ISSN XXXX-XXXX

NATIONAL FOOD SECURITY TRANSFORMATION: INDONESIA'S AGRICULTURAL DIVERSIFICATION AND INNOVATION STRATEGY TO REDUCE DEPENDENCE ON WHEAT IMPORTS AFTER THE UKRAINE CRISIS (2022-2024)

Raihanah Tsabitah Djamar[1], Della Evelin2*

[1] *Department of International Relations,* Universitas Darussalam Gontor, Indonesia
[2] *Department of International Relations,* Universitas Darussalam Gontor, Indonesia
*sabitaadj@gmail.com

Abstract

The Russia-Ukraine geopolitical crisis since 2022 has disrupted global supply chains, including the supply of wheat, which is a strategic food commodity of the world. Indonesia, as one of the largest wheat importing countries, has been significantly affected by price spikes and high import dependence. This study aims to analyze the transformation of national food security through agricultural diversification and innovation strategies in reducing dependence on wheat imports in the post-Ukraine crisis period (2022–2024). The approach used is qualitative with literature study methods and secondary data analysis from BPS, FAO, and the Ministry of Agriculture of the Republic of Indonesia. The results of the study show that food diversification based on local commodities such as sorghum, sweet potatoes, sago, and corn has increased policy support, both in the form of production incentives and research strengthening. Agricultural innovation through agroecotechnology approaches and strengthening local food ecosystems has also been proven to increase the productivity of wheat alternatives by 17.4% in 2023 compared to the previous year. However, challenges such as people's consumption preferences and limited food infrastructure remain major obstacles. This study recommends the integration of food diversification strategies with consumer education approaches and community-based technology investment to build national food independence in a sustainable manner.

Keywords: food security, food diversification, agricultural innovation, wheat imports, Ukraine crisis.

INTRODUCTION

Indonesia's national food security is facing major challenges after the 2022 Russia-Ukraine crisis, which disrupted global wheat supplies. Russia and Ukraine are the world's two largest wheat exporters, accounting for around 28% of global exports in 2021 (Faith dkk., 2022). Based on data from the Central Statistics Agency, Indonesia is one of the largest wheat importers in the world, which relies on imports to meet more than 90% of the national wheat needs,

especially for the wheat flour industry and its derivative products such as noodles, bread and cakes (BPS, 2023).

According to a report released by the Directorate General of Customs and Excise and thoroughly analyzed by the Central Statistics Agency (BPS), Indonesia's imports of meslin and wheat in 2023 reached a significant amount, reaching 10.58 thousand tons, with a total value of US$3.66 billion (CNBC Indonesia, 2024) This significant increase in imports demonstrates Indonesia's continued dependence on foreign resources to meet its agricultural commodity needs. This crisis shows the vulnerability of Indonesia's food system to external turmoil, geopolitical tensions involving both have caused significant disruption in wheat supply, resulting in many countries, including Indonesia, experiencing price fluctuations and the threat of supply shortages.

Based on the FAO report (2024), world wheat production in the 2023-2024 season is estimated to decline by 3% compared to the previous year's record high. By 2024, Indonesia has not produced wheat on a significant scale and is completely dependent on imports to meet domestic consumption needs. Therefore, there is a need to transform food security through a food diversification strategy based on local resources and the application of adaptive agricultural technology innovations.

With Russia's invasion of Ukraine, the state of supply and demand for basic materials has become very volatile in the commodity market. Russia and Ukraine are the world's largest exporters of wheat. Indonesia, Tunisia, Egypt, Turkey, Yemen, and Bangladesh are some of the destination countries for wheat exports of Ukraine and Russia. Indonesia must prepare itself to find the best source of supply. Suppose importing goods from the United States, Canada, Argentina, or Australia. Because wheat flour and instant noodles are some of the staples whose prices will increase if the supply of wheat is hampered (Giarpradipta, 2022).

Indonesia also has great potential to develop alternative foods such as sorghum, sago, cassava, taro, and corn, which are more in line with local agroecology. Sorghum (*Sorghum bicolor*), for example, has agronomic and nutritional potential on par with wheat, with drought-tolerant advantages and health-supporting gluten-free content that can improve food security while opening up new economic opportunities. However, until now the development of these commodities is still constrained by aspects of productivity, added value, distribution, and limited revenue at the consumer level.

The problems that arise are not only related to the wheat supply chain and import dependence, but also on the unbalanced structure of national food consumption and production. People are still more dominant in consuming wheat-based food and have not optimized the implementation of local agricultural innovations, showing the need for evaluation and reform of national food policies. Therefore, the urgency of this research lies in the need for a systematic study of the effectiveness of agricultural diversification and innovation strategies that have been implemented by Indonesia after the Ukraine crisis, in order to identify their potential, challenges, and impacts on national food security.

This research is not only academically relevant as a contribution to the food security literature, but also practically important as a basis for consideration in the formulation of sustainable food policies amid the pressures of the ongoing global crisis. This study aims to analyze the effectiveness of Indonesia's food diversification and agricultural innovation strategies in reducing dependence on wheat imports after the Ukraine crisis (2022-2024). The study also identifies challenges and opportunities related to national food security transformation efforts.

METHODOLOGY

This study uses a qualitative descriptive approach with the library *research method*. The main objective of this study is to critically evaluate local food diversification strategies and agricultural innovations in Indonesia in responding to the impact of the global crisis due to the Russia-Ukraine conflict during the 2022-2024 period. The data used are secondary and obtained from a variety of trusted sources, including scientific literature from journal articles, official reports of international institutions such as FAO, UN Comtrade, and the World Bank, national policy documents of BPS, and the Indonesian Ministry of Agriculture, as well as relevant government publications. The main focus of data collection includes topics such as wheat import dependence, food diversification strategies, and the application of innovative technologies in the agricultural sector.

The data analysis process is carried out by the thematic *analysis method*, which includes the stages of identification, categorization, and interpretation of the main themes. These themes include: local food diversification strategies, challenges and obstacles to implementation in the field, and post-crisis national food security indicators. This approach allows researchers to trace

the linkages between domestic policies and global dynamics in shaping Indonesia's response to national food security.

RESULTS AND DISCUSSION

1. The Impact of the Ukraine Crisis on Indonesia's Wheat Security

Wheat production worldwide is projected to fall slightly (0.1%) from the previous season's level to 787 million tonnes in 2024. Most of this decline is projected as a result of production declines in the European Union, Ukraine, Turkey, the United Kingdom, Northern Ireland and Morocco (FAO, 2024) .

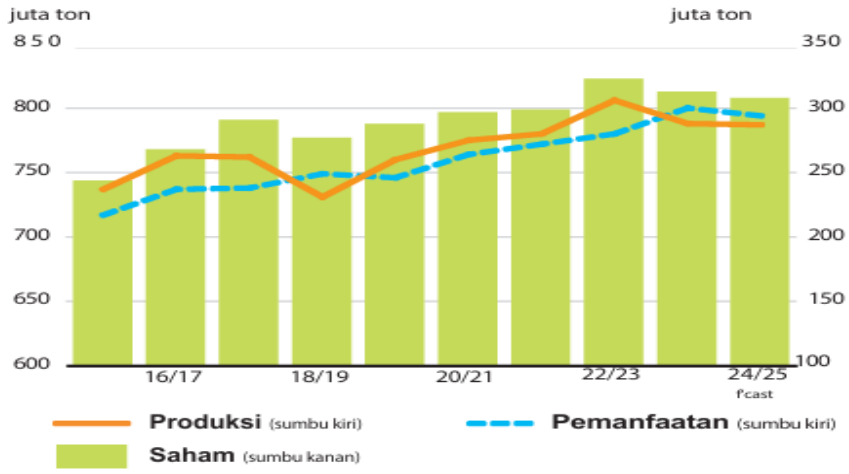


Figure. 1 Wheat production, Utilization, and Stocks.
Sources: FAO, 2024

Global wheat trade in 2024-2025 is expected to shrink by 7.8%. But there is a potential increase of 3.8% for trade in this agricultural commodity in 2025-2026 to 200.6 million tons. Despite the increase, the total global wheat trade is still lower than the record high of 209.6 million tons that occurred in 2023-2024. The trade surge mainly occurred in Asia which had the potential to increase by 16.4% to 14.9 million tonnes (FAO, 2024) .

According to the National Food Agency (2023), Russia's withdrawal from the Black Sea Grain Initiative (BSGI) has also had a significant impact on the global food sector, especially wheat prices. The threat posed by the long-term Russia-Ukraine war also has the potential to impact countries such as China, India, Myanmar, Vietnam, and Cambodia with special implications for Indonesia (Kontan.co.id, 2024).

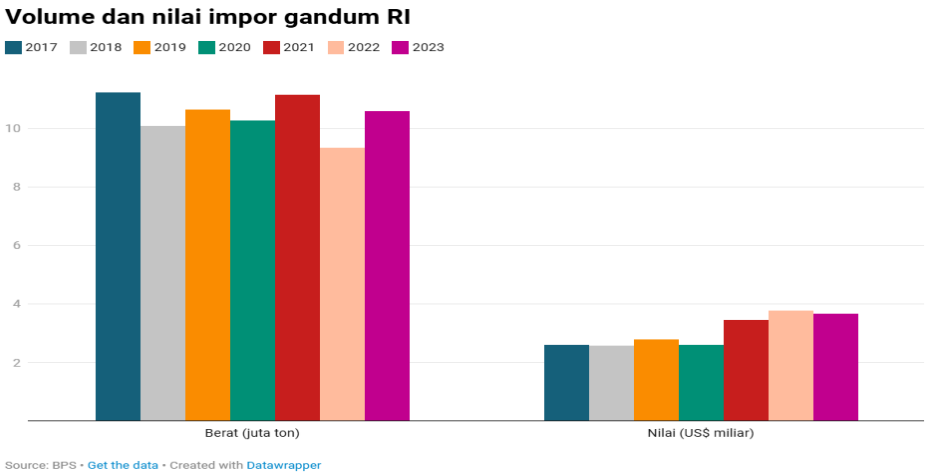
ISSN XXXX-XXXX

The Russia-Ukraine crisis has made Indonesia highly dependent on wheat imports due to several factors, namely: First, wheat consumption continues to increase due to people's diets that increasingly prefer instant foods such as noodles, bread, and cakes, based on data from the World Instant Noodles Association (WINA) in 2022, Indonesia is in second place as the country with the highest consumption of instant noodles in the world. Second, Indonesia is unable to produce large quantities of wheat due to the unsuitable climate and land, so all wheat needs must be met from imports (Bisnis.com, 2024)

Third, efforts to diversify foods such as sorghum are still limited and cannot replace wheat. Fourth, the Russia-Ukraine conflict caused global wheat prices to rise sharply, but imports were still carried out due to urgent domestic needs. Fifth, logistical and security barriers during the conflict make import costs more expensive (Anugraheni et al., 2024)

In addition, major exporting countries also restrict exports for their domestic needs. However, Indonesia can still import because it has good trade relations and long-term contracts with countries such as Australia and India. All of these factors show that Indonesia is not yet independent in terms of food security, especially for wheat commodities.

In 2023, Indonesia's wheat and meslin imports will reach US$ 3.66 billion, or equivalent to Rp 57.26 trillion. Data from the Central Statistics Agency (BPS) shows that the value of wheat and meslin imports in 2023 decreased by 2.72% compared to 2022. However, imports jumped quite sharply in terms of volume, rising 13.22% to 10.59 million tons. The import volume of wheat and meslin has fluctuated at 10-11 million tons over the past seven years. However, the value of imports jumped 40.8% from US$ 2.6 billion in 2017 to US$ 3.66 billion in 2023.



ISSN XXXX-XXXX

Figure 2. Volume and Value of Indonesian Wheat Imports
Source: BPS, 2024

Figure 3. Indonesia's Wheat and Meslin Seed Import Volume by Country of Origin 2023
Source: Badan Pusat Statistik, Good State, 2023

Then Australia emerged as the main supplier occupying the top position in the list of wheat and meslin exporting countries to Indonesia. Australia is also a long-standing trading partner in agriculture. Data shows that Australia accounts for around 40.05% of Indonesia's total imports, sending a significant volume of 4.23 thousand tons of wheat and meslin, with a value of US$1.46 billion (GoodStats, 2024). This shows Australia's important role in meeting Indonesia's demand for wheat. Indonesia's imports of meslin and wheat come from various producing countries around the world, despite Australia's dominance. Among them, Canada made the largest contribution with 2.37 thousand tons of wheat with a value of US$946.5 million, followed by Russia with 909.4 tons with a value of US$257.6 million, and Bulgaria with 867.9 tons with a value of US$257.6 million.

In addition, countries such as Brazil, Ukraine, the United States, Argentina, and Moldova also play a large role in Indonesia's wheat and meslin imports. Brazil exported 828.1 tons at a price of US$318.7 million, and Ukraine exported 652.4 tons at a price of US$195.3 million. In addition, the United States, Argentina, and Moldova make significant contributions, this contribution demonstrates the diversity of Indonesia's import sources and its engagement with traditional and new suppliers in the global wheat market (GoodStats, 2024).

ISSN XXXX-XXXX

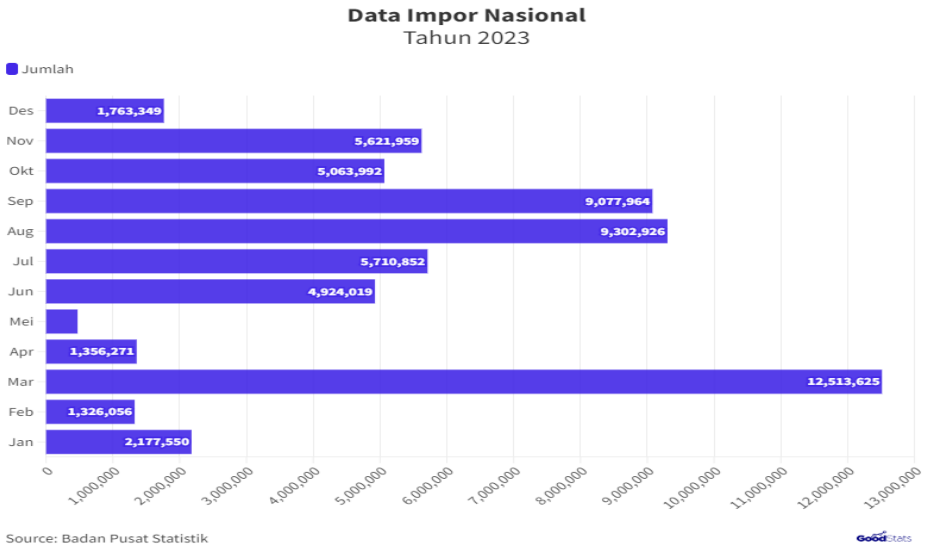


Figure 4. National Import Data in 2023
Sources: BPS, Good State, 2024

Indonesia's economy is heavily influenced by imports, which affect various aspects, from the trade balance to the domestic manufacturing sector.

The surge in wheat and meslin imports does not only reflect people's preferences and consumption patterns that are starting to increase. But it also has significant economic implications. Food security remains a major concern, with increasing spending on the import sector demonstrating the need for a domestic strategy to increase wheat production and reduce dependence on foreign sources.

2. Food Diversification as a Strategic Response

a. The role of local food (Sorghum, Cassava, Sago)

In response to this vulnerability, the government has taken the initiative to encourage the diversification of local foods based on local resources, such as sorghum, cassava, sago, and corn to reduce dependence on imported wheat. Based on the NFA (2022) prediction, this commodity offers a 10% substitution of wheat flour and cassava flour or analog rice can save IDR 2.4 trillion per year (National Food Agency, 2022). The Minister of Agriculture also targets 20% substitution of wheat imports with local commodities such as cassava, sorghum, and sago (*Katadata.co.id*, 2022). The government also encourages diversification of food sources, especially carbohydrates through the development of alternative commodities.

One of the main concerns is sorghum, which is considered to have high nutritional value and resistance to dry conditions, so it has the potential as a substitute for wheat (Antaranews.com, 2022). Research in East Flores Regency shows that the development of sorghum agro-industry can improve local food security and farmers' welfare (Mulyawanti et al., 2023, p. 191).

Sago itself has an important role in meeting the food and nutritional needs of the Indonesian people, especially in the interior and archipelago. This food comes from the sago tree that thrives in tropical forests, and has long been part of the consumption traditions of local communities in various regions. As a source of carbohydrates, sago also has the potential to be an important alternative in strengthening national food security. Indonesia itself is one of the largest sago producers in the world. Sago production is most concentrated in Maluku and Papua, two provinces that have very favorable natural conditions for the natural growth of sago trees.

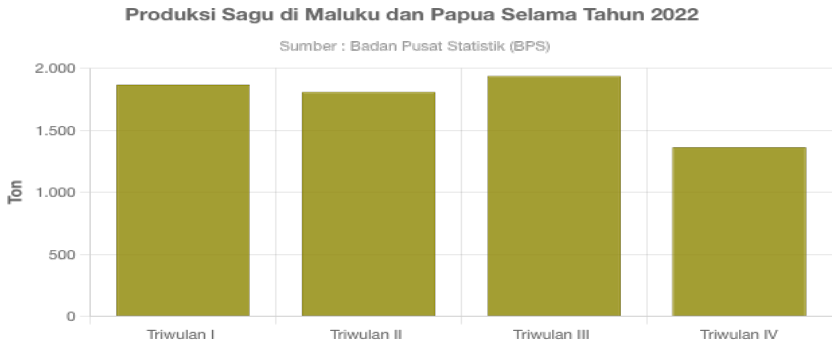


Figure 5. Sago Production in Maluku and Papua During 2022
Sources: Central Bureau of Statistics, 2023

Data from the Central Statistics Agency (BPS) in 2022 shows that sago production in Maluku and Papua fluctuates throughout the year. In the first quarter, production was recorded at 1,867 tons, a figure that was quite promising at the beginning of the year. However, in the second quarter, there was a slight decrease to 1,807 tons.

Production increased again in the third quarter to 1,936 tonnes, indicating a positive recovery. Unfortunately, the decline was quite sharp in the fourth quarter, with production falling to 1,362 tons. This pattern suggests that sago production is strongly influenced by natural and seasonal factors that are not always stable over time (BPS, 2023).

Cassava has also long been a source of traditional food in various regions in Indonesia. The development of cassava-based flour has been carried out in several regions through the

development of farmer groups and cooperation with research institutions. According to Dyah Susilokarti, Director of Miscellaneous Beans and Tubers at the Ministry of Agriculture, Indonesia is among the five largest cassava producing countries in the world.

During the 2020-2024 period, the average national cassava production reached 15.7 million tons per year. This plant is cultivated on an area of about 611 thousand hectares, with an average harvest area of 602 thousand hectares. Its national productivity was recorded at 26.17 tons per hectare. However, the price of non-wheat flour is still relatively more expensive than wheat flour. So, efforts are needed to increase productivity and production efficiency in order to compete in the market.

b. Structural and cultural barriers to public consumption towards alternative foods

Digital agriculture technology in Indonesia faces significant structural barriers. Based on the results of Noviar and Fadhlain's research (2025), only 13.2% of agricultural business actors can access the internet and only 4.3% use digital agricultural applications (Noviar & Fadhlain, 2025, p. 98). According to data from the Central Statistics Agency (BPS) in 2023, the number of farmers in Indonesia will reach around 28.19 million people.

Of these, only around 42% of millennial farmers have utilized digital technology in their agricultural businesses, while 58% have not used it. This shows that although the use of digital technology is starting to grow, there are still many farmers who have not yet felt the benefits of it. The rest still rely on traditional methods (Putri Fadila, 2025).

Uneven digital technology and infrastructure are a major challenge, especially in rural areas. Only 45% of rural Indonesians have adequate internet access, compared to 75% in urban areas (Communications, 2025). Some local materials have special characteristics that require additional technology. For example, sorghum flour does not expand like wheat flour, so it needs special processing techniques or additives (ANTARA News, 2022).

In addition, sorghum seeds, contain quite high levels of tannins, which are limiting because they taste bitter and inhibit amino acids. The technology required is the decoration or breeding of low-tannin varieties, but the high cost hinders the production process. And also internet speed in rural areas is still low and high access costs are a big obstacle in the use of digital technology (Putri Fadila, 2025).

Supply chains and markets are also one of the structural obstacles because a strong market has not been formed for wheat substitutes. The production of sorghum and sagum asih on a small scale and large industries have not mass-absorbed the results. This makes farmers hesitant to develop new crops without collateral *offtaker*. Experts emphasize the need for market traction *(Demand Pull)* such as partnerships with the feed or processed food industry to ensure sustainable local supply chains (antaranews.com, 2022).

The culture of public consumption is one of the obstacles in alternative food, because for a long time the Indonesian people have depended on rice as a staple food (National Food Agency, 2022). According to the perception, people have not eaten if they have not eaten rice, so it is difficult to change their consumption patterns of staple foods to alternative foods (sorghum, sago, cassava). On the other hand, the taste and texture of local food do not match modern tastes. For example, sorghum rice processed from sorghum seeds is less popular with residents because of its harder texture and less fluffy than white rice (Mardhiyyah et al., 2024, pp. 187–188).

The modern lifestyle implemented by today's young generation is also an obstacle to alternative foods, especially when it comes to food they tend to choose fast food based on wheat. Busy consumption patterns or urbanization have led to a decrease in home rice consumption and an increase in consumption outside the home, and the availability of wheat products in shopping places such as convenience stores and restaurants. In addition, there is a lack of awareness and education because without education, people often ignore the nutritional value of local food and still see alternative foods as food for the underprivileged community (Wijayati et al., 2023, pp. 18–19).

3. Innovation in Agricultural Systems and Technology

a. Development of superior varieties of local food

One of the most suitable local crops as a substitute for wheat is sorghum, a very potent drought-resistant cereal crop. Sorghum can grow on marginal land and bear fruit even with minimal water, with planting technology once harvested twice, so that it can harvest up to three times in a year (antaranews.com, 2024). The productivity in NTT and NTB averages 3-4 tons/ha and in Central Java or East Java 4-5 tons/ha. The technological innovations used include the

restoration of waxy varieties (low amylose) so that sorghum rice is fluffy like rice (Mardhiyyah et al., 2024b, pp. 188–189).

Cassava is the main tropical tuber, cassava is widely processed into various flour products such as gaplek, tapioca, and mocaf. Mocaf flour can be a substitute for flour in bread, cakes, and noodles. Even though it has been utilized, the use of mocaf is still limited, so the government also encourages cassava cultivation and fermentation technology to increase the quantity and quality of supply (National Food Agency, 2022).

In addition, another local food is sago traditional food in eastern Indonesia which is very rich in potential. Timber trees have high productivity (20-40 tons of dry starch/ha/year). Sago flour can be processed into a staple food. For example, papeda and industrial materials. The main innovation is the sago-wheat flour mixture, for example, replacing 10-20% of wheat with sago flour in bread or noodles without changing the taste. The analysis shows that the substitution of 20% wheat with sago can reduce import foreign exchange by around Rp4.8 trillion per year. So the need for government encouragement for the improvement of superior sago seeds and the establishment of a sago flour processing industry to support this wheat substitution strategy (antaranews.com, 2022).

b. Smart farming, agroindustry, and supply chain initiatives based on digital technology

After the Ukraine crisis in 2022, Indonesia intensified agricultural innovation efforts through the adoption of digital technology and smart farming 4.0 as a strategic step to reduce dependence on wheat imports. The Ministry of Agriculture has committed to accelerating the implementation of Smart Farming by launching innovative programs that utilize advanced technology (antaranews.com, 2024). According to Rachmawati (2021), the Smart Farming 4.0 developed includes the implementation of the Internet of Things (IoT), spayer drones for precision spraying, smart irrigation systems, and War Room (AWR) agriculture for real-time monitoring, drones for land mapping, soil and weather sensors, systems (information systems) 1.0 (Rachmawati, 2021, pp. 139–142). Blockchain technology is also applied to improve the transparency and traceability of the agricultural product supply chain, allowing farmers to optimize processes from upstream to downstream (Marsha Bintang, 2024). Petrokimia Gresik develops nanotechnology fertilizers that are applied using drones with IoT technology, resulting in precise fertilization efficiency and increasing productivity (Rita Puspita, 2023)

4. Government Policies and Support

a. Evaluation of priority programs such as Food Estate and national food diversification

In response to the increasing dependence on food imports, especially wheat and rice, the government through the National Food Agency (NFA) continues to encourage local food diversification programs. One of the strategic efforts carried out is the launch of the B2SA (Diverse, Nutritious, Balanced, and Safe) Movement, which aims to change the consumption culture of the Indonesian people to better appreciate local food sources. This movement emphasizes the importance of eating healthy foods that are not always based on rice or wheat, as well as strengthening awareness of the diversity of Indonesian food (National Food Agency, 2023).

This diversification effort does not stand alone. The government and academics also emphasized the need for land optimization as an integral part of food security strategies. One of the proposed approaches is the use of social forestry land covering an area of 4 to 7 million hectares for the cultivation of local food crops such as sorghum and tubers. This idea received attention from a number of figures, including Fadli Zon, who at that time served as the Minister of Tourism and Culture. He also emphasized the importance of developing alternative protein sources, such as fish and chicken, which are considered more affordable and accessible to the public than beef (Depok News, 2025).

Furthermore, national initiatives such as *National Sorghum Movement* and development *food estate* in dryland areas reflects the government's long-term commitment to building food security based on domestic resources. This program not only aims to increase local food production, but also strengthen food distribution and access more equitable. In its implementation, NFA and the Ministry of Agriculture actively carry out educational campaigns, including through a review of market operations, redistribution of food from surplus areas to deficit areas, to the promotion of the slogan "satiety does not have to be rice" as part of changing people's consumption patterns (National Food Agency, 2022).

b. Cross-Sector Collaboration in Food Innovation

The Ministry of Agriculture (Kementan) is proactively establishing strategic partnerships with the food industry sector in order to strengthen national food security. One concrete form

of this collaboration can be seen in the collaboration with PT Indofood, which expresses its commitment to develop instant noodle products made from sorghum flour as an alternative to imported wheat flour. The president director of Indofood openly expressed his full support for the diversification initiative of local raw materials, such as sorghum, cassava, and sago. This step is seen as a form of responsibility for the industrial sector in responding to the challenges of the global food crisis, while strengthening the use of local food resources in a more sustainable manner (Agency, 2022).

This effort was then strengthened by the active role of the scientific community and research institutions. In line with initiatives from the industrial sector, institutions such as the National Research and Innovation Agency (BRIN), various universities, and agronomic associations are also involved in the development of research related to local food commodities. The main focus of research includes breeding superior sorghum varieties, increasing land productivity, and food processing technology innovation so that local products such as sorghum can meet modern food standards. This synergy between government, industry, and the research world reflects a collaborative approach in building a more self-reliant and resilient national food system not only as a response to the crisis, but also as a long-term investment towards food sovereignty (Agency, 2022).

Furthermore, food diversification is also translated into the form of technological innovation that reaches local food-producing areas, such as Papua. In cooperation between FAO and the Ministry of Agriculture, a small-scale sago processing machine was introduced that was able to cut production time from days to just about five hours. This machine not only improves efficiency, but also produces more hygienic and consistent sago flour. With this technology, the variety of processed sago is growing, from sago noodles to rice analogue products, opening up a wider and value-added market potential (FAO, 2025).

The development of sago as an alternative to carbohydrates has high cultural and ecological value, especially for the indigenous people of Papua, who have long made sago a sacred staple food. However, in order for sago products to contribute more to national food security, a follow-up strategy is needed to expand consumer acceptance beyond indigenous communities. Education, product innovation, and distribution support are important steps so that sago and other local commodities can be accepted by the wider community as part of a healthy and diverse consumption pattern.

ISSN XXXX-XXXX

CONCLUSIONS AND RECOMMENDATIONS

The Russia-Ukraine geopolitical crisis since 2022 has exposed the vulnerability of Indonesia's food security, especially to wheat commodities that are completely dependent on imports. This dependence is exacerbated by changes in people's consumption patterns, limited domestic production, and global price volatility. In this context, the strategy of food diversification and agricultural innovation is a crucial step that the government has begun to implement as a long-term effort.

This research shows that Indonesia has taken a number of strategic steps to strengthen national food security, including by encouraging the development of local foods such as sorghum, cassava, sago, and corn. This effort is supported through import substitution policies, increasing local commodity research, and the application of smart farming technology and agricultural digitalization.

However, the challenges faced are not only technical, but also structural and cultural. Barriers to access to technology, uneven digital infrastructure, weak local food supply chains, and low public acceptance of alternative foods are real obstacles in this transformation process.

The government needs to take strategic steps such as expanding educational campaigns on local food so that the public better understands the nutritional value and economic benefits of alternative food consumption. Furthermore, it is necessary to strengthen technological infrastructure in the agricultural sector, especially in disadvantaged areas. Support in the form of internet access, modern post-harvest technology. And collaboration between farmers, the government, and industry needs to be strengthened through mutually beneficial partnership schemes.

REFERENCES

Agency, A. N. (2022, August 13). *Indoofod is ready to develop noodles from sorghum*. Antara News West Sumatra. https://sumbar.antaranews.com/berita/522533/indoofod-siap-kembangkan-mie-dari-sorgum

antaranews.com. (2022a, August 4). *The government considers the animal feed industry to be an "offtaker" of sorghum*. Antara News. https://www.antaranews.com/berita/3038829/pemerintah-pertimbangkan-industri-pakan-ternak-jadi-offtaker-sorgum

antaranews.com. (2022b, August 9). *Ministry of Agriculture: Diversification must be carried out in anticipation of the food crisis*. Antara News. https://www.antaranews.com/berita/3047197/kementan-diversifikasi-harus-dilakukan-antisipasi-krisis-pangan

antaranews.com. (2022c, September 16). *The way out of the food trap is through sago and sorghum commodities*. Antara News. https://www.antaranews.com/berita/3120937/jalan-keluar-dari-jebakan-pangan-melalui-komoditas-sagu-dan-sorgum

antaranews.com. (2024, September 4). *The Ministry of Agriculture is committed to implementing digitalization technology in the agricultural sector*. Antara News. https://www.antaranews.com/berita/4308627/kementan-komitmen-terapkan-teknologi-digitalisasi-di-sektor-pertanian

Anugraheni, Z., Darwanto, D. H., & Rohmah, F. (2024). Determinants of Indonesia's Wheat Imports. *Journal of Agribusiness Management and Development*, *5*(1), 22–30. https://doi.org/10.22146/jamadev.v5i1.13129

National Food Agency—Attending FGD at Lemhannas, Deputy 2 NFA Explains Anticipatory Steps to Overcome Food Security Threats—Blog. (t.t.). Retrieved July 12, 2025, from https://badanpangan.go.id/blog/post/hadiri-fgd-di-lemhannas-deputi-2-nfa-paparkan-langkah-antisipasi-mengatasi-ancaman-ketahanan-pangan

National Food Agency—Maintain Food Availability and Stocks, NFA Invites People to Change Consumption Culture to Local Food—Blog. (t.t.). Retrieved July 12, 2025, from https://badanpangan.go.id/blog/post/jaga-ketersediaan-dan-stok-pangan-nfa-ajak-masyarakat-ubah-budaya-konsumsi-ke-pangan-lokal

Blockchain in Agricultural Supply Chain Management. (t.t.). Retrieved July 12, 2025, from https://ftmm.unair.ac.id/blockchain-dalam-supply-chain-management-pertanian/

Communications, M. &. (2025, Mei 2). *Indonesia Rural Digital Inclusion: A Quiet Revolution*. Market Research Indonesia Consulting Firm. https://marketresearchindonesia.com/insights/articles/indonesia-rural-digital-inclusion-revolution

Data, G. (t.t.). *Sago Production in Maluku and Papua During 2022*. GoodStats Data. Retrieved July 14, 2025, from https://data.goodstats.id/statistic/produksi-sagu-di-maluku-dan-papua-selama-tahun-2022-Fj5lJ

Food Outlook – Biannual report on global food markets. (2024). FAO. https://doi.org/10.4060/cd1158en

Giarpradipta. (2022, May 13). The Impact of the War in Ukraine and Russia on the Supply of Wheat Commodity in Indonesia. *Logistics and Supply Chain Management*. https://mlrp.feb.ugm.ac.id/2022/05/dampak-perang-ukraina-dengan-rusia-terhadap-supply-komoditas-gandum-di-indonesia/

Dwight Duncan, A. A. (2024). Comparative Analysis Of Wheat Imports In Indonesia After And Before The Russia-Ukraine Conflict. *15 September 2024*, *12*(3). https://doi.org/DOI : 10.37081/ed.v12i3.5977

Glauben, T., Svanidze, M., Götz, L., Prehn, S., Jamali Jaghdani, T., Đurić, I., & Kuhn, L. (2022). The War in Ukraine, Agricultural Trade and Risks to Global Food Security. *Intereconomics*, *57*(3), 157–163. https://doi.org/10.1007/s10272-022-1052-7

GoodStats. (t.t.-a). *Indonesia's Wheat and Meslin Imports Reach a Record High in 2023*. GoodStats. Retrieved June 20, 2025, from https://goodstats.id/article/impor-gandum-dan-meslin-indonesia-mencapai-rekor-tertinggi-pada-2023-tLp2S

GoodStats. (t.t.-b). *Indonesia's Wheat and Meslin Imports Reach a Record High in 2023*. GoodStats. Retrieved July 12, 2025, from https://goodstats.id/article/impor-gandum-dan-meslin-indonesia-mencapai-rekor-tertinggi-pada-2023-tLp2S

Improving Indigenous People's livelihood through sago processing. (t.t.). FAOinIndonesia. Retrieved July 12, 2025, from https://www.fao.org/indonesia/news/detail/improving-masyarakat-adat-s-livelihood-through-sago-processing/en

Ministry of Agriculture: Local food can free Indonesia from import dependence—ANTARA News. (t.t.). Retrieved July 12, 2025, from https://www.antaranews.com/berita/3051405/kementan-pangan-lokal-bisa-lepaskan-indonesia-ketergantungan-impor

Wheat consumption among Indonesian citizens is increasing, import alarms are soaring. (t.t.). Retrieved July 12, 2025, from https://ekonomi.bisnis.com/read/20240124/12/1735177/konsumsi-gandum-warga-ri-makin-banyak-alarm-impor-melonjak

Reducing Wheat Imports, Government Encourages Massive Sorghum Cultivation. (t.t.). Official News Portal of the Depok City Government. Retrieved July 12, 2025, from https://berita.depok.go.id/kurangi-impor-gandum-pemerintah-dorong-budidaya-sorgum-secara-masif

Mae. (t.t.). *Indonesian Citizens Eat Billions of Noodles Packaged, Wheat Imports Penetrate Rp 57 Trillion*. CNBC Indonesia. Retrieved June 20, 2025, from https://www.cnbcindonesia.com/research/20240120113339-128-507466/warga-ri-makan-mie-miliaran-bungkus-impor-gandum-tembus-rp-57-triliun

Mardhiyyah, R., Wirnas, D., & Trikoesoemaningtyas. (2024a). Inheritance of Waxy Properties of F3 Sorghum Population from Glutinous Rice Cross 3 x PI-150-20A. *Agrohorticulture Bulletin*, *12*(2), 186–194. https://doi.org/10.29244/agrob.v12i2.54529

Mardhiyyah, R., Wirnas, D., & Trikoesoemaningtyas. (2024b). Inheritance of Waxy Properties of F3 Sorghum Population from Glutinous Rice Cross 3 x PI-150-20A. *Agrohorticulture Bulletin*, *12*(2), 186–194. https://doi.org/10.29244/agrob.v12i2.54529

Minister of Agriculture Targets 20% Substitution of Wheat Imports with Sorghum and Cassava—Industry Katadata.co.id. (t.t.). Retrieved July 12, 2025, from https://katadata.co.id/berita/industri/630f5c5fbb7ac/mentan-targetkan-subtitusi-20-impor-gandum-dengan-sorgum-dan-singkong?utm_source=Direct&utm_medium=Sub-Kanal%20Berita%20Industri%20Detail&utm_campaign=Baca%20Juga%20Redaksi%20Pos%203

Mulyawanti, I., Suryana, E. A., Winarti, C. H., & Munarso, S. J. (t. t.). *SORGHUM Agroindustry Development Model Supports Food Diversification: A Case Study In East Flores Regency, East Nusa Tenggara Province*.

Largest Wheat Producing Countries 2024. (t.t.). Retrieved July 13, 2025, from https://pusatdata.kontan.co.id/infografik/127/Negara-Produsen-Gandum-Terbesar-2024

Noviar, H., & Fadhlain, S. (2025). *Millennial Farmer-Based Agricultural Digitalization Policy Strategy In Indonesia: A Swot Analysis Approach*. *11*(1).

Rachmawati, R. R. (2021). Smart Farming 4.0 To Realize Advanced, Independent, And Modern Indonesian Agriculture. *Agroeconomics research forum*, *38*(2), 137. https://doi.org/10.21082/fae.v38n2.2020.137-154

Revitalizing Agriculture Through Smart Precision Farming with IoT. (t.t.). Digital Citizenship Indonesia. Retrieved July 12, 2025, from http://digitalcitizenship.id/berita/revitalisasi-pertanian-melalui-smart-precision-farming-dengan-teknologi-iot

Digital Technology: Hope or Threat to Traditional Farmers? (2025, June 19). *Bireuen News*. https://kabarbireuen.com/teknologi-digital-harapan-atau-ancaman-bagi-petani-tradisional/

Wijayati, P. D., Harianto, N., & Suryana, A. (2023). Demand for Carbohydrate Source Food in Indonesia. *Agricultural Policy Analysis*, *17*(1), 13–26. https://doi.org/10.21082/akp.v17n1.2019.13-26