

Mapping the Agribusiness Potency of Chicken Eggs in Indonesia: The Base Sector Analysis

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Abstract. The sector base mapping of chicken eggs is very important in the development of agribusiness nationally in Indonesia. The novelties of this study are to examine the economic potential of chicken egg agribusiness, and to map the agribusiness potency of chicken eggs by province in Indonesia. The purpose of the study was to analyse: i) mapping of chicken egg production and consumption by province in Indonesia, ii) mapping of the surplus/deficit of chicken eggs by province, iii) base sector of chicken egg by province in Indonesia. Secondary data were obtained from the Statistics of Indonesia (BPS-*Badan Pusat Statistik*) since 2010 until 2020. Data analysis uses quantitative descriptive and determination of base sector with a Location Quotient (LQ) approach which aims to determine the base sector of chicken egg in all provinces in Indonesia. The results showed that there are seven provinces in Indonesia that have more than 150×10^6 t of chicken eggs in one year, the largest of which is East Java Province. The findings of the chicken base sector are expected to be used as a basis for agribusiness actors in finding market opportunities and distribution strategies of chicken eggs.

Keywords: Agribusiness potency, base sector, location quotient.

1 Introduction

Chicken eggs are sources of animal protein, vitamin and mineral needed by consumers from all segments, so the need is very large. Egg consumption is needed by all societies. The level of egg consumption is going to increase from year to year. In 2020 it was recorded that the national chicken egg consumption was $5.67 \text{ kg capita}^{-1} \text{ yr}^{-1}$ [1]. The high consumption of chicken eggs is due to the public's need for animal protein for nutritional fulfillment. The

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amount of egg production is also sufficient for needs, including during the Covid-19 pandemic [2, 3]. Among animal protein sources, egg is the cheapest compared to chicken, fish, and beef [4, 5]. People with low incomes [(IDR 1.2×10^6 to 1.5×10^6) mo^{-1}] can afford to buy eggs for family consumption [6]. Therefore, the fulfillment of egg consumption needs for the community needs to be supported by production in their respective regions so that the distribution process is close and transportation costs are cheap.

The potential of the region to produce chicken eggs is not the same because there are differences in the suitability of environmental conditions and the cultural skills of livestock farmers are also diverse. Therefore, the production capability in an area compared to the consumption needs of its population will have an impact on surplus or deficit. If egg production is greater than the need for consumption, then an area is in surplus if the opposite means a deficit. Areas that have surplus egg production will become the basis of egg production and can distribute eggs to other regions. On the contrary, areas that experience deficits must be supplied from surplus areas. In the national agribusiness development policy, the sector base map is very important.

Previous research on egg agribusiness has been carried out with various approaches. Eggs are produced from chicken agribusiness with the dynamics of its performance [7]. Consumers are willing to pay for chicken eggs that contain antioxidants more expensive than conventional eggs because consumers rate AO eggs as better than conventional eggs in terms of nutritional content and health benefits [6]. Organic chicken eggs have also been studied in the consumer aspect, where consumers are more than 20 % of consumers are still willing to slaughter organic chicken eggs 10 % more expensive than the price during the study [5]. The quality of organic eggs is influenced by genotype, feeding and feed quality [8]. Among the studies on chicken eggs, no one has yet studied their economic potential with the LQ approach. The first novelty of this study is to examine the economic potential of chicken egg agribusiness with an LQ approach.

Several previous studies have examined sector bases on certain commodities or sectors in an area. Sector base research to see economic growth was carried out in Medan City using Gross Regional Domestic Product (GRDP), where agribusiness-related sectors that are the base sector are large trade and retail, as well as the provision of accommodation and drinking food [9]. While the LQ analysis using GRDP in Padang City shows that agricultural sector is not the base sector [10]. However, there has been no comprehensive study of the chicken egg base sector by province. The second novelty of this study is to map the agribusiness potential of chicken eggs by province in Indonesia. The purpose of the study was to analyze the map of chicken egg production and consumption per province in Indonesia, the map of chicken egg surplus/deficit per province and find the chicken egg base sector per province in Indonesia.

Research on agribusiness of broiler chicken eggs or poultry eggs based on secondary data is still very limited. Some of the previous research was traced from national and international journal publications to obtain an overview of the realm of research on eggs macro in Indonesia. As a comparison, research on eggs from secondary data abroad was also traced from international journals, but the number was also limited. As a complement, previous research on chicken eggs sourced from primary data was also studied to provide an overview of the achievements of egg agribusiness research. The following paragraph presents the results of a search of previous research.

The production and consumption of poultry eggs in Lampung Province was carried out using the Ordinary Least Square (OLS) method with time series data from 2000 to 2013. The results showed that the production of poultry eggs in 2013 was 51.39×10^3 t and the average growth rate was $3.64 \% \text{ yr}^{-1}$ [1]. Meanwhile, the consumption of chicken eggs in Lampung Province in 2013 amounted to 51.33×10^3 t and the average growth rate was $2.48 \% \text{ yr}^{-1}$.

Since the growth rate of production is higher than the growth rate of consumption, the projected production will be greater than the consumption from 2026.

Analysis of variables that affect the demand for chicken eggs and the elasticity of chicken egg demand in Magetan Regency with the Cobb-Douglas demand function with the OLS method. The results of the analysis showed that the price of purebred chicken eggs, the price of chicken meat, the price of rice, the number of residents and per capita income influenced the demand for chicken eggs in Magetan Regency [11]. The price elasticity of purebred chicken eggs is negative (-0.280) and is inelastic. Cross elasticity in the price of chicken meat is positive (0.911) meaning that chicken meat is a substitute item (substitute) of chicken eggs. The cross-elasticity of rice prices is negatively valued at less than one (-0.233), meaning that rice is a complementary (companion) item of chicken eggs. The elasticity of income of negative value (-0.476) means that purebred chicken eggs are inferior goods.

The Location Quotient (LQ) method with a labor approach is used in determining superior commodities in Purwaharja district, Banjar City. The results of the analysis show that Purwaharja district has seven types of businesses on which [12]. Ranked first and second with a value of 4.93 LQ are types of bamboo handicraft and pallet business. The third basic type of business is the Ranganang type of business/production with an LQ of 4.48. The egg-based business that is the base sector is salted eggs with an LQ of 1.04.

The dynamics of the performance of local chicken agribusiness in Indonesia consists of three maintenance patterns that are currently still being carried out, namely extensive, semi-intensive and intensive. Intensive chicken business can increase productivity and business income [7]. The market share of local chicken products is still very open with its own market segment. Local chicken businesses for the purpose of egg and meat production are able to provide decent economic benefits for all actors, namely, breeders, cultivators, traders, distributors and retailers. Strengthening cooperative equivalent institutions engaged in the activities of the upstream subsystem and the downstream subsystem can increase the income of farmers. This can be done through businesses that are managed individually and businesses managed by cooperatives, so as to realize improvements in the efficiency of local chicken businesses.

LQ and shift-share analysis was used in analyzing the advantages of the role of the agricultural sector on the GRDP of Lamongan Regency in 2011 to 2015. The results showed that the forestry and agriculture subsector is one of the mainstay sectors, where the growth of the agricultural sector in East Java Province has a positive effect on the growth of the agricultural sector in Lamongan Regency [13].

Business sectors that have not reached the base and advanced categories in the city of Padang are analyzed using the LQ method. As for knowing the forward or backward sectors, shift-share analysis is used. The results of the LQ analysis show that there are two non-base sectors in Padang City, namely (i) the agriculture, forestry and fisheries sectors, (ii) mining and quarrying. Furthermore, the shift-share analysis shows four sectors that are in the backward/sluggish category, namely the sectors: (i) agriculture, (ii) forestry and fisheries, (iii) the treatment industry, water procurement, waste management, waste and recycling, (iv) financial services and insurance [10].

Hutapea et al. [9] analyze sectors that are included in the base and non-base and how economic competitiveness is in increasing economic growth in Medan City. The analysis methods used are LQ and shift-share. The results of the study based on the results of the LQ analysis there are twelve base sectors, namely: water procurement, waste treatment, waste and recycling sectors; construction; large and retail trade, repair of cars and motorcycles; transportation and warehousing, provision of accommodation and drinking meals; information and communication; financial services and insurance; real estate; corporate services; education services, health services and social activities and other service sectors and five other economic sectors become the non-base sector of Medan City. The results of

the shift-share analysis obtained the sectoral results, almost all economic sectors in Medan City have a positive differential shift value which means that these economic sectors have strong competitiveness or have a highly competitive advantage compared to the same sector in the North Sumatra economy.

Mo et al. [14] analyzed changes in the import of Gwangyang Port using shift-share, LQ and BCG matrix techniques. A standard shift-share analysis and spatial shift-share analysis were carried out for the period 2010 to 2018 to find out the import performance of Gwangyang Port for coal, iron ore, natural gas, and vegetables. Static analysis shows that the effects of regional shifts, which are the most important components, are negative for coal and iron ore, but positive for natural gas and vegetable materials. Spatial shift-share analysis also shows that Gwangyang Port is not only experiencing advantages in regional competitiveness but industrial advantages for iron ore, natural gas, and vegetable materials due to its higher competitiveness. Incorporating LQ into the BCG matrix for coal imports, we also show that Gwangyang Port is successfully improving its position for natural gas and vegetables.

Various previous studies have not specifically analyzed the sector base on livestock commodities. In fact, livestock commodities, especially eggs, are very strategic in meeting the needs of regional food security and ultimately supporting national food security. LQ's approach to egg commodities that is detailed nationally based on data by province will contribute to the mapping of the national egg commodity base sector.

LQ is a relative specialization index widely used in the literature on agglomeration economics [15]. In agricultural and agribusiness economics research, the LQ concept is widely used to determine the sector base of a commodity. LQ uses benchmarks of the level of industrial specialization at the local level against the level of industrial specialization of the entire national economy. A sector or a commodity meets the basicity criteria if the LQ value > 1. In agricultural and agribusiness economics research, the LQ concept is widely used to determine the sector base of a commodity. LQ uses benchmarks of the level of industrial specialization at the local level against the level of industrial specialization of the entire national economy. A sector or a commodity meets the basicity criteria if the LQ value > 1 [12, 16]. LQ analysis can use production [17], GRDP based on labor or expenditure approach [12].

This study has similarities in examining the potency of agribusiness. The research aimed to analyze: i) the production mapping of chicken eggs at each province; ii) map of chicken egg surplus/deficit per province; and 3) the base sector of chicken egg at each province in Indonesia.

2 Methods

This study used secondary data obtained from Statistics of Indonesia (*Badan Pusat Statistik/BPS*). The data used include: 1) data on the production of chicken eggs by province in 2018 to 2021; and 2) production data of other types of eggs by province in 2018 to 2021.

Data analysis uses quantitative descriptive and determination of sector bases with a Location Quotient (LQ) approach. The description includes narratives about production and consumption, as well as surpluses and deficits of chicken eggs in each of the province. The description is equipped with tables and graphs to visually amplify the data picture. The LQ formula is used in Equation (1):

$$LQ = \frac{\frac{\text{Prod-CE Prov}}{\text{Prod-E Prov}}}{\frac{\text{Prod-CE Ina}}{\text{Prod-E Ina}}} \quad (1)$$

Where,

- LQ = Location Quotient (base sector if LQ > 1)
- Prod-CE Prov = Production of chicken egg at province level

- Prod-CE Ina = Production of chicken egg at national level of Indonesia
- Prod-E Prov = Production of egg at province level
- Prod-E Ina = Production of egg at national level of Indonesia

Production indicators are used to calculate LQ on various sectors [10]. The use of production indicators in LQ calculations is also used by Pereira-López et al. [17]. The criteria of this analysis if the result $LQ > 1$ then the activities of the sub-sector of the industry is said to be the base sub sector, whereas when the $LQ < 1$ then the activities of sub-sector industry is said to non-base.

3 Results and discussion

3.1 Map of chicken egg production and consumption per province in Indonesia

The BPS data shows that chicken egg production based on provinces in Indonesia is quite diverse, there are provinces that have very high chicken egg production, but some are very low so that they are not visually visible in Figure 1.

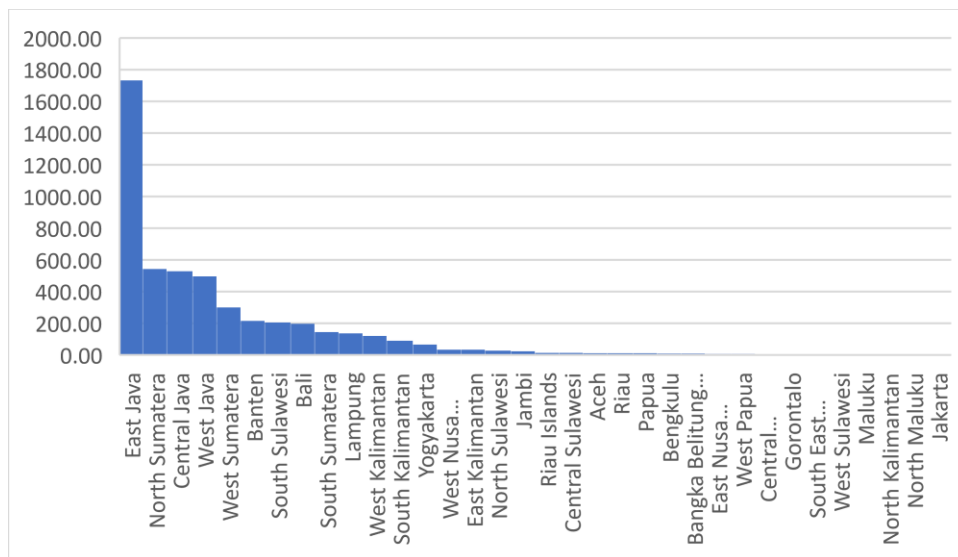


Fig. 1. Production of chicken eggs in 2020 based on province (t)

Figure 1 shows that East Java as the province with the highest number of laying hen production in Indonesia with a total of 1 674 356.27 t, followed by Central Java Province with a total of 668 670.98 t. DKI Jakarta is a province that does not produce chicken eggs. The average production of chicken eggs per province in Indonesia in 2021 is 151 647 t [18].

3.2 Map of chicken egg surplus/deficit per province

The map of egg surplus/deficit in each province is calculated based on the difference between egg production and consumption. Egg production data by province has been known from BPS data. Egg consumption data based on production is calculated from national egg consumption data to obtain per capita egg consumption data. Table 1 presents data on

national egg consumption and population for 2018 to 2019. Furthermore, from the data, per capita egg consumption is calculated in 2018 to 2020.

The average chicken egg consumption per capita in 2020 is used as the basis for calculating egg consumption per province. The assumption used is that the average per capita egg consumption in each province is equal to the national per capita egg consumption. Furthermore, the per capita egg consumption figure multiplied by the total population of each province is found to be the calculation of egg consumption per province, which is used as the basis for calculating the surplus or egg deficit of each province. Table 2 presents a map of the surplus or deficit of chicken eggs by province in 2020.

Table 1. The calculation of egg consumption per capita.

Description	2018	2019	2020
National consumption (t) (a)	1 521 349	1 587 462	1 654 916
National population (thousand) (b)	264 161.6	266 911.9	269 603.4
Consumption per capita yr ⁻¹ (C = a b ⁻¹)	5.76	5.95	6.14

Source: Statistics of Indonesia, analyzed.

Table 2. Map of chicken egg surplus/deficit by province in 2020.

Province	Production (t)*	Consumption (t)**	Surplus/deficit (t)***
Aceh	13 065 870	33 073 963	(20 008 093)
North Sumatera	543 804 010	90 837 537	452 966 473
West Sumatera	301 529 890	34 041 365	267 488 525
Riau	12 972 430	42 668 795	(29 696 365)
Jambi	24 091 980	22 123 787	1 968 193
South Sumatera	145 182 250	52 794 592	92 387 658
Bengkulu	11 505 400	12 241 682	(736 282)
Lampung	138 833 680	52 389 462	86 444 218
Bangka Belitung Islands	11 227 450	9 022 125	2 205 325
Riau Islands	14 843 480	14 176 485	666 995
Jakarta	-	64 921 487	(64 921 487)
West Java	497 577 430	304 247 804	193 329 626
Central Java	530 220 190	213 234 711	316 985 479
Yogyakarta	66 692 800	24 057 363	42 635 437
Jawa Timur	1 732 437 320	245 262 701	1 487 174 619
Banten	216 888 230	79 155 672	137 732 558
Bali	197 716 890	27 097 066	170 619 824
West Nusa Tenggara	36 024 910	32 078 325	3 946 585
East Nusa Tenggara	9 749 420	33 843 096	(24 093 676)
West Kalimantan	122 467 640	31 335 587	91 132 053
Central Kalimantan	7 843 230	16 489 409	(8 646 179)
South Kalimantan	92 089 450	26 202 097	65 887 353
East Kalimantan	35 387 880	22 495 156	12 892 724
North Kalimantan	644 210	4 348 397	(3 704 187)
North Sulawesi	28 215 630	15 425 022	12 790 608
Central Sulawesi	14 681 730	18 916 507	(4 234 777)
South Sulawesi	206 598 220	54 562 433	152 035 787
South East Sulawesi	3 005 080	16 594 989	(13 589 909)
Gorontalo	4 052 960	7 281 907	(3 228 947)
West Sulawesi	2 603 180	8 459 240	(5 856 060)
Maluku	657 100	10 969 819	(10 312 719)
North Maluku	93 810	7 687 037	(7 593 227)
West Papua	8 729 250	6 052 398	2 676 852
Papua	12 961 970	20 827 985	(7 866 015)

* Statistics of Indonesia (BPS) [18].

** Analyzed from egg consumption per capita and population.
 *** Production minus consumption.

Provinces that have a huge surplus of chicken eggs can at least be mentioned successively are East Java, North Sumatra, West Sumatra, Central Java, West Java, Bali, and South Sulawesi (Table 2). Meanwhile, the provinces with the largest deficits are DKI Jakarta, Riau, Aceh, East Nusa Tenggara, Central Kalimantan, and North Kalimantan. The mini egg deficit surplus map can be used as a reference for the egg distribution map from surplus areas to deficit areas.

Marketing of egg commodities should take into account the distance and travel time, as well as the degree of risk of damage to eggs due to physical impact in transit and travel time that must take into account the age of the eggs so as not to spoil. Therefore, the distribution of eggs from surplus areas to deficit areas needs to pay attention to efficiency in transportation [19]. For example, the fulfillment of egg needs in DKI Jakarta Province should be met from the nearest surplus area, namely West Java. Likewise, the fulfillment of the egg deficit in Riau and Aceh should be met from the nearest surplus areas, namely from North Sumatra and West Sumatra. The supply of eggs to the deficit province from the nearest surplus province will save on transportation costs [19].

3.3 The base sectors of chicken eggs per province in Indonesia

The egg base sector of chickens is calculated by the LQ method based on the egg production of chicken eggs, free-range chickens, and ducks at the provincial and national levels. The three types of eggs have data availability in BPS. Chicken production is the largest among the three types of eggs, so the egg production map and the base sector are carried out on the egg type of chicken eggs. Figure 2 presents the provincial order of the largest LQ values of 2020.

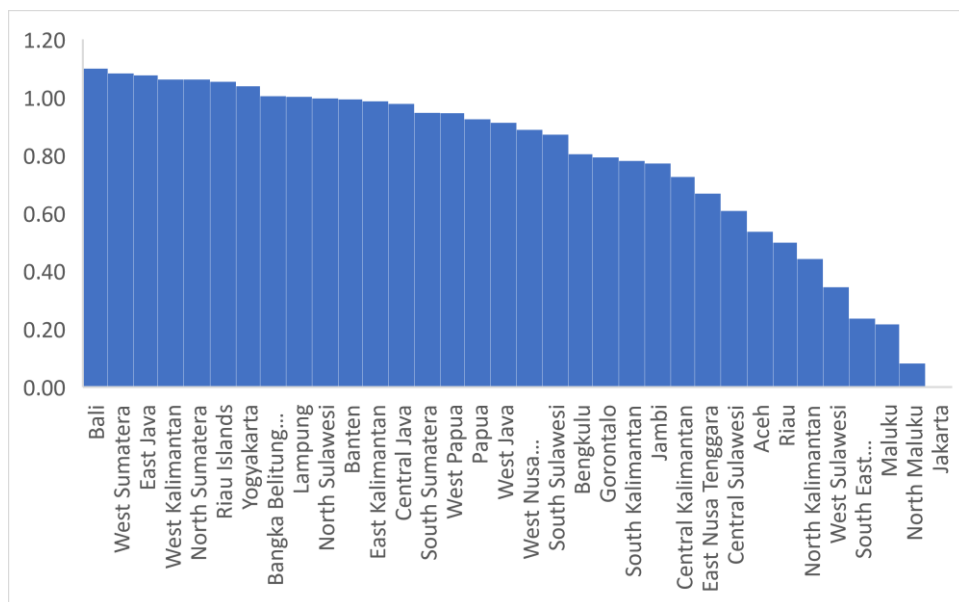


Fig. 2. The location quotient of chicken eggs by province in 2020.

Figure 2 shows that the three provinces that have the highest LQ value are West Sumatra with a value of 1.106, East Java with a value of 1.094 and DI Yogyakarta with a value of

1.086. While the three provinces that have the lowest LQ value are West Sulawesi with a value of 0.167, North Maluku with a value of 0.064 and DKI Jakarta with a value of zero. In 2020, it was recorded that out of thirty-three provinces there were nine provinces that became Indonesia's flagship, especially in laying hen commodities, this was evidenced by the results of the LQ analysis showing the number > 1 . The nine provinces include West Sumatra, East Java, DI Yogyakarta, North Sumatra, Central Java, Bali, North Sulawesi, West Kalimantan and Banten. Meanwhile, in addition to the provinces that are not mentioned, they are non-bases for laying hen commodities. The need for eggs from provinces with an LQ value of < 1 must be supplied from other provinces that are the base sector [16].

Based on LQ calculations, East Java does not rank first, even though East Java's production ranks first with production much higher than the second and third place provinces, namely West Java and Central Java. The small LQ value in East Java is due to the number of other types of egg production is also quite large compared to other provinces. It is worth remembering that this calculation of LQ uses the approach of egg production of various types. The weakness of this calculation can be corrected by LQ analysis based on labor absorption or GRDP (Gross Regional Domestic Product).

The improvement of the LQ figure presentation is carried out by selecting only provinces with $LQ > 1$ (Figure 3). This LQ display restriction clarifies the visual appearance of the province with the largest LQ value.

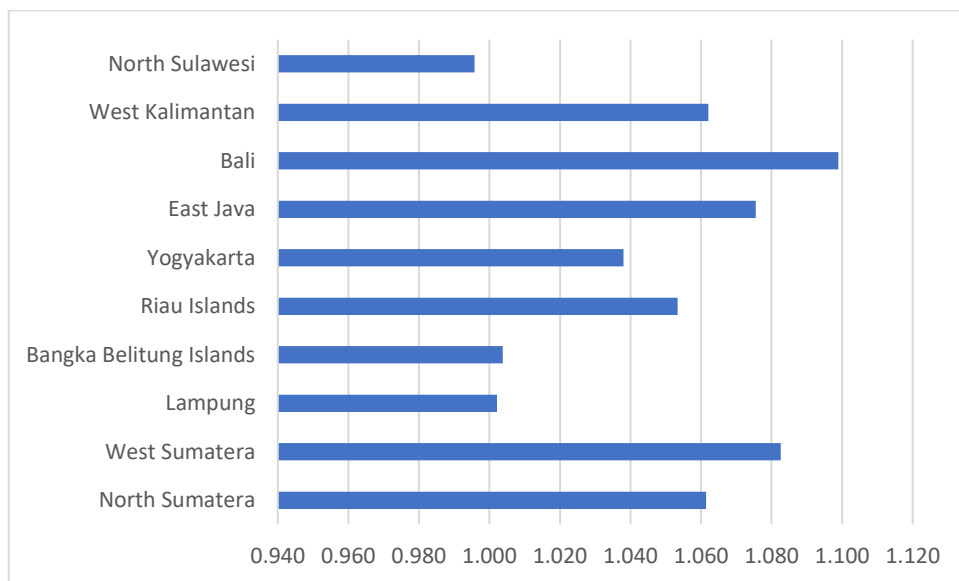


Fig. 3. LQ > 1 of chicken eggs by province in 2020.

Figure 3 shows that the three provinces that have the highest LQ value are Bali, West Sumatera, and East Java, with the LQ value of 1.099, 1.083, and 1.075 respectively. The three provinces were able to maintain the achievement as the top three in the order of the highest LQ score holders since 2020. Meanwhile, the three provinces that have the lowest LQ value are North Kalimantan with a value of 0.21, North Maluku with a value of 0.03 and Jakarta with a value of zero. In 2020, it was recorded that out of thirty-three provinces, there were eight provinces that became Indonesia's flagship, especially in the peteur chicken commodity, this was evidenced by the results of the LQ analysis > 1 . The LQ value of > 1 means that the province has a relatively higher concentration of laying hen egg production than the national concentration [12]. The nine provinces include West Sumatra, East Java, Yogyakarta, North Sumatra, West Kalimantan, Central Java, Bali,

and North Sulawesi. Meanwhile, apart from the provinces that are not mentioned, they are non-superior in laying hen commodities. Provinces that are not the flagship of egg production. become an opportunity for other provinces' egg agribusiness to supply deficit areas [9, 12].

The results of the location quotient analysis provide valuable insights into the geographical distribution of chicken egg production. Regions with significantly elevated location quotients indicate a concentration of conventional chicken egg production, highlighting the prevalence of industrial-scale farming practices. Interestingly, these findings also bear relevance to the willingness of consumers to pay a premium for organic chicken eggs, as found by research in East Java Province [20]. In this province, increasing environmental awareness has begun to motivate consumers to consume organic food, including organic eggs and vegetables [21].

The convergence of location quotient analysis and consumer behavior underscores the role of local agricultural practices in shaping market dynamics. Policymakers and producers can leverage these insights to tailor strategies that align with regional preferences and potentially stimulate the adoption of more sustainable farming practices. Further research could delve deeper into the specific factors influencing consumer choices in different regions, shedding light on the complex interplay between production patterns, consumer preferences, and the broader agricultural landscape.

4 Conclusion

The study results show that there are seven provinces in Indonesia who have more than 150×10^6 t of chicken eggs in one year, which is the biggest one is East Java Province. Among of them, there are nine provinces who have the LQ value more than one, which is meant that those provinces are the base sector of chicken egg in Indonesia. The base sector provinces can export, namely distributes the chicken eggs to other provinces who are deficit of the commodity. The research found that the biggest production is not always followed by the biggest LQ since the production of others egg also high. Therefore, the superior mapping of egg agribusiness is not enough just with LQ but must also take into account the egg production of chickens and the surplus position after deducting the consumption of the population.

Further research needs to analyze the LQ based on the labor force and or Gross Regional Product of chicken eggs and other kinds of egg. The improvement of the base sector analysis based on LQ and potential surplus/deficit in each province helps to map the potential of egg agribusiness and is a consideration for egg commodity agribusiness actors.

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