Assessment of Local Chicken Production Base Area in Minahasa Regency: A Location Quotient Approach

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ABSTRACT

Local chickens have considerable potential to be developed and are reared as a source of animal protein and income. The production of local chickens is distributed across Minahasa Regency under a traditional free-ranging system. This study aims to assess the base area of local chicken farming and to determine the distribution of the superior commodity through the growth and share of local chicken production. Assessing the base area of the region for local chicken production can serve as the basis for the evaluation and design of policies. This study utilized a location quotient (LQ) approach in the empirical works in the regency and district. This analytical tool was applied to analyze the dynamics of the economic base in the cases of districts in Minahasa Regency, Indonesia. The analysis results denoted that 17 of 25 districts in Minahasa Regency ranked among the top base areas for local chicken development, as indicated by the highest LQ coefficients. Concerning the district potential base area, three districts fell into the superior category, four districts belonged to the static category, and 15 districts were in the potential category. This evidence reflects the potential and prospects of local chicken farming and its development plans as a leading commodity in Minahasa Regency. Encouraging farmers to maintain and develop livestock enterprises could support the provision of animal protein for consumption. There has been hope for the future of the local chicken commodity thanks to its inclusive development in resource-rich base areas.

Keywords: Base area; Growth; Local chicken; Location Quotient (LQ); Share

INTRODUCTION

Livestock are crucial for rural livelihoods and the economy (Herrero et al., 2013). Keeping livestock is a component of a strategy to diversify sources of income (Danso-Abbeam, Ogundei, Asale, & Baiyegunhi, 2024). It has been demonstrated to be among the best strategies for addressing food insecurity and alleviating poverty (Christian, Wilson, Aryeetey, & Jones, 2019; Sargison, 2020). The production of livestock improves household food security by allowing easy access to high-quality protein foods (Adesogan, Havelaar, McKune, Eilittä, & Dahl, 2020). Increased food security, livestock ownership in rural households, and the importance of micronutrients to fight malnutrition are associated with a better diet (Ali & Khan, 2013). As the
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population rises, animal production needs to escalate to ensure food security in developing countries (Abu Hatab, Cavinato, & Lagerkvist, 2019).

The potential for achieving food security, creating jobs, and improving equity in poultry farming, in particular in rural areas, is considerable (Guèye, 2009). The quantity and quality of poultry products, in particular meat and eggs, serve as an indication of the development of local chicken farms based on food security (Wong et al., 2017). Both products are described as affordable and valuable sources of protein in quantities that are easy to obtain and manage (Muzayyanah, Putra et al., 2021). Local chickens have been depicted to provide a practical and effective way of alleviating severe rural poverty (Kpomasse et al., 2023). Chickens may be bartered as an asset, and proceeds from the sale of local chickens provide funding to meet basic needs for human survival (Camus et al., 2020). However, production and efficiency levels are still low and restricted by numerous social, financial, and market factors (Alemayehu, Bruno, Getachew, & Dessie, 2018).

North Sulawesi Province could be alleviated geographically through local poultry farms. The development of local poultry livestock in this province has positive potential and opportunities to advance poultry meat self-sufficiency in the future (Wantasen & Paputungan, 2017). Local chicken meat is mostly consumed in Minahasa Regency (Elly, Manese, Santa, & Lumenta, 2015), obtained from their farm and partly acquired by purchasing (Silondae, Muzayyanah, Sulastri, & Guntoro, 2022a). However, local poultry farming in North Sulawesi has experienced impediments in its development, one of which is due to the accelerating population in the province (Najoan, Elly, Leke, & Bagau, 2018). The rise in population in this province has caused limited land for local poultry rearing and the conversion of other purposes (Rotinsulu, Runtunuwu, Walangitan, Paat, & Zaini, 2022).

Recent empirical studies on local chicken livestock have consistently revealed its potential to boost population and domestication (Hata et al., 2021), improve genetics (Ramadan et al., 2024), assess the meat quality (Zidane, Ababou, Taherti, Metlef, & Gadouche, 2023), enhance productivity performance (Zouaoui et al., 2023), and escalate farmer well-being and market participatory (Manzvera, Mutandwa, Katema, Stack, & Tirivanhu, 2023). The development strategy of local chickens is mostly restructuring from an extensive to an intensive way (Dest, 2021; Ipara, Otieno, Nyikal, & Makokha, 2021), raising farmers’ income (Keambou et al., 2016), supporting farmers’ relationships among actors in the business (Makmun, Fahmid, Ali, Saud, & Rahmadaniih, 2024), and breeding high-quality local chickens (Chebo & Nigussie, 2016). However, these studies focused solely on the productivity of chicken rearing and all its economic benefits without examining the major areas in developing local chickens.

Furthermore, to the best of the authors’ knowledge, no study on both mapping and priority area determination relied on an approach based on local conditional. Hence, this study aims to assess the potential for local chicken farming areas. It might also help the government to determine and identify the most “concentrated” areas in the development of local potential livestock farming, to provide information to formulate better development...
strategies and policy by considering evidence of base and non-base areas and make the regional economy grow.

**RESEARCH METHOD**

**Study Area**

This research was conducted in Minahasa Regency, North Sulawesi Province, with the implementation of a purposive method. Minahasa Regency has boasted North Sulawesi Province’s greatest number of local chickens, reaching 751,712 birds. Minahasa Regency occupies an area of 1,141.64 km², as portrayed in Figure 1. Poultry from Minahasa Regency, both local poultry (local chickens, ducks, and quails) and purebred chickens (laying and broilers) made up the study’s population.

![Map of Research Location in Minahasa Regency](image)

**FIGURE 1. MAP OF MINAHASA REGENCY, NORTH SULAWESI PROVINCE**

**Data Source and Analysis**

The data analyzed in this study came from five-year time series data of local poultry population (local chickens, ducks and quail) and purebred chicken (layers and broilers). These complete data were gathered from the Central Bureau of Statistics, Statistics Agency (BPS) of North Sulawesi Province and BPS of Minahasa Regency.

The potential for local chicken farming in each district in Minahasa Regency was examined using the location quotient (LQ) approach, aiming to identify the basic and non-basic areas and to determine the distribution of the superior poultry. This analysis tool was convenient to use, comprehensible, accurate, and expeditious as an initial analysis for an area, following further evaluation with other analysis tools. A comparative study of annual LQ
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could be adopted to understand changes in each sector’s degree of specialization, and it does not require complex data processing algorithms (Heldayani, Asiyah, & Mardianto, 2022).

An LQ approach refers to a way of measuring the relative local chicken contribution of a district to the whole regency. It was employed to determine regions with industry or commodity specialization and detect spatial phenomena (Alibekova, Alzhanova, Osmanov, & Omarov, 2023; Costa, Neves, & Telles, 2020). \( X_i \) and \( n_i \) denote the outcome and population of local chickens in the \( i^{th} \) district, respectively. Similarly, \( X_{ij} = \sum x_j \) and \( X_{in} = \sum x_n \) signify the outcome and local chicken population of the whole region, respectively. Equation 1 defines the location quotient for the \( i^{th} \) district.

\[
LQ_{ij} = \frac{X_{ij}}{X_{in}} \div \frac{X_{rij}}{X_{rin}}
\]  

(1)

\( LQ_{ij} \) represents the location quotient (comparative advantage) of district \( i \) for poultry \( j \); subscript \( r \) signifies all districts except district \( i \); and subscript \( n \) refers to all poultry except poultry \( j \). The index values vary from 0 to infinity \((0 \leq LQ_{ij} \leq \infty)\). If the value of \( LQ_{ij} \) is greater than one, district \( i \) has the comparative advantage in poultry \( j \) (local chicken). In contrast, if the value of \( LQ_{ij} \) is less than one, district \( i \) has a comparative disadvantage in local chickens. It was assumed that overproduction would be spread out of districts or regions.

This study mapped the ‘concentrated’ area using the area’s distribution of all poultry and the local chicken population, providing a reference or base area corresponding to the high-to-low ratio in terms of growth rate potential. This study extended the assessment using LQ measure to pattern at the region level.

In the static term, population data remain unchanged. In the dynamic case, on the other hand, they changed from period to period, and the different periods must be distinguished. In regard to this, \( t \) indicates the time aligned with respect to the initial point, taking the unit of time as one period. Since the dynamic models were to be developed from static models, it seemed desirable that the static models used as a basis should reflect the distribution of population that characterized the interval 2017-2021.

The growth rate assumes that each commodity has added value, and the average growth rate for each district in time \( (t) \) can apply the dynamic location quotient (DLQ) analysis. This study performed DLQ analysis to discover whether the local chickens and the respective poultry livestock would experience a change of role in the future. Equation 2 pictures the formula for the DLQ analysis.

\[
DLQ_{ij} = \left\{ \frac{(1 + g_i)(1 + g_j)}{(1 + G_i)(1 + G_j)} \right\}^t
\]  

(2)

In expression of Equation 2, the following definitions were proposed:

\[
g_i = \frac{(X_{ij}^{t+1} - X_{ij}^t)}{X_{ij}^t}
\]  

(3)

\[
g = \frac{(X_{i}^{t+1} - X_{i}^t)}{X_{i}^t}
\]  

(4)

\[
G_i = \frac{(X_{ij}^{t+1} - X_{ij}^t)}{X_{ij}^t}
\]  

(5)

\[
G = \frac{(X_{i}^{t+1} - X_{i}^t)}{X_{i}^t}
\]  

(6)
\( g_i \) is the growth rate of value added of sector \( i \); \( g_j \) denotes the average population growth rate; \( G_i \) represents the growth rate of the poultry \( i \) in the whole region; \( G \) indicates the average growth rate of population in the whole region; and \( t \) reflects time change.

Growth analysis is an advanced method after LQ, aiming to determine the growth rate of the economic sector each year, with a minimum in the last three years (Khair, Wahdi, & Habibah, 2023). This analysis could describe the growth of local chickens in the districts. The growth analysis in the development of local chickens in Minahasa Regency categorized potential commodities into negative growth values (−) and positive growth values (+). Contribution analysis has been considered useful for determining the growth of a region’s economic sector by explaining sector growth (Neffke, Henning, & Boschma, 2011). This analysis allowed for the determination of whether the growth of the local chicken population in the district was lower or higher than that of the reference area (regency). The calculation using the share method was obtained from local chickens with a large contribution (share had a positive value).

Share analysis assessed the growth rate of local chickens in the study area. The district specializing in local chickens with the highest growth at the regency level could benefit from a favorable poultry livestock mix effect. Moreover, it could point out the advantages it earned in local chickens by comparing the performance of district \( j \) and the nation (competitive effect). The shift-share analysis is an interregional comparison, measuring and evaluating sectoral performance. Numerous studies have emerged since the methodology was first described. Its widespread use is explained by its simplicity, modest data requirements, and the fact that the results are relatively easy to assess and interpret (Chiang, 2012; Montanía, Márquez, Fernández-Núñez, & Hewings, 2024). The authors also proposed a method to calculate shift-share. This method was utilized to identify how the growth of local chickens in each district contributed to the growth of the whole region. \( j \) denotes changes in local chickens in the district; \( R_{ij} \) refers to total effect; \( M_{ij} \) implies growth; \( C_{ij} \) indicates regional share as the competitive advantage of local chickens in district \( j \); and \( G_{ij} \) represents the growth rate of local chickens in district \( j \). They are all expressed as Equation 7.

\[
R_{ij} = G_{ij} + M_{ij} + C_{ij}
\] (7)

The equation is denoted by:

\[
R_{ij} = E^*_{ij} - E_{ij}
\] (8)

\[
G_{ij} = E_{ij} \times r_n
\] (9)

\[
M_{ij} = E_{ij} (\tau_{in} - \tau_n)
\] (10)

\[
C_{ij} = E_{ij} (\tau_{ij} - \tau_{in})
\] (11)

\( \tau_{ij}, \tau_{in}, \) and \( r_n \) represent the growth rate, defined as \( r_{ij} = (E^*_{ij} - E_{ij})/E_{ij} \); \( \tau_{in} = (E^*_{in} - E_{in})/E_{in} \); and \( \tau_{in} = (E^*_{in} - E_{in})/E_{in} \).
RESULTS AND DISCUSSION

Spread of Local Chicken Population

The livestock sector, particularly poultry, has been spread throughout the whole region. With a growth rate of 0.85%, the population in North Sulawesi jumped from 2,270,596 in 2020 to 2,638,631 in 2021 (BPS-Statistics of Minahasa Regency, 2022). Figure 2 provides an overview of the distribution of all poultry in Minahasa Regency. The population of local chickens has accounted for almost 80% of the total poultry population in the regency, placing it in the first position with the largest population, with chicken meat and egg production being 816,813.69 kg and 571,118.60 kg, respectively (BPS-Statistics of Minahasa Regency, 2022).

Almost all farmers in Minahasa Regency practiced local chicken farming by maintaining the traditional way of raising local chickens. The sources of feed were the nearby household wastage and food grains complemented by the farmers (Kalangi, Lainawa, & Rahasia, 2021). Rearing local chickens has become a great way for small farmers to keep production costs down because it requires low investment and utilizes local resources. Local chicken production performed by households in rural and peri-urban areas could contribute to food security through income derived from chicken sales. Additionally, as a result of taking charge of rising production, women have frequently risen in social status and gained financial autonomy (Silondae, Muzayyanah, Sulastrí, & Guntoro, 2022b).
Concentration Area of the Local Chicken Development

Local chicken development could be more efficient by determining the population concentration at the regency level. This study adopted the LQ approach to identify an area, district, or region that might become the concentrated base of local chicken-rearing development (Costa et al., 2020; Ribeiro, Ponce, & Telles, 2020).

Figure 3 exhibits the LQ analysis results, showcasing that 17 out of 25 districts in Minahasa Regency have been categorized as base areas for local chicken farming, with an LQ coefficient of ≥1. With a distance of 17 km, East Lembean and Kombi Districts emerged as the second region with the highest LQ coefficient. Both regions could contribute to the local chicken supply to meet consumers' needs, signifying their comparative advantage in developing the local chicken commodity to transform into one of the leading commodities in the supply of high-protein meat sources besides cattle, goats, ducks, and other livestock. The community could easily obtain local chicken products, including meat and eggs, from the nearest market, and they could even get the chickens delivered (Muzayyanah, Syahlani et al., 2021). Additionally, price disparity has occurred in neighboring areas, and excess production of a commodity would be distributed to nearby areas (Triatmojo, Muzayyanah, & Guntoro, 2023).

![Figure 3: Distribution of LQ Score in Minahasa Regency](image-url)

The establishment of a base area could ensure a stable supply and distribution of local chickens to the surrounding areas. Local chickens in rural Minahasa have been kept by households on a limited basis (Silondae et al., 2022a). Low-income families tended to raise...
chickens to raise food security and nutrition for the household. Currently, local household-scale chicken businesses in rural areas with an ownership scale of 5-20 birds have been prioritized for producing meat (Christian et al., 2019; Daba, Murimi, Abegaz, & Hailu, 2021). Accordingly, livestock development needs special attention due to its contribution to food fulfillment and enhancement of food security (Elly et al., 2015).

The LQ analysis results disclosed that Minahasa Regency could evolve as a base for developing local chickens in North Sulawesi. This regency could be declared capable of sustaining the demands of local chicken livestock in its area and could provision it outside the area. Meanwhile, non-base districts were formed as a result of the inferior development of the local chicken livestock population.

The assessment of livestock development areas relied on several main criteria, including the area’s comparative advantage in fostering the growth of the livestock population. The LQ index represents this criterion, which also exhibits livestock commodities that could be prioritized for their development (Alibekova et al., 2023). As displayed in Figure 4, the analysis in this research focused on identifying areas or districts in Minahasa Regency with the potential to serve as either bases or non-bases for developing local chickens.

The local chicken population has spread across all districts in Minahasa Regency. The selected base area indicated that the local chicken commodity in the region had experienced relatively good population development. The more developed the local chicken population, the better the resources they have for rearing this commodity. Furthermore, the local chicken development program would have a higher potential success rate in these centers because of
its superior resource potential. Indeed, the livestock sector requires sufficient and balanced feed and water resources with other sectors to ensure food security, such as corn resources as the main ingredient of poultry feed (El-Deek et al., 2020; Heinke et al., 2020). In addition, local livestock species, such as local chickens, have been intricately linked to socio-cultural factors and environmental ecology, hence contributing to the empowerment of local communities (Franzoni et al., 2021; Silondae et al., 2022b).

Figure 4 illustrates a map displaying the distribution of base districts, highlighted in green, with an LQ coefficient of ≥1. The green areas on the local chicken map denote the base areas of local chicken development, encompassing 25 districts. Conversely, the red areas indicate non-base areas, consisting of eight districts. Product concentration and economic specialization have contributed to the emergence of positive impacts, affecting economic development, employment, and income in a particular region (Groot, Poot, & Smit, 2009; Tolstykh, Gamidullaeva, & Shmeleva, 2020). When the green areas were adjacent to other regions, they had the potential to become emerging sales markets. Additionally, the company’s products become more effective, the interdependence between suppliers and consumers rises, and the rate of innovative activity of the company escalates (Frenken, Van Oort, & Verburg, 2007).

**District Identification through Growth and Share Value**

The local chicken population in Minahasa Regency underwent an average growth rate of 41% between 2017 and 2021, as exhibited in Table 1 (BPS-Statistic of Sulawesi Utara Province, 2022). The analysis of local chicken farming in this regency from 2017 to 2021 revealed that the contribution values ranged from highest to lowest, suggesting the potential for regional dominance. Following this analysis, the majority of the districts (60%) were considered ‘potential areas’ for developing and farming local chickens. It is in line with the research of Khair et al. (2023), disclosing that the livestock population significantly impacted the high growth of an area.

Figure 5 exhibits the relation between the growth value and the contribution of local chickens. The local chicken commodity was highly and positively correlated among areas with growth and share values being in the same category. Figure 5 portrays a linear relationship between the population growth rate and the contribution of local chickens in each district in Minahasa Regency. The higher the local chicken population in a district, the greater the contribution to the total local chicken production rate in the whole regency. The development of areas in the superior, potential, and dominant categories has depicted positive potential in providing local chicken chicks. Districts with superior, potential, and dominant categories could boost the supply of day-old chicken (DOC) and distribute it to other districts.

The higher the livestock population in an area, the greater the growth rate, indicating a more prominent opportunity for the area to become a leading sector. The gradual increase in the local chicken population might be the result of the rising demand for chicken meat among consumers. Moreover, Elly et al. (2015) discovered that the animal protein consumed by households on a daily basis primarily came from chicken products.
TABLE 1. GROWTH AND SHARE OF LOCAL CHICKEN POPULATION

<table>
<thead>
<tr>
<th>No.</th>
<th>District</th>
<th>Growth (%)</th>
<th>Share (%)</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>East Langowan</td>
<td>5.36</td>
<td>2.01</td>
<td>4.95</td>
</tr>
<tr>
<td>2</td>
<td>West Langowan</td>
<td>2.18</td>
<td>2.00</td>
<td>10.47</td>
</tr>
<tr>
<td>3</td>
<td>South Langowan</td>
<td>4.28</td>
<td>1.99</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>North Langowan</td>
<td>2.56</td>
<td>1.99</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>Tompaso</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>6</td>
<td>West Tompaso</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>7</td>
<td>Kawangkoan</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>8</td>
<td>West Kawangkoan</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>9</td>
<td>North Kawangkoan</td>
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<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>Sonder</td>
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<td>2.00</td>
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</tr>
<tr>
<td>11</td>
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<td>0.00</td>
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<td>2.00</td>
<td>0.00</td>
</tr>
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<td>Tombulu</td>
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<td>1.93</td>
<td>0.00</td>
</tr>
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<td>Mandolang</td>
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<td>2.00</td>
<td>0.00</td>
</tr>
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<td>West Tondano</td>
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</tr>
<tr>
<td>17</td>
<td>South Tondano</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>18</td>
<td>Remboken</td>
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</tr>
<tr>
<td>19</td>
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<td>2.00</td>
<td>0.00</td>
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<tr>
<td>22</td>
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<td>2.00</td>
<td>0.00</td>
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<tr>
<td>25</td>
<td>North Tondano</td>
<td>0.06</td>
<td>2.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Minahasa Regency               -24.80   50  0  16.00  100.00 100.00 100.00 100.00 100.00
Specifically, 88.18% of the protein came from chicken meat, and 96.36% came from chicken eggs. Inevitably, local chickens with good management have huge market potential (Pham et al., 2013). Similarly, the positive growth rate could be recognized due to the increased preference and easy manageability of the chickens and the high compensable prices. The government has assisted in the development of the Agropolitan-Pakakaan Area in Minahasa Regency, aiming to develop an integrated local chicken agribusiness system to achieve market-oriented (Silondae et al., 2022a; Tendean, Katiandagho, & Kapantow, 2023).

The results clearly demonstrated that the development of local chickens in superior areas could significantly contribute to regional economic growth, such as in poverty alleviation and food security. The local government could utilize the identified concentrated areas as a basis for decision-making and provide regional development planning and design of policies on local chickens to achieve food security and sustainability in Minahasa Regency. The implementation of the local chicken agribusiness development program should adopt a community empowerment approach by strengthening institutions, supporting production systems, improving market access, and ensuring the sustainability of local chicken businesses. It resonates with the findings of Perelli, Cacchiarelli, Peveri, and Branca (2024), who asserted that empowerment relates to farm sustainability.

**CONCLUSION**

The local chicken livestock industry has depicted considerable potential for development, contributing to both the rising consumption of animal protein from livestock and the income of rural communities. This study aims to determine the distribution of local chicken livestock, identify the base areas for local chicken livestock development, analyze the
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growth rate and contribution or share of local chicken commodities in each district, and ascertain superior areas for local chicken development in Minahasa Regency. The potential for local chicken farming in each district could be achieved by adopting the LQ approach, which involved identifying the base and non-basic areas and determining the distribution of superior commodities. The local chicken population in Minahasa Regency has expanded across all districts, with most districts (68%) serving as local chicken farming centers (bases). This local development needs to be harmonized with subsistence activities as well, such as cultural and social activities. Local cultures such as gotongroyong (cooperation) and traditional ceremonies or celebrations have continued to be practiced, such as Mapalus—reciprocally bringing gifts in the form of local chickens. These phenomena indicated the region’s superior resource potential for the commodity. These chicken centers have provided significant potential for the development of poultry commodity farming. The development of local chicken farming based on the center areas, along with the enhancement of resources, could potentially enhance and preserve the local chicken commodity.

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Authors’ Contributions: H.S.: Conceiving and designing the research; analyzing and interpreting the data; writing the paper. M.A.U.M.: performing the research; contributing to the analysis and guiding analytical tools or data; writing the paper. E.S.and B.G.: reviewing and guiding in interpreting analysis results.

Conflict of interest: The authors declare no conflict of interest.

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