The views of forestry employees on the cultivation of food crops in forest areas: a case study in Central Java

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Abstract. The environment and forestry sectors are expected to contribute to achieving food sovereignty. However, the cultivation of food crops in forest areas for commercial purposes is still limited since incommodity nomenclature, the food crops are only as crops. The objective of this study was to find out the views of forestry employees in Central Java on the cultivation of food crops in forest areas. Data was collected through a survey and analyzed through a descriptive quantitative method. The results showed the views of forestry employees were as follows. First, food crops need to be cultivated in forest areas on a large scale to increase forest benefits for communities and companies. Food crops such as paddy and maize were cultivated using an intercropping system during forest regeneration, shade-resistant food crops such as coffee and porang were cultivated under forest stands and fruit crops such as durian and mangosteen were cultivated in a mixture with woody trees. Second, foods obtained from the forests were recorded in statistics of environment and forestry and accounted for as contributions of environment and forestry sector. Therefore, the forests need to be managed for wood and food production to support food sovereignty.

1. Introduction
The environment and forestry sectors are expected to contribute to the provision of food to support food sovereignty[1,2]. This can be realized by managing forests for wood and food and is made possible by environmental and forestry policies that support the utilization of forests as food providers[3,4]. Food crops can be cultivated in areas: industrial plantation forests, people's plantation forests, village forests, community forests, and non-wood plantation forests [5–8].

In the Regulation of the Minister of Environment and Forestry Number P.62/2019 concerning The Development of Industrial Plantation Forests, forest plants are grouped into three groups, namely: (a) woody forest plants producing wood, energy, or food, (b) annual woody cultivation plants producing wood, energy, or food and (c) other plants producing food or energy. Food crops in the form of trees, such as durian and mangosteen can be cultivated with monoculture, mixed, and agroforestry patterns, while food crops other than trees, such as coffee and tubers can only be cultivated with agroforestry patterns.

Currently, various types of food crops have been cultivated in forest areas, among others: rice, corn, cassava, sago, soybeans, porang and peanuts, jackfruit, mango, avocado, mangosteen, melinjo, petai, jengkol, and coffee[9–13]. However, the contribution of the environment and forestry sectors in
supporting food sovereignty has not been measured because food obtained from forests is not recorded in environmental and forestry statistics\textsuperscript{[14,15]}. The cultivation of food crops in forests for commercial purposes is still influenced by conventions and commodity nomenclatures that place food crops only as crops \textsuperscript{[16\textendash}18].

This research is conducted to know the views of forestry employees on the extent to which the conventions needed to be followed or the extent to which policies that encourage forest utilization for food production need to be implemented on a wide scale to support food sovereignty. The objective of this research is to find out the views of forestry employees in Central Java (The Central Java Regional Division of PerumPerhutani, The Forest District of Pati, The Forest District of East Pekalongan, and the Forest Service of Central Java Province) on the cultivation of food crops in forest areas.

2. Research methods

2.1. The location and time of research
The research was conducted in several places in Central Java, namely: (1) Perum Perhutani Central Java Regional Division, (2) The Forest District of East Pekalongan, (3) The Forest District of Pati, and (4) The Forest Service of Central Java Province in July 2018.

2.2. Respondents
Ideally, the research respondents represent all forest stakeholder groups in Central Java. Given the limited funding and research time, the group of stakeholders who become respondents are limited to forestry employees of the PerumPerhutani Central Java Regional Division, The Forest District of East Pekalongan, The Forest District of Pati, and The Forest Service of Central Java Province. Respondents are chosen deliberately. Forestry employees with minimum high school education and willing to fill out a list of questions are designated as respondents. The number of respondents chosen is 100 people.

2.3. Data collection
The data collected are primary data and secondary data. Primary data was collected from March 2018 until August 2018 through observations and interviews with forestry employees, using a prepared list of questions. The primary data collected are investigating the views of forestry employees on the cultivation of 4 (four) categories of food crops (intercropping plants, tubers, coffee, and fruits) in forest areas, related to (a) the cultivation of large-scale food crops, (b) the benefits of cultivating food crops and (c) grouping, recording, and sectors that contribute to food obtained from forest areas. Meanwhile, secondary data was collected through the recording at the Forestry offices in July 2018.

2.4. Data analysis
The views of forestry employees on the cultivation of food crops in forest areas are shown by respondents' answers to 4 groups of questions related to (a) intercropping plants, (b) tubers, (c) coffee, and (d) fruits. Each group of questions consists of several questions that each have several alternative answers. In general, the available alternative answers can be sorted into 3 groups, namely alternative answers that: (a) support the cultivation of food crops, (b) do not support the cultivation of food crops, and (c) neutral\textsuperscript{[19]}. The views of forestry employees on the cultivation of food crops are analyzed quantitatively and descriptively by calculating the percentage of each alternative answer given by respondents to all questions \textsuperscript{[20]}. Alternative answers with the highest percentage indicate the views of forestry employees in supporting or not supporting the cultivation of food crops in forest areas. The more alternative answer “(a)”, the higher the support of forestry employees to the cultivation of food crops in forest areas. On the contrary, the more alternative answer “(b)”, the lower the support of forestry employees to the cultivation of food crops in forest areas.
3. Results and discussion

3.1. The forest area of Perum Perhutani Central Java Regional Division

The area of forest managed by PerumPerhutani Central Java Regional Division (RD of Central Java) is 635,746 ha, consisting of a production forest of 550,963 ha and a protected forest of 84,463 ha[21]. As a state-owned enterprise mandated to manage state forests in Java, PerumPerhutani is required to pay great attention to the people living in and around the forest. Therefore, forest management in Central Java is carried out in conjunction with the community or forests managed with a system of Community Based Forest Management (CBFM)

According to the employees of PerumPerhutani and the Provincial Forest Service, all Forest District in Central Java produce food commodities. For example (a) Forest District of Semarang produces nests of swallows, cassava, and corn, (b) Forest District of East Pekalongan produces rice, corn, coffee, and durian, and (c) Forest District of Pati produces coffee, cassava, porang, ginger, and turmeric.

3.2. The views of forestry employees on the cultivation of food crops in forest areas

Food crops cultivated in forest areas can be sorted into 4 (four) groups, namely: (a) intercropping plants, which are cultivated at the time of forest development, (b) shade-resistant tubers, which are cultivated under forest stands, (c) coffee and shade-resistant shrubs, which are cultivated under forest stands and (d) fruit crops, which are cultivated in monoculture or mixed forest areas. The following description discusses the views of forestry employees on the cultivation of 4 (four) types of food crops.

3.2.1. Intercropping plants during forest regeneration. Intercropping forest regeneration system has been carried out since the beginning of the development of teak forests in Java. In this system, woody plants are planted by farmers, who work without wages but get the opportunity to cultivate food crops among the woody plants. Food crops such as rice, corn, and beans are cultivated during the first two years while maintaining the woody plants. After that, the forest is managed entirely for wood production. In the development, the intercropping forest regeneration system is modified, which is done by widening the planting distance of wood plants to become 3 m X 3 m, extending the intercropping time to become 3 years, and cultivating food crops more intensively, namely using superior seeds, fertilizers, and medicines [22,23].

The results of the survey show that the views of the forestry employees on intercropping are as follows (Table 1). First, to increase food production from forest areas, most respondents do not agree the planting distance is widened but they agree that intercropping crops are cultivated for more than three years. This indicates that the planting distance of woody plants 3 m X 3 m does not need to be widened. Food production from intercropping activities can be increased by cultivating shade-resistant food crops in the 4th year and the following years. In addition to rice, corn, and beans, the crops that are mostly proposed by respondents to be cultivated by intercropping are ginger, turmeric, porang, pineapple, and papaya.

Second, most respondents view that intercropping results should be grouped as agricultural products derived from forests, recorded in environmental and forestry statistics (LHK statistics), and calculated as contributions to the environment and forestry sector (LHK sector). So far, intercropping crop yields are not recorded in LHK statistics [23–25].

| No. | Description | The views of forestry employees | A (n=20) | B (n=29) | C (n=24) | D (n=28) | Total |
|-----|-------------|--------------------------------|---------|---------|---------|---------|-------|
|     |            | (%)                            | (%)     | (%)     | (%)     | (%)     | (%)    |
| 1   | Agree/disagree spacing of woody plant widened | | | | | | |
|     | - Agree    | 68                             | 28      | 25      | 29      | 35      |
|     | - Disagree | 26                             | 72      | 75      | 71      | 64      |

Table 1. The views of forestry employees on intercropping in the tangy system.
### 3.2.2. Cultivation of tubers under forest stands

Plant tubers such as canna (ganyong), purse (kimpul), porang, arrowroot (garut), suweg, gembili, curcuma, ginger, and turmeric have long been cultivated under forest stands, generally in a limited area [15]. The tubers are shade resistant so that they are appropriately cultivated in the forest.

The results of the survey show that most respondents are aware of the cultivation of tubers under the forest stands. Their views of the cultivation of tubers under the forest stands are as follows. First, most respondents agree that tubers are cultivated under forest stands to increase the benefits of forests for communities and companies (Table 2). Second, tubers that are harvested from forests are grouped by most respondents as agricultural products derived from forests, recorded in LHK statistics, and calculated as contributions to the LHK sector.

#### Table 2. The views of forestry employees on the cultivation of tubers under forest stands.

| No. | Description                                                                 | A (n=20) (%) | B (n=29) (%) | C (n=24) (%) | D (n=28) (%) | Total (%) |
|-----|------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|-----------|
| 1   | Knowing/not knowing cultivation of tubers under forest stands               | 95           | 83           | 88           | 96           | 90        |
|     | - Knowing                                                                    | 5            | 17           | 12           | 4            | 10        |
| 2   | Cultivation of tubers under forest stands reduce/increase the benefit of the forest as a producer of goods and services | 0            | 0            | 4            | 7            | 3         |
|     | - Decrease                                                                   | 100          | 93           | 79           | 93           | 88        |
|     | - Increase                                                                   | 0            | 7            | 8            | 0            | 8         |
|     | - Do not increase/decrease                                                  | 0            | 0            | 4            | 0            | 1         |
| 3   | Agree/disagree tubers cultivated under forest stands                        | 100          | 100          | 92           | 89           | 95        |
|     | - Agree                                                                      | 0            | 0            | 8            | 11           | 5         |
|     | - Disagree                                                                   | 0            | 0            | 0            | 0            | 0         |
|     | - Do not know                                                                |              |              |              |              |           |
### Table 3. The views of forestry employees on the cultivation of coffee under forest stands

| No. | Description                                                                 | A (n=20) (%) | B (n=29) (%) | C (n=24) (%) | D (n=28) (%) | Total (%) |
|-----|------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|-----------|
| 1.  | Knowing/not knowing cultivation of coffee under forest stands                |              |              |              |              |           |
|     | Knowing                                                                      | 84           | 97           | 100          | 96           | 95        |
|     | Do not know                                                                  | 16           | 3            | 0            | 4            | 5         |
| 2.  | Cultivation of coffee under forest stands reduce/increase the benefit of the forest as a producer of goods and services |              |              |              |              |           |
|     | Decrease                                                                     | 11           | 0            | 0            | 4            | 3         |
|     | Increase                                                                     | 89           | 97           | 100          | 96           | 96        |

Remarks: n=number of respondents, A=Central Java Provincial Forestry Office, B=PerumPerhutani Central Java Regional Division, C=Forest District of Pati, D=Forest District of East Pekalongan

3.2.3. **Cultivation of coffee under forest stands.** In forest areas managed by PerumPerhutani, coffee has been cultivated in all regional divisions, namely: West Java and Banten, Central Java, and East Java. In Central Java, coffee is cultivated under the establishment of forests in 7 (seven) Forest Districts, namely: Balapulang, West Pekalongan, East Pekalongan, WestBanyumas, North Kedu, and SouthKedu.

The results of the survey show that most respondents are aware of coffee cultivation under the establishment of forests managed by Perum Perhutani. Their views of coffee cultivation under the establishment of the forest areas follow. First, most respondents agree that coffee is cultivated under forest stands to increase the benefits of forests for communities and companies (Table 3). Second, coffee harvested from forests is grouped by most respondents as agricultural products, recorded in LHK statistics, and calculated as the contribution of the LHK sector. Furthermore, most respondents agree that coffee is cultivated under forest stands on a wide scale.
3. The views of forestry employees

| No. | Description | A (n=20) | B (n=29) | C (n=24) | D (n=28) | Total |
|-----|-------------|----------|----------|----------|----------|-------|
| - Do not increase/decrease | - | 0 | 3 | 0 | 0 | 1 |
| - Do not know | - | 0 | 0 | 0 | 0 | 0 |
| 3. Agree/disagree coffee cultivated under forest stands | - Agree | 68 | 97 | 92 | 93 | 89 |
| - Disagree | - | 26 | 3 | 8 | 7 | 10 |
| - Do not know | - | 5 | 0 | 0 | 0 | 1 |

4. Beneficiaries of the cultivation of coffee under forest stands

| - Community | - | 0 | 0 | 0 | 0 | 0 |
| - Company | - | 0 | 10 | 4 | 14 | 8 |
| - Community and company | - | 74 | 90 | 88 | 79 | 83 |
| - Do not know | - | 26 | 0 | 8 | 7 | 9 |

5. Grouping of coffee derived from forest

| - Agricultural product | - | 63 | 83 | 63 | 50 | 65 |
| - Forest product | - | 26 | 7 | 17 | 43 | 23 |
| - Agricultural product from forest | - | 11 | 10 | 21 | 7 | 12 |
| - Do not know | - | 0 | 0 | 8 | 7 | 9 |

6. The sector that contributes to the coffee obtained from forest

| - Agricultural sector | - | 0 | 7 | 13 | 11 | 8 |
| - Environment and forestry sector | - | 100 | 93 | 71 | 89 | 88 |
| - Do not know | - | 0 | 0 | 16 | 0 | 4 |

7. The statistic that notes coffee obtained from forest

| - Agricultural statistic | - | 0 | 17 | 12 | 14 | 12 |
| - Environment and forestry statistic | - | 100 | 83 | 67 | 86 | 83 |
| - Do not know | - | 0 | 0 | 21 | 0 | 5 |

8. Agree/disagree cultivation of coffee on a large scale

| - Agree | - | 63 | 86 | 50 | 71 | 69 |
| - Disagree | - | 32 | 14 | 46 | 29 | 29 |
| - Do not know | - | 5 | 0 | 4 | 0 | 2 |

Remarks: n=number of respondents, A=Central Java Provincial Forestry Office, B=PerumPerhutani Central Java Regional Division, C=Forest District of Pati, D=Forest District of East Pekalongan

### 3.2.4. Cultivation of fruit trees in forest areas

Fruit trees have long been cultivated in forest areas managed by PerumPerhutani, generally as filler plants or intermittent plants. The number and type of fruit trees planted in the production forest area differ from one Forest District to another. In the Forest District of Banten, fruit trees that are widely planted are melinjo, durian, petai, and jengkol; in Forest District of Jember, fruit trees that are widely planted are durian, mangosteen, guava, and rambutan; while in the Forest District of Kediri, there is a durian forest covering an area of 650 ha. In addition to durian, plants in durian forest include mangosteen, cloves, palm, coconut, and sengon.

The results of the survey show that most respondents are aware of the cultivation of fruit trees in forest areas managed by PerumPerhutani. Their views on the cultivation of fruit trees in forest areas are as follows (Table 4). First, most respondents agree that fruit trees are cultivated in forest areas to increase the benefits of forests for communities and companies. Second, fruits harvested from forests are grouped as agricultural products, recorded in LHK statistics, and calculated as contributions to the LHK sector. Furthermore, fruit trees need to be cultivated in forest areas on a wide scale.
Table 4. The views of forestry employees on the cultivation of fruit trees in the forest

| No. | Description                                                                 | A (n=20) (%) | B (n=29) (%) | C (n=24) (%) | D (n=28) (%) | Total (%) |
|-----|------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|-----------|
| 1.  | Knowing/not knowing cultivation of fruit trees in the forest                 |              |              |              |              |           |
|     | - Knowing                                                                     | 63           | 72           | 50           | 82           | 68        |
|     | - Do not know                                                                 | 37           | 28           | 50           | 18           | 32        |
| 2.  | Cultivation of fruit trees in the forest reduce/increase the benefit of the forest as a producer of goods and services |              |              |              |              |           |
|     | - Decrease                                                                    | 5            | 0            | 4            | 11           | 5         |
|     | - Increase                                                                    | 95           | 94           | 96           | 89           | 93        |
|     | - Do not increase/decrease                                                   | 0            | 3            | 0            | 0            | 1         |
|     | - Do not know                                                                 | 0            | 3            | 0            | 0            | 1         |
| 3.  | Agree/disagree fruit trees cultivated in the forest                          |              |              |              |              |           |
|     | - Agree                                                                       | 84           | 90           | 79           | 96           | 84        |
|     | - Disagree                                                                    | 11           | 10           | 21           | 4            | 15        |
|     | - Do not know                                                                 | 5            | 0            | 0            | 0            | 1         |
| 4.  | Beneficiaries of the cultivation of fruit trees in the forest                 |              |              |              |              |           |
|     | - Community                                                                   | 16           | 0            | 17           | 0            | 7         |
|     | - Company                                                                     | 0            | 0            | 0            | 11           | 3         |
|     | - Community and company                                                       | 68           | 90           | 58           | 82           | 76        |
|     | - Do not know                                                                 | 16           | 10           | 25           | 7            | 14        |
| 5.  | Grouping of fruits derived from forest                                        |              |              |              |              |           |
|     | - Agricultural product                                                        | 63           | 72           | 67           | 61           | 65        |
|     | - Forest product                                                              | 26           | 3            | 21           | 36           | 21        |
|     | - Agricultural product from forest                                            | 11           | 24           | 8            | 4            | 12        |
|     | - Do not know                                                                 | 0            | 0            | 8            | 0            | 2         |
| 6.  | The sector that contributes to the fruits obtained from forest                |              |              |              |              |           |
|     | - Agricultural sector                                                         | 0            | 28           | 4            | 4            | 10        |
|     | - Environment and forestry sector                                             | 100          | 72           | 79           | 96           | 87        |
|     | - Do not know                                                                 | 0            | 0            | 12           | 0            | 3         |
| 7.  | The statistic that notes fruits obtained from forest                          |              |              |              |              |           |
|     | - Agricultural statistic                                                      | 0            | 28           | 17           | 14           | 16        |
|     | - Environment and forestry statistic                                          | 100          | 72           | 63           | 86           | 79        |
|     | - Do not know                                                                 | 0            | 0            | 21           | 0            | 5         |
| 8.  | Agree/disagree cultivation of fruit trees on a large scale                    |              |              |              |              |           |
|     | - Agree                                                                       | 63           | 66           | 25           | 75           | 58        |
|     | - Disagree                                                                    | 37           | 34           | 75           | 25           | 42        |
|     | - Do not know                                                                 | 0            | 0            | 0            | 0             | 0         |

Remarks: n=number of respondents, A=Central Java Provincial Forestry Office, B=PerumPerhutani Central Java Regional Division, C=Forest District of Pati, D=Forest District of East Pekalongan.

4. Conclusion and recommendation

4.1. Conclusions
The views of forestry employees on the cultivation of food crops in forest areas are as follows. First, food crops need to cultivate in forest areas on a large scale to increase the benefits of forests for communities and companies. Food crops such as paddy and maize are cultivated using an intercropping system during forest regeneration, shade-resistant food crops such as coffee; and canna are cultivated under forest stands, and fruit crops such as durian and mangosteen are cultivated in a mixture with woody plants. Second, foods obtained from the forests are recorded in statistics of environment and forestry and accounted for as contributions of the environment and forestry sector.
4.2. Recommendations
Overall the survey results show that forestry employees in Central Java, i.e. the employees who work in the office of PerumPerhutani Central Java Regional Division, Forest District of EastPekalongan, Forest District of Pati, and ForestService of Provincial Central Java support forest management for wood and food production. Food crops in the form of trees are cultivated in a mixture of woody plants, while food crops other than trees are cultivated under forest stands.

The views of forestry employees in Central Java are in line with the policies that place food crops as part of forest crops and that support the utilization of forest areas for food production (Peraturan Menteri Lingkungan Hidup dan Kehutanan P.81/2016; P.62/2019). Therefore, PerumPerhutani Central Java Regional Division should not hesitate to cultivate food crops in forest areas and record the results in company statistics. Furthermore, food production from forest areas is reported to the Ministry of Environment and Forestry to be recorded in LHK statistics and calculated as the contribution of the LHK sector in supporting food sovereignty.

Therefore, Perum Perhutani Central Java Regional Division needs to encourage the Forest Districts in Central Java to manage forests for wood and food to increase the benefits of forests for the community and the company as well as to increase the contribution of the environment and forestry sector in supporting food sovereignty.

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