Dynamic of migration and labor productivity in the rural area of PATANAS villages

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Abstract. The agricultural sector still becomes a source of household income in rural areas, although its role tends to decrease. In the period 2011–2015, the number of agricultural workers decreased about 1% per year and is inversely proportional to the increasing Indonesian labor, which reached an average of 1.2% per year. Several leading causes of labor decreases are migration and productivity issues in the agricultural sector. This paper aims to determine migration and labor productivity dynamics in three-time points in villages on Panel Petani Nasional Program (PATANAS) located at three agroecosystems: plantation, secondary crop, and vegetable. Amount of respondents in each agroecosystem were 312, 232, and 121 farmers. Data analysis was presented descriptively. The results of the study indicated that labor productivity varies between agroecosystems. The highest increase in productivity occurred in vegetable, then secondary crop, and plantation. Labor productivity in the agricultural sector is inversely proportional to the migration on an agroecosystem. There is not excessive migration in the vegetable agroecosystems since labor productivity is highest than the others. There is a phenomenon of increasing working family members followed by an increase in the number of migrations. This phenomenon negatively impacts the agricultural sector because there is no increase in the number of workers in the agricultural sector. There is a trend for young people in PATANAS villages to undertake permanent migration. Increasing labor productivity in rural areas predicted could reduce labor migration. Efforts that can be created are gradually encouraging off-farm and non-farm activities, including small-scale agro-industries.

1. Introduction

Indonesia's population growth rate from 2015 to 2020 is 1.07% per year. In 2015, it was estimated that Indonesia's population is 255 million, and in 2020 it is 269 million. The labor force participation rate in Indonesia during the period 2015 to 2020 is still at 69%. The jobs that absorb the most labor are the agriculture, forestry, and fisheries sectors. In 2020, as many as 38.9 million or 29% of Indonesia's population worked in the agricultural sector. This figure tends to decrease by 1% every year starting in 2018. Other sectors that absorb many workers are the trade sector as much as 19% and the manufacturing sector as much as 14%. Employment of the two sectors tends to stagnate every year or even increase.

Kuznets' classic theory [1] reveals that the agricultural sector has a vital role in national economic growth for developing countries. The decrease in employment in the farm sector and the increase in labor absorption in the non-agricultural sector are influenced by age, income, and education. At the same time, land ownership does not affect labor migration [2].

There were five groups of factors that influence the decision to switch jobs from the agricultural sector to non-agriculture, namely, (1) individual characteristics (age, education, experience, gender,
marital status, and ethnicity); (2) family characteristics (number of children, age of children, and family size); (3) agricultural business characteristics (land tenure size, farm size, farming system, productivity); (4) financial characteristics (nonwork income, agricultural subsidies, social benefits, and variable income); and (5) the characteristics of the location and the labor market (rate of employment, access to work, population density, urbanization, and regional location) [3].

The difference in labor productivity in the sector is due to differences in the working hours of each sector [4]. Labor productivity in the agricultural sector is obtained by dividing the GDP of the agricultural sector by the number of workers in the agricultural sector. The results of the 2013 Agricultural Census obtained information that labor productivity in the agricultural sector was the lowest at only IDR 34.44 million/person/year [5]. On a micro basis (at the household level), agricultural labor productivity is the ratio of agricultural income to the number of workers working in agriculture.

This paper aims to determine the relationship between migration and labor productivity in the agricultural sector in the National Farmers Panel (PATANAS) villages covering three agroecosystems: dryland for plantations, dryland for secondary crops, and dryland for vegetables.

2. Materials and methods

2.1. Materials
This study utilized the secondary data from the National Farmers Panel (PATANAS). For plantation dryland, data are obtained from survey panels in 2009, 2012, and 2018. Data for dryland secondary crops generated from survey panels in 2008, 2011, and 2017. At the same time, vegetable dryland data is obtained from survey panels 2018, 2011, and 2017. The variables that are the focus of the research are migration (commutation, circulation, and permanent) and labor productivity. Agricultural labor productivity is the division between farm income received by households and the number of workers working in the agricultural sector.

2.2. Methods
The PATANAS data was processed in a descriptive panel based on the survey year and agroecosystem. The descriptive statistics used are the average. Pearson correlation analysis is used to determine the relationship between variables. Two variables are said to be correlated if a change in one variable is accompanied by a change in the other variable, either in the same direction or in the opposite direction. Furthermore, to determine the dynamics of the panel data, it will be analyzed using Biplot. Biplot is a graphical demonstration of the predictor variable data matrix in a plot by superimposing vectors in a low-dimensional space [6]. This analysis is used to position and perceptual map a set of objects (rows of the predictor variable data matrix).

3. Results and discussion

3.1. Migration dynamic of PATANAS village
The PATANAS survey on dryland for estate crop in 2018 was a resurvey from 2012 and 2009. While the PATANAS survey on dryland for secondary crops and vegetables in 2017 was a resurvey of 2011 and 2008. Based on the time dimension, migration is divided into three categories. First, migration is carried out by commuting from home to work (commutation); second, migration carried out by staying less than six months is called circulation; third, permanent migration, i.e., staying at the migration site for more than six months.

Based on Table 1, it is shown that permanent migration is most commonly found in dryland agroecosystems of estate crop. The sample villages of PATANAS in dryland-estate crop have eight locations for four basic commodities. Kebonan and Rejosari Villages are samples of sugarcane commodity; Bakti and Pakeng Villages are samples of cacao commodity; Hibun and Matra Manunggal Villages for oil palm commodity. Meanwhile, Penerokan and Semoncol Villages are samples of rubber commodity.
Table 1. Percentage of household members who migrated in the PATANAS villages.

| Agroecosystem          | Migration type | Period |   |   |   |
|------------------------|----------------|--------|---|---|---|
|                        |                | I      | II | III|
| Dryland-estate crop\(^1\) | No migration  | 73.57  | 58.97 | 57.32 |
|                        | Commutation    | 11.78  | 20.19 | 22.61 |
|                        | Circulation    | 7.64   | 9.62  | 9.55 |
|                        | Permanent      | 13.06  | 17.63 | 15.29 |
| Dryland-secondary crop\(^2\) | No migration | 58.26  | 66.23 | 64.32 |
|                        | Commutation    | 12.81  | 15.58 | 13.28 |
|                        | Circulation    | 22.73  | 12.99 | 18.67 |
|                        | Permanent      | 9.92   | 8.23  | 5.81 |
| Dryland-vegetable \(^3\) | No migration  | 84.30  | 77.50 | 70.25 |
|                        | Commutation    | 9.09   | 11.67 | 23.97 |
|                        | Circulation    | 4.96   | 8.33  | 5.79 |
|                        | Permanent      | 4.13   | 5.83  | 3.31 |

Note: the percentage can be more than 100% because it is possible that 1 HH has two types of migration

\(^1\) Dryland-estate crop villages => Year I: 2009; Year II: 2012; Year III: 2018
\(^2\) Dryland-secondary crop villages => Year I: 2008; Year II: 2011; Year III: 2017
\(^3\) Dryland-vegetable crop villages => Year I: 2008; Year II: 2011; Year III: 2017

One factor of the high migration rate in rural areas based on plantation commodities is the low planting intensity, which ultimately leads to low-income levels. In addition, there is a strong pull, such as income outside the agricultural sector which is higher than income earned inside the village. The driving factors of aggregate migration in plantation-based dryland agroecosystem villages include limited employment opportunities in the village, lack of land/ narrow land, skills/higher education, low season for agricultural activities, and working in agriculture is considered unprestigious especially by the younger generation [7].

Based on the last education completed, the community in the dryland-estate crop has the highest education compared to other agroecosystems. The average of last education in the dryland-estate crop was 7.38 years (junior high school, grade 1), the dryland-vegetable was 7.04 years, and the dryland-secondary crops was 6.46 (graduated from elementary school). Descriptively, the higher the education completed by the population in a location, the greater the tendency for permanent migration. A person's level of education determines the frequency of displacement. This happens because the higher the level of education a person has, the wider his insight into employment opportunities in other areas. In addition, the calculation to read job opportunities is getting more mature, so that his standard of living can be improved for the better. The higher the level of education, the more potential a person makes a migration [8].

The high rate of permanent migration in dryland agroecosystems is inseparable from the working hours in the family in carrying out agricultural activities on the land. The result of Pearson correlation analysis show that there is a negative correlation of -0.2126 between the daily working people in the household and permanent migration in dryland gardens. It means that if the daily average of working people in the household is greater, so fewer people tend to migrate. On dryland-estate crop estate, the household's lowest daily average is Kebonan and Rejosari Villages (sugarcane commodity). The household's highest daily average of working people is Semoncol and Penerokan Villages (rubber commodity).

In the dryland for secondary crop villages, apart from working on owned and leased land, farmers also work on Perhutani land for areas adjacent to Perhutani. Circular migration is commonly found in the dryland agroecosystem of secondary crops. The sample villages of PATANAS dryland for the secondary crop are Bumiayu and Resongo Villages for corn commodity, Caturkarya Village for cassava, Sindang Mekar Village for soybean, Mekarsari and Ngelo Villages for peanut commodity. In addition
to farming on dryland, these residents also work a lot as construction workers and traders who do not commute every day.

For farmers, vegetable farming is the most potential source of income. The sample villages of PATANAS dryland for vegetable crops, includes Karang Tengah, Marga Mulya, Bendosari, and Baroko. Mostly farmers cultivate vegetables such as chilies, tomatoes, and onions. Nevertheless, occasionally replace with other vegetables. Chili farming is very profitable for farmers if the price is stable, but chili prices fluctuate considerably. If the price of chili is regular, farmers can get a net profit of between IDR 38,000,000–73,000,000/ha in one growing season. The average R/C ratio of chili farming is around 3. With relatively large profits compared to other agroecosystems, vegetable farmers tend not to do permanent migration. The most common migration found in vegetable dryland agroecosystems is circulation migration. Apart from being dryland vegetable farmers, some residents also work as sellers or collectors of harvested produce to be sold outside the region. However, this work is done on a round-trip system in a short time. Migrants migrate to work to earn money, in general, and then they spend it in their area of origin to improve the welfare of their families in the area [9].

Table 2. Permanent migration by status in the household.

| Agroecosystem                  | Period | Head of HH | Spouse/wife | Children | Others |
|--------------------------------|--------|------------|-------------|----------|--------|
| Dryland-estate crop1)          | I      | 3%         | 2%          | 7%       | 2%     |
|                                | II     | 4%         | 2%          | 7%       | 5%     |
|                                | III    | 2%         | 2%          | 7%       | 2%     |
| Dryland-secondary crop2)       | I      | 1%         | 0%          | 5%       | 1%     |
|                                | II     | 3%         | 0%          | 5%       | 1%     |
|                                | III    | 0%         | 0%          | 4%       | 1%     |
| Dryland-vegetables3)           | I      | 1%         | 0%          | 2%       | 0%     |
|                                | II     | 1%         | 0%          | 3%       | 0%     |
|                                | III    | 0%         | 0%          | 2%       | 0%     |

Note: 1) Dryland-estate crop villages => Year I: 2009; Year II: 2012; Year III: 2018
2) Dryland-secondary crop villages => Year I: 2008; Year II: 2011; Year III: 2017
3) Dryland-vegetable crop villages => Year I: 2008; Year II: 2011; Year III: 2017

The phenomenon of permanent migration is mainly done by the young people of the heads of farmer families, especially in estate crop dryland, as shown in Table 2. The main destination of permanent migration is out of town, especially to Jakarta and big cities in each farmer's province. The factors driving labor migration as follows: (a) low and unsustainable wages, (b) small land ownership, (c) limited employment/business opportunities in the village, (d) low season for agricultural activities in the village, and (e) agriculture activities is considered by young workers as dirty and less prestigious. Meanwhile, the pull factors for labor migration are (a) higher wages at the destination, (b) more secure income stability, (c) having acquaintances or family at the destination, (d) more available socioeconomic facilities, and (e) improve the social status of the family. Thus, economics are the dominant factors causing migration [10].

Migration is proven to positively impact increasing household income and economic development in rural areas [11]. The amount of remittances significantly influences total household income. Meanwhile, the income of a migrant household is significantly affected by the number of migrating household members and the education of migrants [11].

3.2. Productivity of worker
In the 1984 Oslo conference doctrine, productivity is a universal concept that aims to provide more people by using fewer natural resources [12]. The results of the 2013 Agricultural Census stated that labor productivity in the agricultural sector in Indonesia was the lowest compared to other sectors. Poverty is inversely proportional to labor productivity [13]. The reduction in poverty in Indonesia during 2011–2015 was accompanied by an increase in labor productivity in the agricultural sector [14].
Table 3 shows that agricultural labor productivity increases in estate crop dryland, secondary crops, and vegetables every period. The increase in agricultural labor productivity was accompanied by an increase in labor productivity in the non-agricultural sector. In nominal terms, on dryland plantation crops and dryland secondary crops, non-agricultural labor productivity tends to be higher than agricultural labor productivity. Side jobs as traders and non-agricultural workers are often found in these two agroecosystems. In addition, the low working hours for farming is a reason to work in the non-agricultural sector. This phenomenon does not occur to dryland vegetable farmers. In one year on dryland, vegetables can be planted and harvested between two to three times. Caring for vegetable crops requires more time, energy, and costs than estate crops and secondary crops.

Table 3. Labor productivity in the agricultural and non-agricultural sectors at the PATANAS villages.

| Agroecosystem            | Periode (IDR 000) |   |   |
|--------------------------|------------------|---|---|
|                          | Average | Average | Average |
| Dryland-estate crop¹)    |         |         |         |
| Productivity of agric. worker | 7,940  | 13,086  | 16,909  |
| Productivity of          |         |         |         |
| worker                   | 10,213  | 16,714  | 23,397  |
| Productivity of non-agric. worker | 10,620 | 16,012  | 33,025  |
| Dryland-secondary crop²) |         |         |         |
| Productivity of agric. worker | 1,991  | 5,994   | 11,681  |
| Productivity of          |         |         |         |
| worker                   | 3,783   | 9,292   | 17,552  |
| Productivity of non-agric. worker | 6,903  | 15,339  | 23,737  |
| Dryland-vegetables³)     |         |         |         |
| Productivity of agric. worker | 5,100  | 18,073  | 46,805  |
| Productivity of          |         |         |         |
| worker                   | 6,231   | 16,570  | 49,393  |
| Productivity of non-agric. worker | 5,683  | 18,862  | 24,749  |

Note: ¹) Dryland-estate crop villages => Year I: 2009; Year II: 2012; Year III: 2018
²) Dryland-secondary crop villages => Year I: 2008; Year II: 2011; Year III: 2017
³) Dryland-vegetable crop villages => Year I: 2008; Year II: 2011; Year III: 2017

According to Oktavia et al. [15], the higher the level of education completed by agricultural sector workers, the productivity level of agricultural sector workers will also increase. However, it is not occurred in PATANAS village. The higher the education completed, the greater the tendency for migration and the smaller the impact on agricultural labor productivity.

Vegetable farmers in dryland relatively have small land compared to secondary crops and estate crop farmers. The high productivity of vegetable farmers is due to the high selling price per unit weight of harvest. As a result, the productivity of labor in vegetable farming has a very high increase of 90.86% per year. The increased productivity of vegetable farm labor is also supported by high yield and reasonable selling prices during peak harvest season. However, in the 2019–2020 period, the weather in Indonesia (rainy season and dry season) is unpredictable. The problem faced by dryland vegetable farmers is water supply. The majority of vegetable farmers rely on rainwater sources. A long rainy season can cause a flood, then damage plants. Conversely, if the dry season is too long, the plants will be dried/lack water or even late for planting.

In contrast to the vegetable farmers, the secondary crop farmers have extensive arable lands. However, because the harvest's selling price per unit weight is low, the productivity is below. Meanwhile, the estate crop farmers have lower agricultural labor productivity than vegetable farmers because the plantation yields they can yield after a maximum of one year (for instance, sugarcane); however, in one planting season, the products obtained are relatively large.

3.3. The linkage of migration and productivity
Migration is associated with labor productivity in a broader dimension. The results of the study show that migrant workers contribute to increasing labor productivity. It is explained that on the one hand, the number of in-migration (absolute) increases every period; on the other hand, labor productivity also increases.
Legend:
1. Dryland-estate crop, Period I
2. Dryland-estate crop, Period II
3. Dryland-estate crop, Period III
4. Dryland-secondary crop, Period I
5. Dryland-secondary crop, Period II
6. Dryland-secondary crop, Periode III
7. Dryland-vegetable crop, Period I
8. Dryland-vegetable crop, Period II
9. Dryland-vegetable crop, Period III

mper = permanen migration
arterja = percentage of HH member who worked
produktv = productivity of agricultural worker

Figure 1. Biplot analysis of migration and productivity

Based on Figure 1, points 1, 2, 3 represent the dynamics of dryland for estate crops in periods I, II, and III, respectively. Points 4, 5, 6 exhibit the dynamics of dryland for secondary crops for periods I, II, and III, sequentially. Meanwhile, points 6, 7, 8 represent the dynamics of dryland for vegetables in periods I, II, and III, respectively. The dynamics of dryland gardens tend to be static because the three points tend to gather in one block, which leads to high agricultural migration and low productivity. The dynamics of dryland for secondary crops occur in labor absorption and leads to productivity improvements starting from the I, II, and III periods. A high increase in productivity characterizes the dynamics of dryland for vegetables. In addition to the high absorption of labor, it is accompanied by increased productivity and a decreasing trend of permanent migration. Thus, the correlation between permanent migration and productivity is negative; the higher the agricultural labor productivity in an agroecosystem, the less likely it is to migrate.

4. Conclusions
Permanent migration is generally still found in dryland plantations. The majority of permanent migration actors are children (young age). The relatively low working hours motivate residents in dryland (estate crop) to undertake permanent migration. On the other hand, dryland for vegetables have high labor productivity in the agricultural sector. Vegetable crops have a relatively high harvest frequency in one year and a good price for vegetable commodities. There is a trend in the dynamics of increasing productivity of dryland for vegetable and secondary crop farmers. However, this phenomenon has not been found in dryland-estate crop farmers.

On dryland plantations, it is necessary to conduct a transformation assessment toward mechanization of agricultural machine tools. With this modernization, it is felt that it will attract young farmers to continue working in the agricultural sector. In addition, crop rejuvenation and side processing of commodity crops will increase the entrepreneurial farmers in the agroecosystem which will have an impact on increasing labor productivity.

On vegetable agroecosystems, high labor productivity has an impact on the lack of migration. Commodity price stability is indispensable especially when prices are falling. In addition, the fulfillment of fertilizers in this agroecosystem is strived to be fulfilled to maintain the quality of crop yields. Counseling and coaching farmers in using fertilizers or organic and chemical materials are deemed necessary so as not to appear new diseases or pests that are resistant to the use of fertilizers or chemicals.

Acknowledgment
This research was supported by the Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS) for the valuable data resource.
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