The Trend of Agricultural Sector Resilience in Indonesia During 2008-2020


Received: 08th February 2023 / Accepted: 18th March 2024

ABSTRACT

Purpose: The agricultural sector has an essential role in developing the economy of Indonesia (food, feed, raw materials for industry, contributor to gross domestic product, and labor absorption). For decades, this business field has survived (positive economic growth, while most of the business field faces contraction) during the country’s economic shock (financial crisis, economic setback, and pandemic situation). Thus, this study aims to measure Indonesia’s agricultural sector’s resilience and trends.

Research Method: Secondary data have been collected from various sources: The UN Comtrade, World Bank, Central Bureau of Statistics, Ministry of Agriculture, Bank Indonesia, and Investing Coordinating Board of Indonesia. Moreover, principal component analysis is used to determine the index of agricultural sector resilience in Indonesia, while trend analysis is employed to investigate the development of the resilience index from time to time.

Findings: The resilience of the agricultural sector varies from time to time. However, it is statistically proven (α = 1%) that resilience tends to increase over the last twelve years.

Research Limitations: The variables to determine the agricultural sector resilience in Indonesia consist of trade balance, agricultural terms of trade, total investment, government spending in the agricultural sector, total credit, agricultural workers’ income, and percentage of agricultural workers to total workers. It is suggested that the future study, employed non-agricultural parameters such as environmental conditions and research and development budget to capture a more comprehensive situation on agricultural sector resilience.

Originality/ Value: This study contributes to the renewal of the literature on the resilience of the agricultural sector. Moreover, the variables used to represent the parameters of agricultural development in Indonesia may be applied in other countries.

Keywords: Agricultural sector resilience index, Agricultural sector development

INTRODUCTION

The agricultural sector has a strategic role in Indonesia’s economic development. This sector contributes to the supply of food and industrial raw materials, employment, foreign exchange, and Gross Domestic Product (GDP). The agricultural sector was also the backbone during the economic recession; first, due to the financial crisis in 1998, and then the COVID-19 pandemic throughout 2020 and 2021.
BPS (2022) and Bank Indonesia (2020) recorded that the agricultural sector grew -1.33% and 1.75% in 1998 and 2020. These were higher than the other sectors, as reflected in the plummeting total GDP growth of -13.13% and -2.06% in those periods. On this basis, Ringwood et al. (2019) claimed that the agriculture sector is a more resilient sector than other sectors in the economy.

According to Boldeanu and Constantinescu (2015), resilience shows the ability of the agricultural sector to face and recover from shocks. Marchese et al. (2018) explained that in response to disturbances, the impact on the economic sector would begin with absorption, recovery, and then the adaptation process. Absorption occurred from the first time shocks impacted the agricultural sector until this business field fell to its lowest point. Recovery is a condition where the impact of the shock has begun to be overcome. Finally, adaptation appears when the agricultural sector has adjusted its activities based on the effects of previous or ongoing shocks.

Ringwood et al. (2019) found that a county or a region with agriculture as its base sector experiences relatively stable economic growth as crises occur. This stability is supported by the fact that this business field is the primarycrop producer, and the number of agriculture workers did not decline when the shocks happened. Therefore, the suggestion from these results is to foster and enhance resilience through sustainable employment growth. Tan et al. (2017) studied Northeast China’s economic resilience from 1995 to 2014. This country experienced both Asian and global financial crises during the period. The methods used are sensitivity index and average growth rate. The results showed that economic crises and recessions weaken economic growth, captured by declining total GDP. Nevertheless, the GDP can recover rapidly in the next year with some policy support: the government improved and built up infrastructure, which can lead to more investment, increased financial aid, and enhanced innovation.

Concerning disturbance in the agricultural sector, cooperation in international trade may help this business field survive economic shocks by imposing exports and imports. Exporters may benefit from relatively higher prices and supply more of the products harvested to the international market. On the other side, the importers may get relatively lower prices or ensure the availability of raw materials for production and consumption activities. Volkov et al. (2021) used export as one of Lithuania’s economic resilience indicators. This research concluded that the higher value of agricultural commodities export might elevate economic growth and lead to better resilience. Moreover, the study found that export activities may occur even though a global financial crisis happens because importers need to fulfill their domestic needs.

Desai and Rudra (2019) used the trade balance as a parameter for economic resilience in social protection. This study found that countries with higher export values than imports for agricultural commodities could provide better social security to their citizens compared to countries with surplus manufacturing. The social protections are an insurance program for low-income households and cash assistance to meet daily household needs. Moreover, Sulaksana (2020) explained that agrarian regions might use farmers’ terms of trade as economic resilience. This suggestion comes from the fact that most people in rural areas work in the agricultural sector. Therefore, higher product selling prices with constant or lower total costs will generate higher income and make the producers more resilient when the crisis occurs. On the macro-view, this condition will support reducing the impacts of shocks.

West and Haug (2017) explained that sustainability in agriculture needs investment as one of its accelerator factors. More investment supported with consistent, transparent, and enforceable ‘rules of the game’ will benefit the producers to access employment, agricultural production technologies, skills and training, and access to inputs, credit, and markets. Therefore, these factors also act as the improvement of smallholder livelihoods and rural development and encourage national economic development goals. Moreover, Jayne et al. (2019) used investment in the research and found that this variable contributes to resilience in the agricultural sector by enhancing crop productivity and improving rural infrastructures.

However, agricultural sector resilience cannot be separated from the role of the government. History records that the government’s involvement plays a crucial role in a crisis. One manifestation of this alignment is the budget allocation, both for production activities and the producer economy (Marsden and Sonnino, 2008; Sparrow et al., 2020). For example, in the middle of the COVID-19 pandemic in 2020, the Government of India increased the allocation for the agricultural sector as the incentive for producers to maintain labor productivity and ensure the supply of food and raw materials (Singh, 2021). Moreover, funding for the agricultural sector can also be carried out independently or in groups by farmers through credit to financial institutions. In this way, producers tend to increase technology adoption in overcoming
problems on the upstream, on-farm, and off-farm sides (Ranjan, 2013; Deng et al., 2017). In addition, credit helps producers access production factors with more quantity and better quality (Chandio et al., 2018). The impact of the increase in accessibility is an increase in productivity. In conclusion, agricultural sectors’ resilience is encouraged through the ease or stability of access to farm credit when the economic situation is contracted.

Angulo et al. (2018) described areas with an agricultural sector basis as experiencing relatively lower economic growth than areas with a non-agricultural sector basis. In terms of employment, the declining number of workers in the farming sector was relatively smaller than in the industrial and construction sectors. Fallon and Lucas (2002) concluded that when a financial crisis occurs, the participation of family workers in the agricultural sector tends to increase in anticipation of a decline in income. Meanwhile, according to Malahayati et al. (2021), this phenomenon follows Engel’s law which states that when economic disturbances or shocks occur in the non-agricultural sector, workers who are fired or given holidays without pay tend to choose the agricultural sector as an alternative job. Thus, when a crisis occurs, the resilience of the agricultural sector is encouraged by increasing the number of workers as the main factor of production, especially for labor-intensive regions or countries.

Seeing resilience as a necessary condition, Volkov (2021) developed an index to measure these conditions in the agricultural sector. Several indicators form the index, namely food production at affordable prices, farm insurance viability, and job opportunities. Meanwhile, Morkünas et al. (2018) calculated agricultural sector resilience using the cost of additional revenue in the agricultural sector, revenue volatility, number of export markets, and percentage risk from export markets.

Principal Component Analysis (PCA) is one of the tools to measure the resilience index. PCA is a statistical technique that can reduce data sets into new variables called uncorrelated Principal Components (PCs) (Rahman and Rahman, 2020; Abdel-Fattah et al., 2021). In this method, PCA will successively create new uncorrelated variables (uncorrelated PC) to maximize variance. Then, reduce it to produce an eigenvector or eigenvalue (Jolliffe and Cadima, 2016). Moreover, this measurement is employed to measure the resilience index because it does not have special requirements for weighting. Therefore, the ranking results shown by the PCA depend on the indicators listed in the resilience index.

Agriculture is a sector that is vulnerable to climate change, natural disasters, and economic crises. Therefore, resilience needs to be studied to determine whether components in the agricultural sector play a role as a driver for recovery or contribute to weakening performance amid shocks. Thus, each component used may have a different effect on resilience. This study uses seven indicators called the Agriculture Resilience Index (ARI) constituent factors, which are then analyzed using PCA.

Maltou and Bahta (2019) and Bahta and Myeki (2021) conducted a similar study, applying PCA to measure the resilience index with indicators in production in the farming sector when experiencing drought and not experiencing drought to produce the Agriculture Drought Resilience Index (ADRI) in South Africa. In addition, Siminyu et al. (2021) applied PCA to determine the resilience of farmers in Bungoma County, Kenya, using the Resilience Capacity Index (CDI). Some of the factors used are corn production, fertilizers, and labor.

As a country with abundant natural resources, Indonesia relies on the agricultural sector as one of the driving forces of development. Despite the strategic role of the agricultural sector, this sector is inseparable from various challenges, such as the dynamics of the number of workers, accessibility of credit for farming capital, international trade, sectoral investment, and government intervention. These factors can play a role in increasing or even reducing the resilience of the agricultural sector. Therefore, this study seeks to determine the resilience of the agricultural sector in Indonesia, using PCA and variables, which are relatively more comprehensive compared to the studies previously described. In addition, this study also aims to determine the dynamics of the resilience of the agricultural sector in Indonesia from time to time. Furthermore, to date, measuring the resilience of the agricultural sector in Indonesia, including its trends, has never been carried out in Indonesia. This situation is a novelty presented through this research.

MATERIALS AND METHODS

Variables and Data Sources

The resilience of the Indonesian agricultural sector is measured using seven indicators with data from the period of 2008 until 2020.
Table 1: Variables and Data Source

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unit</th>
<th>Expected Sign</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural commodities trade balance</td>
<td>‘000 USD</td>
<td>+</td>
<td>UN COMTRADE (2021)</td>
</tr>
<tr>
<td>(HS 01 to HS24, HS 50 to HS 53)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural term of trade (NTUP)</td>
<td>-</td>
<td>+</td>
<td>BPS (2016, 2017, 2021a, 2021b)</td>
</tr>
<tr>
<td>Agricultural investment</td>
<td>USD</td>
<td>+</td>
<td>Investing Coordinating Board of Indonesia (2021)</td>
</tr>
<tr>
<td>Government spending in the agricultural sector</td>
<td>USD</td>
<td>+</td>
<td>Ministry of Agriculture (2021)</td>
</tr>
<tr>
<td>Credit in the agricultural sector</td>
<td>USD</td>
<td>+</td>
<td>BPS (2021c)</td>
</tr>
<tr>
<td>Agricultural workers’ income</td>
<td>USD/worker/year</td>
<td>+</td>
<td>Bank Indonesia (2022a)</td>
</tr>
<tr>
<td>Percentage of agricultural workers to total workers</td>
<td>Percent (%)</td>
<td>+</td>
<td>BPS (2021d), World Bank (2016), Ministry of Agriculture (2022a)</td>
</tr>
</tbody>
</table>

Source: Modified from Volkov (2021)

\[
\text{Trade Balance} = \text{Export}_{ag(i)} - \text{Import}_{ag(i)} \tag{1}
\]

\[
\text{NTUP} = \left( \frac{I_t}{I_b} \right) \times 100 \tag{2}
\]

\[
\text{Agricultural workers’ income} = \frac{\text{GDP}_i}{\text{Workers}} \tag{3}
\]

The indicators used in this study are assumed to contribute positively to the resilience index of the agricultural sector: First, producing countries benefit from an increasing trade balance value because it shows that domestic production is absorbed more in the international market (Goswami and Nishad, 2014). On the other hand, producing countries also import agricultural and food products to meet domestic needs in excess demand. According to Pawlak and Kolołdziejczak (2020), mutually beneficial trade activities can drive sustainable development. Second, a higher NTUP value indicates that the farmer’s production value is higher than the costs incurred for farming (Khan et al., 2004). In other words, higher NTUP indicates a better level of farmer welfare (Sunderlin et al., 2001). Therefore, higher NTUP is an incentive for farmers to maintain the sustainability of farming and participate in managing the agricultural sector’s sustainability on a macro scale. Third, investment is one of the accelerators in agricultural development. The limitation of farming actors in accessing capital is one of the obstacles to the sustainability of production activities.

Fourth, the government’s support for agricultural development is proxied by budget allocations (Aerni, 2009). In recent years, the government has focused on repairing roads, irrigation canals, and reservoirs (McCawley, 2015; Maryati et al., 2020; Blekking et al., 2021). The purpose of infrastructure development is to increase the productivity of agricultural commodities and indirectly ensure the sustainability of the agricultural sector.

Fifth, the credit acts like an investment, namely an accelerator of agricultural development (Önal et al., 1995; Mohan, 2006). The greater the credit disbursed, the more producers’ access and the greater the loan value to maintain the sustainability of agricultural activities. Sixth, the higher added value obtained by workers in the agricultural sector has implications for the sustainability of the agricultural sector itself. This condition comes from the fact that the agricultural sector in Indonesia is still in a position of labor-intensive activity (Abey et al., 1981). Among the indicators already explained, the following parameter, namely the percentage of workers in the agricultural sector to the total workforce, is expected to discourage the agricultural sector’s resilience. This assumption is because the higher absorption of labor reduces the productivity of the agricultural sector (Chen, 2017).

**Data Analysis (Principal Component Analysis)**

According to Jiang et al., (2018) and Rehman and Lee (2018), there are several steps to employing principal component analysis:
Percentage of agricultural workers = \left( \frac{\text{Number of agricultural workers}_i}{\text{Total workers}_i} \right) \times 100 \quad (4)

Where:

\( I_t = \) Index of prices received by farmers

\( I_b = \) Index of prices paid by farmers for agricultural production

\( GDP = \) Gross Domestic Product

\( i = \) year

Step 1: Constructing the Original Data Matrix \( X_{a \times b} \) of Year \( \times \) Agricultural Sector Resilience Indicators Variables

\[ X_{n \times p} = \begin{bmatrix} X_{11} & \ldots & X_{1b} \\ \vdots & \ddots & \vdots \\ X_{a1} & \ldots & X_{ab} \end{bmatrix} \quad (5) \]

The row of \( X_{ij} \) represents the \( i \)th year of the data \((i = 1, 2, \ldots, a)\), while the column represents the \( j \)th indicator \((j = 1, 2, \ldots, b)\).

Step 2: Data Standardization

\[ z_i = \frac{X_i - \mu}{\sigma} \quad (6) \]

Where:

\( z_i = \) data standardized for the \( i \)th indicator

\( X_i = \) observation for the \( i \)th indicator

\( \mu = \) mean

\( \sigma = \) standard deviation

Step 3: Calculate the Variance-Covariance Matrix \( R_{b \times b} \) of the Original Data Matrix \( X_{a \times b} \)

Step 4: Calculating the Eigenvalues \( \lambda_i \) (for \( i = 1, 2, \ldots, b; \lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_b \)) and Eigenvectors \( e_1, e_2, \ldots, e_b \) of the Variance-Covariance Matrix \( R_{b \times b} \) by Solving the Characteristic Equation

\[ |\lambda I - R| = 0 \quad (7) \]

Step 5: Calculating the Proportion of Variation and the Cumulative Proportion of Variation

\[ \sum_{i=1}^{b} \lambda_i \]

Step 6: Identifying the Component with the Highest Eigenvalues

Step 7: Calculate the Factor Loadings

Step 8: Calculating Principal Component Scores (\( \xi \)) of Each Year \( (n) \)

\[ xi_a^{(i)} = e_{11}x_1 + e_{12}x_2 + \ldots + e_{1b}x_b \quad (8) \]

Where:

\( (i = 1, 2, 3, \ldots, m) \) and \( (a = 1, 2, \ldots, n) \)

Step 9: Calculating the Agriculture Resilience Index of Each Year \( (n) \) Using the Highest Eigenvalues (6), where \( \frac{\sum_{i=1}^{m} \lambda_i}{\sum_{i=1}^{m} \xi_a^{(i)}} \) is the Weight of the \( i \)th Principal Component

\[ \text{PCAARI}(a) = \sum_{i=1}^{m} \frac{\lambda_i}{\sum_{i=1}^{m} \lambda_i} \xi_a^{(i)} \quad (9) \]

Where:

\( (a = 1, 2, \ldots, n) \) and \( (i = 1, 2, \ldots, m) \)

Furthermore, trend analysis is accomplished by using equation (10):

\[ Y = a + bX + e \quad (10) \]

Where:

\( a = \) intercept

\( b = \) coefficient

\( Y = \) Agricultural sector resilience index

\( X = \) time

\( e = \) error

RESULTS AND DISCUSSION

Trade Balance of Agricultural Commodities

Commodities mapping is conducted before trade balance measurement. This study used agricultural product grouping proposed by Wang and Pawlak (2019). As a result, agricultural commodities in
this research consist of products registered in the Harmonized System (HS) Code 01 to HS Code 24, and HS Code 50 to HS Code 53. In 1996, the trade balance performance was declining to about US$ 705,902,335 from the previous year (Fig.01). This study found that the value of imports in 1996 increased higher than in 1995. According to Siregar and Suryadi (2006), Indonesia experienced higher imports in 1996 due to drought which can reduce food production. Less production cannot fulfill the community’s needs for food. Consequently, the volume of imports will be higher. Moreover, the trade balance in the agricultural sector has never been in deficit, even during the 1998 economic crisis. The 1998 economic crisis reduced the trade balance due to a drop in exports. However, it did not result in a trade balance in the agricultural sector from a deficit (Badaruddin and Octavia, 2017).

In 2017, Indonesia’s trade balance surplus reached a record high of more than US$ 20 billion. This is attributed to the execution of ground-breaking policies and programs to achieve food self-sufficiency that has dramatically expanded strategic food production (Ministry of Agriculture, 2017b). As a result, the number of exports of all strategic food items increased in 2017, while the volume of imports decreased. Although there are some drops during economic downturns, such as the one caused by the COVID-19 epidemic, the trade balance rate reflects an increasing trend in the long term. This demonstrates the trade balance’s high level of resilience since it can recover and continue to grow after a shock (Simmie and Martin, 2010).

### Agricultural Terms of Trade

Agricultural terms of trade (NTUP) is the ratio between the price index received by farmers and the price index chosen to run the business. An NTUP value below 100 indicates a loss condition, an NTUP equal to 100 means break-even, while a ratio value above 100 indicates a surplus condition. Furthermore, as the institution that opens NTUP data, BPS uses three base years for calculating NTUP from 2008 to 2020. First, starting in 2008 and finishing in 2013, BPS used the base year of 2007 (Fig.02). Then, the base year 2012 is used as the benchmark for calculating NTUP from 2014 to 2019. Finally, the base year 2018 was used for NTUP in 2020 (Ministry of Agriculture, 2022b). Consequently, the conversion factor value is determined. The score was later combined with the base year 2007 for NTUP calculation from 2008 until 2020.

From 2008 to 2020, Indonesia experienced at least three economic crises (in 1998, 2008, and 2020). However, the economic downturn in 1998 is exceptional in this subchapter among the three events. The reason is that the publication of NTUP began in 2008.

In 2008, Indonesia’s macroeconomic conditions were impacted by the global financial crisis in the United States. During the first three months to the third quarter of 2008, Indonesia’s GDP was above 6 percent. However, in the fourth quarter, it fell to 5.28%. Nevertheless, on an annual basis, GDP increased by around 6 percent compared to 2007. On the other hand, for the same period, the agricultural business aspect, corn, rice, and soybeans as the three primary food crop commodities, experienced an increase of 5%, 22%, and 30%, respectively (Basri, 2013). Furthermore, the positive gains in rice were followed by an increase in the price of dry milled grain, from around US$ 0.19 (January 2008) to US$ 0.20 (end of 2008). Next, the production escalation combined with the higher price increased farmers’ revenue. Based on the value of NTUP in 2008, which reached 101.95, it indicates that the average farmer experienced a surplus.

In general, despite the economic crisis in 2008, the causes of the economic shock came from external parties and the relatively enormous impact on the financial sector. On the other hand, as the primary sector and the leading actor in the food supply, it can survive because the product is intended for the domestic market. In addition, the production process was not disrupted by the financial crisis in 2008. Overall, activity in the agricultural sector was relatively stable.

In 2020, the COVID-19 pandemic caused people’s purchasing power to decline. This decrease was due to the disruption of production activities at both the industrial scale and small and medium-sized businesses and a decline in sales turnover. Business owners took salary reductions, laid off workers without being paid a salary, or even terminated employment. Furthermore, the decline in demand for agricultural commodities also emerged from the little time of restaurant operating hours and meetings, incentives, conferences, and exhibitions (MICE) activities. Cumulatively, the reduced number of requests affects the absorption of agricultural production. In general, a combination of abundant supply and reduced demand will lead to a decline in commodity prices. However, during the COVID pandemic, commodity prices, especially food, are continuously monitored by the government so that producers do not suffer losses and consumers can still fulfill their primary needs. One example is dry grain, where policymakers set a government purchase price...
increase of 0.29 US$ per kilogram, an increase of about 14% compared to 2019. Moreover, since the farmer no longer sells the products in terms of fresh products rather than manufactured ones, the farmers still earn the increased revenue.

Investment in the Agricultural Sector

In 2008, although the impact of the global financial crisis had reached Indonesia, all business fields in this country continued to experience an increase in value-added, and GDP increased to 6.01 percent. However, from the aspect of investment value, there was a decrease compared to 2017 to 2018 (Fig.03). For example, the agricultural sector grew by 6.01 percent, but the investment value fell by 75.56 percent. According to Basri (2013), the global financial crisis has had an impact on financial institutions and other elements of the economy. As a result, investors hold the capital they want to invest in anticipating the uncertainty of the current situation.

In the following period, agricultural investment recorded a positive growth from 2008 to 2009. According to Basri (2013), the financial crisis that occurred in 2008, although the spectrum was broader (involving various countries in the world), the impact was relatively shorter than crisis in 1997/1998. This phenomenon is because there are differences between the two situations, namely political conditions in Indonesia, policy responses, exchange rates, and the source or origin of the crisis. On the other hand, in 2008, Indonesia aggressively implemented irrigation development programs to encourage increased crop yields. Based on data from the World Bank (2010), the program has succeeded in increasing crop yields and helping reduce poverty levels. This achievement is a positive signal for investors to invest and contribute to the development of the agricultural sector.

Moreover, besides the financial crisis ending, agricultural investment also rose significantly from 2017 and peaked at the end of 2019. In supporting these developments, the government has a strategic role in providing signals that encourage investors to invest. According to the Asian Development Bank (2019), government programs in the agricultural sector, one of which is water catchment receptacles, have benefits in increasing the planting index of agricultural commodities because these commodities can be planted and harvested more during one year often. Investors capture this productive activity as an opportunity to invest and, at the same time, contribute to agricultural development.

After reaching its peak in 2019, agricultural investment decreased by 38.41 percent in 2020. This decline was due to the COVID-19 pandemic in Indonesia. Because the effect of the pandemic is so broad, the government must postpone/stop aid or programs to reallocate to national economic recovery. From an investor’s point of view, the ongoing pandemic has caused uncertainty that investors tend to avoid. Furthermore, the decline was caused by allocating investment to social protection programs to help the underprivileged. Therefore, the government focuses more on national recovery (UNICEF, 2021).

In general, investment in the agricultural sector benefits technology development. Technology packages in the agricultural sector can help save the labor and time of farmers. Long-term technology development also contributes to increased productivity and efficient use of inputs. This condition became a driving factor for the agricultural sector to become more resilient (Ikhsan and Virananda, 2021).
Government Spending on the Agricultural Sector

Business actors in the agricultural sector can independently seek the existence of a market for transactions for agricultural production, technology development, provision of agricultural materials or tools and machines, and distribution facilities. Furthermore, information exchange between one producer and another can increase knowledge and skills and possibly happen. Moreover, through collective efforts, business actors can assist other producers in need, including capital and intensification of farming businesses. These actions/efforts are something that is not impossible to happen. However, it will take a relatively long time. Therefore, government intervention is needed. As stated by Keynesians, government involvement is strategic and crucial in economic development. This role is also applied in the agricultural sector.

One form of government intervention is the provision of production factor subsidies, development/maintenance of agricultural infrastructure, extension and education for farmers, and development of agricultural technology. This involvement, in this study, is illustrated by the total funds realized by the government for the agricultural sector. In line with the crucial role of the agricultural sector, in the social, economic, and cultural aspects of Indonesian society, from 2008 to 2020, the realized budget increased by 109 percent. However, since 2015, the amount of funds channeled to the agricultural sector by the government has tended to decline (Fig.04). Based on Ministry of Finance data published by the Ministry of Agriculture (2020), the decline came from reduced assistance for food subsidies, seed subsidies, and fertilizer subsidies. According to Elisa (2019), food subsidies diminished because the low-priced rice program targeted households with weak economies exchanged with a non-cash food assistance program managed by the Ministry of Social. Next, the Ministry of Agriculture (2022c) stated that the seed subsidy was called off because the absorption by farmers was relatively small. In 2015, the absorption was about 5 percent, and the decision was to change the scheme to the distribution of free superior seeds. Furthermore, fertilizer subsidies diminished because the government expects farmers to be more independent in the supply of
fertilizers. Nevertheless, Wirakusuma (2020) advised the government to be more careful in reducing input subsidies because the program has a real positive impact on the performance of the agricultural sector.

**Total Value of Credit in the Agricultural Sector**

Business actors in the agricultural sector utilize credit to develop their businesses by providing more production factors, using modern tools and technology, and financing to facilitate production activities. Therefore, as time goes by, credit realization in the agricultural sector has tended to increase from time to time. However, in 2013, investment in this sector grew negatively to 12.03 percent (Fig.05). This decline is possibly the effect of inflation which causes the prices of goods and services to increase over a certain period.

Based on data from Bank Indonesia (2022), Indonesia experienced a relatively high increase in inflation from December 2012 to December 2013. One of the policies taken by the government to overcome this was to regulate the money supply by lowering interest rates. In general, the decrease in loan interest costs is an impetus for business actors to add to their loan portfolios. However, the fact that it happened in Indonesia is the opposite. When interest rates fall, relatively few access the program. This incident is due to an increase in the price of goods, which makes business actors refrain from accessing capital to obtain certainty about when the economic issue will end. If the price of goods continues to increase, including the cost of production facilities, business actors tend to choose to reduce the amount of credit or not to do credit. Furthermore, Financial Service Authority (2013) and Financial Service Authority (2014) explained that the agricultural sector experienced an increase in non-performing loans (bad loans) from around US$ 2 million in 2012 to approximately US$ 2.4 million in 2013. An indication that the business is experiencing a downturn and the decision of business actors to be careful in taking additional loans is the right decision.

Then, in 2014, credit in the agricultural sector began to increase for the next several years. This credit growth is encouraged by the government’s target of achieving food self-sufficiency in Indonesia. The targets consist of an increase in rice production by 16.44 percent, corn production growth by 64 percent, and 217.65 percent for soybeans. In line with this target, there has been an increase in planted areas and harvested dimensions in various regions in Indonesia. However, ceteris paribus, if the land size is larger, the costs will be higher for using the seeds, fertilizers, and pesticides will also be greater (Ika et al., 2015).

Credit is one of the favorable indicators for agriculture resilience. The influence of access and allocation of credit on the agricultural sector has proven to be able to support the performance of the agricultural sector and its sustainability. Empirically, Ananzeh (2016) proves that bank credit can have a positive impact on economic growth through the agricultural sector. In addition, Olaniyi (2017) who identifies credit as inclusiveness of the financial sector, finds that, in the long and short term, financial service support provides an accelerating power to agricultural sector growth. A more holistic finding is stated by Chisasa and Makina (2015). They prove that there is a dynamic relationship between credit and agricultural output through production, capital formation, and increased labor intensity.

In the aspect of sustainability, agricultural credit has proven to be able to stimulate farmers to utilize sustainable agricultural technologies and facilities that have conservation value (Baffoe et al., 2014). However, strengthening credit indicators to improve agriculture resilience needs to overcome several problems. First, financial literacy must be intensified for farmers to be able to access credit sources. Credit literacy will
be able to increase opportunities for farmers to take advantage of financial services by taking into account the risks and results that will arise from the use of these credits. Golait (2007) confirms that access to formal credit for farmers is still relatively difficult to reach. Small farmers still have doubts about utilizing financial services in managing their farms. Therefore, the government must create an initiative to bridge farmers with these formal sources of credit so that farmers do not depend on informal financial services which are relatively burdensome to farmers.

**Agricultural Workers’ Income**

Labor productivity in the agricultural sector is a proxy for agricultural workers’ income. This parameter comes from the division of the added value generated by agricultural activities, with the labor involved from pre-planting, tillage, planting, maintenance, harvesting, and post-harvesting. Fig.06 shows the calculation of agricultural workers’ income. In 1990, the GDP of the agricultural sector was 37 billion US$. The added value of this sector continues to increase until at the end of 2020 it is around 96 billion US$. Meanwhile, the number of workers in the agricultural sector in the last 30 years has tended to decline; wherein 1990 it was 40 million people, while at the end of 2020, it was 38 million people. The development between the two variables indicates that the agricultural sector is becoming more efficient due to a decrease in labor (a reduction of inputs) followed by an increase in output. This situation is in line with data from BPS (2021e) and the Ministry of Agriculture (2018), which state that agricultural commodities, particularly rice and maize, continue to increase.

Over time, one of the problems that continue to be a concern in the agricultural sector is that the younger generation tends to be reluctant to become farmers, especially in food crops. Furthermore, this study found that the younger generation’s existence is vital for the sustainability of the agricultural sector. However, the fundamental issue is the efforts to support the more youthful age already involved in the agricultural sector or interested in this business field to be skillful and get an in-depth understanding of the agricultural sector, to maintain or even continue to increase.

Based on Martinez et al. (2014), income is a factor in the transition of workers to non-farm. Increasing income could be achieved by government policies through farmer empowerment policies on agricultural production and empowering professional farmers in Indonesia.
The share of the agricultural workforce represents the comparison between the number of employees in the agricultural sector and the entire labor from a total of 17 business fields in Indonesia. In general, this ratio tends to decrease. It is hardly surprising as this situation also occurred in other countries. Felipe et al. (2014) reported that the People’s Republic of China’s agricultural employment rate declined more than 50% in half of the century (1962 to 2013; 82% to 31%) and estimated that it will reach only 5% of the share by 2042-2048. A similar situation was also reported in Vietnam (Liu et al., 2020). Meanwhile, in India, there has been a decline in the number of cultivators, but the total number of agricultural laborers has interestingly increased (Li et al., 2017).

This reduction occurred because individuals working in the agricultural sector tended to decline, while other business fields experienced an upward trend. This trend was due to the industrialization and urbanization that have pulled labor, capital, as well as other factors of production to move to non-agricultural sectors, mainly in the cities (Long et al., 2010), which in turn led to a widening income disparity between agricultural and non-agricultural sectors (Rigg et al., 2016; Liu et al., 2020). This situation then encouraged workers in the agricultural sector to move to the non-agricultural sector (Kirchberger, 2017). However, this shift concentrated on the higher wage rates from the non-agricultural sector than in the agricultural sector, so these farmers decided to change professions to sectors that generate higher incomes.

According to Siregar et al. (2021), four of crucial sectors in the Indonesian economy are manufacturing, wholesale and retail trade, construction, and agriculture (based on shift-share calculations). The decreased number of workers followed the shift in the agricultural sector in GDP. Meanwhile, individuals who decided to work in the three main sectors are increasing. Yamauchi (2016) explained that mechanization also contributes to a decrease in the number of workers. Landowners prefer to increase the efficiency of their farms through the use of tools and machines rather than using more human labor.

Meanwhile, the share of agricultural labor increased in 2020 (Fig.07). The driving factor for this increase is the number of agricultural workers, which previously decreased, and then increased by 4.96%. This increase was even more higher than the increase in the total workforce from all sectors, which was 0.499%. Furthermore, the Indonesian Government implemented PSBB (large-scale social restriction) regulations to deal with the COVID-19 pandemic in 2020. As a result, most businesses could not operate and depressed economic conditions. In line with this, Temenggung et al. (2021) stated that in conditions of economic crisis, both caused by financial and non-financial aspects, there is a tendency to shift the sectoral workforce from non-agricultural to agricultural.

**Agricultural Sector Resilience in Indonesia**

Vyas and Kumaranayak (2006) explained that the results of the PCA show a factor score that can describe whether a variable has a heavier weight (a positive factor score) to ARI or a lighter weight to ARI because it has a negative value. Among the seven variables, the percentage of labor per farm to the total workforce is the only negative value (Table 2). This position shows that if the number of workers in the agricultural sector is greater than the growth in the entire labor, assuming other variables remain constant, agricultural sector resilience will be lower. The explanation for this is the existence of The Law of Marginal Diminishing Return. The increase in the number of workers leads to a higher...
quantity in production (increasing marginal returns). However, Völlrath (2011) states that if the number of workers grows, production will decrease (decreasing marginal returns). In the case of the agricultural sector, there is a limitation, namely the area of land. If the workforce continues to increase while the land size remains, the addition reduces productivity. On the other hand, it will also lead to higher costs, reducing producers’ income. Based on this, Yang and Zhu (2013) suggested that the solution to long-term growth for the agricultural sector is to increase tools and machines (mechanization).

Labor productivity in the agricultural sector has the highest factor score among other variables. This position shows that more income is earned by the workforce in the agricultural sector, causing a relatively more considerable boost to the level of resilience of this sector. However, according to the trend line in Fig.08, it is shown that the ARI value in 2020 decreased due to the increase in the number of workers in the field of agricultural business exceeding the growth in the value-added of this sector. According to Rada (2011), although the number of workers increases, efforts to increase productivity must continue to be carried out. The steps in question consist of applying technology and diversifying farming businesses, for example, initially concentrating on food crops and doing business in horticulture, aquaculture, or animal husbandry. Thus, the sub-sectors in the agricultural sector need to seek other possibilities.
Agricultural terms of trade have a positive contribution to the resilience of the agricultural sector. The results of this analysis emphasize the position of farmers as the leading actors in this sector. Rising commodity prices or decreasing farming costs are two incentives that can encourage farmers to maintain their farming activities. The use of agricultural terms of trade as an indicator of agricultural development ensures that the government continues to strive to maintain the stability of selling agricultural products and prices of agricultural inputs. According to Repetto (1987), selling price stability encourages farmers to maintain and strive for land conservation. Furthermore, Acs et al. (2010) explained that the government’s efforts to ensure the sustainability of farmers’ incomes align with measures to ensure the sustainability of social capital (community inter-linkages and institutions) within the farmers’ environment. On this basis, although the agricultural terms of trade are closely related to the price index received and paid, the impact is related to sustainable agricultural development.

Concerning ARI, the higher value of agricultural terms of trade encourages stronger resilience. Therefore, the government’s efforts to reduce farming costs by providing subsidies must be maintained. On the other hand, the program implemented by the government guarantees the minimum selling price (government purchase price) and the increase in production and strategic productivity to be carried out continuously. Therefore, assuming other variables are held constant, increased production will increase income and positively correlate to sustainable agricultural development (Lunduka et al., 2013).

Agricultural credit is ranked third and positively correlates with the agricultural sector resilience index. This position shows that loan money for activities in the agricultural sector supports the resilience of this business field which is relatively more significant than the other four parameters but not as extensive as agricultural workers’ income and credit. In 2013, agricultural credit disbursement decreased by around 12.03%. At the same time, the agricultural sector resilience index has declined. This development is an indication that the role of capital in the sustainability of farming still plays an important role. Mosher (1966) explained that capital is one of the accelerator factors in agricultural development. Furthermore, according to Mariyono (2019), agricultural business actors who can access credit can obtain broader benefits, such as the opportunity to take advantage of technology.

Moreover, a decline in agricultural credit also occurred in 2020, followed by the agricultural sector’s weaker resilience. The realization of loan funds in the agricultural sector decreased due to the decline in farmers’ income during COVID-19. If farmers become customers of banks that provide agricultural credit, this will affect the rate of loan repayment. Banks or financial institutions also responded to this by being more careful in lending (Ashari et al., 2020). Meanwhile, at the same time, farmers need credit to survive during the COVID-19 pandemic, where the number of requests for agricultural commodities from restaurants or food stalls has decreased, while for these two business actors, the absorption of harvested supplies is relatively large (Mishra et al., 2021).

This study concludes that the critical role of agricultural credit needs to be supported by increasing the accessibility of farmers to financial institutions (agricultural cooperatives, microfinance institutions, and banks) (Nguyen and Bui, 2021). Currently, Indonesia’s average cost of borrowing is relatively higher than the average loan interest rate in other ASEAN countries (Justjobs Network, 2015). In line with this, the government issued a People’s Business Credit policy and assisted producers with an interest rate of 7 percent a year. This percentage decreased up to 6 percent during the pandemic as a form of national economic recovery (Ashari et al., 2020). However, in addition to interest rates, other obstacles faced by producers in accessing credit are unfeasible businesses or irregular financial records. Thus, continuous assistance is urged for recording farming businesses and efforts to increase the capacity of farmers and farming businesses towards the financially feasible category.
Investment has a positive contribution to the resilience of the agricultural sector. According to Siregar and Widjanarko (2022), investment is vital in development, especially in agrarian countries. Investment is an accelerator in developing agricultural commodities into semi-finished and processed products that will be ready to be consumed by consumers. In addition, attracting more investment is beneficial for upgrading or purchasing agricultural tools and machines to produce more products effectively and efficiently.

The results of this study support the government’s efforts to improve the ease of doing business. According to the BKPM (2022), these efforts include improving regulations in various sectors, accelerating service time standards with more straightforward procedures, socializing more effective principles that can encourage business convenience in Indonesia, and improving services with the online system. On a macro level, Bétila (2021) stated that the ease of doing business impacts the economy as a whole. Align with that statement, Indonesia is currently ranked 73 out of 190 countries, and this achievement is better than 2017 (ranked 91).

According to Henry (2020), the COVID-19 pandemic has impacted the food production system. Some business actors reduce the number of workers and instead use machines to anticipate the spread of the virus. In plant cultivation activities, the imposition of social restrictions or physical interactions also impacts labor mobility. Therefore, investment can support the resilience of the agricultural sector by maintaining a smooth production process through support for increased use of tools and machines, as well as automation, both on-farm and off-farm.

Government spending in 2020 is relatively smaller because policymakers decided to reduce the budget disbursed for infrastructure and business actors in the agricultural sector. According to Armas et al. (2010), farmers and farmer groups get relatively large benefits from subsidies for agricultural production facilities and irrigation development. Fertilizer as a production factor plays an essential role in plant cultivation sustainability. The existence of subsidies helps farmers pay relatively cheaper costs and supports the sustainability of farming. Meanwhile, the presence of irrigation facilities supports farmers in the smooth maintenance of plants. Therefore, if the funds spent by the government for the agricultural sector are called off, it will have an impact on the sustainability of production and reduce agricultural sector resilience.

According to DPR RI (2021), fertilizer subsidies from 2016 to 2020 amounted to US$ 9 billion. On the other hand, the cost of irrigation infrastructure development reached US$ 600 million. Therefore, this study concludes that the government (policymaker and interested party to ensure the people’s livelihood) must always consider the percentage of the agricultural sector budget from the total budget. This consideration is because Indonesia, as an agrarian country, has a large population in the agricultural sector, so if there is a decrease in agricultural sector resilience, it will impact the lives of individuals in large numbers. Furthermore, apart from the strategic role of the government, it is expected that budget realization can also impact increasing productivity, capital, agricultural terms of trade, and investment, as four parameters with a higher factor score on agricultural sector resilience.

Through international trade, Indonesia emphasizes being a country with an agricultural base. The fifteenth largest area in the world and has prosperous and diverse natural resources this country has a variety of agricultural commodities needed by domestic consumers and buyers from other countries. Export activities benefit domestic producers through relatively high product prices in the international market compared to the domestic market. Therefore, despite the economic crisis, shipments of agricultural products abroad were relatively stable, and even during several periods of economic downturn, they increased (Arifah and Kim, 2022). This condition comes from other nations requiring products produced by Indonesia as food and industrial raw materials.

The value of the trade balance of agricultural commodities, which tends to increase from time to time, shows that between exports (X) and imports (M) for items with the same HS Code, Indonesia is generally and consistently relatively superior (X>M). In these conditions, three conditions may occur: 1) the quantity of products sent abroad is greater than the previous period, with a fixed price, 2) the number of products does not differ/decrease from the previous period, but prices increase, and 3) increasingly high quantity of products shipped and followed by price increases. Among the three conditions, all benefit business actors, both exporters and producers who carry out export-oriented commodity farming.

In 2020, when the COVID-19 pandemic occurred, agricultural commodities exports grew positive. It impacted the resilience of the agricultural sector, which was getting stronger, as demand from other countries for farmers’ production in Indonesia ensured that domestic producers’ production process and income...
continued. In the first year of the COVID-19 pandemic, the trade balance surplus of agricultural commodities increased by 5.2 billion US$ (43%) compared to 2019. Furthermore, as cited in the Ministry of Foreign Affairs (2021), the Ministry of Agriculture stated that the export of agricultural commodities is one of the accelerators of economic improvement during the pandemic. Furthermore, Indonesia seeks to prevent a decline in exports by connecting domestic business actors with buyers from abroad and limiting imports. In addition, the government is also preparing capital assistance to facilitate exporters in preparing and sending their products. On the other hand, Fig.08 shows that ARI tends to increase positively and significantly over time. This condition showed that in general, variables that contribute positively to ARI formation experienced positive performance, and it will help the agricultural sector be more resilient in the future.

CONCLUSION

This study aimed to measure the resilience of the agricultural sector in Indonesia using seven variables (trade balance of agricultural commodities, agricultural terms of trade (NTUP), agricultural investment, government spending in the agricultural sector, total value of credit in the agricultural sector, agricultural workers’ income, and share of agricultural workers to total workers) and determined the trend. The results are Agriculture Resilience Index (ARI) has been formed, and from 2008 to 2020, the ARI value tended to go upward, which indicates this business field has become more resilient as time goes by.

Next, this study found that among the variables, agricultural workers’ income predicates the highest linkages to ARI, followed by NTUP, total credit, investment, government spending, and trade balance. On the other hand, a higher share of agricultural workers in total labor tends to lower resilience. The sequence between the first and the last rank in relation to the index indicates that human resources play the most important role in ensuring the resilience of the agricultural sector.

Higher-income becomes the incentive for agricultural laborers to ensure the existence of the agricultural sector or even move forward the business. Meanwhile, increasing the percentage of the workforce in the agricultural sector compared to the total labor in all business fields, will weaken this sector’s resilience. Based on the data analysis outputs, the suggestion for a government program to encourage more youth to become young farmers (Millennials Farmers) and encourage the existing laborers, is, to begin with providing skills in using technology, comprehensive information (from pre-cultivation until marketing the product), and knowledge so that skilled business actors can boost higher productivity of the agricultural sector, instead of only concern on regeneration regardless their ability. This suggestion comes with the fact that the area of agricultural land in Indonesia is relatively stagnant or tends to decrease, while human capital is a factor that still has a quite large space for improvement.

This study contributes to the renewal of the literature on the resilience of the agricultural sector. The variables used to represent the parameters of agricultural development in Indonesia can be applied in other countries. We suggest the study results be taken into account in policy formulation to maintain the stability of the resilience of the agricultural sector. In the future, it is recommended to add environmental conditions and a research and development budget, so that the measurement of the resilience of the agricultural sector becomes more comprehensive.

Acknowledgements

This research was funded by the Department of Agricultural Socio-Economics, Faculty of Agriculture Universitas Gadjah Mada, for project 243A/TU/III/2021 regarding the Disruption and Resilience of the Agricultural Sector in Indonesia.

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