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URBAN AGRICULTURAL DEVELOPMENT FOR FOOD SECURITY AT THE TIME OF COVID-19 PANDEMIES IN INDONESIA

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ABSTRACT: Corona virus pandemic (Covid-19) threatens the lives of people in the world and has an impact on the economy of society, including in Indonesia, both in the industrial, trade and agriculture sectors. In the agricultural sector, food security is the main thing that must receive attention from the government because it can disrupt national stability. One effort that can be done is the development of urban agriculture. Urban agriculture can improve local food security and quality of agricultural products. The combination of innovative urban agriculture such as vertical garden, hydroponic, and vertiminaponic cultivation systems at various scales (small, medium, and commercial) is able to support three dimensions of food security, namely food availability, food access, and food utilization. On a small and medium scale urban agriculture is able to produce a number of vegetables for the local market. On a medium and commercial scale it can be developed to complement national or even global needs. Urban innovative agriculture also has the potential to contribute to food stability, namely reducing dependence on long and poorly developed food value chains, from rural producers to urban consumers. On that basis, innovative urban agriculture has paved the way to the second green revolution, ensuring availability and maintaining food security during the COVID-19 pandemic in Indonesia. However, in its development requires cooperation from all parties, including farmers, government, surrounding communities, entrepreneurs, educational institutions, and other parties for sustainability.

Keywords: Development, urban agriculture, food security, the Covid-19 pandemic

1. INTRODUCTION

The Covid-19 pandemic threatens the safety of human life in the world, because of its rapid spread. The first country to experience the Covid-19 pandemic was China in December 2019. According to Al Khasi (2020), after six months it had spread to 213 countries with 6.26 million positive cases of infected people including Indonesia. Based on the number of people infected with Covid-19, Indonesia ranks 33rd in the world [1] [2] [3] [4]. In Indonesia, Covid-19 began to be confirmed positive at the end of February 2020 in Depok City, West Java Province. Entering the 5th month, it has spread to 34 provinces and 416 districts/cities with a number of positive confirmed people of 26,473 people [3]

Covid-19 which has expanded to several districts/cities in every province in Indonesia has had an impact on the economy, both in the trade sector, investment, tourism, and even agriculture, especially food. If the availability of food is not immediately addressed, it is possible that it will have a negative impact on food security [3] [4].

The World Food and Agriculture Organization (FAO) has warned of a food shortage and emergency amidst the Covid-19 pandemic. Social restrictions and lockdown schemes applied in many countries have affected global agricultural production. Likewise, in Indonesia, implementing Large-Scale Social Restrictions (LSSR). Although the government has ensured that a number of food supplies such as rice, sugar, meat, cooking oil and garlic are sufficient, the distribution and purchasing power of the residents will greatly affect their accessibility. Most of the people who felt the impact were mostly in urban areas.

There were two main problems for people in urban areas during the Covid-19 pandemic and the implementation of the LSSR, namely economic resilience and the ability of households to access food at affordable prices. The ability of households to access foodstuffs is very dependent on food supplies at affordable prices while maintaining the welfare of farmers. Transportation unevenness due to the application of LSSR to break the chain of distribution of Covid-19 has an impact on food supply, so the selling prices of some food commodities in urban areas become expensive.

Expensive prices in the city does not mean providing benefits for farmers, due to the fact in the field of transportation disruption that actually reduces the selling price of food commodities at the farm level due to increased supply (harvest season)

while decreasing demand (non-smooth distribution). The increase in food prices in a number of regions until June 2020 is still relatively small, but the government must be aware of the game of the food mafia which often accumulates these basic necessities in order to maintain price stability at the level of consumers and food producers. The process of national food production can be disrupted which implies a decline in domestic food stock. On that basis, the government must compose concrete steps to prevent food emergencies, including through the development of urban agriculture which will be described in this paper.

2. THE INFLUENCE OF COVID-19 PANDEMIC ON URBAN FOOD PROVISIONS

The widespread spread of Covid-19 not only increased Covid-19 casualties, but also affected the performance of the food processing and agriculture sectors. The national food production process is disrupted which has implications for the decline in domestic food stock. Meanwhile, most developed countries are also still experiencing a pandemic, so that it will implement a tightening of inspection of goods at the entrance and exit, as a result the amount of foodstuffs imported into Indonesia also declined.

On the other hand, scarcity of food turned out not to be a benefit for farmers as producers or providers of food. Farmers have become the most affected party in the threat of a food security crisis. Many farmers produce food that cannot be sold due to the disruption of transportation for distribution [5]. Traders cannot buy all agricultural produce and what can be bought is also cheap.

Examples of cases of rural farmers in several areas of Java such as West Java, Yogyakarta, Central Java and East Java. Prices of some agricultural commodities such as curly chillies, large red chilies, green chilies, eggplants, mustard greens, cucumbers, tomatoes, and fruits have decreased. Based on the application of the market price check owned by the Ministry of Agriculture "SIMHARGA", the price of curly red chillies in various markets in Yogyakarta which previously at the beginning of February 2020 reached Rp. 70,000/kg, dropped dramatically in April 2020 to Rp. 17,500/kg. At the farm level, in March 2020 the price of curly red chillies was only Rp. 7,000.00/kg [6]. Prices of several other food commodities also declined to very low levels.

The drop in agricultural commodity prices is very detrimental to farmers in the middle of a pandemic, farmers who become the foundation of hope as producers of food providers for the survival of the population in the middle of a pandemic are in fact threatened to suffer losses. Farmers also become powerless to plant the following season due to not getting profits in the previous season and the price of production facilities increases so that it is not usual to buy seeds or seeds and other production facilities.

[7] there are three groups that are most vulnerable to the COVID-19 pandemic, namely the poor, farmers, and urban communities. Farmers who are producers of food ingredients but during this pandemic do not have access to a broad market, so that the results of agricultural production are only sold modestly on the local market at low prices. In addition, the prices of other necessities which are increasing including the price of agricultural materials also increase vulnerability for farmers. Communities in urban areas are classified as vulnerable because food availability is limited due to disruption of food distribution and people's purchasing power is declining due to rising prices while decreasing household income.

The survey results of the Director General of the Small and Medium Industries and Miscellaneous Industries (IKMA) of the Ministry of Agriculture showed that some staple food prices surged, among others: soybeans, sugar, garlic, and red chillies around 30-50% [8]. [1] due to the COVID-19 pandemic, Termination of Employment (PHK) can occur in urban areas. [1] show that at the time of the COVID-19 pandemic layoffs had reached 15 million. This phenomenon of mass job losses has resulted in a decline in the purchasing power of urban communities.

The government continues to address these problems, among others by monitoring food prices starting from the level of producers (farmers) to the hands of consumers in urban areas so that food production continues to run optimally. The government has also activated farmer resilience systems from the village level with the help of village cooperatives, so that the price can be affordable by people in urban areas. However, these efforts have not shown optimal results. On that basis, one solution that can be done by people in urban areas is to develop urban agricultural businesses.

3. INNOVATIVE TECHNOLOGY OF URBAN AGRICULTURE

3.1. Urban Agriculture

At present more than 50% of the world's population lives in cities, this number is expected to continue to increase in the future [8]. [9] the world's population in urban areas will increase to almost 70% by 2050. In Indonesia urbanization has occurred since 1970. In 2010, urban population in Indonesia has increased from 21 million to 123 million people. [9] The amount is 6 times greater than 40 years ago. It is possible that in 2050, the

urban population in Indonesia will reach 180.2 million [10]. The development of urban areas in Indonesia due to the increasing rate of urbanization at this time, has resulted in the acceleration of changes in land use, including for settlement.

The high rate of urbanization is related to several important issues such as poverty, pollution, environmental damage, land use change, and food shortages. Transfer of land functions results in increasingly narrow agricultural land for productive agriculture in urban areas so that it must be dealt with by the urban agricultural system [10].

Urban agriculture is the practice of crop and livestock/fish cultivation in the urban and surrounding environment. Urban agriculture is agriculture integrated into the urban economy and ecosystem [11]. Thus, urban agriculture is carried out by utilizing narrow plots in urban areas for agricultural activities. Urban agriculture allows the planting, harvesting, and distribution of agricultural produce in the form of food in urban areas, so that it can overcome one of the problems of food security in Indonesia during the Covid-19 pandemic.

Urban agriculture, in addition to meeting food needs in urban areas, is also to increase the household income of urban farmers. There are several benefits derived from urban agriculture, including: (1) increasing food security, (2) absorbing carbon to reduce pollution, (3) increasing innovation, (4) reducing waste, (5) conserving a variety of types of flora and fauna, (6) environmental revitalization, and (7) learning and community development [11]

To keep pace with the pace of urbanization, since 2010, hopes have emerged for promising new sources of food production. The development of innovative urban farming systems (innovative urban farming) began to bloom [12]. The combination of the latest agricultural technology innovations with the optimization of urban areas gives birth to small-scale urban farming practices (as a new lifestyle), medium scale (community food gardens), to commercial scale (a vegetable factory in the middle of the city).

Innovative urban farming systems have changed the way in producing food. A leap or revolution in increasing new sources of food production. This is a sign of the arrival of the second green revolution, a revolution to meet future food needs by bringing production locations closer to consumers, the majority of the world's population (urban society). This urban agricultural system revolution is considered more effective, efficient, and environmentally friendly [12].

Urban agricultural processes usually use organic farming systems and agricultural waste is processed with the concept of 3R (reuse, reduce, and recycle). Such urban agricultural activities refer to the sustainability of urban agriculture and the quality of agricultural products. Some of the characteristics of urban agriculture can be seen as follows [10]: (1) new farmers, (2) urban agriculture models, (3) opportunities for collaboration with various organizations, (4) natural agriculture, and (5) resource concentration and market in an urban environment. The application of urban agriculture provides several benefits both for farmers, the government, the general public, and the environment.

3.2. Innovative Technology in Urban Agriculture

In general this urban farming system is seen as more environmentally friendly. The innovation makes the aspects of care and resources used to be minimalist, but produces maximum harvest. Vertical garden is a technique of farming in a room/ arrow land by utilizing a vertical field as a place for farming which is carried out in stages. This vertical or terraced crop cultivation system is a greening concept suitable for urban areas and limited land [10].

The purpose of Vertical Garden is to make optimal use of narrow land. Vertical farming systems at a glance look complicated, but are actually very easy to do. The difficulty of growing vertically depends on the model and additional system used. In a simple model, the basic structure that is used is easy to follow and the fabrication is easy to find, so it can be applied in homes [11].

The advantages of Vertical garden according to [11] include: (1) efficiency in land use, (2) increasing green open space, (3) reducing air pollution, especially CO2, (4) increasing environmental aesthetics, (5) saving fertilizer use and pesticides, (6) can be moved easily because plants are placed in certain containers, and (7) easy in terms of plant monitoring/maintenance.

Plant cultivation systems that are carried out vertically or stratified can be done indoors or outdoors. Requirements Vertical garden is strong and easy to move. Plants to be planted should be adjusted to the needs and have high economic value, short-lived, and short-rooted.

The types of plants that are cultivated are tailored to their needs and have high economic value, are short-lived, and have short roots. In addition it must be adapted to the available containers or the ability of containers to prepare media for the needs of plants to be planted. Vertical garden technology can grow various types of plants such as celery, chili peppers, eggplants, chives, cucumbers, pots, onions, tomatoes, basil, mustard greens, spinach, kale and various other types of vegetables which are important small plants with short roots. Agriculture with Vertical garden technology can apply several models, just adjusting to the available materials, conditions and desires.

Fig. 1. Example of hanging gardens

Fig. 2. Example of Ecological Screen Gardens

Fig. 3. Example of Wall Gardens

Fig. 4. Example of Container Gardens

The word hydroponics comes from the Greek word "hydro" which means water and "ponics" which means power or energy or labor. Hydroponics is also known as soil culture or crop cultivation without using soil media [12].

Thus, hydroponics is a technique of cultivating plants by utilizing water as a plant medium but taking into account the fulfillment of nutritional needs for the plant being cultivated [12].

A plant will continue to grow well if the nutrients (nutrients) needed are always fulfilled. This means that the role of the soil is to support the plants while the nutrient solvent is water which can then be absorbed by plants. This mindset finally gave birth to hydroponic farming techniques, where the emphasis was on meeting nutritional needs. Hydroponic systems can be used for the future in overcoming the problem of land shortages that are increasingly narrow in urban areas.

Some of the benefits of cultivating plants with a hydroponic system: (1) does not need soil, (2) water will continue to circulate in the system and can be used for other purposes, such as being an aquarium, (3) simpler nutrition control so that nutrients can be provided more effectively and efficient, (4) relatively does not produce nutrient pollution to the environment, (5) gives more results, (6) easy to harvest results, (7) sterile and clean, (8) planting media can be used repeatedly, (9)) free from weeds / weeds, and (10) plants grow faster

There are several hydroponic systems that are common and easy to do so that the opportunity is developed in urban areas, including [12]:

1) Static solution culture
2) Dynamic water culture (Continuous-flow solution culture): Wick hydroponics system, Nutrient Film Technique (NFT) hydroponic system, Drip hydroponic system, water culture with fogging (Aeroponics), and
3) Virtiminaponic combined water culture

4. STATIC SOLUTION CULTURE

Static solution culture has the meaning of hydroponic cultivation with static water (still and not flowing), a hydroponic technique whose roots are continuously dipped in containers containing nutrient solutions [13].

In Indonesia, the Static solution culture is better known as the floating technique or called the floating raft and the axis system or called the wick system. This system is the simplest compared to all types of hydroponics. The place or container of the nutrient solution can differ depending on the use and size of the plant. On a small scale (household scale), can be made with containers that are usually used in the house such as glass, jars, buckets, or water tanks. On a larger scale it can be in a fish pond or channel but using a small pot with an axis, as in Fig. 5.

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Fig. 5. Static Solution Culture Vegetable Culture in Ponds

Nutrition can be done in stages according to the growth period. On a small scale, you can use a solution that is mixed directly with plant media and replaced according to plant needs. On a large scale, for example in ponds nutrition can use a solution or leaf fertilizer. If using a solution, so that the nutrient solution can circulate evenly, it is necessary to be oxygenated by an air bubble machine or called an aerator. If in the channel (running water), nutrition must be given through leaf fertilizer to be more effective and efficient.

The wick system cultivation technique has constraints on decreasing the volume of the solution. To prevent the height of the nutrient solution from falling below the root or axis, it can be done with a tap and a ball buoy valve (commonly used in reservoirs) to maintain the height of the solution automatically. In the cultivation of floating solution rafts, plants are placed in gaps in cork/ tereofoam sheets that float on the surface of the nutrient solution. With the floating technique, the height of the solution will not drop below the root and the root is always immersed in a nutrient solution [13].

5. DYNAMIC WATER CULTURE

Continuous-flow solution culture is one part of a hydroponic system with continuous water supply. Dynamic water culture systems have been adopted, among others: wick systems, the Nutrient Film Technique (NFT) hydroponic system, and water culture with fogging (Aeroponics). This system is the simplest, using an axis that connects the potted plant with nutrient solution media. The process of absorption of nutrients occurs due to capillary forces.

Fig. 6. Vegetable Cultivation of Wics Hydroponic System

Hydrionic Film Technique (NFT) Hydroponic System

Nutrient solutions are continuously flowed on the roots of plants using PVC pipes using pumps with recirculation techniques.

Fig. 7. Vegetable Cultivation of NFT Hydroponic Systems

Drip hydroponic system

This system is also simple because in principle it only provides water and nutrients in the form of droplets that are dripping continuously all the time. The droplets are directed right at the plant's rooting area so that they can absorb water directly from the nutrients provided.

Fig. 8. Vegetable Cultivation of the Drip Hydroponic System

Aeoponics System

Aeroponics comes from the word aero which means air and ponus which means power. So

aeroponics is empowering air. Thus, the aeroponic system is a way to grow vegetables in the air without the use of soil, nutrients are sprayed on the roots of plants, water containing nutrient solution is sprayed in the form of mist to hit the roots of plants. Hanging planted roots will absorb the nutrient solution. Water and nutrients are sprayed using a sprinkler irrigation.

The principle of aeroponics is as follows: Styrofoam sheets are given planting holes with a distance of 15 cm. by using foam padding or rock wool, the vegetable seedlings are plugged into the planting hole. Plant roots will dangle freely down. Under the strands of Styrofoam, there is a sprinkler that emits a mist of nutrient solution up to the roots.

One key advantage of aeroponic cultivation is the oxygenation of each fine mist grain of nutrient solution that reaches the roots. During the trip from the sprinkler hole to the roots, the granules will tether oxygen from the air until the oxygen content dissolved in the granules increases. Thus the process of respiration at the root can take place smoothly and produce a lot of energy. In addition to skilled management, production with an aeroponic system can meet the quality, quantity and continuity.

Aeroponic systems can provide benefits for farmers who do not have land like the community in urban areas, because aeroponics do not need land, but the growing media in the form of Styrofoam whose roots hang in the air. So that it can be used as land in the yard of the house.

The advantages of the Aeroponic System are (1) the aeroponic system helps the environment by saving water, (2) reducing the amount of human labor involved, (3) because the roots in the air, plants receive more oxygen, (4) the additional oxygen that plants receive can alleviate the growth of dangerous pathogens, and (5) plants can utilize oxygen-rich carbon dioxide in the air to carry out photosynthesis.

The types of plants that are often cultivated aeroponically are generally leaf vegetables, which harvest time is about one month after transplanting, such as lettuce, water spinach and spinach. However, many also cultivate root vegetables, such as potatoes. Vegetables produced with aeroponic systems are proven to have good quality, hygienic, healthy, fresh, crispy, flavorful, and accompanied by a high taste. Aeroponic vegetables can fill the opportunity needs of middle and upper levels of society. Therefore, aeroponic systems began to be developed in Indonesia.

Vertiminaponik

The term vertiminaponik is a combination of fragments of verti, mina, and ponik. The fragment of the word "verti" is taken from the term verticulture, where this system originally adopted a verticultural crop cultivation system. While the fragment of the word "mina" has the meaning of fish. For the fragment of the word "ponik" has the meaning of cultivation, the fragment of this word is usually attached to the terms hydroponics and aquaponics.

Vertiminaponik consists of two main subsystems, namely the hydroponic subsystem (for the cultivation of vegetable crops) and the aquaculture subsystem (for fish cultivation). The two subsystems are interconnected and influence each other. Plant growth in the hydroponic subsystem is highly dependent on the nutrient content derived from the aquaculture subsystem. And vice versa, the growth of fish raised in the aquaculture subsystem is highly dependent on the ability of filtration or filtering feces and leftover food in the hydroponic subsystem.

In the vertiminaponic system, the cultivation of vegetables is directly supported by the aquaculture system underneath. Aquaculture systems produce fish food residues and manure containing high concentrations of nutrients that can be used as fertilizer by plants on it. Meanwhile, the growing media and plants above it will filter water so that the water quality in the aquaculture system can be maintained. With the preservation of water quality in the fish maintenance subsystem, and free from fish food waste and feces, fish growth will be good.

6. URBAN AGRICULTURAL CONTRIBUTIONS

The contribution of innovative agricultural systems in urban areas to food security has been reviewed by several researchers in the world, including Indonesia. [13] in 15 developing countries noted the proportion of urban agriculture in the agricultural system as a whole, the percentage varied, ranging from 3 to 27%. While the yields can reach 50 kilograms per square meter. While in developed countries, such as Aerofarm agriculture in New Jersey, the US yields even reach 140 kilograms per square meter.

When comparing the productivity of urban agriculture with conventional, the results are quite encouraging. Hydroponic techniques for lettuce produce 11 times more crops per hectare. While in the greenhouse system, strawberries harvest 13 times more per hectare, while tomatoes 1.5 times. Thus, the results of innovative urban farming systems obtained depend on specific situations and conditions (location, technology, requirements, and types of plants), so they cannot be generalized.

Horticultural crops (vegetables and fruit) to date still dominate the results of urban agriculture, because of its easy maintenance, practical and fast harvest. However, farmers continue to develop by planting several types of food crops as a source of

carbohydrates. Even diversification has spread to the results of animal protein source products, namely with veriminaponik techniques that combine horticultural and fisheries production systems.

Based on the potential that has been stated above, it can be concluded that the combination of innovative urban agriculture in various practice scales (small, medium, and commercial) contributes to supporting three dimensions of food security, namely food availability, food access, and food utilization.

Small and medium scale agriculture is able to produce a number of vegetables for the local market. Whereas medium and commercial scale agriculture can be developed to complement national or even global needs. Although still being debated, innovative farming systems also have the potential to contribute to food stability (including food security). Namely by reducing dependence on long and poorly developed food supply chains, from rural producers to urban consumers.

In the financial aspect, the hydroponic vegetable cultivation business is feasible to run. This can be seen from the results of the calculation of investment criteria including NPV of 48 870 292.01. IRR value is greater than the discount rate of 7.8 percent. Net B/C is greater than one, that is 1,073. And the calculation of Payback Period for 12 years 11 months 6 days.

7. CONCLUSION

The COVID-19 pandemic which has an impact on the economic sector is predicted not to fully recover until 2021. In Indonesia, if it is not immediately addressed, economic growth can reach its lowest point in the second quarter. In the macroeconomic aspect, the Government of Indonesia must improve itself, among others, by the presence of fiscal stimulus (lower interest rates) and legal certainty so as to create more attractive conditions for investors. To increase the movement on the micro aspect, it must be grown among others in the business sector and small industry and the agricultural business sector. In the agricultural sector including the development of urban agriculture which is technically and financially proven to be very profitable. Urban agriculture if implemented in Indonesia will bring many positive sides to the development of the nation. However, the implementation of the plan certainly has its own obstacles and challenges. The community and the government need to work together if they want to implement it.

Implementation of urban agriculture requires cooperation from all parties involved. Some of the parties involved include farmers, the government, surrounding communities, entrepreneurs, educational institutions, and other parties. All efforts need to be mobilized in synergy so that Indonesia can rise from the impact of the COVID-19 pandemic. Some steps that can be applied in the implementation of urban agriculture are as follows: (1) Development of Pilot Project, (2) Formation of Farmer Groups, (3) Urban Agriculture Knowledge Training, (4) Providing incentives to urban farmers, and (5) Support and Cooperation from various parties.

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