The Demand of Maize by Feed Mill in Indonesia During the Covid 19 Pandemic

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Abstract. Restrictions on maize importation by government in 2016 have resulted in limited stocks for livestock feed resources and stimulate an increase of maize prices in Indonesia. This will impact on the development of feed mill business as well as the sustainability of poultry industry in Indonesia. This study aims to analyse the demand of maize by feed mills during the Covid 19 pandemics and formulate the alternative strategies to support the development of maize industry in Indonesia. Total of 15 feed mills in Banten and East Java Province, Indonesia was interviewed to gather primary data as well as secondary data were applied related to maize purchasing, feed production, and strategies required to support feed mills business. The result found that purchasing of maize by feed mills in 2021 decreased by 2,2% from 2019, followed by decreasing feed production which reached about 3.4%. On the other hand, the price of maize has increased from IDR 4663 per kg to IDR 5873 in April 2022. This indicates that the availability of maize in the market diminished. To support the development of feed mill business, maize planting program is required to be continued supported by seeds innovation for dry land as well as infrastructure development to deal with water problem in majority maize development areas. Moreover, continue providing accurate data related to maize plantation and harvesting area as well as mapping the demand of maize for industry is also necessary. In addition, the procurements of alternative feed resources are also important to substitute maize in feed formula.

Keywords: Feed Resources · Livestock · Maize Importation

1 Introduction

The livestock feed industry is one of the most important industries in Indonesia, in fact it is one of the industries that grew in the early days of Indonesia's development. This industry has a strong forward linkage to the livestock sector, while livestock also has a backward linkage related to the need for feed inputs, especially maize [1]. Haque et al. [2] mentioned that an important linkage between feed producers and livestock or farms who utilize feed were provided by livestock feed industry where backward linkage connects feed mill to collection of raw materials while forward linkage connects to distribution of

E. Widodo et al. (Eds.): ICESAI 2022, ABSR 28, pp. 118–131, 2023.
https://doi.org/10.2991/978-94-6463-116-6_16

feed. The fluctuation price of animal feed in the market influences the price of livestock commodity [3, 4], due to the cost of feed dominated about 60–70% of production cost of livestock commodity [2, 4, 5].

The structure of the feed industry in Indonesia is categorized into a loose oligopoly. Agustina [6] reported that feed industry had an average market concentration ratio of 41.33 percent; and the average value of the Minimum Efficiency Scale is 16.61 percent, indicating high barriers for new companies to entry the animal feed industry in Indonesia. Currently, the number of feed mills with large scale capacity was counted about 110 plants (including aquaculture feed) in 2021 spread in 10 provinces in Indonesia which most of them (about 74%) were concentrated on the island of Java. About 85 feed mills have been registered and reported their maize purchasing at Feed Directorate, Jakarta with their production capacity was about 27.1 million ton per year in 2020. This production capacity has increased about 34.7% from that capacity in 2019 which has reached 20.2 million ton per year [7]. Different production figures were reported by Feed Company Association that total of 110 plants have about 29.7 million ton in 2020 [8]. The case in Bangladesh showed that the number of commercial poultry was higher compared to in Indonesia which reached about 75,000 in 2012, hence this number has decreased every year since 2010 which reached about 114,000 feed mills with produced sufficient amount of feed [9].

Maize is one of the largest raw materials for livestock feed, counting for more than 55% to 72% [10, 11] that it plays a significant role in feed prices. For example, corn accounts for 51.4% of the total raw materials in broiler feed [12]. Other than as feed raw materials, maize is also commercial commodity as food, biofuels and other raw materials for industrial processes [13, 14] which estimated about 28% [11].

However, with the Covid-19 pandemic, the government has issued various policies that indirectly or directly affect the livestock industry. Firstly, the Large-Scale Social Restriction Policy (PSBB) issued by the government caused restrictions on community activities and the Indonesian Economy. Cappelli and Cini [15] asserted that Indonesian economy as well as the economy of other countries were threatened due to the failure of company performances. Moreover, restriction affected to transportation access, resulting in a decrease in consumption and the number of products purchased by the public. Restrictions on access to transportation hinder the movement of poultry players in the distribution of chicken meat between cities, resulting in supply chain management disruptions. Study by Budastra [16] reported the impact of Covid-19 on the livestock sector, namely disruption of supply chains of seeds, feed and medicines, operations, distribution and marketing of production.

Another government's policy was the restriction of maize importation established by The Ministry of Trade through regulation of Trade Ministry No 20 on April 2016. Restrictions on importation activities for livestock feed industry certainly become vulnerable for the price risk due to exchange rate fluctuations, various logistical issues, and various other issues, which cumulatively have a direct impact on the selling price of feed; then affects the selling price of livestock products. Restriction also become obstacle for animal feed mill in order to search maize with specific quality raw feed material [17], resulted in limited stocks for animal feed raw materials and triggered an increase in maize prices in Indonesia. Actually, this importation ban is also difficult to

be implemented because contradict with the ASEAN-China Free Trade Area (ACFTA) agreement [10].

According to the development of these various issues, this study aims to provide information related to the demand of maize by feed mills during the 19 pandemics in Indonesia and factors determined the demand of maize. This research will be useful for policymakers, in this case the Government of Indonesia, in developing policies to assist the growth of the animal feed business and hence the development of livestock in Indonesia.

2 Materials and Methods

This study that focused on the analysis of demand for maize by feed mills in Indonesia, were conducted in Banten and East Java Province where the feed mills industry was mostly located from September to November 2022. Total of 15 feed mills in Banten and East Java Province (7 feed mills in Serang District and 7 feed mills in Tangerang, Banten Province; and 2 feed mills in East Java Province) were surveyed and interviewed using open questionnaires in regards with the profile of companies, demand and purchase characteristics of maize, and others issues related to fulfil the demand. Data gathered combined with secondary data from Statistic/Website or information from Directorate General of Livestock and Animal Health were descriptively and statistically analyzed (percentage, mean).

3 Results and Discussion

3.1 Characteristic of Feed Mills

Generally, feed mills surveyed have started their operation for about 18 years, supported by around 146 permanent employees and 55 temporary employees. The feed mills areas were around 4–22 ha. Most of them were funded by domestic investment, and there were also companies sourced their capital from foreign investment. These companies (about 74% of them) produce especially poultry feed in the form of concentrate, mash (flour), pellet (granules) or crumble (fine grains), with varied product brands. Apart from producing poultry feed, the company also has other businesses such as livestock (14%), processing livestock products (2%), manufacture of animal feed other than poultry such as pig feed etc. (11%).

To ease their operation, companies were equipped by on average 10 silos to store their feed resources including maize with capacity 1000–5000 ton/silo. However, three companies reported owned 20–23 silos, while there were also the other three companies found having three small silos with capacity 250–500 ton/silos. Moreover, only one company surveyed reported having 1–2 driers with capacity 500 tons/day. The production capacity of Feed Mills can reach 5 million tons per year. Poultry feed products were still the main production in addition to other animal feeds, which reach 25,000–35,000 tons/month, while the production capacity of pig feed was only 600 tons/month.

In addition to internal support for the sustainability of the company's performance, feed mills required support from external which mainly to ensure the availability of raw material supply for maize. Most of companies connected to 10–20 suppliers while only 13% of them had less than 10 suppliers, and about 27% of them had more than 20 suppliers. These suppliers were officially registered by the company, in fact the number of unofficial suppliers can be more than the official ones, due to unofficial suppliers have subcontracted or signed an agreement with the company's official suppliers.

3.2 Volume and Price of Maize Purchased by Feed Mills in Indonesia

In general, the purchase of maize by feed mills has decreased during pandemic 19 from 2019 to 2021 which about 3.3% both for received maize and maize with 15% water content (Fig. 1). This might be the decreased of economic activity during lock down due to the implementation of Large-Scale Social Restriction Policy such as closing restaurant, physical and social distancing etc. which caused a decreasing of demand for agricultural product including chicken product, as well as decreasing purchasing power. Study by Surni et al. [18] reported that Logistics system were attached mostly due to the spread of Covid-19.

Main purposes of purchasing maize by Feed mills varied. According to interviewed with Feed Mills, purchasing maize by 93% of feed mills was aimed for poultry; while only 7% of feed mill purchased maize for pigs' feed. All feed mills mentioned that maize is main component in livestock feed, which used about 40–60%; if the price of maize increase, the percentage of maize in feed formula can be minimised at minimum 15–20%. For poultry feed purposes, the use of maize in feed for breeding was about 10–20%; for layer about 10–55% and for broiler was about 40–90%. Maize is the most commonly used cereal grain in the diets of intensively reared poultry which it contributed approximately 65% of metabolizable energy [19].

Moreover, the decrease of maize purchased by feed mills was also due to an increased price of maize which about 6–7% from 2019 to 2021 (Fig. 2). However, even the price of maize continued to increase in 2022, the purchasing volume was starting to increase in the same year which reached about 2.9 million ton in first quarter or increased about 26% compared to those number in the first quarter in 2019–2021 (Fig. 3). This increase indicates that the Indonesian economy is slowly strengthening, where people's purchasing power is starting to increase.

According to data from [7], the price of maize was likely to be constant during a year except in January and December the price has slightly increased (Fig. 4). This indicated that the price of maize influenced by decreased of maize stock in January-December, as an impact of the planting season and it is not a massive harvest yet. However, in 2022, the increased price of maize tends to increase from January to April from IDR 5372 to IDR 5739. This figure is the highest price of maize in Indonesia since 2019. The increase in maize prices has an impact on the prices of animal feed and poultry meat. The Ministry of Agriculture encourages maize business actors, independent breeders and the livestock feed industry to access corn that is being harvested in Central Java, East Java, Lampung, NTB, South Sulawesi, Southeast Sulawesi and South Kalimantan.

In addition, the average national price of maize both the prize received by feed mill and the price with a moisture content of 15 percent in Sulawesi were the lowest price

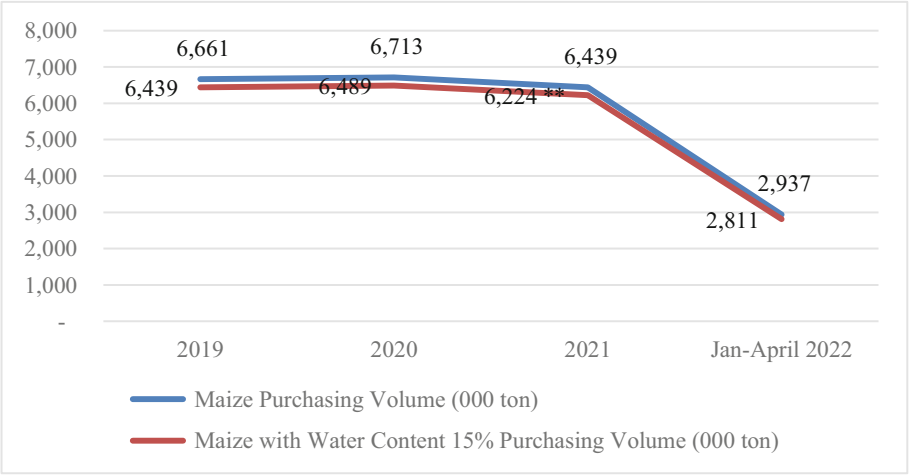
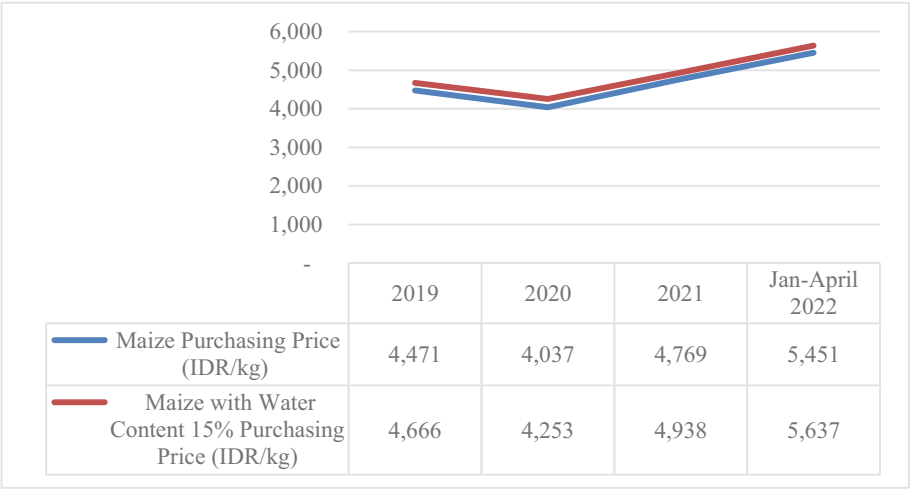


Fig. 1. Total volume of maize purchased by feed mills in Indonesia. Note: ** Figure is converted from volume of maize purchased in 2021 by 96.66% Source: [20] and [7]



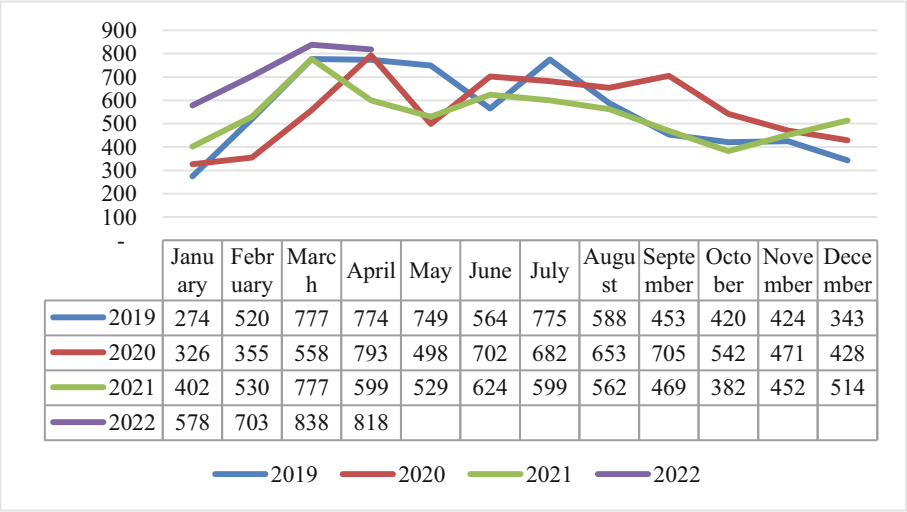
	2019	2020	2021	Jan-April 2022
Maize Purchasing Price (IDR/kg)	4,471	4,037	4,769	5,451
Maize with Water Content 15% Purchasing Price (IDR/kg)	4,666	4,253	4,938	5,637

Fig. 2. Trend of maize price purchased by feed mills in Indonesia. Source: [20] and [7]

compared to the other regions (Fig. 5). This might be many silos were located in Sulawesi which have already contracted with farmers, as a result the price received by feedmill were lower.

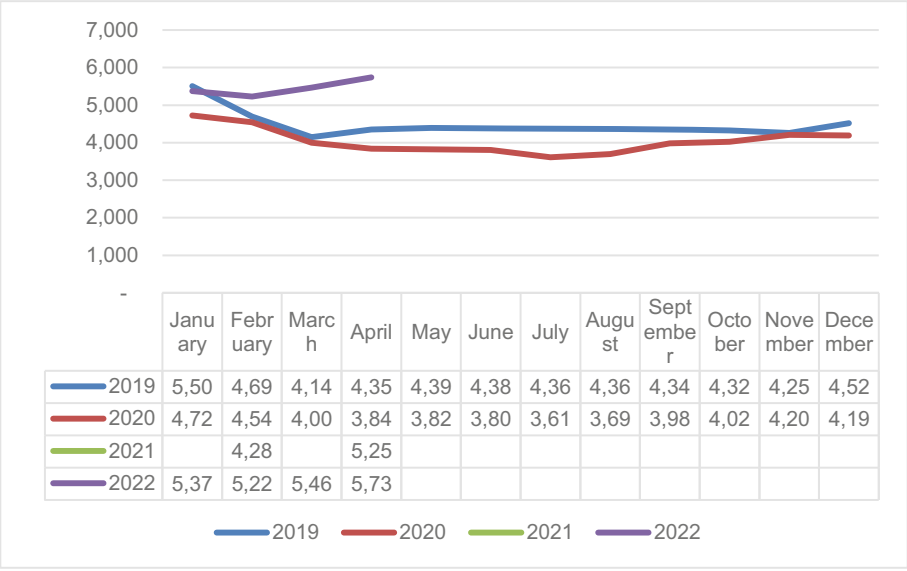
3.3 Stock of Maize at National Feed Mills

Maize stock at National Feed Mills has increased since 2019 which were counted about 697 thousand ton in January 2022 from 426 thousand ton of stock in 2019 (Fig. 6) or has increased about 63%. The increased stock was higher particularly in 2020 which



	January	February	March	April	May	June	July	August	September	October	November	December
2019	274	520	777	774	749	564	775	588	453	420	424	343
2020	326	355	558	793	498	702	682	653	705	542	471	428
2021	402	530	777	599	529	624	599	562	469	382	452	514
2022	578	703	838	818								

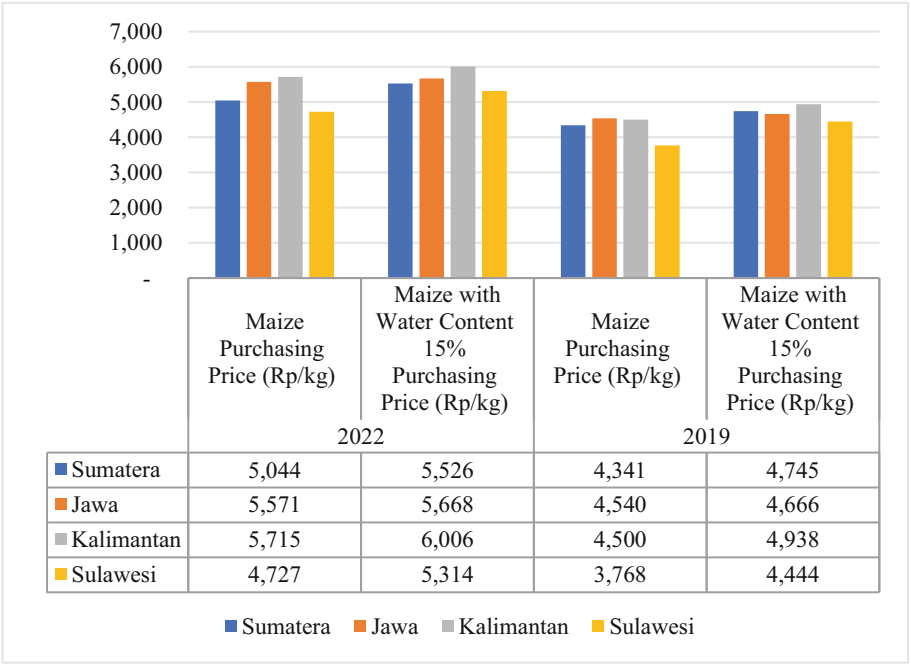
Fig. 3. Trend of maize volume per month purchased by feed mills in Indonesia (000 ton). Source: [20] and [7]



	January	February	March	April	May	June	July	August	September	October	November	December
2019	5,50	4,69	4,14	4,35	4,39	4,38	4,36	4,36	4,34	4,32	4,25	4,52
2020	4,72	4,54	4,00	3,84	3,82	3,80	3,61	3,69	3,98	4,02	4,20	4,19
2021		4,28		5,25								
2022	5,37	5,22	5,46	5,73								

Fig. 4. Trend of maize price per month purchased by feed mills in Indonesia (IDR/kg). Source: [20] and [7]

was about 65% due to increased purchase of maize in the same year (Fig. 1). Nevertheless, the production of livestock feed was lower. Although the number of Covid-19 suffered in 2022 is lower than in previous years, the economy needs time to recover. This recovery was hampered by the Russia-Ukraine war which caused a food security crisis,



	2022		2019	
	Maize Purchasing Price (Rp/kg)	Maize with Water Content 15% Purchasing Price (Rp/kg)	Maize Purchasing Price (Rp/kg)	Maize with Water Content 15% Purchasing Price (Rp/kg)
Sumatera	5,044	5,526	4,341	4,745
Jawa	5,571	5,668	4,540	4,666
Kalimantan	5,715	6,006	4,500	4,938
Sulawesi	4,727	5,314	3,768	4,444

Fig. 5. Trend of maize price purchased by feed mills per areas in Indonesia. Source: [20] and [7]

economic crisis and financial crisis. Rising world crude oil prices forced the Indonesian government to increased fuel prices which resulted in an increase in inflation. Inflation can be seen from the increase in the price of chicken feed, and prices of other agricultural commodities. Breeders reduced production and even close their businesses. That's why animal feed production is lower in 2022 compared to 2021 although it was still higher than 2019. In other words, the Indonesian economy continues to grow positively even though it does not meet the expected target. The highest stock was in Java Island, followed by Sumatera, Sulawesi and Kalimantan areas, the same distribution for every year.

Moreover, the trend of maize stock from January to December for every year was similar where in early year, the stock has increased from January to September and started going down in October to December except in 2019 the stock started going down in September (Fig. 7).

In accordance with that, the condition of maize sufficiency for the livestock feed industry rose from January to August or September 2019) and June (2020) before decreasing in the second half of the year (Fig. 8). Maize should be adequate for two months; however, the level of sufficiency has decreased since January 2021. The local maize prices continue to rise as the main harvest approaches in March-April 2021, which touched about IDR 6,100 per kg with a moisture content of 15 percent in North Sumatera. Due to the weakening of corn sufficiency, the price of feed in 2021 will increase with a price range of IDR 7,000 per kg - IDR 7,800 per kg.

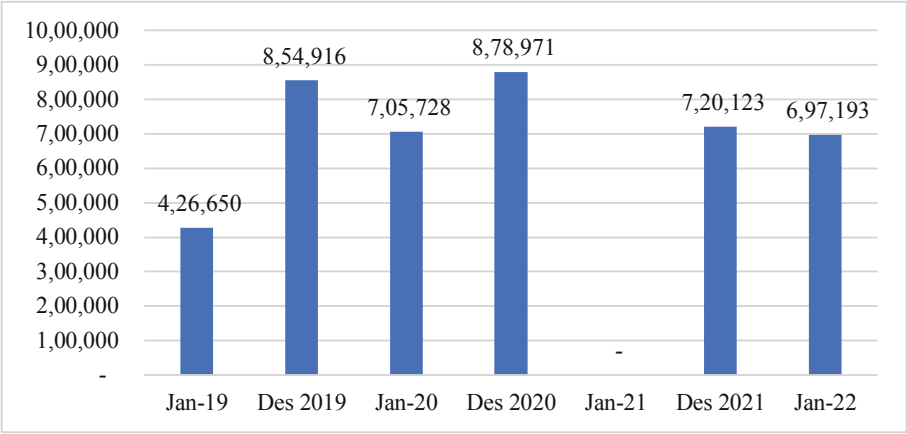


Fig. 6. Stock of maize at feed mills in Indonesia from 2019–2022 (ton). Source: [20] and [7]

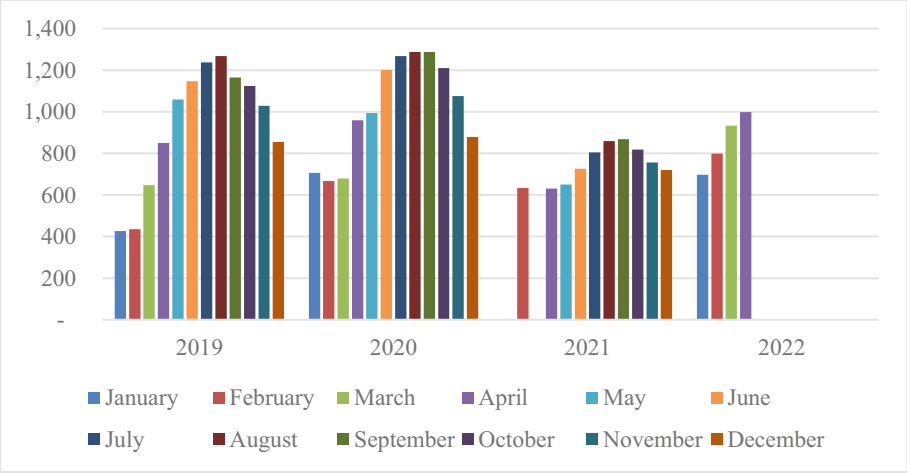
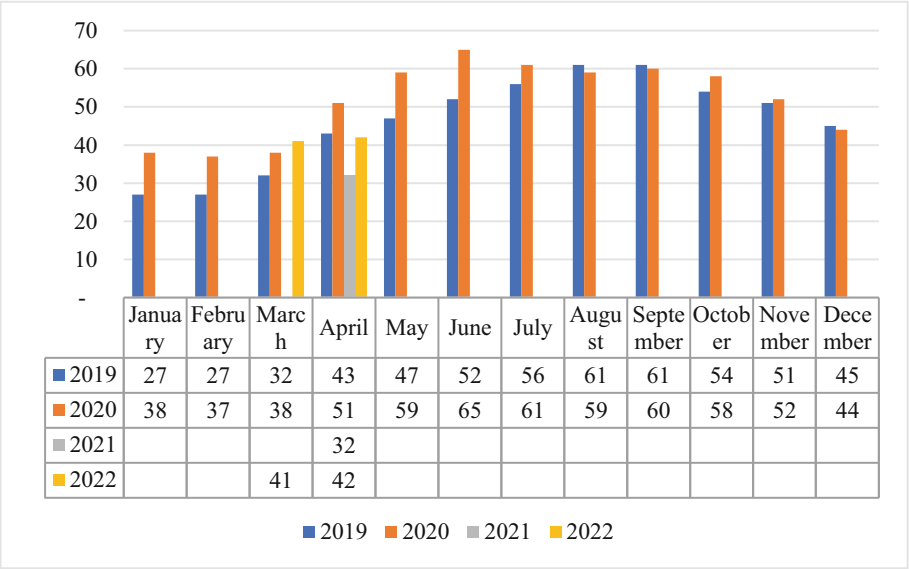


Fig. 7. Stock of maize per month at feed mills in Indonesia. Source: [20] and [7]

A small number of feed mills (7%) reported that maize was used directly to their production. To those who stored the maize in the silos were done some treatment both to the maize and the silos. Majority of feedmills treated the silos such as cleaning silo from clea, controlling the temperature and humidity, adjusting blower and spraying anti-fungal. Maize, on the other hand was sorted, cleaned and grinded before being stored in the silos.

3.4 Feed Production and Price

Feed production reached 20.5 million ton in 2019 and this number fell to about 19.8 million ton in 2021 or decreased about 3.4% and much more decreased in 2020 which



	January	February	March	April	May	June	July	August	September	October	November	December
2019	27	27	32	43	47	52	56	61	61	54	51	45
2020	38	37	38	51	59	65	61	59	60	58	52	44
2021				32								
2022			41	42								

Fig. 8. Trend of maize sufficiency at feed mills in Indonesia per month. Source: [20] and [7]

was about 7.8%. This might be because the extremely cases of pandemic in 2020, and this situation has slightly improved in 2021. In 2020 the average production of livestock feed companies was 336,761 ton/year, of which the monthly production was about 28,063 tons. In May and June, livestock feed production felt to 15,000 tons/month (Fig. 9), this was due to the Large-Scale Social Restriction Policy (PSBB) issued by the government as a result of the COVID-19 pandemic. However, in July to September 2020 production returned to normal, due to the adjustment of the PSBB policy, which loosened the distribution of logistics between regions in Indonesia.

On the other hand, in 2020 the price of livestock feed was almost constant which were on average about IDR 6,472 per kg (Fig. 9). This might be because The Government of Indonesia has encouraged feed mills company to not increasing the price of livestock feed.

The majority of livestock feed companies observed distributed their feed production both to open market as well as for internal/partnership needs, where 69% of the animal feed production produced by the company was distributed to the open market and the remaining 33% was distributed to the internal/partnership farm. However, about 18.18% of those feed mills sold feed only to open market.

3.5 Government Policy Supports

Existing Government Policy: Government of Indonesia has supported the development of feed mills business in several ways, including: 1) Developing a maize planting program in several corn food estate areas; 2) Providing free tax for imported feed resources such as wheat, pollard etc.; 3) Procuring alternative feed resources; 4) Intervening the selling price of maize at IDR 4,500 per kg; and 5) Validating/providing accurate

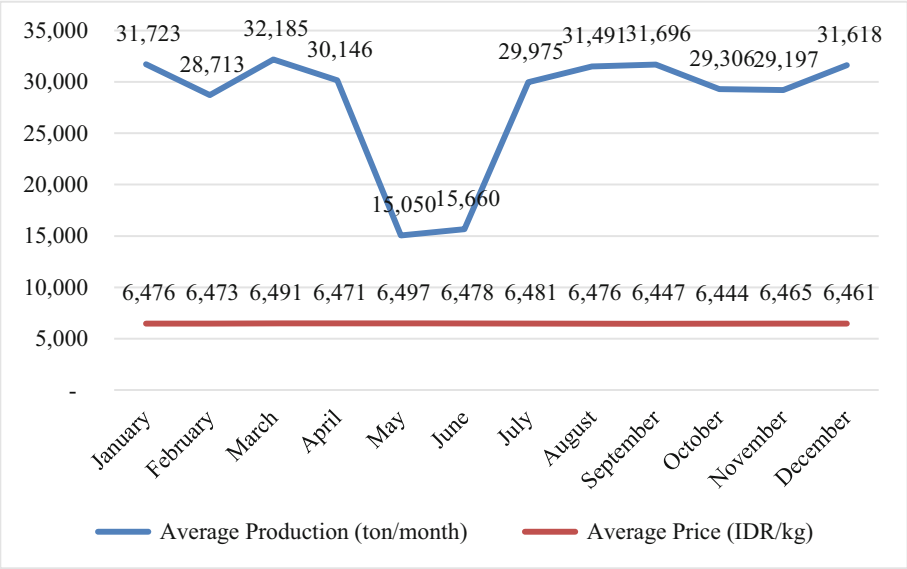


Fig. 9. Production and Price of Livestock Feed at feed mills in Indonesia per month. Source: Average data from feed mills report (unpublished)

data in regards with maize plantation area and harvesting area. These programs, however, have not greatly increased the availability of maize for feed mills.

The support on the development of maize through maize planting program has been a priority on Government Policy through Ministry of Agriculture by distributing good quality seed, fertilizer, or other technology in planting pattern. The study of market chain in Ethiopia recommended to improve maize production by farmers through identification of new technologies [21]. However, as other agricultural commodities, the maize production was subject to the condition of climate particularly in Eastern Indonesia such as Sumbawa, West Nusa Tenggara which was mainly dry land area. Maize can only be planted one time a year and only few areas was able to plant maize 2 times a year with a lower production. Consequently, the availability of this commodity was not stable during a year. This condition required maize seed that adapted to dry land condition. Indonesian Agency for Agriculture Research and Development (IAARD) have invented maize seed called JH-29, NASA-29, JH 37/BENINDO 701 and Bima-9/PREMIUM 919 which have been tried in Sumbawa District during the second planting season (in November-May). This possibly can be generated in other areas with the similar climate condition as in Sumbawa. In addition, the development of maize by intercropping was necessary to prevent land damage in maize planting areas as occurred in mountain slopes area specifically in Bima Regency.

Another government strategy to promote maize development was the exemption of import taxes on alternative feedstuffs that may be used to substitute maize, such as wheat, pollard, etc. However, due to a high demand for these alternative resources, the price of those resources has risen. Moreover, the availability of these substitute products was also fluctuated due to importation which also impacted on the price. The next policy

established by government was to in regards with the procurements of alternative feed resources, which this also subject to the sustainability of those resources.

Government of Indonesia has also intervened the selling price of maize at IDR 4,500 per kg which was beneficial for farmers. However, this policy incriminated the feed mill due to difficult to meet input production cost particularly when this policy was followed by another policy from government to ban feed mill to increase the price of animal feed. It is likely that government has to consider and evaluate this selling price of maize so then beneficial for farmers as well as for feed mill and poultry farms.

Finally, government program to validate/provide accurate data in regards with maize plantation area and harvesting area also become important to develop maize supply. Ministry of Agriculture established application to obtain data related to maize (production and harvesting) which was reported regularly by local government (in this case through Agricultural Agency). However, this application still has not represented actual data from the field, so then validating data program is required to be continued with some improvements such as by improving the Sampling Area Framework (KSA) method as the basis for calculating corn production figures.

Option for Improvements: To deal with those situations, the Indonesian government required to define new strategies to expand maize industry in order to support the development of feed mills industry in Indonesia. According to discussion with livestock feed companies, some government's policies improvements were required as mentioned in Table 1.

The stability of maize price seems become the highest priority of policy improvement as this factor affected the sustainability of feed production which also impact on the continuity of poultry farms in Indonesia particularly in research area. A study in Nigeria reported that price stabilization policy in maize will position and strengthen the maize industry and trigger the production of maize for sustainable food security [22].

In regard with the supply of maize, providing maize buffer by special logistic agency (BULOG) is also required to sustain the production of animal feed; as well as improvement in maize production by adoption technology to increase production. [10] reported that to be maize self-sufficiency, combination policies are required such as the increase of planting areal about 6.29% a year; increase productivity of maize by 3.5%; and implementation of price subsidy to increase maize price by 4.47%. Another study also suggested to expand maize cultivation area to increase production which also enhance the function of farmers as permanent maize suppliers [23].

Even though maize importation will impact on the price of local production and also increase the potency of other maize-substitution importation, this can be important during shortage period in particular. Research conducted in Ghana has also reported that to shift imports required various policies and investment option such as: 1) improved seed and technologies; 2) improved post-harvest handling strategies; 3) expanded irrigation; 4) enhanced storage capacity; and 5) improved infrastructure (road and transportation) [1].

Table 1. Expected government policy in maize industry

No	Alternative government policy	Percentage of Feed mills (%)
1	Control the price of maize through: a. price intervention or define minimum price for maize b. utilize logistic agency (such as BULOG) to purchase maize from farmers and sell it with standard price c. strengthen port capacity to increase logistics cost efficiency d. provide post-harvest facilities to maintain corn prices and quality during the main harvest	41.03
2	Sustain the supply of maize through providing maize buffer stock for 1–2 months	34.64
3	Develop potential region such as Sumbawa (West Nusa Tenggara) to produce maize through planting maize program, farmers' empowering, infrastructure development, ensure the availability of seed and fertilizer, and regulate planting season	10.24
4	Collaborate and coordinate among ministries for providing accurate data regarding to availability of maize as well as mapping the demand of maize for industry (not only for feed industry)	7.70
5	Government provides alternative feed resources in terms of price and availability	3.85
6	Maize importation particularly when low maize season	2.54

4 Conclusions

During Pandemic-19, the maize purchased by feed mills has decreased by 2.2%, impacted on decreasing of feed production by 3.4%. While the price of maize has increased from IDR 4663 per kg to IDR 5873 in April 2022 which indicated the shortage of maize. To increase the supply of maize requires an increase of production particularly in research areas such as by continuing maize planting program with introduction of seeds innovation for dry land area followed by improving infrastructure to access water, fertilizer, transportation etc. as well as introduction of post-harvest technology to obtain optimal products. Moreover, stabilization on the price of maize is needed by controlling price of maize, providing buffer stock; options for maize-substitution as well as maize importation during shortage time. In addition, providing accurate data related to maize plantation and harvesting area as well as mapping the demand of maize for industry are also necessary to be continued.

Acknowledgment. High appreciation to the entire team who engaged in the survey and interviews conducted in this research; staff or representative of Feed Mill who provided data and information related to maize; and staff of Agricultural Services Agency in research areas (Serang

District, Tangerang, Banten Province; and East Java Province). Finally, authors also acknowledge Indonesian Centre for Animal Research and Development (ICARD) who funded the research.

References

1. K. S. Andam, M. E. Johnson, C. Ragasa, D. S. Kufoalor, and S. DasGupta, "A Chicken and Maize Situation The Poultry Feed Sector in Ghana Kwaw," Washington D.C., (2017).
2. M. A. Haque, M. Akteruzzaman, M. A. Hashem, and S. Haque, "Profitability and forward linkage analysis of poultry feed mill in Bangladesh," *J. Bangladesh Agril. Univ.*, vol. 14, no. 2, pp. 201–208 (2016).
3. Nur Baladina, A. N. Sugiharto, R. Anindita, and F. Laili, "Price volatility of maize and animal protein commodities in Indonesia during the Covid-19 season," in *IOP Conf. Series: Earth and Environmental Science 803 (2021) 012060*, 2021, pp. 1–6, https://doi.org/10.1088/1755-1315/803/1/012060.
4. G. S. Becker, *Livestock Feed Costs: Concerns and Options.* Washington D.C.: Library of Congress. Congressional Research Service, (2008).
5. O. Alqaisi, N. OA, and H. T, "Global view on feed cost and feed efficiency on dairy farms," *All About Feed Mag.*, vol. 2, no. 4, (2011).
6. S. E. Agustina, "Analisis Struktur-Perilaku-Kinerja Industri Pakan Ternak Indonesia," Institut Pertanian Bogor, Bogor, Bogor, Indonesia, (2009).
7. Direktorat Pakan, *Pemanfaatan Jagung Lokal oleh Industri Pakan Tahun 2020*. Jakarta, Indonesia: Direktorat Jenderal Peternakan dan Kesehatan Hewan, (2021).
8. E. Suryanto, "Usaha Pakan Ternak dan Implementasinya," in Kegiatan Talkshow – Dinas Pangan dan Pertanian Kabupaten Sidoarjo 18 Oktober 2021, (2021).
9. M. A. Haque *et al.*, "An Analysis of Profitability and Resource Use Efficiency of Poultry Feed Mills in Bangladesh," in *30th International Conference of Agricultural Economists, July 28 - August 2, 2018*, 2018, pp. 1–23, [Online]. Available: https://digital.library.unt.edu/ark:/67531/metadc94242/.
10. Y. Ferrianta, N. Hanani, B. Setiawan, and W. Muhaimin, "Impact of Trade Liberalization Asean-China Free Trade Area (ACFTA) on the Performance of Indonesia Maize Economy," *J. Basic. Appl. Sci. Res*, vol. 2, no. 7, pp. 6801–6809, (2012).
11. E. Soare, I.-A. Chiurciu, A.-V. Balan, and L. David, "World market research on maize," in *Agric. Life Conference Proc.*, pp. 216–222 (2018).
12. B. Tangendjaja, Y. Yusdja, and N. Ilham, "Analisis Ekonomi Permintaan Jagung untuk Pakan," in *Makalah disampaikan pada Diskusi Nasional Jagung, 4 Juni 2002 di Bogor*, (2002).
13. S. H. Susilowati, E. Ariningsih, H. P. Saliem, E. Roosganda, C. R. Adawiyah, and Muksin, "Opportunities and challenges to increase corn export from Gorontalo Province of Indonesia," in *The 3rd International Conference on Food and Agriculture*, pp. 1–9 (2021).
14. M. Nedeljkovic', B. Krstic', and A. Maksimovic', "Analysis and forecast of foreign trade indicators of corn in Bosnia and Herzegovina," *Agro-knowl. J.*, vol. 19, pp. 265–274, 2019.
15. A. Cappelli and E. Cini, "Will the COVID-19 pandemic make us reconsider the relevance of short food supply chains and local productions?," *Trends Food Sci Technol*, vol. 99, p. 566 (2020).
16. I. K. Budastra, "Dampak Sosial Ekonomi Covid-19 dan Program Potensial Untuk Penanganannya: Studi Kasus di Kabupaten Lombok Barat," *J. Agribisnis Manjement Ext.*, vol. 20, no. 2, pp. 48–57 (2020).
17. L. Z. Rafsanjani, S. Hartoyo, and H. Sasongko, "Effect of Government Regulation on Import Quota of Maize: Case of The Indonesian Animal Feed Companies," *Int. J. Bus. Manag. Rev.*, vol. 5, no. 8, pp. 1–11 (2017).

18. Surni, D. R. Nendissa, M. A. Wahib, M. H. Astuti, P. Arimbawa, and M. M. J. K. and E. F. E. 5, Miar6, "Socio-economic impact of the Covid-19 pandemic: Empirical study on the supply of chicken meat in Indonesia," *Agric. Food*, vol. 6, no. 1, pp. 65–81 (2020).
19. A. J. Cowieson, "Factors that affect the nutritional value of maize for broilers," *Anim. Feed Sci. Tech. 119293–305.*, vol. 119, pp. 293–305, 2005, https://doi.org/10.1016/j.anifeedsci.2004.12.017.
20. Direktorat Jenderal Peternakan dan Kesehatan Hewan, "Sijagung: Sistem Informasi Serapan Jagung Lokal," 2022. http://simpakan.ditjenpkh.pertanian.go.id/sim1/backend/web/site/login (accessed Sep. 14, 2022).
21. K. Kusse, K. Kassu, and Y. Alemayehu, "Market Chain Analysis of Maize (Zea Mays) in South Omo Zone in South Nation Nationalities Peoples Region (Snnpr), Ethiopia," *Int. J. Res. Agric. For.*, vol. 6, no. 8, pp. 34–48 (2019).
22. H. Egwuma, F. Dutse, Y. U. Oladimeji, O. A. Ojeleye, O. O. Ugbabe, and M. A. Ahmed, "Demand and Supply Estimation of Maize in Nigeria," *FUDMA J. Agric. Agric. Technol.*, vol. 5, no. 2, pp. 12–20 (2019).
23. T. W. Widayati *et al.*, "Financial Feasibility Study of Establishment of Poultry Feed Mill in Bintuni District West Papua Province," in *The 7th International Seminar on Tropical Animal Production*, pp. 645–649 (2017).