Socio-economic aspect and carrying capacity of agricultural land resources to support the development of strategic agricultural commodities

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Abstract. The challenges of future agricultural development in Indonesia are still very heavy in relation to the carrying capacity of land resources and socio-economic aspects. This paper aimed to analyze the important steps of strategic commodity development based on the role of socio-economic aspects and the support of agricultural land carrying capacity. The analyses showed that the contribution of the agricultural sector to national income is quite high as indicated by the agricultural gross domestic product (GDP) at around 10.27% of the national GDP and current agricultural commodities as a source of foreign exchange come from oil palm and cocoa. However, fluctuation in market demand and price of agricultural commodities still depends on supply and demand. The supply is affected by climate disturbances and natural disasters, while the demand is related to the growing population. Socio-economic aspects as the prerequisites for agricultural commodity development include markets, farmer exchange rates and other supporting facilities. Land resources include the availability of land and irrigation water. The carrying capacity of rice fields in Indonesia is still very heavy, namely 34 people ha⁻¹ of rice fields, while neighboring countries such as Vietnam and Thailand are 14.0 and 2.5 people ha⁻¹, respectively.

1. Introduction

The challenges of agricultural development in Indonesia are mostly related to the increase of human population which encourages the escalated demand for more varied and quality food, both from the aspects of food safety, environment, nutritional completeness as well as aesthetic aspects. Therefore, the food supply system in Indonesia needs to adapt to the challenges of these changes. To date, the export market is open for agricultural commodities, such as staple food, horticulture, spices, estate crops and livestock. Some horticultural products have become the main export commodities, such as mangosteen, mango, dragon fruit and some fresh vegetable commodities. Other agricultural products also need to be pushed towards leading export commodities in accordance with efforts to increase exports three-fold through the Ministry of Agriculture's Gratieks program in the next 5 (five) years. The application of Good Agricultural Practices (GAP) and Good Handling Practices (GHP) is absolutely necessary to increase product competitiveness in the global market, and also to improve the quality of agricultural products with a growing domestic market potential. In addition, Indonesia, which has the largest diversity of agricultural genetic resources in the world after Brazil, has the potential to be further explored to meet the increasing need for food, industry and renewable energy. In the plantation sector,
several leading commodities such as coffee, pepper, cloves and cocoa need to be encouraged with a touch of modern mechanized technology at the farm level so that the quality of their products can be maintained and well received in the export market.

In the past few decades, agricultural development continued to record various successes. Indonesia succeeded in achieving rice self-sufficiency in 1983/84 and 2007, and corn self-sufficiency in 2009 [1]. However, this success must be alerted to in connection with various problems that hit agricultural sector recently. The balance of food production and consumption is a national problem. The widespread conversion of fertile land in food production centers affects the production side. On the other hand, the population growth rate which affects the consumption side is 1.35% per year and currently the population is around 267 million people. If the consumption level is about 114 kg of rice per capita, then every year there should be available rice for food around 30.4 million tonnes of milled rice or the equivalent of 46.7 million tonnes of rice. Experience shows that the steady production of rice which is the main domestic food is very helpful in stabilizing food prices, so that Indonesia can avoid food crisis like the one that hit many countries.

Another aspect that needs attention is the free trade system in which various agricultural products will compete freely and will face tough challenges. With the opening of the domestic market to similar imported agricultural products and the strict quality standards in the export market as a non-barrier instrument which is often imposed by many countries in this globalization era will further suppress and threaten the competitiveness of agricultural products, both in domestic and export markets. Moreover, the implementation of strengthening economic cooperation in the ASEAN environment has been realized since 2015. With the framework of cooperation of the ASEAN Economic Community (AEC) or the ASEAN Economic Community (AEC), ASEAN is becoming a fully integrated region with the global economy. In such condition all producing countries will compete in producing agricultural products efficiently and with good quality.

Various obstacles and challenges ahead in maintaining food security and sustainable food self-sufficiency are mainly related to the continued conversion of agricultural land to non-agricultural activities, especially on fertile agricultural land in Java, which causes less land for agriculture. Meanwhile, new openings of agricultural land have relatively low fertility. According to Santosa [2] in the last 10 years in Java, there has been a conversion of 508 thousand ha of paddy fields, which has the potential to reduce food production on fertile land. This decline in production can result in an increase in imports of main food crops, as reflected in an increase in imports of staple foods in 2015, namely rice (2.1%), corn (3.7%), soybeans (9.8%) sugar (14.2%) and cassava (64.4%). In addition to conversion of agricultural land, food security challenges are related to socio-economic problems that often occur, such as price fluctuations and supply chains for domestic food demands and availability.

This paper analyzed the socio-economic aspects and carrying capacity of land as the basis to develop agricultural commodities optimally. The main sources of data are from Statistics Indonesia (BPS), directives of Minister of Agricultural and secondary data from various relevant literatures. The data and information referred to the economic value of agricultural commodities, agricultural trade balance, agricultural land support for food commodities, production systems and policy implications.

2. Economic value of some strategic commodities
Agriculture is the activity of utilizing biological resources carried out by humans to produce food, industrial raw materials, energy while still managing the environment. In the use of biological resources economic value is generated that can be measured in the scale of farmers (micro) or aggregate scale in the form of regional or national income. The micro economy can include price, production processes, and product distribution. Price will be related to demand and supply in a commodity market, then the price will be influenced by market structure, supply elasticity. The production processes will be related to production costs, optimal production levels, especially for the producers. While the distribution will be related to the distribution path and length, product durability during the distribution process. Farmer-scale income will be strongly related to farmer exchange rates (FER). The FER is the ratio between the
price index received by farmers and the price index paid by farmers (mainly production inputs) expressed in percentage. FER is one indicator in determining the level of welfare of farmers.

The price of agricultural commodities has a characteristic. Prices can increase if supply decreases due to crop failure (“Puso”) or natural disasters, while demand, especially food commodities, will continue to increase in line with the rate of population growth. To overcome this, the government sets a floor price to protect producers, while the ceiling price is to protect consumers. Determination of the basic price and the highest price is quite effective if the agricultural commodity has a perfectly competitive market, whereas for commodities which are monopolistic and monopsonic by an agency or company will harm consumers (monopoly) and will harm farmers as producers (monopsony).

The Ministry of Agriculture's experience in year 2016 has targeted production for several main commodities, such as rice (75.13 million tonnes of Milled Dry Grain = MDG), corn (21.35 million tonnes), soybean (1.6 million tonnes), sugar (2.8 million tonnes), shallots (1.17 million tonnes), large chili (1.11 million tonnes) and cayenne pepper (759 thousand tonnes). In order to achieve this production, especially for rice commodity, it is expected to be fulfilled from the rice planting area of 15 million ha and the harvest area of 14.8 million ha. In addition to the 7 commodities above, the Ministry of Agriculture [3] also focuses on four strategic plantation commodities with income targets for palm oil, rubber, coffee and cocoa as much as 31, 25.9, 23, 21 trillion IDR, respectively. Eleven agricultural commodities above contributed to the increase in foreign exchange through exports of agricultural commodities, which averaged in five years (2010 - 2014) reached 34.3 billion USD or equivalent to 377.3 trillion IDR. This value has grown in the range of 3.47 - 4.58% or an average growth of 3.90% per year.

Based on the Ministry of Agriculture data [4, 5], from year 2015 to 2018 the contribution of agricultural sector to Gross Domestic Product (GDP) was 9.55% to 10.27% (table 1). However, from these data, it appears that the development of the contribution of the agricultural sector for four years has continued to decline even though its value at current prices has increased.

| Year | Value (Billion IDR) | Agriculture Sector | National | Agriculture Sector Contribution (%) |
|------|---------------------|-------------------|---------|------------------------------------|
| 2015 | 1,183,969           | 11,526,333        | 10.27   |
| 2016 | 1,266,865           | 12,401,729        | 10.21   |
| 2017 | 1,346,867           | 13,587,213        | 9.91    |
| 2018 | 1,417,075           | 14,837,358        | 9.55    |

Source: Pusdatin [6].

Some agricultural commodities become export commodities, especially oil palm and cocoa which are currently the mainstay of Indonesia's exports amidst the increasing number of food imports (especially soybeans). Indonesia's export destinations for oil palm are India, China, USA, Netherlands, Pakistan, Malaysia, Italy, Japan, Singapore, and Bangladesh. Indonesia's export destinations for chili and cacao area India and China, respectively. Meanwhile, imports from the USA are mainly for soybeans and maize, while imports from Australia are mainly for soybeans, sugar and sugar cane. Table 2 presents the trade balance for several strategic commodities in 2018.

Based on data from the Ministry of Agriculture's Pusdatin (compiled from Statistics Indonesia), it shows that the trend of food import value continues to increase from year to year, namely 7,811,894,000 USD (2014); 6,789,739,000 USD (2015); 6,498,553,000 USD (2016); 6,491,985,000 USD (2017); and 7,971,014,000 USD (year 2018). Most of the import values are in the form of wheat, soybeans, corn, and rice. In addition to the large number that needs to be more vigilant is the trend which continues to increase every year. This increasing trend threatens national food sovereignty. In total, the four sub-
sectors still have a surplus because they are supported by the plantation sub-sector exports, particularly from the oil palm commodity.

Table 2. Trade balance of several strategic commodities in 2018.

| No. | Subsector     | Value (1,000 USD) | Balance Sheet |
|-----|---------------|-------------------|---------------|
| 1   | Food Crops    | 213,256           | 7,971,014     | (7,757,758) |
| 2   | Horticulture  | 439,614           | 2,309,054     | (1,869,440) |
| 3   | Plantation    | 28,093,925        | 5,231,978     | 22,861,947  |
| 4   | Animal Husbandry | 640,171       | 7,682,625     | (7,042,454) |
|     | Total         | 29,386,966        | 23,194,671    | 6,192,925   |

Source: Pusdatin [6].

The definition of food sovereignty is the right of every country and the right of every people to have the ability to produce and market basic needs independently [7]. The meaning of self-policy is that farmers can be independent in doing business, starting from producing, distributing and so on, so that food sovereignty rests with the farmers, not by the entrepreneur.

3. Land resources support for food security

A commodity development program in an area is highly dependent on the support of natural resources. Experience shows that these natural resources are the mainstay in spurring Indonesia's economic growth. These resources include oil, forests and mining goods, which account for more than 25% of the GDP, both in the form of renewable and non-renewable resources [8]. Indonesia has a target of not only food self-sufficiency but also food sovereignty. A country must have the ability to determine its policies by prioritizing local food production for its own needs, ensuring the availability of arable land, water, seeds, including financial for farming and prohibit trade by dumping.

If the current rice field area is 7,886 million ha with a population of 267 million people (2020), the ratio of rice field to total population will be 1: 33.8 which means that every 1 ha of rice fields must provide food for 34 people. The ratio shows how heavy Indonesia's burden compared to that of other countries. Table 3 below presents the ratio of land area to population food supply in several countries.

Based on the data above, it can be seen how heavy the carrying capacity of paddy fields is, reaching 34 people per ha, very far compared to that of other countries. To maintain food security, land availability factors for food are fundamental, especially the land which is generally used also to grow other crops such as soybeans, corn, peanuts, onions and other vegetables. Nationally, food in Indonesia cannot be separated from rice, bearing in mind that rice is a staple food, even in some areas where the staple food was originally non-rice, there is a tendency to switch to rice as staple food. Rice is a staple food that has a role in fulfilling around 45% of food intake or around 80% of main carbohydrate sources in the consumption patterns of Indonesian people [10]. To meet the needs of rice faces various problems, among others the conversion of paddy fields (especially irrigated paddy fields), climate disturbances, pest and disease attacks, rice exchange rates and the dynamics of world trade. This is in line with the results of leverage analysis [11, 12] that several variables related to aspects of land resources that are very sensitive affecting the national rice availability including the availability of irrigated land, conversion of paddy fields, land suitability, new paddy fields construction and productivity.

The driving factors for food imports include huge domestic demand in line with population growth, relatively low stimulation of international market prices, sometimes in the form of import assistance from exporting countries, and insufficient domestic production. In global trade politics, consumers like Indonesia are a very large market and are the target of various foreign producers to be able to continue
to take advantage as long as Indonesia does not have food sovereignty and continues depending on foreign supplies.

Table 3. Ratio of land area to total population.

| No. | Countries       | Land area for food (x 1000 ha) | Total population (x 1000 people) | Ratio of land area to total population (m² capita⁻¹) | Land burden to provide food (people ha⁻¹) |
|-----|-----------------|-------------------------------|----------------------------------|-----------------------------------------------------|------------------------------------------|
| 1.  | Indonesia       | 7,886                         | 267,000 (*)                      | 295                                                 | 34                                       |
|     | - Rice field    |                               |                                  |                                                     |                                          |
|     | - Rice field + wetland | 13,386                     | 267,000 (*)                      | 501                                                 | 20                                       |
| 2.  | Bangladesh      | 8,085                         | 173,000                          | 468                                                 | 21                                       |
| 3.  | China           | 143,625                       | 1,504,000                        | 708                                                 | 14                                       |
| 4.  | Vietnam         | 7,500                         | 102,000                          | 735                                                 | 14                                       |
| 5.  | India           | 176,630                       | 1,329,000                        | 1,328                                               | 7.5                                      |
| 6.  | Brazil          | 58,865                        | 200,000                          | 2,980                                               | 3.4                                      |
| 7.  | Thailand        | 31,839                        | 79,000                           | 4,030                                               | 2.5                                      |
| 8.  | Argentina       | 28,360                        | 50,000                           | 5,672                                               | 1.8                                      |
| 9.  | USA             | 183,010                       | 315,000                          | 5,810                                               | 1.7                                      |
| 10. | Canada          | 49,920                        | 35,000                           | 14,263                                              | 0.7                                      |
| 11. | Australia       | 50,304                        | 28,000                           | 17,699                                              | 0.6                                      |

Source: Sumarno [9], note: *) in year 2020.

Most Indonesians (over 60%) live in rural areas and more than 70% depend on the agricultural sector (mainly rice and horticulture as well as plantations and animal husbandry) and they generally have a narrow land of less than 0.5 ha and a large proportion of farm laborers and plantations. Awareness of the diversification of staple foods (especially rice) is still low, so the challenge going forward is to divert staple foods from rice to other carbohydrate sources such as cassava, corn, etc.

Based on the analysis of Sudaryanto in Ritung and Mulyani [13], in 2020 assuming a population of 260 million people and per capita consumption of 139 kg year⁻¹ it is predicted that there will be a rice shortage of 1.09 million tonnes, and the deficit will continue to increase until it reaches 12.25 million tonnes in 2045. To produce rice and other foodstuffs at a sufficient level of domestic consumption needs (national food self-sufficiency level) from 2015 to 2045, it is necessary to increase the area of paddy fields to 10.7 million ha assuming that the productivity of lowland rice is stable at 5 t ha⁻¹ MDG and 160% rice crop index (IP). Assuming an initial paddy field area of 7.73 million ha (95% of 8.13 million ha of raw paddy land), to meet domestic food and material industry needs, an additional 1.86 million ha of paddy fields will be needed in 2025, and cumulative additional paddy fields of 4.977 million ha until 2045. To increase the area of paddy fields, the most likely alternative is to use peat or tidal land outside Java.

In developing regional commodities, it is based on two considerations, namely: strategic commodity development policies and regional leading commodity development policies. Development of strategic commodities, is based on regulation of Minister of Agriculture (No: 50/ Permentan / OT. 140/8/2012, August 23, 2012 concerning guidelines for developing agricultural areas). This regulation aims to achieve the fulfillment of food needs in addition to the development of leading commodities in horticulture, animal husbandry and plantations as well as an increase in exports of plantation products and other agricultural products. In the regulation, agricultural activities are carried out intact and integrated, and focus on the achievement of existing targets, especially targets on major food commodities. In addition, regulation of Minister of Agriculture Number 46/Kpts / PD.300 /1/2005 was issued also on January 10, 2015, concerning the determination of national plantation areas, for several
commodities, namely: oil palm, rubber, coconut, cashew, sugar cane, cocoa, coffee, tea, pepper, nutmeg and cloves.

In addition to strategic commodities, there are superior (leading) commodities, which are one of the most profitable mainstay commodities to be cultivated or developed in an area that has a market prospect and is able to increase the income or welfare of farmers and families, as well as having considerable land resource potential. These superior commodities are needed to compete with other countries in the era of globalization. Each region has superior commodities that vary according to the natural resources they have and are generally the main sector (leading sector) in the area. Development of leading commodities in agribusiness requires special strategies so that they can provide optimal contributions to economic development. The criteria for leading commodities are (1) has a technology content that is quite prominent and innovative both in the agricultural sector and small industries and services, (2) has a broad marketing reach, both local, national and export, (3) has characteristics of the area and involving the community at large (local labor), and has a high local raw material content, (4) has a guarantee of a lot of local raw materials and stable or through cultivation, and (5) has an environmentally friendly and can promote local culture.

If the average conversion of fertile rice field is 100,000 per year, since the development of the industry over the past 40 years, there has been a land conversion of about 4 million ha of fertile rice fields. If the assumption of productivity is 5 tonnes ha$^{-1}$ with an IP 100, then rice production will decrease around 20 million tonnes. If the conversion rate continues, it can imagine that the rice fields will be run out and where rice will be planted, even though 95% rice is the main staple food.

4. Agricultural production systems

4.1. Production optimization

Agricultural commodities can be cultivated optimally if they meet two main requirements, namely the necessary and sufficient requirement. The necessary requirements must be related to biophysical aspects of land, namely elevation, climate, soil texture, mineral soil depth, soil acidity (pH), organic C and terrain (topography). While the sufficiency requirements include socio-economic aspects, namely: preferences of stakeholders (government institutions, farmers) related to farmers' interest in a commodity, marketing aspects (market, price feasibility), labor availability, support of resources (capital, information), economic scale (especially industrial commodities), contributions to regional income and farmer income, central government policies and regional policies (especially regional priority commodity development programs) and infrastructure (especially irrigation infrastructure).

The two requirements above can be carried out sequentially with two stages. Stage one is an evaluation of the biophysical aspects as a prerequisite, and stage two is an evaluation of the social economy as a condition of adequacy. Figure 1 below presents an evaluation of the production system.

4.2. Farmers' product marketing

There are two important elements in marketing, namely the availability of markets that farmers can easily sell their products, and the element of appropriate price stability. The appropriate price will be directly related to the exchange value of the product, especially when it is compared to the price of inputs purchased and used in the production process, for example the price of inorganic fertilizer and the price of labor costs.

4.3. Economies of scale

In general, the orientation of the development of agricultural commodities is to fulfill the consumption needs of farmers and industrial raw materials. Specifically, for agricultural commodities that are industry oriented (such as oil palm and cocoa), the development must meet economic scale (economy of scale). The economic scale refers to the size of cultivation of agricultural commodities that are sufficient or at least able to fulfill the needs of the processing industry (processing industry capacity) in an integrated and sustainable manner in an area.
4.4. Labor availability

Agricultural labor is one of the main production factors in a seasonal production process, which is characterized by fluctuations in the availability of labor at certain times such as the growing season and harvest time for lowland rice. The availability of agricultural labor is influenced by the uneven distribution of labor according to space and time. Agricultural labor is often a barrier in some areas.

The definition of agricultural labor (according to BPS) is labor that works in agriculture 6 hours per day or 35 hours per week. Based on the working hours of labor it is assumed that each person works for 6 days a week, when there is a 6-hours work every day, there are 35 hours in a week. The number of hours worked can be divided into two categories, namely the flow of time above 35 hours per week which is commonly referred to as active labor and the time spent below 35 hours per week which is commonly referred to as underemployed (half employed) labor. Based on the BPS survey results, the development of the number of agricultural workers globally has decreased from year to year due to low interest of the younger generation in farming.

5. Conclusions

Socio-economic aspect is one of the requirements that must be used as a basis in developing an agricultural commodity, and is an advanced stage of evaluating the agricultural land carrying capacity (biophysical suitability) that needs to be conducted to develop agricultural commodities optimally. The socio-economic aspects include markets, farmer exchange rates, production input support (good seeds, fertilizers and pesticides, labor, etc.), farmer and local income and other supporting facilities. Land resources include the availability of suitable land, water for irrigation and ease of the product distribution. The carrying capacity of rice fields in Indonesia is still very heavy, namely 34 people per ha of rice fields, while neighboring countries such as Vietnam and Thailand are 14.0 and 2.5 people per ha, respectively. Therefore, making new rice fields outside Java and optimizing the productivity of new fields also need to be concerned.
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