Pursuing sustainable ginger production and supply performance in Central Kalimantan Province

S Sujianto*, E S Iriani, A Setiadi, C Syukur, M Rizal

Indonesian Spice and Medicinal Crops Research Institute, Indonesian Agency for Agricultural Research and Development, Bogor, Indonesia

*sujj14nt0@gmail.com

Abstract. Ginger is one of the demanded spices during pandemic covid-19 which the price rose sharply. Besides the spice utility, Peoples believe that ginger can be used for traditional medicine, improving and preventing folk diseases. Central Kalimantan as consumers of ginger, especially red ginger, is affected by this fluctuation price directly which is indicated by soared price of red ginger almost tripled from IDR 20,000 to more than IDR 55,000. Moreover, the ginger supply of the province seems to depend on other surrounding provinces such as South Kalimantan. This paper analyzes the supply chain and its performance of ginger in Central Kalimantan province, including product, information, and financial flows from the farmers to the consumers. It also evaluates the efficiency and performance of ginger supply chain for improving the balancing system in the future. Data were collected from the farmers in the central of ginger area production, middle traders, traders in the central market in Palangkaraya city, and consumers households. The result shows that Central Kalimantan produce ginger in some regencies such as Pulang Pisau, Kapuas, Kota Waringin, Gunung Mas. However, it did not sufficiently meet ginger’s production but still supported by south Kalimantan province and West Kalimantan province. Therefore, this paper can give the information generally for all drivers, and it can drive appropriate policy for the government, especially for the development plan of ginger in Kalimantan.

1. Introduction
Ginger is one of the spice commodities that traded internationally as an export and import product. Indonesian ginger production trend towards declining up to 15% in five years. In 2015, domestic produced 313,064 ton of fresh ginger and in 2019 dropped into 173,380 tons [1]. Generally, the crucial problems that came from ginger cultivation need intensive cultivation and disease management control due to bacterial wilt decease caused by Rastolinia solanacearum, resulting in loss of yield and farmers' failure. Moreover, it is frequently attacked by leaf spot disease. This uncertainty tends to lower farmers' interest in planting this produce. Additionally, farmer gate price of ginger in grand of seasonal time or excess condition usually drop and become unprofitable to the farmers. This distortion makes the quantity in the market is not available continuously. While in other conditions, ginger's shortage made international traders shift, taking the chance from exporter to the importer. The importing countries of ginger are Thailand, Vietnam, China, India, and Malaysia. In 2018, Thailand, Vietnam, China, India, and Malaysia imported 1,584 tons, 1,150 tons, 937 tons, 160 tons, 2 tons, respectively [1]. Central ginger production in Indonesia is North Sumatra, Bengkulu, West Java, Central Java, East Java, and South Sulawesi [2]. Even though Central Kalimantan is not one of the big five of central production, the government initiates to give focus to develop medicinal plant as part of the food estate program of the...
Ministry of Agriculture in Kapuas and Pulang Pisau District. This development supports the mitigation of continuous import by increasing the self-production of ginger in the domestic area.

In pandemic covid-19, ginger has become one of the demanded commodities in the Indonesian market include in central Kalimantan. Some people believe that ginger can boost the immune system and maintain body health. It is sold in fresh produce from farmers to the consumers. Some people processed ginger into a derivative product such as instant healthy drinks and milk-ginger drinks. Ginger is a seasonal agriculture commodity that needs 5-8 months from planting to be harvesting. After being harvested, it is immediately transferred to the consumers through a multi-level agent market because fresh ginger has a short-life storage time. Its weight could be drop drastically 10-50% within one to three months. During the pandemic, fresh ginger's price in Central Kalimantan increased almost triple from 20,000 IDR to 55,000 IDR in the retail market. This volatile price has made several actors fell into the uncertainty and risk zone. It was hypothesized some problems on each actors in the supply chain system. Farmers had difficulties buying healthy seeds for the cultivation of ginger production. Middle traders got difficulties with a limited supply of ginger and tended to stock as minimum quantity as they can. This behavior avoiding loss and consistently selling products to the consumers is an interesting matter to be solved with the supply chain analysis approach, which can describe the actual problems faced and find out the strategy of development.

This research has a three-importance objective. First, it aims to find the farmers perspective related to ginger production and the condition of supporting sub-system agribusiness pre-production of ginger at the farmer level such as seed, fertilizers, farmers' knowledge technology, productivity, and central production area. Second, it has the objective to analyze the supply chain flow and performance of red ginger. Third, knowing the inter-dependency of actors and improvement strategies to the better supply chain in the future. This article gives comprehensive information for all drivers involved in the ginger business and farmers who want to initiate cultivating ginger. This research would be useful for the government to design a sustainable ginger development policy.

2. Materials and method

This research had been conducted from March to September 2021 focused on Central Kalimantan Province. Data were taken from essential actors related to ginger. The in-depth interview was given to the following category of respondents: farmers or groups of farmers, micro-enterprise, local traders, inter-provincial merchants, traders in grand market, retailers, and consumers.

For answering the first objective related to the condition of sub-system agribusiness pre-production ginger, we interviewed 20 member of ginger farmers group from Klampangan Village, Sembangan. We also interviewed other farmers in Terusan Mulya and Terusan Karya Village, Bataguh Sundistrict Kapuas District with 15 members of the group, and farmers in Belanti Siam Village, Pandih Batu Sundistrict, Pulang Pisau District with amount 15 members, respectively. They had been questioned about their perspective to the ginger cultivation and production whether they had significant problems such as production input, Good Agricultural Practises (GAP) knowledge, and their experiences. Farmers were confirmed which channel was used for selling products, price, quantity, quality, and continuity of ginger production. The second objective, for knowing and analysing the supply chain flow and performance, we interviewed all actors and focus on perspective problem close to supply chain. Beside farmers, we also tried to dig further information from the local traders who bought ginger directly from the cultivators from the farmers’ perspective. Then we collected data from the micro-enterprise of “Anyelir Bahalap” located in Klampangan Village. Sembangan Central Kalimantan. Furthermore, for analyzing the marketing flow of product, price, and market, we interviewed traders in the grand market of "Pasar Besar" at Palangkaraya city, one of the biggest market sold agricultural commodities. About fifteen sellers were interview related to procurement channel, quality, and continuity of the ginger. For enriching the elaborated data, the intense discussion was conducted with the local governmental agency who have related responsibility to the ginger' market and production, such as the local horticultural department, seed supervisor institute, and local micro and small industry department.
All data gained were analyzed further through simple descriptive statistics analytic and elaborated with the secondary data. We filtered, selected, categorized, and finally presented in the discussion text, table, and figure to give accurate data and information. Then it was used for supporting third objective diskriptively knowing the inter-dependency of actors and setting up the improvement strategies to the better supply chain in the future.

3. Results and discussion

3.1 Farmers perspective of ginger production
The successes of ginger cultivation depend on internal and external factors. The internal factors include healthy seed, fertilizer availability, and farmers’ knowledge of the technology. While the external factors are supported by climate conditions and marketing support. Both external and internal support directly lead to the profit gained by farmers.

Ginger farmers in central Kalimantan face some challenges. Farmers had difficulties to find the certified healthy seed of ginger. It was similar to other research that farmers still found it hard to find a good seed [3]. Usually, they use ginger seed from the previous production, which no guarantees free from pests and diseases. Farmers only see the outward appearance of the ginger rhizome, such as shiny skin, clean, not pest-perforated, and big rhizome. Some of them use seed ginger, which is too young (<7 months), leading to lower average productivity under 2 tons per ha. They did not understand how to select qualified seed ginger and use a superior variety. It is similar to other cases in Sri Lanka [4]. It needs an extension and technical assistance from the local government to increase the awareness and knowledge they have through workshops or field school.

For the fertilizer application, they gave a perfunctory fertilizer, in which they give it merely from the available organic manure from their livestock. They add an-organic fertilizer under recommendation dose (<350kg of NPK/ha) [5]. It depends on the farmers’ awareness and farmers knowledge. For the cultivation technique and technologies related to ginger, the truly farmers are generally known to do good cultivation, but beginner farmers need more understanding of Good Agricultural Practices (GAP) of ginger cultivation. Adoption GAP could make a better quality, price and income [6]. Farmers experienced pest and disease such as bacterial wilt, leaf-spot, grasshopper, and nematode. They used pesticide from the near agricultural shop in their area. Unfavorable weather like high rain intensity could make ginger plants submerged in water, inducing emerging diseases such as rhizome rot. Due to an interview, the most feared ginger disease by farmers is wilt disease (Ralstonia solanacearum) which can lead to the total loss. Otherwise, the low rain intensity on non-irrigated land can make the plant drought, and the growth was not going well.

In other hand, the center of ginger production in central Kalimantan relatively in small and sporadic. Farmers planted the ginger in their yard and field which was under 0.5 ha. It mean that it has not been clustered well. Only farmers in particular area was practically cultivated ginger. The spread of cultivation area of red ginger in Central Kalimantan are Barito utara, Sambas, Gunung Mas, Pulang Pisau and Kapuas District.

3.2 Supply chain flow
After visiting and discussion with the all actors of ginger in central Kalimantan, it is revealed that the majority of ginger type cultivated and traded is red ginger. Only a small amount of white ginger is sold in the market. It is estimated that red ginger is more than 90% dominant of ginger in market. People use the red ginger not only for special drinks related to habitual culture but also for daily spices in their dishes. Red ginger is originally the special ginger from Indonesia. Even though red ginger in other areas, for example in the Java Island, is used for a healthy drink. Women in that area are rarely using red ginger instead of white ginger for spices. The strong aroma properties in red ginger become something to like and preferred by them; however, they know the taste of red ginger is a bit tart and bitter. For analysing supply chain and performance we would go further into the production, price, market channel and then assessing the overall performance.
3.2.1 Production. The total production of ginger in Central Kalimantan is 464 tons, and the estimated demand is 1,110 tons annually. The total production compared with other provinces in Kalimantan is the smallest one. It can be seen in Tables 1 and 2. It means that the total consumption of ginger in central kalimantan is still fulfilled by other close provinces. According to the confirmed interview to traders in Pasar Besar, Palangkaranya, ginger sold was coming from the other province like south Kalimantan and north Kalimantan.

The production growth of ginger cultivation in Central Kalimantan is significantly in the development program. The growth in 2019 over 2018 is about 59% (Table 1), and it will increase from year to year (Hortikultura, 2019). South Kalimantan is the biggest supplier province because it has a center of ginger production such as Pelaibari Sundistrict, Tanah Laut District, and Kalumpang Sundistrict, Kotabaru District. But the growth of ginger production is slightly declining about 1% in 2019 over 2018. In other hands, the consumption of spices includes ginger, in Central Kalimantan is relatively higher than in other provinces. It is indicated by per capita monthly consumption of spices [7]. It can be said that central Kalimantan needs more supply of spices for fulfilling the consumption need.

| Province       | Population* | Acreage (ha) | Production (kg)** | Production growth 2019 over 2018 (%) | Per capita consumption of spices /month (IDR)** | Total gross demand (kg) | Surplus (+) /shortage (-) |
|----------------|-------------|--------------|-------------------|--------------------------------------|-----------------------------------------------|-------------------------|---------------------------|
| Central Kalimantan | 2,449,607   | 28.9         | 464,583           | 59                                   | 16,698                                        | 1,110,765               | -                         |
| South Kalimantan  | 3,704,780   | 218.7        | 2,666,594         | -1                                   | 12,470                                        | 1,679,918               | +                         |
| West Kalimantan   | 4,942,365   | 126.5        | 1,987,529         | 26                                   | 12,698                                        | 2,241,096               | -                         |
| East Kalimantan   | 3,451,255   | 35.9         | 1,161,737         | 81                                   | 16,340                                        | 1,564,958               | -                         |
| North Kalimantan  | 643,172     | 16.5         | 607,937           | 63                                   | 16,492                                        | 291,644                 | +                         |

*Census data without children group under 5 years **Data production of ginger in 2019 (BPS, 2020) [1] ***SUSENAS data of September 2018 (ginger, turmeric, etc.)

3.2.2 Price and margin. In two decades, the price of ginger is increased double from under ten thousand rupiahs to twenty thousand rupiahs. It condition seems driven by declining production in the domestic. Figure 1.a shows that the price is volatile, which sometimes increases and decreases very contrast. White big ginger is cheaper than red ginger, but both rise and down in a volatile price. From 2013 to 2015, ginger's price decreased and led to exporters trying to export to other countries, but since 2016 shortage has shifted to becoming importer due to increasing prices in the domestic area. The integration of the national agriculture and international markets becomes essential [8,9].

Moreover, in 2020 the price-increased fluctuation steeply occurs because of the shortage and the increasing demand due to pandemic covid-19. Price was not uncontrolled and determined by the mechanism of the market, especially in March 2021. At that month, consumers had a shocking physiological expectation and had interest to buy red ginger in line with the people increasing awareness for maintaining health and immune preventing from covid-19 disease. It make a kind of shocking price. It was happened also in northeast of Thailand that the price of ginger was increasing due to pandemics [10]. The supply chain should be flexible in responding a new challenge that occurred in the market, like facing pandemic-19 [11]. In the following months, the ginger price was slowly declining, and farmers tried to cultivate more.

The price of ginger in Central Kalimantan was determined by some factors such as the seasonal availability of ginger and the endowment factor that belong to the farmers who want to cultivate gingers, access of consumers to the information and market, and the bargaining power based on the degree of consumers need (Table 2). The price of ginger tends to be low in the season of harvesting between July to September. Farmers usually commence planting seed on September to November, the beginning of the rain season. After planting time, the price begins to rise till the months before harvesting. In other
hand, access of information and market normality will lead the price to be more competitive. Now consumers can check the price easily by joining the ginger group on social media for consideration price. But in the pandemic 2020, buyers had a less bargaining position because they need fresh ginger to make own healthy drinks.

Figure 1. Ginger price: a. price of ginger in Indonesian retail market; b. average of price ginger in central Kalimantan during 2020

Table 2. Affecting factors to price ginger in Central Kalimantan 2020

| Factors                  | Degree of factors influence | Note                                                                 |
|--------------------------|----------------------------|----------------------------------------------------------------------|
| Endowment factors        | Moderate factor            | Endowment factors such as land fertility, fertilizer availability, seed availability for supporting ginger cultivation |
| Seasonal availability    | Strong factor              | The strong factor because the ginger is seasonal and continuously available supplied by farmers |
| Access to market         | Moderate factor            | Consumers who want to buy ginger can get it in a particular market. There was no shop or market sell the red ginger. But it was easy to order |
| Market information       | Normal factor              | All actors could check the price information of ginger through a group of social media and portal news whether the price increasing or decreasing |
| Bargaining power         | Slightly factor            | Consumers did not have strong bargaining power, and seller determined price than consumer only can bargain slightly |

Due to the increased price of ginger during the pandemic covid-19, farmers who cultivated ginger had a high profitable margin of profit due to deduction of revenue by expended cost. But the aggregate of margin profit was shared to all actors in the chain unevenly (Table 3). Distortion and leveling price are the price asymmetry [12]. From the discussion to the seller in the grand market of Palangkara city, this condition became hard for them to sell ginger. They did not want to stock ginger in large amounts because it needed enormous capital and had a high risk such as the depreciation of ginger weight and freshness. Each seller displayed the ginger only 20-50 kg per week and bought again from the grand market and inter-provincial traders after 90% of the goods sold. Inter-provincial traders depended on the local traders and farmers' supply. Retailers who sold directly to the consumers tried to gain more margin because they sold in small quantities, only under ten kg, and retail into one or two per package. They provided ginger due to the demand of neighbors' consumers.
3.2.3 Marketing Flow of Ginger. From the data of interviews based on the farmers' experience and other actors, there are threemain categories of marketing channel of ginger. First, farmers sell the fresh ginger directly to their neighbors and traditional market, which are held weekly in their district. In that place, there is not available contract farming system that possibly preventing risk and source of profitable income [13,14]. Usually, the farmers conduct it, which the produce harvested, is in small quantity and limited in their area. It happens during the beginning of pandemic covid-19, which farmers get easy to sell to direct consumers, even the buyers come to the farmers by their selves. For Millennials farmers, they like to sell their products directly to the consumers due to the expectation of a high margin based on the short-chain of marketing. In group Anyelir Bahalap, farmers play a role as processors who create added value products. Social media applications and the online shopping market commence to be used, but it is still limited. The cost of shipment still becomes an obstacle for the online market. Second, farmers sell their products to the local trader. This trader collects ginger from several farmers and sells it to consumers. Farmers who do not have a marketing skill tend to choose this channel even though the profit margin gained is shared to a local trader. Third, farmers sell their products to local traders. Then local traders sell it to inter-provincial traders if the quantity is achieved and the expected benefit can cover emerging transportation cost. This trader then sell it to market trader in grand market and retail market. It is similar to the other research that the supply chain of ginger in other countries was still unstructured and inadequate strengthening of business enabling environment [15-17].

3.3 Performance of inter-dependency and improvement strategy

Each actor has his experience and perception about the performance of the ginger supply chain in Central Kalimantan. They are linked each other. Their dependency can be assessed from their perception and experience about performance. The actors were farmers, local traders, inter-provincial traders, grand-market traders, and retailers. They were gave the Linkert score (1-5) of satisfaction to the supply chain performance (Figure 2).

According to farmers' perspective, supply chain performance had good satisfaction. They had an unsatisfied performance on profit margin obtained, market access, and information access which assumed not going well. Farmers had own risk perception correlate to price rice management compared with other business decision [18,19]. Farmers assume that product producers should have a profit margin of more than in range of 70-100% due to high risk, time, and high capital expansion. Local traders think that performance of the supply chain of ginger is overall satisfied. They could take advantage of the opportunity to sell the ginger to consumers during pandemic covid-19. Inter-provincial trader and the grand market retail gave rating that the performance was in the satisfied score. They did not experience a difference compared to the previous year. In this situation, only retailers were not satisfied about profit, getting difficulties of information price, and market access.

Table 3. Average of selling price margin distribution among actors based in Central Kalimantan in 2020

| Actors             | Cost or buying price/kg | Average of selling price of fresh ginger (IDR/kg) | Margin of profit range (%) |
|--------------------|-------------------------|-------------------------------------------------|---------------------------|
| Farmers            | 15,550                  | 27,250                                          | 20 -50                    |
| Local traders      | 28,440                  | 38,500                                          | 18-25                     |
| Inter-provincial traders | 35,750          | 45,500                                          | 15-20                     |
| Grand market       | 40,000                  | 47,000                                          | 10-15                     |
| Retailer           | 50,500                  | 55,000                                          | 20-28                     |
Some improvement strategies related to the existing performance of supply chain are needed. Due to the production shortage of ginger, it is a big chance for the farmers to cultivate ginger in Central Kalimantan. Farmers can use their yard and idle land for planting ginger both directly sowing it on the land or using plastic bag. Then farmers have to check the price intensively on the internet, so when they will sell their product the information of price more transparency and will gain profitable price. Seed difficulties can be solved by the group farmers should do self-production of healthy seed. For increasing farmers understanding of ginger cultivation, local or central government can give workshop and an extension.

4. Conclusions
Farmers still had difficulties finding healthy certified seeds and had a limited understanding of good agricultural practices of ginger cultivation. For fulfilling the ginger need, Central Kalimantan was supported by other provinces’ internal production and external production. The center of the ginger production area was small sporadic and has not been the regional base. Ginger flow from farmers to consumers through some marketing channel: farmers to consumers, farmers-local traders-consumers, and farmers-local traders-inter-provincial traders-grand market traders-retailers. The price of the ginger was very volatile due to psychological consumers demand related to covid-19. The highest price was on March 2021, then slowly decreasing later on. The price was affected by factors such as endowment farmers' factor to cultivate ginger, seasonal availability of ginger, access to market and information, and bargaining power of sellers or consumers. For stabilizing the price, the new production production area based on the endowments factors should be extended so the quantity required could be supplied. Local and central government could give farmers support through increasing the farmers knowledge about GAP, providing healthy seed and an extension.

Acknowledgment
We would like to thank Mr. Juniasaputra from Agricultural Human Resource Extension and Development Agency Ministry of Agriculture, who helped us collect additional data from several main markets in South Kalimantan. Adding ginger's supply line data to the central Kalimantan, the data become complete and informative.

References
[1] BPS-statistics Indonesia 2020 Statistic of Medicinal Plants of Indonesia.
[2] Pusdatin. (2014). Outlook Komoditi Jahe (Jakarta: Pusdatin) 1–88.
[3] Raj Dahal B and Rijal S 2020 Ginger value chain analysis: A case of smallholder ginger production and marketing in hills of Central Nepal. Agric. Sci. and Technol. 12 31–36
[4] Weerasooriya W M N K and Silva S De 2014 Analysis of ginger value-chain: The case study of Kandy and Gampaha Districts. Peradeniya Univ. International Research Sessions, Sri Lanka 18.
[5] Raharjo M 2012 Pengaruh Pupuk K terhadap pertumbuhan hasil dan mutu rimpang jahe muda (Zingiber officinale Rocs.) J. Penelit. Tan. Indus. 18 10-16
[6] Sharangi, A. B. (2018). Indian spices: the legacy, production, and processing of India's treasured export pp.461.
[7] Badan Pusat Statistik Indonesia 2018 Consumption expenditure of Population of Indonesia by Province.
[8] Gardas B. B., Raut, R. D., Cheikhrouhou, N., & Narkhede, B. E. (2019). A hybrid decision support system for analyzing challenges of the agricultural supply chain. Sustainable Production and Consumption AGRIS Sci. 18 19–32.
[9] Waiyawuththanapoom P, Tirastittam P and Tirastittam M 2018 Critical Success Factor of Exporting Thailand's
[10] Wannaprasert P and Choenkwan S 2021 Impacts of the covid-19 pandemic on ginger production: supply chains, labor, and food security in northeast Thailand Forest and Society 5 120–135
[11] Aday S and Aday M S 2020 Impact of COVID-19 on the food supply chain. Food Quality and Safety 4 167–180.
[12] Bunte F 2006 Pricing and performance in agri-food supply chains. Quantifying the Agri-Food Supply Chain 39–47
[13] Arumugam N, Fatimah M A, Chiew E F C and Zainalabidin M 2010 Supply chain analysis of fresh fruits and vegetables (FFV): Prospects of contract farming Agric. Econ. 56 435–42.
[14] Rahmah S, Khotimah H, Gunawan W and Dwiartama A 2020 effectiveness of ginger supply chains in rural communities as a form of farming sustainability (study case in Cianjur District) (Bandung: Department of Biomanagement, School of Life Sciences and Technology Institut Teknologi Bandung)
[15] Khanal K 2018 Factors affecting and marketing chain of ginger in Salyan District, Nepal. Int. J. of Applied Sci. and Biotechnol 6 127–31.
[16] Abah D 2020 Analysis of the ginger value chain in Kaduna State, Nigeria Nigerian J. of Econ. and Soc. Studi. 61 399-416
[17] Varalakshmi H R 2013 Supply Chain Management of Ginger in Shimoga District of Karnataka. (Bangalore : University of Agricultural Sciences GKVK).
[18] Assefa T T, Meuwissen, M P M and Oude Lansink A G J M(2017 Price risk perceptions and management strategies in selected European food supply chains: an exploratory approach. NJAS - Wageningen J. of Life Sci. 80 15–26.
[19] Moon I, Jeong Y J and Saha S 2020 Investment and coordination decisions in a supply chain of fresh agricultural products Operational Res. 20 2307–31.