



## Chapter 6

# Healthy and Sustainable Food System to Secure Future Human Capital

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## A. Introduction

Indonesia is expected to reach its demographic bonus by 2030, where 67.8 % of its population will be dominated by youth in the working-age group. If appropriately managed, this demographic bonus will provide Indonesia with a skilled workforce, a vital component of human capital that will strengthen Indonesia's employment sector and ultimately benefit the economic growth (Adriani & Yustini, 2021) to achieve Indonesia's golden era in 2045. Indonesia has focused on tackling malnutrition, primarily undernutrition, preventing stunting, improving health, and securing its future human capital in the past few decades. However, with many resources diverted to aid COVID-19 for social assistance, the national health status (Djalante et al., 2020) and Indonesia's demographic bonus are at risk.

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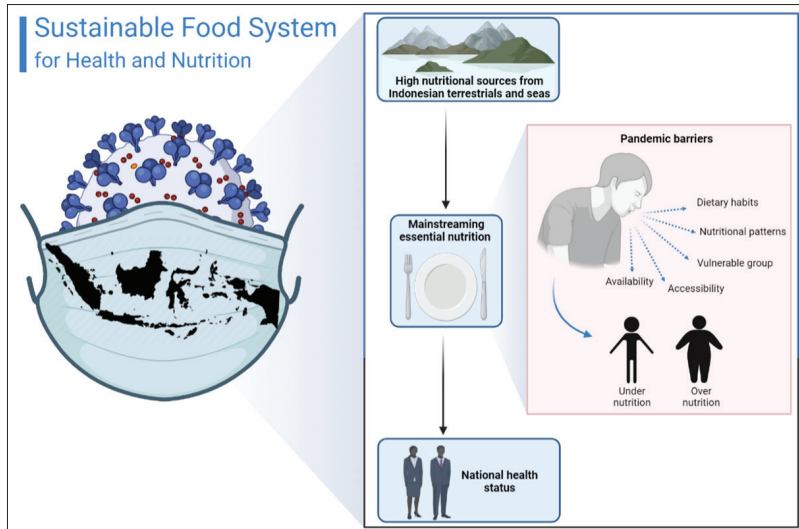
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Indonesia's current strategies to tackle malnutrition mainly rely on nutritional intervention programs and improvement of healthcare delivery for mothers and children. Food security, affordability, and accessibility in terms of micro-level are critical components of the strategies. COVID-19 disrupts food security (Suryana et al., 2021). It has significantly affected the global food system, caused a widespread economic downturn and disruptions in agricultural-based food supply chains, and crashed the food system (Swinnen & McDermott, 2020). With many restrictions and lockdowns being implemented, access to healthy and nutritious foods has become limited (Rodriguez-leyva & Pierce, 2021). These restriction policies make people more vulnerable to diseases, especially mothers and children. Simultaneously, before climate change, crop yield and nutritional value reductions, as well as exchange between food production and industrial crops, continue to pose obstacles to achieving a balanced diet and a sustainable food system.

As an archipelagic country, Indonesia has high biodiversity and can source varieties of foods from its land and sea. However, its potential has not been fully explored, particularly in food security, human capital, and reaction to the pandemic of COVID-19. Hence, this chapter discusses COVID-19's consequences on nutritional status and food security in Indonesia. Additionally, we elaborate on the current state, challenges, and how we can use the potency of Indonesia's biodiversity to improve food security and sustainability—to strengthen human capital in the recovery post-pandemic (Figure 6.1).



**Figure 6.1** Illustration of the Sustainable Food System for National Health Status to Secure Future Human Capital (Figure Made in BioRender.com)

## B. COVID-19 pandemic's impacts on nutritional status

Nutritional status has been compromised during the COVID-19 pandemic due to many reasons related to a high catabolic state increased by an inflammatory response to the infection and impacted gastrointestinal (GI) system. That could be manifested as vomiting, diarrhea, nausea, anorexia, and a significant GI mucosal inflammation (Almeida & Chehter, 2020; Silverio et al., 2021). Obesity was highly prevalent in developing and developed countries such as China and the US, with nearly 50% of the hospitalized patients being obese or overweight (Silverio et al., 2021). In addition, malnutrition was very high among hospitalized COVID-19, ranging from 11.57% to 88.39%, according to a meta-analysis study that included China, France, and Italy (Abate et al., 2021). COVID-19 significantly impacted both under- (e.g., stunting and wasting) and over-nutrition (e.g., obesity) cases in Indonesia, not only affecting individuals with pre-existing

malnutrition but also potentially increasing the prevalence of malnutrition in the future (Table 6.1). For example, stunting is a significant and longstanding problem affecting one in three children under five years old in Indonesia (Labolo, 2021). On the other hand, according to the Indonesian Toddler Nutrition Status Survey (SSGI) in 2019, this incidence was reduced to 27.7% compared to *Riskesdas* 2018 (30.8%) (Izwardy, 2020). Furthermore, to accelerate the prevention of stunting through the Governmental Medium-Term Growth Strategy (RPJMN) 2020–2024, the government aim to decrease the national stunting rate to 14% by 2024.

Meanwhile, Indonesia’s number of stunting incidences is predicted to rise due to the COVID-19 outbreak. Due to imposed pandemic restrictions, This condition can be caused by the limited access to optimal health services for mothers and children. For example, it was recorded that only 19.2% of public health centers (*Puskesmas*) continued to carry out integrated health care center (*Posyandu*) activities during the pandemic in 2020 (Rini, 2020). Furthermore, the Ministry of Health also reported decreased visits to antenatal care and health services for infants, toddlers, and children. Thus, immunization services, monitoring activities for the development and growth of infants and toddlers, and maternal and child health intervention may not run optimally (Labolo, 2021).

**Table 6.1** Nutritional Issues during the COVID-19 Pandemic

No.	Nutritional issues	Impact		Reference
		Short-term	Long-term	
1.	Underweight (Stunting, Wasting)	<ul style="list-style-type: none"> <li>• The increased mortality from the COVID-19</li> <li>• Increasing length of hospitalization.</li> <li>• The increased possibility of COVID-19 secondary infection</li> </ul>	<ul style="list-style-type: none"> <li>• The increased risk of community-acquired infectious diseases</li> <li>• Increasing risk of primary immunodeficiency diseases (PID), such as susceptibility to infections, autoimmunity, lymphoproliferatios, and atopy</li> </ul>	Golub-nitschaja et al., 2021; Ye et al., 2021

No.	Nutritional issues	Impact		Reference
		Short-term	Long-term	
2.	Overweight and obesity	<ul style="list-style-type: none"> <li>• A poor outcome for COVID-19 (COVID-19 death rates increase tenfold in nations where more than half of the population is obese)</li> <li>• The increase in hospitality rate and morbidity rate. Around 85 percent of patients with obesity required mechanical ventilation, while 62 percent died of infectious disease)</li> </ul>	Increasing risk for developing NCD	Senthilingam, 2021; Centers for Disease Control and Prevention, 2021; Yan, L. T., 2021.

COVID-19 restrictions may also lead to an increased prevalence of overweight and obesity. The stay-at-home rule and restricted store opening hours have shifted lifestyle habits, resulting in poorer diet quality and decreased physical activity. As a result of widespread anxiety of shortage, panic buying and stockpiling of household commodities, especially food, has grown wider since COVID-19. During the pandemic lockdown period, people consumed more meals at home. (Arora & Grey, 2020), mainly processed meat, potatoes, and dairy products (Evans, 2020). During this period, dietary patterns and food choices were changing as people preferred to buy instant, pre-made or canned foods with a longer shelf life than fresh foods, which are almost undoubtedly unhealthy (Blendon et al., 2004; Mattioli et al., 2020). Furthermore, increasing time spent at home also increases exposure to advertisements for unhealthy diets (e.g., high sodium, energy-dense foods, and sugary beverages) (Nurhasan et al., 2021), snacking behaviors (Bakaloudi et al., 2021), and sedentary lifestyles (Zheng et al., 2020). Prolonged exposure to these behaviors during pandemics may lead to energy imbalance, resulting in unhealthy weight gain, significantly impacting the pandemic infection and mortality rates (Rodriguez-leyva & Pierce, 2021).

COVID-19 infection is thought to be exacerbated by malnutrition (Huizar et al., 2020). Undernourished individuals have a weakened

immune system (Mertens & Peñalvo, 2021). On the other hand, individuals with obesity-associated comorbidities, such as hypertension, cardiovascular and cerebrovascular diseases, and diabetes, have higher predisposed inflammatory status. These conditions put them at a higher risk of developing severe COVID-19 symptoms (Nishiga et al., 2020; Paudel, 2020; Zhu et al., 2020). Obesity or morbid obesity has also been identified as a critical risk factor for high hospitalization rates and the ventilator usage of COVID-19 patients (Clemente-Suárez et al., 2021). This condition may lead to an increased length of hospital stays compared to non-ICU patients (Nguyen et al., 2021) and also an increased mortality rate which had a higher percentage (19.2%) in contrast to mortality without morbid obesity (7.8%) (Klang et al., 2020). Therefore, developing strategies to improve nutritional status in the COVID-19 recovery plan is essential.

### **C. COVID-19 pandemic's impacts on food security**

UN report on food security showed an increased rate from 23.3% to 26.4% between 2014 and 2018; before the COVID-19 pandemic, around 10% of the population was undernutrition globally (FAO et al., 2021). In low- and middle-income countries, more than a hundred million were food insecure (FSIN, 2020). It has also been reported that the pandemic impacted the global food supply chain in 2020 (Anthem, 2020; FAO, 2020). Not only that, global warming, disease outbreaks, and military conflicts also pose a threat to the food chain (FSIN, 2020). Food security, comprised of four primary pillars: food availability, food accessibility, food utilization, and food stability (García-Díez et al., 2021), is an essential factor in ensuring nutritional status. On the other hand, the imposed limits and lockdowns in Indonesia weaken the stability of these four pillars, resulting in food insecurity and a potentially dangerous health situation.

#### **1. Availability and accessibility**

In the food supply chain, the pandemic has thrown up some new obstacles that led to reduced availability and accessibility to some

foods. According to a report, as the COVID-19 pandemic spread, food supply and distribution, quality, and prices were adversely affected; and food insecurity was closely linked to unemployment-related loss of income, particularly in rural areas (Rodriguez-leyva & Pierce, 2021).

On the consumer end, panic buying and stockpiling induced a massive shortage of staple foods and subsequently increased demand globally (Arora & Grey, 2020). Indonesia's National Food Security Report during the COVID-19 pandemic shows that food production has not changed much regarding food stability and output. Besides that, The National Team for Acceleration of Poverty Reduction confirmed that Indonesia has sufficient assets to meet domestic food needs (Asmanto et al., 2020). However, there is a possibility that a food crisis may occur in the future.

Restrictions, lockdowns, and mandatory isolations for individuals with COVID-19 have also posed challenges in food distribution. As a result, food stocks are not equally distributed in all regions, mainly remote areas. For instance, COVID-19 made things worse for people in Central Sulawesi, especially those who lived in rural areas and worked in agriculture. Sigli, a group of farmers in the Gumbasa irrigation area, had to find something else to do until their irrigation system could be fixed (Lassa, 2021). The combination of shortage and supply chain disruption may worsen food insecurity, especially in households that have experienced food insecurity before the COVID-19 pandemic (Niles et al., 2020). Increasing food insecurity can harm health, as well. Studies have shown that food insecurity and poor diet quality are linked (Niles et al., 2020). For instance, a survey from Leung et al. (2014) reported a strong association ( $p < 0.005$ ) between food insecurity and high intake of a highly palatable diet such as fat-rich dairy products, salted foods, sugary drinks, processed meat, and few vegetable intake than those without food insecurity. Another study found a substantial difference in the psychosocial precursors of healthy eating behaviors, such as self-efficacy for healthy eating, meal planning with vegetables, and the fruit and vegetable diet pattern, between food insecure and secure families. Generally, food-insecure

low-income adults' healthy eating habits and procurement practices were significantly lower than those of food-secure low-income adults (Ranjit et al., 2020). A study by Maulida et al. (2016) on Indonesian adolescents in Jakarta revealed that students from low-income families tend to choose food based on 'convenience and price.' In contrast, students from affluent families tend to choose food based on health factors. This indicates that former students opted for less expensive and more convenient meals over healthier options.

This poor-quality diet could increase the risk of chronic disease in the foreseeable future. An explanatory model presented by Keenan et al. (2021) revealed novel insights into the close association between food insecurity and an unhealthy diet. In addition, a large-scale restriction policy has also reduced food options as access to fresh markets becomes limited and purchasing habits shift into long shelf-life food products, such as canned food, over new products (Naja & Hamadeh, 2020).

## **2. Utilisation and stability**

Many countries' food systems were affected by the COVID-19 pandemic because of the importance placed on food safety and sustainability. The epidemic wreaked havoc on the food system's functions, from the point of origin to the end of use (Giudice et al., 2020). The pandemic, directly and indirectly, impacted the food system by disrupting food delivery stability, high economic burdens, and low purchasing power in rural and urban populations (Ikhsan & Virananda, 2021).

Dudek and Piewak (2022) described possible approaches for food system stakeholders in managing the worsening socio-economic situation during the COVID-19 pandemic. These approaches include:

- a. Controlling the supply chains from food producers to consumers;
- b. Intensifying the additional benefits of offered products, including the nutritional value, the unique taste, the location (locally made preference), and introducing the eco-friendly products;
- c. Expanding the network to increase sales.



This approach adheres to the Food Security Movement policy of the Ministry of Agriculture (2020), which consists of four methods:

- a. Increase food production capacity by accelerating Harvesting Season II (2020) on 6.1 million hectares and establishing 85,456 hectares of marshland in Central Kalimantan.
- b. Local food diversification centered on the essential staple commodities
- c. Strengthen the food system's reserving and logistics by increasing rice deposits in provinces and cities.
- d. Develop contemporary agricultural practices utilizing the “smart farming system”.

#### **D. COVID-19 pandemic's impacts on current policies in nutrition**

The Indonesian government has implemented various policies to overcome malnutrition and food insecurity to maintain nutritional and health status (Table 6.2). As a result, despite being late and indecisive in crisis management decisions, Indonesia was “lucky” enough to implement some social protection measures ahead of the impending food crisis and hunger (Lassa, 2021). However, many current policies were generated before the pandemic, changing the public food expenses structure. According to Clemente-Suárez et al. (2021), COVID-19 restrictions altered eating habits and dietary patterns in several countries. The form and period of home quarantine, cultural and social trends in the countries studied, the average age of respondents analyzed, and the prevalence of pre-existing obesity are all examples of discrepancies in this context. During the lockdown, for example, teens in Brazil and some European countries like Spain and Italy consumed more vegetables, legumes, and fruit (Ruiz-Roso et al., 2020). In Indonesia, undergraduate students' consumption patterns during the COVID-19 pandemic were categorized as sufficient and close to the general guidelines for balanced nutrition by consuming carbohydrates, animal and vegetable protein, and various other foods (Kristiandi et al., 2022). Although the majority have been successfully

implemented to meet population needs, particularly to maintain food quantity and supply chain across nations, they may no longer be suitable to mitigate potential food crises caused by the pandemic. Thus, concrete action plans, including dietary pattern recommendations for individuals of various ages, cultures, and social groups, are needed to address nutrition concerns during the COVID-19 confinement across Indonesia.

**Table 6.2** National Policy for Developing Health and Nutrition Status

No.	Policy	Purpose	Reference
1.	<i>Gerakan Masyarakat Hidup Sehat</i> (GERMAS) 2016, of which the main programs involve education on clean and healthy living behavior, education on healthy food preparation, and nutrient optimization	To raise citizens' awareness and capability to practice a healthy lifestyle for better life quality.	Presidential Regulation No. 42 of 2013 concerning the National Movement for the Acceleration of Nutrition Improvement
2.	Food diversification and prioritization of nutritional needs for increasing pregnant women, breastfeeding women, babies, toddlers, and other vulnerable groups	To improve nutritional needs	Government Regulation No. 17 of 2015 concerning Food Security and Nutrition
3.	<i>Rencana Aksi Nasional Pangan dan Gizi</i> (RAN-PG) 2017–2019 with key programmes as follows; <ul style="list-style-type: none"> <li>• Enhancing nutrition surveillance and child development supervision</li> <li>• Improving healthcare accessibility and quality</li> <li>• Promoting health, nutrition, sanitation, hygiene, and child care-related behavior change</li> <li>• Increasing role of community in a nutrition intervention program (ex: A Nutrition Aware Family)</li> <li>• Increasing the effectiveness and efficiency with which nutrition regulations are implemented and evaluated</li> <li>• Increasing cross-sector collaboration in the implementation of targeted nutrition interventions</li> </ul>	<ul style="list-style-type: none"> <li>• To improve the nutritional status of the community.</li> <li>• To increase public food accessibility.</li> <li>• Food quality and safety</li> <li>• Hygiene and healthy habits</li> <li>• Coordinating the development of food and nutrition</li> </ul>	Presidential Decree No. 83 of 2017 concerning Food and Nutrition Strategic Policy

No.	Policy	Purpose	Reference
4.	<p><i>Strategi Nasional Percepatan Pencegahan Anak Kerdil (Stranas Stunting) 2018</i> with a multi-sectoral approach providing two types of interventions with its prioritized groups:</p> <ul style="list-style-type: none"> <li>• Nutrition-specific intervention</li> <li>• Nutrition-sensitive intervention (ex: water, sanitation and hygiene, agriculture and food security)</li> </ul>	<p>The nutrition-specific intervention aims to conquer the immediate aspects of fetal and child nutrition and development.</p> <p>Nutrition-sensitive interventions overcome the other non-related nutrition factors that obtain nutrition status.</p>	<p>National Strategy for the Acceleration of Stunting Prevention of Children (Stranas Stunting) (TNP2K, Bappenas, and Ministry of Home Affairs, 2018)</p>
5.	<p><i>Strategi Pemerintah untuk Mengatasi Dampak COVID-19 terhadap Sektor Pertanian</i> with 5 priorities:</p> <p>(i) ensure the availability of staple food, especially rice and corn; (ii) maintain the country's economic growth by accelerating the export strategies of local commodities; (iii) educate farmers and workers about the Ministry of Health's health protocols to halt the spread of the virus; (iv) The SMERU Research Institute 45 establishes agricultural retails in each province, increases consumption of regional foods and enhances agricultural commodity logistics and electronic marketing systems; and (v) to counteract the adverse effects of COVID-19, implementing labor-intensive programs in rural areas would help to stimulate agriculture and subsidize rural communities.</p>	<p>Improving food security and economic stability in the wake of the COVID-19 outbreak</p>	<p>Circular of the Secretary General of the Ministry of Agriculture No. 1056/SE/RC.10/03/2020</p>
6	<p><i>Perluasan Program Perlindungan Sosial Selama Pandemi COVID-19</i></p>	<p>Allocating more resources for programs that could promote protection and prosperity of the people</p>	<p>Ministry of Social Affairs and DKI Jakarta Provincial Government</p>

Source: Arif et al. (2020)

## E. Strategies to secure human capital in the recovery post-pandemic

### 1. Strengthening agriculture and food sectors

There are several strategies to strengthen the agriculture and food sector in Indonesia. *The first* is increasing local food diversification. “Diversity” is a significant component of sustainable and resilient systems. “Local” is defined as ‘the smallest unit used to describe the origin of food’ (Stein & Santini, 2021). The diversification of carbohydrate sources in Indonesia is an example. Indonesia is the world’s leading rice producer and major wheat importer (Rozaki, 2020). Therefore, it makes sense that rice and wheat-based products have become primary staple foods in Indonesia. However, Indonesia’s available sources of carbohydrates are not just rice or wheat. Indonesia is rich in other sources of carbohydrates that are locally based and could be utilized as a staple food to support food diversification to substitute wheat or rice, including breadfruit, cassava, corn, potatoes, and many other carbohydrate sources (Imelda et al., 2017). Diversifying local foods enables people to manage their dietary patterns and rely on a single food source. This measure can boost the economic worth of various local foods as alternatives, boosting family and national food security. Diversification of food from locals could also empower farmers to use the land for farm crops and other tubers. As a result, a harvest failure or a particular food distribution issue may not affect household food security (Imelda et al., 2017).

In agricultural and food production settings, local food diversification means limiting reliance on external sources, diversifying crops and landscapes, and incorporating cattle into agriculture activities (Bisoffi et al., 2021). A success story of crop diversification from the rice-wheat cropping system (RWCS) with legumes and vegetables of South Asia’s Indo-Gangetic Plains region has successfully enhanced food and nutritional security. This system improves dietary diversity and enriches soil health, resulting in the agroecosystem’s enhanced

system productivity and sustainability (Dwivedi et al., 2017). Therefore, this method may be suitable to adopt in Indonesia.

Moreover, to tackle these multifaceted and vigorous settings and reinforce positive outcomes, we need to consider seven approaches (Blay-Palmer et al., 2020):

- a. Conducting more disaster planning, awareness, and sustainable food systems should be prioritized. The coordination and cooperation between the government and all levels in the system, particularly at local and regional levels where the supply chains are susceptible to decrease, need to be reasonably integrated. For instance, in BULOG's (the Indonesia Logistics Bureau) management, as suggested by Setiadi (2013), the central government may control rice stock centrally for operating, backup, and pipeline stocks. In contrast, local governments manage decentralized backup stocks for emergencies such as natural disasters, regional conflicts, and non-rice food reserves following local foodstuff. Community food stocks are developed by: 1) Maintaining and managing the community's tradition of setting aside a portion of their harvest on an individual basis for food stocks on the local basis, and 2) Maintaining the community's tradition of collectively handling food stocks by building a food warehouse at the local basis. Shifting away from global supply reliance sometimes compromises the livelihoods of landless farmers and smallholders. It focuses more on diversified food systems that are profound to the environment and local cultures. Good coordination between local, regional, and global supply chains, including infrastructural development, is more likely to build food system resilience. Despite its food biodiversity and vast agricultural land, Indonesia often relies on imported food such as rice and soybean. This import reliance is not wise from a sustainability perspective because it is not sustainable. Importing food should only be a short-term option for food shortage and/or securing food availability and not for a long-term solution.

- b. Adopting a systemic approach that prioritizes secure and healthy food systems as the primary goal of food policy and explicitly designating agroecology and renewable agriculture as the best agricultural and food production practices wherever possible. For example, providing training and affordable smallholdings related to organic farming for young generations in Indonesia who are interested in agribusiness.
- c. Strengthening social safety networks to assure the viability of food sources by forging firm commitments among food suppliers, such as farmers, medium-sized enterprises, and authorities, as well as local government, to assure food sustainability and, as a result, social resilience. The government must ensure food availability and demand on a local and regional level by implementing a “stable public procurement” program that provides a universal basic income to stabilize food supply and demand. BULOG (Indonesian Bureau of Logistics) plays a prominent role in achieving these goals by managing and controlling the food stockpiles and their distributions at national and local levels.
- d. Centralizing transfer of knowledge: Place emphasis on storytelling and sharing as a means of conserving best practices and lessons gained and building unity to empower the perspectives of the community seeking answers. These knowledge forms must be appreciated the same way science is valued. Smallholder farmers, indigenous peoples, women, and youth must all have their views heard. For instance, direct communication between leaders and their people in the community can be significantly facilitated by reactivating *Kelompencapir* (*Kelompok Pendengar, Pembaca, dan Pemirsa / Listeners, Readers, and Viewers Group*). This program was a gathering activity for farmers and fishers in Indonesia that began during President Suharto’s reign. Outstanding farmers from various regions participated in this activity. They were contested against their intellectual capacity and agricultural knowledge, including good farming practices and fertilizer knowledge. This program took part when Indonesia achieved food self-sufficiency

and received an award from the FAO in 1984. This program could be remodeled as an interactive discussion between local farmers and the government to exchange information between both parties.

- e. Enabling relevant scaled intervention: Encourage as nearly as possible to the grassroots level to allocate resources and decision-making to the proper size, implement scale-appropriate technology, and make institutional governance choices. In addition, decision-making must be inclusive, consistent, and transparent. This intervention could be actualized by utilizing evidence from research or studies, which enables policymakers to avoid bias towards the effectiveness of the proposed interventions or solutions.
- f. Enabling evidence-based decision-making: Collecting data from the successful programs. We require evidence-based study to figure out what works and why it works. This necessitates the democratization of knowledge and its recognition as a public good rather than a commodity. In the Indonesian context, we could make this happen by incorporating all research studies regarding the proposed options for achieving the national food security goals. It is not only from research and development institutions (LITBANG) perspectives but also from those from higher educational institutions, e.g., universities, and makes a food security-related policy brief based on those studies. The following principles govern evidence-based decision-making in public health that could be implemented in Indonesia: 1) setting policy based on the best available peer-reviewed evidence (both quantitative and qualitative research), 2) systematically utilizing data and information systems, 3) implementing program-planning frameworks, 4) involving the general public in assessment and decision-making, 5) implementing reasonable evaluation, and 6) disseminating what is learned to key stakeholders and decision-makers (Brownson et al., 2009). One way to initiate this is by making the research results accessible to the policymaker.

By applying this, the policymakers could also anticipate each decision's risks since it is based on the evidence.

- g. Taking into account the right to food: All authorities should uphold their humanitarian responsibilities to ensure the individuals' access to food. Shocks to the food system and economic hardships are to blame for the rising levels of food insecurity. Acknowledging the human right to food should underpin policy responses to hunger and food insecurity. Rozaki (2021) suggests that food accessibility strongly affects the supply chain. The rice supply chain pattern in Indonesia, for instance, in which each design defines the price at the level of farmers and consumers. The longer the chain is, the higher the price that the consumers must pay. Hence, cutting the unnecessary middleman involvement that might cause the extended supply chain is essential. Understanding the food supply chain can be a win-win solution for farmers and consumers. Farmers can get the best price to improve their productivity, and consumers can get the best price to afford the food to fulfill their demands.

Combining all these seven factors should be authorized and supported across a multi-sectoral approach involving the government from both national and regional as well as local levels and the communities (Blay-Palmer et al., 2020). This approach needs a strong commitment among stakeholders and communities to build sustainable transformation of the green, healthy, and promising food systems.

*Second*, strengthening food stockpiles and logistics systems. We can learn from China's approach to food system recovery following the COVID-19 pandemic, which included ensuring an adequate allocation of agricultural products and resources. They declared a "green channel policy" for perishable farming commodities and confirmed that agricultural products were transported safely from producers to consumers. They also guarantee that the agricultural resources are sufficient such as breeding animals, newborn chicks, and feedstuffs supply for livestock feeding (Zhan & Chen, 2021). In Indonesia, the Indonesian Bureau of Logistics (BULOG) is in charge



of price stabilization, and the company's rice reserves serve as a buffer stock. Therefore, expanding the business process to include rice and other staple foods like animal products is necessary to address this problem. Utilizing e-commerce and delivery services could be one of the methods to attain effective logistics at the consumer level. As a large-scale social restriction policy had been applied, there was a high demand for in-home delivery services for most of the products, including the food. Introducing and using a contactless delivery app without face-to-face interaction could minimize the risk of infection from direct groceries in the market (Zhan & Chen, 2021).

*Third*, incorporating advanced technology and innovation, such as smart farming (Musa & Basir, 2021). The application of intelligent farming technologies such as autonomous flight control equipped with 'hyperspectral snapshot cameras' that could calculate and predict the biomass and fertilization level of the crops would reduce the carbon footprints by effectively managing the application of fertilizers and pesticides. It is also more profitable for farmers to limit the inputs of natural resources, which could help them use their capital and labor efficiently. Smart farming could also increase the data reliability, which will help mitigate the potential risks by providing specific information on potential agricultural sites, weather forecast, and the projection of agricultural yield (Walter et al., 2017).

*Fourth*, economic stimulus. Current policy from the national government to mitigate economic loss by offering financial support and around 25% of the budget is for the low-income community in the form of a social protection policy could help protect the poor and vulnerable people during the COVID-19 pandemic. Another program from Family Hope Program (PKH) has also supported the economic recovery, including pre-employment cards, discounts on electricity rates (for both 450 and 900VA households), cash transfers, and educational support in the form of internet data support for students and teachers. These programs might, at the very least, lessen the burden on the community, particularly low-income populations or those who are socially and economically vulnerable to the spread of

COVID-19 (Hirawan & Verselita, 2020). In addition, farmers' health should also be considered in any relief programs. Pandemic affects farmers' health; small farmers as a low-income group, any issues in agricultural production and logistics severely affect the farmers, which may affect their lives physically and mentally (Daghagh Yazd et al., 2020). It is crucial to approach the farmers as the front lines to support them in adapting to the pandemic conditions and ease their access to health services (Rozaki, 2020). Nevertheless, most of those still getting social assistance said they were getting cash assistance. This number can be explained by the roll-out of village fund direct cash assistance, which made more households eligible for cash assistance programs (UNESCO, 2021).

Fifth is promoting a sustainable healthy diet. According to the Food and Agriculture Organization (FAO), a sustainable diet considers the medical benefits, nutritional quality, and environmental impact. In general, fruits and vegetables, whole grain products, nuts and legumes, and a plant-based diet are the foundation of a healthy diet. The shift to a plant-based diet has been proposed in numerous studies to promote a better health outcome and help reduce the harmful effect of greenhouse gasses on the environment and free up land currently cultivated for feed (MacDiarmid, 2013). This proposal does not imply that people should not consume animal-based diets or that domesticated animals should be prohibited from agriculture. Instead, animal-based diets should be consumed moderately, and cattle should be merged into a circular farming strategy that contributes to soil fertility restoration.

Increasing the diversification of food sources also supports a transition into a sustainable healthy diet. Diversification of dietary intake, in general, can be defined as an effort to expand the variety of food consumed invariably with the principles or guidelines of a balanced diet, resulting in enhanced food quality. Indonesia has at least hundreds of crops that produce flour and sugar as a source of carbohydrates. While the current dietary guidelines have acknowledged the other carbohydrate variants, only a few carbohydrate sources are

widely known and consumed in large quantities, such as rice and wheat. Various local foods, such as corn, cassava, sweet potatoes, and sago, have great potential to be developed as rice substitutes and processed into prestigious foods (Hardono, 2014). Exploring possibilities of using such local foods may boost diversification. Thus, it will provide health benefits and drive the growth of local agriculture and the economy.

To ensure a smooth transition to a sustainable healthy diet, another thing that needs to be considered is individual approaches through health promotion, in this case, promoting a nutritious diet in more sustainable ways. Many reports showing a link between healthier food intakes and the low environmental impact initiate the term ‘sustainable diets,’ which may considerably improve health and the background (Meybeck & Gitz, 2017).

## **2. Nutrition as a strategy for management of COVID-19**

Indonesia is the largest archipelagic country, with thousands of islands spread across the country, making it “a mega-biodiverse country” globally (Nurhasan et al., 2021). Indonesia has many natural resources from forests and seas, creating a wide range of edible and nutritious food sources. Indonesia’s marine fish, for example, contains high essential micronutrients such as calcium, iron, and zinc. In addition, the Ministry of Environment and Forestry reported that Indonesia has hundreds of native food crop cultivars. Despite its mega biodiversity, however, up to now, the agronomic crops productions primarily focus on high-value commodities and high-yielding crops, including rice production. This type of production limits the variability of the kind of food supplied to the market, making the majority of other nutrient-rich food sources underutilized.

The possibility of nutritious and functional foods in managing COVID-19, especially at the individual level, is highly appealing. There is currently no specific medication available to alleviate the complex symptoms that appear during COVID-19. Since the virus can mutate, no particular vaccination is ultimately effective against SARS-

CoV-2. As a result, scientists are working to identify new approaches to managing this global issue. Finding the ultimate cure for various diseases is a difficult task for humankind. In such cases, the emphasis is on making the best food choices to increase immunity and reduce the disease severity. In the current COVID-19 pandemic, Hippocrates' philosophy of "food as medicine," which he preached over 2,500 years ago, is an essential strategy for reducing COVID-19 severe effects. The body can combat the infection if you eat the proper meals. Some reports have shown the positive impact of a nutritious diet in lowering the prevalence of COVID-19 infection and decreasing the disease's incidence (Rodriguez-leyva & Pierce, 2021). In malnourished patients, COVID-19 is more likely to be severe than in those who are otherwise healthy. Besides, more than 50% of COVID-19 patients had severe malnutrition. Although there were still limited studies on the association between nutrition status and the morbidity rates of COVID-19, a study showed a higher mortality rate in elderly with protein deficiency than those without (Rodriguez-leyva & Pierce, 2021).

Nutrients have different responsibilities in preserving the immune system, and it is evident that an adequate and balanced nutrient intake is essential for performing a better immune response. A better nutrition status serves as an effective immune response. In contrast, malnutrition impacts the immune systems' impairments. Both immune dysfunction and the vulnerability to infections can be corrected by improving the quality of nutrient intakes, particularly on the specific immune support (Calder, 2020). Thus, an individual's nutritional status is significantly affected by the body's response to COVID-19 infection and its severity. Below are the lists of certain nutrients, including proteins, vitamins, minerals, and probiotics, that play significant roles in maintaining immunity towards illness, specifically towards viral respiratory infection, which may aid in developing new strategies for preventing and managing COVID-19 (Mortaz et al., 2021).

#### a. Proteins

Proteins are macronutrients required to synthesize immunoglobulins and cytokines, among other things. Dietary proteins are broken down into amino acid materials, and a protein deficiency lowers the plasma concentrations of most amino acids. Arginine is a conditionally essential amino acid precursor to polyamines necessary for DNA replication and cell division regulation. Furthermore, adequate plasma arginine levels are required for optimal antibody production. Arginine supplementation significantly improves T cell function and number compared to control subjects. It plays a vital role in producing nitric oxide, a compound essential for immune function. Another amino acid required for the structural parts of vital organs that are related to the immunity response is methionine. The deficiency of this type of amino acid alters the lymphocyte functions and the multiplication of cells. Methionine deficiency is associated with a significant decrease in antibody titers and serum IgG, IgA, and IgM levels, lowering the proportion of CD3<sup>+</sup>, CD3<sup>+</sup>/CD8<sup>+</sup>, and CD3<sup>+</sup>/CD4<sup>+</sup> T lymphocytes. According to methionine's protective function against COVID-19 through T cells above, it has been proven that methionine can prevent and reduce infection. Dietary proteins have been shown to improve immune function in cancer patients. Clinical studies show that giving chemotherapy patients whey protein isolate supplemented with zinc and selenium improves cellular immunity and antioxidant capacity. This type of protein is rich in protein and amino acid composition.

## b Vitamins

Vitamins are necessary for better protection against infections, and their consumption significantly affects immune responses. Additionally, having an adequate and balanced proportion of nutrients in the diet, including vitamins, has a beneficial effect on maintaining exercise performance and immune function in individuals who have not eaten in a while. Vitamin A and D, for example, improve a child's body's immune response after getting the influenza vaccine. Following antiviral vaccination, antibody responses were significantly increased in both the humoral and cellular resistant arms of the immune system after taking vitamin A. Vitamin A inhibits the synthesis of

pro-inflammatory cytokines, including TNF and IL 6, by regulating immune cell proliferation and differentiation via the nuclear retinoic acid receptor (Mortaz et al., 2021).

B vitamins are essential for normal metabolism, especially when organic compounds are involved. Furthermore, the immunological role has long been recognized to depend on folic acid, vitamin B12, and vitamin B6. For example, vitamin B6 in its active form, pyridoxal phosphate, functions as a cofactor in some metabolic activities, including the metabolism of critical immunomodulatory mediators and the turnover of amino acids. These metabolic pathways are also linked to viral infections, meaning a sufficient supply of these vitamins is needed to regulate the immune response to viral infections. They regulate innate immune cells and cytotoxic CD8+ lymphocytes' activity, supporting the complete removal of viruses (Mortaz et al., 2021).

Vitamin C enhances phagocytosis, antibody production, immune cell multiplication, and leukocyte transfer to the infected area by promoting cell transmission. Numerous physiological processes, such as endocrine and immunological homeostasis, are also influenced by vitamin C's ability to serve as an essential antioxidant and cofactor in multiple cell processes. Researchers believe it boosts interferon production and responds to the influenza A virus, which could explain its ability to protect against animal coronavirus infection. Pneumonia and other respiratory tract infections are less common when vitamin C levels are higher in the blood. Cold and flu symptoms are less severe and last less time when vitamin C is taken.

Additionally, high-dose intravenous vitamin C therapy is beneficial for patients with viral acute respiratory distress syndrome (ARDS), characterized by severe lung injury, as it aids tissue healing. People with severe COVID-19 are more likely to develop ARDS, which supports the theory that vitamin C could assist in treating the disease. COVID-19 incidence and severity may be linked to a person's vitamin C status, but further study must confirm this possibility (Mortaz et al., 2021).

As a fat-soluble vitamin with numerous roles in the body, including the immune system, vitamin D is well-recognized for its many benefits. Vitamin D receptors can be found on many epithelial and immunological cells in the respiratory system, which cytokines and toll-like receptors can activate. Epidemiological studies show that vitamin D is required to protect against respiratory viral infections like influenza. Researchers have found a link between low vitamin D levels in the blood and exposure to upper and lower respiratory infections. When the vitamin D serum levels are below the requirements standard, the respiratory tract diseases caused by viruses' frequency are reduced twofold. According to the National Institutes of Health, people with low vitamin D levels are more prone to several ailments. Thrombotic events, obesity, and diabetes have all been linked to vitamin D insufficiency. Vitamin D was discovered to inhibit and protect human nasal endothelial cells attacked with SARS-CoV-2S virus infection (Mortaz et al., 2021).

Vitamin E exerts a strong influence on the immune system of the host because of its antioxidant properties. Vitamin E's ability to affect gene transcription can consequently influence a wide range of immunological and inflammatory responses, such as T-cells. Vitamin E deficiency weakens both humoral and cellular immunity. Although a brief pilot study showed that vitamin E supplementation increased the risk of pneumonia in smokers, patients with chronic hepatitis B (HBV) may benefit from it. According to another randomized controlled study, administering children vitamin E boosted their anti-HBe seroconversion. According to a computational investigation of FDA-approved medications to prevent coronavirus binding to ACE2 or transmembrane protease serine 2, vitamin E can modify downstream transcriptome profiles that drastically reduce SARS-CoV-2 infection (TMPRSS2). Clinical studies are needed to clarify this (Mortaz et al., 2021).

### c. Minerals

Antiviral immune responses may be improved by supplementing with vitamins, minerals, and other nutrients, such as zinc, copper, and

selenium. Zinc provides immunity, a vital component of the immune system. Torque Teno Virus-infected patients' immune responses benefit from a high zinc dose (TTV). Antibody titers rose following influenza vaccine administration in mice given low amounts of zinc and selenium (Mortaz et al., 2021).

#### d. Probiotics

Coronavirus infection has both consequences on the gastrointestinal system. Viral entry mechanisms such as ACE2 and TMPRSS2 enhance the release of pro-inflammatory chemokines and cytokines into intestinal epithelial cells. The SARS-CoV-2 virus has been shown to cause an immediate inflammatory response in the intestines, as indicated by elevated serum IL-6 levels and fecal calprotectin, which are linked to diarrhea symptoms. COVID-19 has always relied on hunches regarding pre-and probiotics, as well as other microbiome modulators. Researchers showed that those who got prebiotics containing *Enterococcus faecalis*, *Bacillus subtilis*, and *Lactobacillus rhamnosus* GG had significantly lower ventilator-associated pneumonia rates than those who received a placebo in critically sick patients on mechanical ventilation. This treatment technique may be helpful before the symptoms of severe COVID-19 approximate those of pneumonia-induced acute respiratory distress syndrome. Pathogens (*Roseburia* and *Lachnospiraceae* taxa) appear to have increased in COVID-19 patients, whereas probiotics (*Faecalibacterium prausnitzii*, *Roseburia*, and *Eubacterium ventriosum*) seem to have declined (*Actinomyces viscosus*, *Bacteroides nordii*, and *Clostridium hathewayi*). People with severe COVID-19 may benefit from probiotics or changes to the microbiome. An imbalance in gut microbiota and its metabolites may lead to an unbalanced immune response. This symptom can manifest in various ways, including inflammation and lung illness. Patients with comorbidities including diabetes and cardiovascular disease, are more likely to have an abnormal gut microbiota, which may exacerbate COVID-19. Probiotic use in COVID-19 is justified by circumstantial evidence, so additional research is needed before composing a specific prescription for the probiotic (Mortaz et al., 2021).



## F. Conclusion

To achieve Indonesia's demographic bonus by 2030 and golden age by 2045, the country has prioritized improving health and securing its future human capital, including addressing malnutrition. Nevertheless, numerous resources have been diverted to assist COVID-19. As a result, the country's health status and demographic advantage are jeopardized. The COVID-19 outbreak impacted all facets of life, including nutritional status, food security, and government policies. Several strategies can be implemented to improve this condition and strengthen human capital during the post-pandemic recovery process, including supporting the agriculture and food sectors and developing a plan for mainstreaming essential nutrition.

Maintaining food availability throughout the COVID-19 pandemic requires a sufficient quantity and a healthy, balanced, varied, and sustainable approach. Governments can implement an evidence-based policy during the COVID-19 pandemic by ensuring the availability of basic and essential foods, as well as scientifically recommended dietary nutrition guidelines, that are sufficient to meet national food consumption needs across all ages, cultures, and social groups. In addition, the government also needs to ensure the provision of food, primarily through diverse domestic production, so that food intake with balanced nutritional content is met.

To ensure that all citizens have access to sufficient, nutritious, and easy-to-obtain food at all times and reasonable prices, the policymakers must implement policies on the food affordability subsystem. It includes managing the smooth distribution of basic and essential food to remote areas, facilitating food trade between surplus and deficit regions, shortening the food marketing chain from farmers/farmer groups to consumer markets, and developing food marketing through e-commerce. From the sustainability perspective, the suggested efforts that local communities and food producers can execute are to continue and increase the intensity of the use of agricultural production technology, implement irrigation water management to increase cropping index, optimize swamp and dry land for the production

of various types of food, reduce crop loss and processing, as well as intensify efforts to diversify food by developing and promoting a variety of local food. Those efforts also need full support from national and local governments.

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