percent (%) |
|----|-----------------------------------------------------|-----------------|-----------------------|-------------|
|    | Land area (m²)                                      |                 |                       |             |
| 1  | < 1000                                              | 4               | 13.33                 |             |
|    | ≤1000                                               | 1               | 53.34                 |             |
|    | >1000-≤ 2000                                        | 6               |                       |             |
|    | 1 type                                              | 1               | 43.33                 |             |
|    | 2 types                                             | 3               |                       |             |
|    | 3 types                                             | 3               |                       |             |
| 2  | Number of species of plants cultivated              |                 |                       |             |
|    | 1 species of plant (carrot); land area <1000 m²     | 1.000           | 4                     | 13.33       |
|    | 1 species of plant (carrot); land area ≤1000 m²     | 3000            | 4                     | 13.33       |
|    | 1 species of plant (carrot); land area > 1000-≤ 2000 m² | 3500           | 5                     | 16.67       |
|    | 2 species of plants (carrots, broccoli); land area ≤1000 m² | 6000         | 4                     | 13.33       |
|    | 3 types of plants (carrots, eggplants, leeks; land area ≤1000 m²) | 4350       | 4                     | 13.33       |
|    | 3 species of plants (carrots, turnips, cauliflower; land area ≤1000 m²) | 4400       | 4                     | 13.33       |
|    | 3 species of plants (carrots, broccoli, mustard greens; land area ≤ 2000 m²) | 9000       | 5                     | 16.68       |
| 3  | RT expenditure (RP. x 1,000 / month)                |                 |                       |             |
|    | 500 – 750                                           | 1               | 46.67                 |             |
|    | 751 - ≤1000                                         | 1               | 53.33                 |             |
| 4  | Contribution of farm income to total income (Rp 1,000) / year (%) |                 |                       |             |
|    | 10-25%                                              | 4               | 13.33                 |             |
|    | 26 - 40 %                                           | 1               | 56.67                 |             |
|    | > 40 %                                               | 7               | 30.0                  |             |

The highest income obtained if there were planted two species of plants, namely broccoli and carrots. Respondents' income from farming results with an area of 0.1 ha from one species of planted crop is Rp 1,000,000 – Rp 3,000,000 1x harvest season / 4 months, whereas if two species of crops cultivated Rp 6,000,000 / 1x harvest season / 4 months. If 3 species of plants are cultivated, then the income is Rp 4,350,000 - Rp 4,400,000 / 1x harvest season / 4 months. The amount of respondents' income from farming depends on the number of plants cultivated, types of plants, maintenance, and fertilization of plants. These farmers as respondents sell their crops to middlemen, narrow common areas of cultivation.
with an average of 1,000 m², lack of capital so that for the cost of production of loans to middlemen, the selling price is uncertain. Often the selling price falls when the harvest occurs, and all respondents do not own land. Data shows that broccoli has the highest selling value compared to other types of plants.

The income from farming with an intercropping system under pine stands contributed 12.19 - 47.83% to the respondents' total household income, with an average of 34.41%. Because farming under pine stands is very supportive of the respondent's household economy. Various crops from the agroforestry model applied by communities of commercial value are optimal and sustainable use management. They have an impact to increasing the income of farmers around the forest. Rahadi [10] stated, if the implementation of the intercropping system is not supervised, it will cause erosion caused by the conversion of productive forest land to the intensive agriculture. The more extensive the conversion of pine forests into intensive agriculture, increasing erosion, and sedimentation per year. Currently, the study site has changed its function into a community arable land. This is because the more intensive the community is managing pine forest area into agriculture, at the community's request to the manager of Perum Perhutani Public Corporation to exchange this area with other domains owned by the community.

The land use of pine forest in KPH Malang was distributed to farmers into three groups, there were < 1000m², 1000m², and 1000 -2000m². The farmers planted various vegetables such as carrot, eggplant, cauliflower, broccoli, turnips, leeks, and mustard green. These vegetables are be grown in a monoculture or a mixture systems which 2-3 species in four months. This activity contributed 13.33% - 56.67% from total income of household. Table 3 showed that the arable land distributed to farmers 1000 m² was sufficient to earn additional income.

3.3. Socio economic characteristics of individual communities
The individual community's socioeconomic characteristics are the characteristics of the individual that are strictly related to various aspects of the life and environment of the individual concerned [32]. Social characteristics of the community include the level of education, the number of family members, the number of family dependents, the level of health and age [33, 34], while the economic characteristics include main occupations, side jobs, land area and income [32].

The identification of individual respondents based on gender, religion, and ethnicity of the 30 respondents interviewed consisted of 26 male respondents (86.67%) and four female respondents (13.33%). All respondents were Muslim and Javanese. Religious life is an essential thing because it concerns about inner peace and influences behavior in daily life [32].

The age of the respondents varied between 35 to 62 years (table 4). Based on age class classification [35], most respondents (83.33%) belong to productive age (over 15 years to 55 years), and 16.67% of respondents at the non-productive age level (above 55 years). Most respondents have the potential to move to the maximum, in various efforts to meet the needs of their families. Age level influences a person's ability related to physical condition, way of thinking, and workability. In general, farmers of productive age are quick to accept innovation so new recommended ideas compared to farmers of the unproductive period [36]. Therefore, the potential for productive generation needs to be properly utilized in the forest management.

Most respondents with formal education levels were classified into two categories, viz. 80% of elementary school (SD) respondents and 16.67% of respondents with junior high school (SLTP). It was indicated that respondents' formal education was still low. There are even heads of families who cannot complete elementary school (SD)Formal education level indicators indicate that human resources around the majority of forest areas are in a low category. The community's weak economic capacity is one of the reasons people do not continue their education in the high school or college. The low level of education leaves people have no choice but to work as farmers [32]. The level of education can affect one's way of thinking and plays an essential role in shaping the mindset of society in acting [36]. The low level of education affects farmers' incomes because land management based on instincts and hereditary experience without applying innovations [32]. Hamid et al. [37] argued, there is a relationship between the level of education with the community's income. If the level of education is low. The level
of community welfare will also be low.

Table 3 reveals that all respondents are local community who have been occupying the land since birth. As many 46.67% of respondents with a length of stay of 20 - 40 years and 50% of respondents over 40 years were in their community. This is definite support for the programs that will provide the implementation in forest management. Indigenous people who have lived for a long time have an attachment to their area of residence and an attachment to surrounding land resources [37].

**Table 4.** Individual characteristics of the community of the Sumbergondo Village, Bumiaji District Batu City, East Java.

| Respondent characteristics | Classifications | Number of respondents | Percent (%) |
|---------------------------|-----------------|-----------------------|-------------|
| Gender                    | Male            | 26                    | 86.67       |
|                           | Female          | 4                     | 13.33       |
| Ethnic                    | Javanese        | 30                    | 100.0       |
| Religion                  | Islam           | 30                    | 100.0       |
| Age variation of respondents | Productive age (> 15 years) | 25 | 83.33 |
| 35-62 years               | Non-productive age (> 56 years) | 5 | 16.67 |
| Formal Education          | Not graduated-graduated primary school (low) | 24 | 80.00 |
|                           | Junior High School (moderate) | 5 | 16.67 |
|                           | High School (high) | 1 | 3.33 |
| Residence status          | Origin          | 30                    | 100.0       |
|                           | Immigrant       | 0                     | 0           |
| Length of stay (years)    | ≤ 20 years (low category) | 1 | 3.33 |
|                           | 21-40 years (moderate category) | 14 | 46.67 |
|                           | > 40 years (high category) | 15 | 50.0 |
| Number of family members (person) | < 4 (low category) | 5 | 16.67 |
|                           | 4 (moderate category) | 16 | 53.33 |
|                           | > 4 (high category) | 9 | 30.0 |
| Number of dependents (person) | ≤ 2 (low category) | 5 | 16.67 |
|                           | 3 (moderate category) | 16 | 53.33 |
|                           | ≥ 4 (high category) | 9 | 30.0 |
| Main occupation (person)  | Farmer          | 24                    | 80.0        |
|                           | Labor           | 6                     | 20.0        |
| Side jobs (person)        | Others          | 0                     | 0           |
|                           | Farmer          | 6                     | 20.0        |
|                           | Labor           | 22                    | 73.33       |
|                           | Others          | 2                     | 6.67        |
|                           | Jobless         | 0                     | 0           |
|                           | Landless (low)  | 30                    | 100.0       |
| Land area (ha)            | ≤ 0.2 ha (moderate) | 0 | 0 |
|                           | > 0.2 ha (high) | 0                     | 0           |
| The area of arable land in the forest area (ha) | ≤ 0.1 ha | 20 | 66.67 |
|                           | > 0.1 - ≤ 0.2 ha | 10 | 33.33 |
|                           | > 0.3 ha        | 0                     | 0           |
| Income level from main and sidejobs (Rp1,000)/month | <Rp 1,500 (low) | 9 | 30.0 |
|                           | Rp 1,500 - ≤ 2,000 (moderate) | 12 | 40.0 |
|                           | >Rp 2,000 (high) | 9 | 30.0 |
The number of family members affected the head of the family's enthusiasm and creativity to meet the economic needs [36]. Data in Table 4 showed that the number of families of more than four people as much as nine respondents (30%), worked side job as laborers to meet four family members' living needs. If the potential power source used optimally, it could reduce the burden on the family [38].

The types of respondents' livelihoods varied, 22 respondents (73.33%) as farm laborers, as farmers 20% and others as many as 6.67%. Most respondents work as farmers describing the high level of dependence of communities around the forest on land resources.

The area of arable land is the land cultivated by respondents for production, both owned land and arable land in the forest area. All respondents do not own property, so land use in the forest area is the mainstay of the primary income source in supporting the respondent's household economy. Maryudi and Krott [39] stated that the problem faced by farmers in sustaining their livelihoods is limited agricultural land. There is a genuine relationship between the extent of land ownership with the socio-economic aspects of the community; the more extensive land ownership, and the more prosperous community [37]. Table 4 shows 20 respondents (66.67%) have arable land area in forest areas with a low category (< 0.1 ha) and ten respondents (33.33%) with an area of a medium type (> 0.1 - ≤ 0.2 ha). The majority of respondents have been working on regional land since 1996.

Family income is measured by the amount of accumulated income of all family members, after being converted into per month. Income in this study is all respondents' income, both from the main income and from side jobs. Based on the value interval equation [40], it found the respondents' income was below Rp 1,500,000 in the low category, income was Rp 1,500,000 to Rp 2,000,000 in the medium category and income above Rp 2,000,000 in the high category. The data showed that nine respondents or 30% had low-income levels, most respondents (40%) as medium category, and nine respondents (30%) as high level income. The average income of respondents was Rp 1,697,000 per month, with an interval of Rp 1,283,000 to Rp 2,133,000 (table 4). When referring to the regional minimum wage (UMR), respondents' average level of income is below the UMR of Malang City, which is Rp 2,895,000. This condition affected from agricultural products which was strongly influenced by weather factors and market factors so that the results are uncertain. The market for agricultural products is also controlled by middlemen so that most farmers do not have a high bargaining position.

Pine forest in KPH Malang has tree density of 214 individual/ha, a pole level 63 individual/ha, and a sapling rate of 35 individual/ha. This condition indicated that land use in this areas allowed intercropping plants to grow because the spacing is estimated at 5 m x 6 m. In addition, this can be seen by the presence of seedling, about 11 species of grass, taro and ferns. All of these were supported by the physical conditions of the pine forest, especially from the physical factors, such as the cool temperature (21.5°C), humidity (86%), the high rainfall (875 - 3000 mm per year), flat to hilly topography, and fertile soil conditions.

The optimal of land use in pine forest was made possible by planting intercropping understanding by the surrounding community through the PHBM program. The community gets a arable land of < 1000 m - < 2000 m which is divided into three categories, such as < 1000 m, 1000 m, and > 1000 m - < 2000 m. The land distributed to farmers in Sumbergondo Village is narrower if its compared to other areas such as in Pujonkidul Village, Pujon District, Malang Regency, covering an area of 2500 m² - 1000 m² per individu [41]. The arable land is planted with one species of vegetable such as carrot or a combination mixture of 2-3 vegetable species such as eggplant, turnips, cauliflower, carrot, broccoli, leeks and mustard greens. The time for vegetable crops is quite short, which is 4 months, which is more profitable than planting horticulture such as corn and medicinal plants such as ginger [42].

Agroforestry in pine forest provides additional income for the people of productive age with low education, livelihoods as farmers or laborers, and dependents of 2-4 people per family. Their land ownership had yards and gardens. While, as farmers or laborers in the garden plus the produce from their yards, they have an average income of Rp 1.5 million - Rp 2 million. The income is considered low and below the regional minimum wage. The activity of agroforestry system by cultivated land in the pine forest provided an additional income for the community of Rp 4.51 million - Rp 6 million, so it's hoped increased income promising prosperity.
4. Conclusion
Land use of pine forest in Management Forest Unit Malang which planted such as tree, fruit, food, medicinal, ornamental and vegetables species. Another plant species was gramineae that can be used as fodder for livestock. The results of the analysis of vegetation include 5 species of plants at the tree level, five types of pole level, and 13 species of undergrown. Besides *Pinus merkusii*, the other tree plants that dominated were *Toona sureni* and *Coffea* sp., which is a staple plant in forest vegetation.

Most of land users in the pine forest cultivated crop plant with the intercropping systems. Intercropping systems provides many benefits, including ecological, economic, and socio-cultural aspects.

The characteristics of individual respondents are relatively homogeneous; all respondents are local communities categorized into the productive age with a relatively low level of formal education, and working as farmers. The average respondent's income is below the regional minimum wage (UMR) of Malang City. Respondents' income from farming under pine stands is Rp 4,5 milion - Rp 6 milion / 1 x harvest / 4 months.

Acknowledgments
The authors would like to thank to the management of KPH Malang who have funded and facilitated the research implementation. Acknowledgments also the authors convey to the Sub-Office Head KPH Malang and RPH Junggo Perum Perhutani who have facilitated and permitted the implementation of this research activity. The authors also thank all those who have helped in the implementation of this research.

References
[1] Ardhana I P G 2016 *J. Metamorfosa* III(2) 120–129
[2] MoEF 2018 *The State of Indonesia’s Forests 2018*. Ministry of Environment and Forestry, The Republic of Indonesia, Jakarta
[3] Ningrum A D K 2006 *Bachelor Theses* IPB University
[4] Ngabdani M, Muryni C and Sudaryanto R 2015 *J. GeoEco* I(1) 58 – 66
[5] Mayrowani H and Ashari 2011 In *Forum Penelitian Agro Ekonomi* 29 (2) 83– 98
[6] Fanani Z and Suliantoro H 2010 *J. Teknik Industri* 11(2) 178–183
[7] Damiati V, Lumangkun A and Dirhamasyah M 2015 *J. Hutan Lestari* 3(1) 142–149
[8] Nurrochmat D R and Hasan M F 2012 *Ekonomi Politik Kehutanan: Mengurangi Mitos dan Fakta Pengelolaan Hutan* Jakarta 14INDEF
[9] Junaedi E and Maryani R 2013 *J. Penelitian Sosial Ekonomi Kehutanan* 10(2) 122–139
[10] Rahadi B 2012 *J. Industri Teknologi Pertanian Beranda* 6 (2)
[11] Pusat Penelitian Tanah dan Agroklimat 1996 *Badan Penelitian dan Pengembangan Pertanian, Departemen Pertanian*
[12] Soerianegara M I and Indrawan 2002 *Ekologi Hutan Indonesia* Jurusan Manajemen Hutan IPB Bogor
[13] Sadeli A 2015 *Berita Biologi* 14(3) 241–248
[14] Adalina Y, Nurrochmat D R, Darusman D and Sundawati I 2014 *J. Manajemen Hutan Tropika* XX (2) 103–111
[15] Yoom L I and Suryanto A 2018 *J. Produksi Tanaman* 6(9) 2157–2165
[16] Triwanto J 2011 *Humanity* 7(1) 23–27
[17] Putri S M, Indriyanto and Riniarti M 2019 *J. Silva Tropika* 3(1) 118 –131
[18] Arrijani, Setiadi D, Guhardja E and Qayim I 2006 *J. Biodiversitas* 7(2) 147–153
[19] Gunawan W, Basuni S, Indrawan A, Prasetyo L B and Soedjito H 2013 *JPSL* 1(2) 93–10
[20] Destaranti D, Sulistyni and Yani E 2017 *Scripta Biologica* 4(3) 155–160.
[21] Rahmawati A, Wibowo D N and Yani E 2019 J. Ilmiah Biologi Unsoed 1(2) 134–149
[22] Sekarini D A 2010 Skripsi Fakultas Kehutanan. Institut Pertanian Bogor
[23] Djufri 2003 J. Biodiversitas 4(1) 30-34
[24] Hilwan I, Mulyana D and Pananjung W G 2013 J. Silvikultur Tropika 4(1) 6–10
[25] Hilwan I and Masyrafina I 2015 J. Silvikultur Tropika 6(2) 119–125
[26] Adhitya F, Rusdiana O and Saleh M D 2016 J. Silvikultur Tropika 8(1) 9–19
[27] Nirwani Z 2011 Tesis Medan Universitas Sumatera Utara
[28] Dahlan M M 2011 Skripsi Bogor Fakultas Kehutanan IPB
[29] Indriyanto 2006 Ekologi Hutan Jakarta PT Bumi Aksara
[30] Perhutani 2013 Pengelolaan Hutan Bersama Masyarakat (PHBM), (Online), (http://perumperhutani.com/csr/phbm/)
[31] Waluyani D and Corryanti 2015 Cetakan pertama Puslitbang Perum Perhutani Cepu Jawa Tengah
[32] Adalina Y, Nurrochmat D R, Darusman D and Sundawati I 2015 J. Rehabilitasi Hutan dan Konservasi Alam 12(2) 105–118
[33] Masri 2010 Tesis Program Pascasarjana Universitas Dipenogoro Semarang
[34] Watung N, Dien C and Kotambunan O 2013 J. AKULTURASI 1(2) 9–12
[35] Mantra I B 2000 Demografi umum Pustaka Pelajar Yogyakarta pp 396
[36] Kadir A, Awang S A, Purwanto R H and Poedjirahajoe E 2012 J. Manusia dan Lingkungan 19(1) 1–11
[37] Hamid R, Zulkarnaini and Saam Z 2011 J. Ilmu Lingkungan 5(2) 130–148
[38] Pujowati P, Arifin A S and Mugnisjah W Q 2010 J. Agro Ekonomi Kehutanan EPP 7(1) 8–13
[39] Maryudi A and Krott M 2012 J. of Sustainable Development 5(7) 62–68
[40] Supranto J 2000 Statistik, teori dan aplikasi Tulus S dan Ali S, Edidor, Edisi 6 Cetakan pertama Erlangga Jakarta pp 384
[41] Yoo L I and Suryanto 2018 J. Produksi Tanaman 6(9) 2157–2165
[42] Triwanto J and Muttaqiqin T 2018 SYLVA VII(2) 40 – 48