EMAGRAP
Economic Military and Geographically Business Review
EMAGRAP 2(1): 41–58
ISSN 3025-3160

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

The impact of population growth on housing food security and transportation

Dewi Lestari[1], Nanik Ambar[1,*], Lina Nidau Lathifah[1]
[1] *School of Environmental Science, Universitas Indonesia, Central Jakarta, DKI Jakarta 10430*
*Correspondence: nanik.ambar@ui.ac.id

Received Date: July 26, 2024 Revised Date: August 23, 2020 Accepted Date: August 30, 2024

ABSTRACT

Background: Rapid population growth and its impact on the environment is a major problem facing the world today, in addition to other issues that also require serious handling and attention. Rapid population growth, especially in cities and urban areas, puts pressure on the fulfillment of population needs that must be provided to ensure the survival of the population. Population growth has an impact on the increasing needs of the population for affordable housing, food needs, transportation. **Methods:** This research uses a qualitative approach based on case studies and literature reviews. This approach involves a critical and in-depth evaluation of previous research, focusing on data collected from various sources related to the impact of population growth on affordable housing, food needs, and sustainable transportation. **Findings:** The rate of population growth has an impact on environmental sustainability, as a result of the exploitation of natural resources to fulfill various needs, including food needs. Population growth has a linear effect on the demand for food, such as rice and tubers, through the provision of agricultural land. This increase in consumption value occurs in an increasingly limited stock of natural resources, therefore a food fulfillment strategy is needed to achieve national food security and sovereignty, to meet the needs of the population and for food stocks to anticipate undesirable things, such as natural disasters and crop failures. Some of the efforts that can be made are food diversification, intensification, and extensification of agriculture accompanied by the active role of the government in providing infrastructure and supporting policies. Population growth also affects the level of population mobility. Each individual carries out daily activities such as school, work and other activities. This population mobility greatly affects the use of transportation modes to reach certain destinations. The mode of transportation consists of private vehicles and public vehicles. **Conclusion:** If the use of private vehicles is more than public vehicles, there is the potential for traffic congestion. In addition, the more vehicles used, the greater the carbon emissions produced so that it can cause greenhouse gas effects. One of the efforts that can be made is to implement sustainable transportation management through Transit Oriented Development (TOD) in the provision of transportation modes. TOD is expected to make private vehicle users switch to using public transportation. **Novelty/Originality of this study:** This research proposes a holistic approach to address the impacts of urban population growth, combining strategies for food diversification, transit-based development, and affordable housing. This framework is expected to be a practical innovation for sustainable urban development in countries with rapid population growth.

KEYWORDS: baduy; flood prevention; local wisdom; spatial planning.

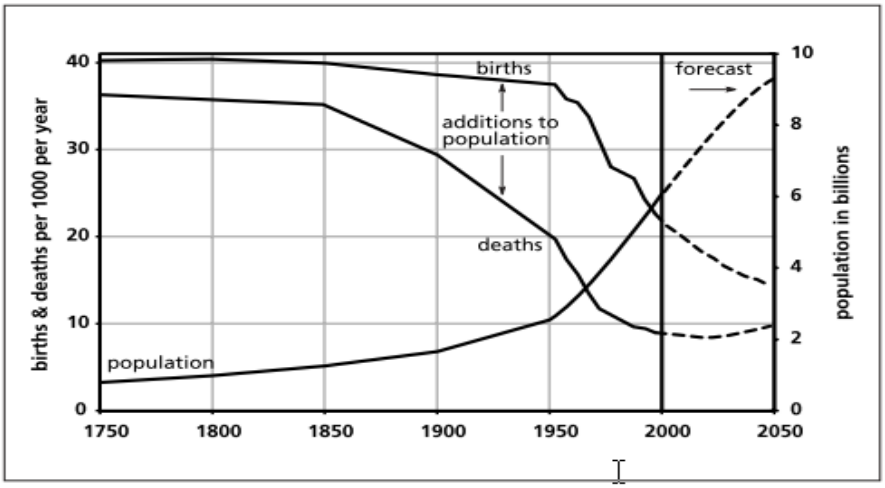
1. Introduction

Indonesia is an archipelago consisting of 16,065 islands with an area of 1,916,862.20 km2. Currently, Indonesia consists of 34 provinces, 416 regencies, and 98 cities (BPS, 2019). According to the Central Bureau of Statistics (2019), the total population of Indonesia is 265,015,300 people with a population growth rate in Indonesia of 1.33% during the 2010-

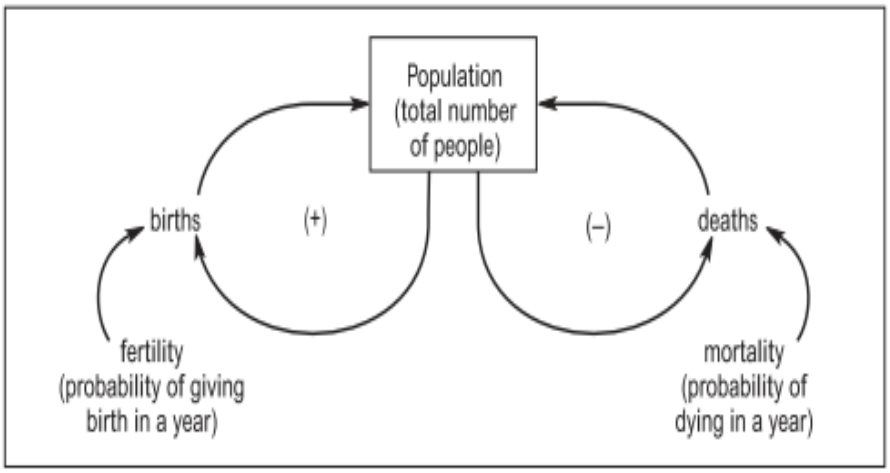
Cite This Article:
Lestari, D., Ambar, N., & Lidaul, N. (2024). The impact of population growth on housing food security and transportation. *Economic Military and Geographically Business Review, 2*(1), 41-58. https://doi.org/10.61511/emagrap.v2i1.2024.821

2018 period. The increase in population is influenced by birth, death and migration. Meadows et al. (2004) in their work Limits to Growth: The 30 Year Update discusses the relationship between births and deaths and population. The results are shown in Figure 1.

According to Fig. 1, the gap between births and deaths determines the rate of population growth. Until around 1965, the average human death rate declined faster than the birth rate, so the population growth rate increased. Since 1965, the average birth rate has fallen faster than the death rate. The population growth rate has therefore declined significantly although growth continues to be exponential (Meadows et al., 2004).



(a)



(b)

Fig. 1 (a) World Demographic Transition; (b) birth-death feedback loop (Meadows et al., 2004)

Figure 1(b) illustrates the positive relationship for birth loops and negative for death loops. Positive loops result in uncontrolled growth, negative loops tend to regulate growth, to hold a system within an acceptable range, or return it to a stable state where system stocks have more or less constant values over time (Meadows et al., 2004).

Based on the figure, it is known that birth, death and population have a dynamic relationship where the population will continue to grow if the birth rate continues to increase and will only decrease when there is a decrease in the birth or death rate. An increase in population volume will have an impact on the quality of human life because it brings several accompanying impacts including the need for space / housing, food and transportation as a supporting factor for mobilization.

Population growth is also one aspect that puts pressure on the environment as a result of land use changes aimed at providing settlements for the needs of the population (Li et al., 2015). Land that is often chosen for conversion is agricultural land, which also has an impact

on food fulfillment, especially rice. However, population growth is not the only aspect but a dynamic system with a high degree of complexity and an interaction between socio-economic and environmental factors at various scales. This research is limited to the provision of affordable housing and the environment. An increasing population requires a decent place to live that is supported by good infrastructure, this means that population growth has an impact on increasing demand for settlements, especially to have a decent home, and is faced with limited supply and land. This encourages an increase in house prices that is not in line with the purchasing power of the community, and this limitation forces people with low economic capacity to build houses with makeshift raw materials and an environment where adequate infrastructure is not available. The government offers a solution to meet the needs of settlements through the construction of flats (vertical houses) while still trying to maintain productive agricultural land.

Rapid population growth and increased urbanization have contributed to increasing demands on global energy, water and food resource systems (Namany, et al., 2019). Over the next few decades humanity will demand more food from fewer land and water resources. Land and water are essential resources for food production and are therefore two of the most fundamental resources for humanity. These resources are under pressure from population growth, economic development and environmental change (Schneider et al., 2011).

One of the challenges faced in relation to population growth is the fulfillment of food until national food security is achieved. According to Mustimin (2000), sustainable food security is defined as the ability to provide adequate food for the population over time, thus they will be able to lead a healthy life and be able to carry out activities in daily life. Adequate in this sense includes quantity, quality, and accessibility to food products for all (Waridin, 2013). Several researchers have predicted the relationship between population growth and the earth's ability to provide food. One of them argued that population growth is faster than food growth (Malthus, 1798). This becomes interesting to study and consider so that these predictions do not actually happen. Based on these problems, synergy between the community and the government is needed to realize sustainable food security with various strategies so as to achieve food self-sufficiency from the household to the national level.

In addition to meeting the needs of housing and food consumption, population growth also affects population mobility. This population mobility is strongly supported by using modes of transportation that can cause congestion. Congestion in Jakarta is expected to get worse as 1,000 to 2,000 new motorcycles and 500 new cars appear on the road every day (Zuhro, 2015). To move, transportation modes require energy as a driver. Energy is one of the important inputs in the production process, the more output produced, the higher the use of energy. Water and energy are interrelated, and both are equally important for economic and population growth (Carrillo & Frei, 2009; Lampe, 2009).

The energy discussed today focuses on the provision of transportation. Population growth has a positive impact on carbon dioxide emissions; the larger the population, the more carbon dioxide emissions are generated. People consume energy for various purposes; the greater the amount of population growth, the more energy consumption is demanded resulting in increased carbon dioxide emissions. And the higher the population, the higher the energy used, because every human being needs transportation to facilitate daily life activities. Although the use of fossil fuels in electricity production and energy consumption has detrimental effects on the environment (Baek & Kim, 2013). And energy use will have long-term effects of increasing levels of CO2 emissions that are detrimental to the environment (Lin & Wesseh Jr., 2014). The average carbon dioxide emission in Indonesia is 5.7%, the average population growth is 1.4%, the average renewable energy consumption is 45.5%, and the average fossil energy consumption is 62.1% (Sasana & Putri, 2018).

Indonesia has a target to cut carbon emissions by 26% by 2020 and extend it to 41% under international assistance using the Business as Usual (BAU) scenario. In addition, in energy consumption, granger causality is used as an indication of the increasing level of energy consumption in Indonesia along with the increasing urban population. Urban

population is influenced by increasing modernity, industrialization process, transportation and heat island (Jafari et al., 2012). Urban population is highly influenced by human activities. These activities can lead to an increase in the concentration of the spread of greenhouse gases in the atmosphere globally.

One of the efforts to reduce carbon emissions is to shift the use of private transportation modes to public transportation modes. In the management of transportation modes, the application of transit oriented development (TOD) is needed as a user attraction. TOD management is a transportation management that provides convenience for users through an integrated system. The indicators used in TOD come from the built environment with the following indicators: (1) Density, density is expressed by residential density, commercial density, and employment density. It reflects the intensity of residential and employment development, which is measured for potential commuters in the TOD area; (2) Diversity, land use diversity affects travel demand, as users can reach facilities and services within a short distance; (3) Design, design dimensions for the built environment are generally related to the street network. The street network design includes the shape of the street and the streetscape of the sidewalks on interconnecting streets leading to transit; (4) Destination Accessibility; destination accessibility measures potential access to destinations. Regional destination accessibility refers to access from residential locations to business centers or city centers, while local destination accessibility refers to access from residential areas to nearby shops; (5) Distance to Transit, distance to transit relates to the distance from origin to transit. This indicator shows how a station can be reached within 10 minutes of walking in the surrounding area.

With the use of TOD, road users can switch to using public transportation modes. Public transportation modes can consist of MRT, LRT, Trans Jakarta as well as Jak Lingko which can now access neighborhood streets. In addition to the mode of transportation, the arrangement of pedestrian paths can also be an attraction for users to walk to reach short distances.

2. Methods

The research method used is a qualitative method based on a case study through literature reviews. Literature Review is a critical and in depth evaluation of previous research (Shuttleworth, 2009 in Wahono, 2015). Researchers collect data from various sources that are reviewed so as to give meaning and process them according to the chosen theme. The selection of this method is based on a literature review of journals with appropriate themes, regarding the observation of the impact of population growth on affordable housing needs, food needs, and sustainable transportation.

3. Results and Discussion

The rate of population growth is influenced by natural population growth (births and deaths) and population migration from villages to cities. Population growth affects the area to which people move to fulfill settlement needs, impacts on the environment, and will affect interactions in the social and economic (Marshall, 2007). Rapid population growth will increase population demand based on population projections, both for housing, food, and other needs (Myers et al., 2002).

Based on Indonesian Population Projection Data published by the Central Bureau of Statistics and the National Development Planning Agency (2013), Indonesia's population projection until 2035 will increase with a decreasing population growth rate. According to BPS, although the population growth rate has decreased, the national population will still increase. Indonesia's population projection in 2020 is estimated to reach 271,066,400 people, and it is estimated that with a population growth rate of 1.02% per year it will reach 284,829,000 people in 2020 (BPS, 2013).

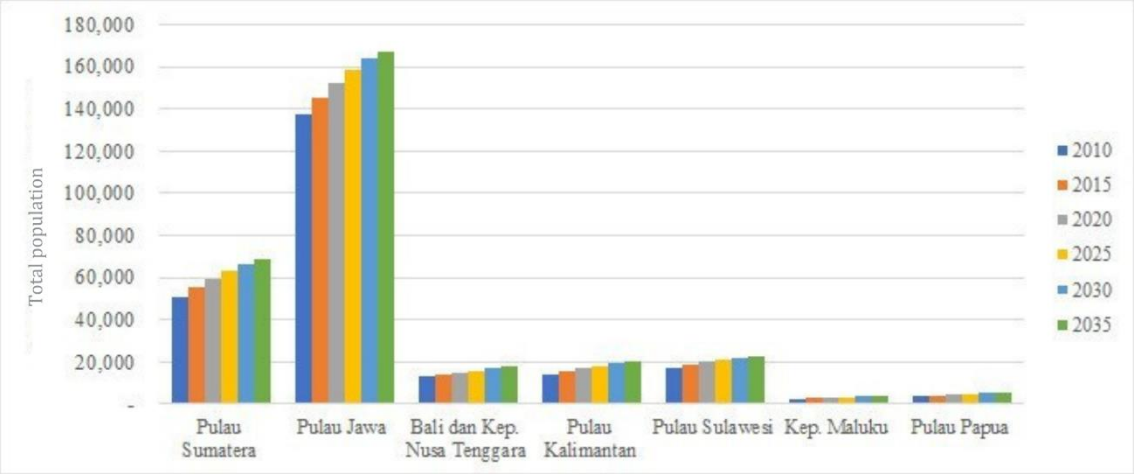


Fig. 3 Indonesia population growth projections by island
(Indonesian Population Projection Data, BPS, 2013)

From Fig. 3 of the Population Growth Projection Chart, it can be seen that the largest population is on Java Island with a projected population of 152,449,900 people in 2020 and following Sumatra Island with 59,337,100 people, while Papua Island with 3,435,400 people and Maluku Islands with 3,110,700 people and is the island with the lowest population.

With the large population of Indonesia, the Government needs to provide national attention and policies so that the needs of the population can be met. This research focuses on meeting the needs of housing, food consumption, and transportation.

3.1 Impact of population growth on the need for affordable housing

The first impact of population growth is the provision of affordable housing. This section will also discuss how to control population through women's participation in family planning programs.

3.1.1 Population growth and settlement needs

According to Housing and Settlement Statistics Data (BPS, 2016), the provision of adequate housing is a major basic human need. To date, housing is still a primary need, and future home ownership is the greatest desire of households that can provide economic and social benefits to the owner (Myers et al., 2002). Estimating future housing needs through population growth projections has been universally adopted (Myers et al., 2002). Population increase occurs in all regions of the earth's surface, according to the World Population Data Sheet in 2017 the world population reached 7.536 billion people (Hardati & Setyowati, 2019), and currently Indonesia has the fourth largest population after China, India, and the United States.

The rapid increase in population in a city will drive the demand for residential land in the city higher. According to Hardati and Setyowati (2019) who conducted research in Semarang, high population growth is always followed by changes in land use from agriculture to non-agriculture, especially for housing. Hardati and Setyowati's (2019) opinion is in line with that of Yossyafra et al. (2018) who said that the increasing demand for housing will be in line with the increasing need for land to build housing in the area, resulting in pressure on the environment and agricultural land, as listed in Table 1. The conversion of agricultural land into housing is a challenge for sustainable urban development, how to provide good housing for residents and at affordable prices, while minimizing the impact on the environment, especially agricultural land, which will have an impact on national food supply. The impact on national food will be described in the next section.

Research by Yossyafra et al. (2018) as described in Table 1 explains the decline in the area of agricultural land converted into settlements. This can be understood with the increasing number of people, the more households that need a house to live in. Agricultural land is often considered a potential land for conversion to settlements, especially dry and unproductive agricultural land.

Table 1. Conversion of agricultural land to settlement in West Sumatra Province

Municipality/Regency	Total agricultural land in 2012 (Ha)*	Total agricultural land in 2015 (Ha)*	Housing area in agricultural lan (Ha)**	% of housing area in agricultural land
Limapuluh Kota	43356	43035	321	0,74
Tanah Datar	60473	60052	421	0,70
Padang	3016	2856	159	5,27
Pariaman	2057	2014	43	2,08

* Regional spatial planning
* Digitizing using citra satellite map

(A Challenge in Providing Housing Land and Sustainable Agricultural Land; An Effort to Meet The Backlog of Housing and Food Security in West Sumatera, 2018)

For example, in West Sumatra Province, the decline in the area of agricultural land due to conversion to settlements ranged from 43 ha-321 ha in a 3-year period from 2012 to 2015, with an average decline of 11 ha-100 ha per year. The need for land will remain high, and the threat of conversion of agricultural land to settlements will also be high, especially if the provision of settlements still relies on the landed house pattern as in Indonesia. The decline in the area of agricultural land due to conversion to settlements does not only occur in West Sumatra Province, but also in other regions. In addition to providing residential land, conversion of agricultural land also occurs for industrial land and urban infrastructure facilities.

Based on Statistical Information Data on Public Works and Public Housing published by the Ministry of Public Works and Public Housing (2018), to meet the people's needs for housing and settlements that can be affordable by low-income people, the government is always faced with the problem of limited land area available for development, especially in densely populated urban areas. For this reason, the provision of flats (vertical houses) is a solution to overcome housing and settlement needs, especially in urban areas where the population continues to increase.

The Ministry of Public Works and Public Housing as the person in charge of providing housing for the community has built flats throughout Indonesia, especially in urban areas to meet the needs of the population as illustrated in Figure 4, the construction of flats per island. This means that the provision of settlements is a concern of the Government to be prepared and built throughout Indonesia.

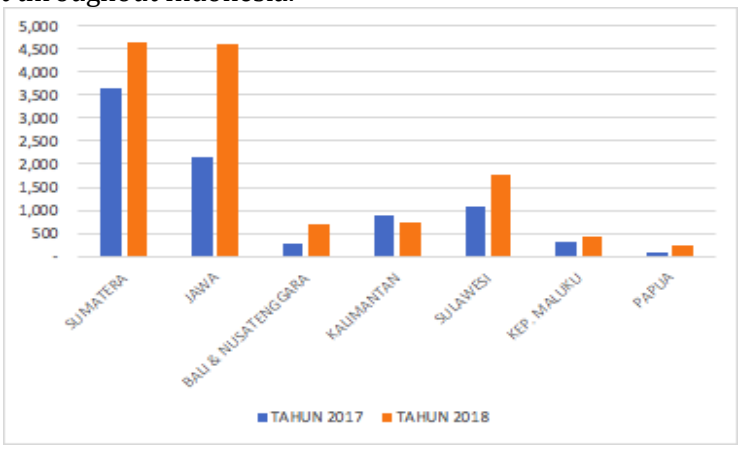


Fig. 4 Number of flats per island in 2017 and 2018
(Data Informasi Statistik Pekerjaan Umum dan Perumahan Rakyat, 2018)

The construction of flats (vertical houses) is a government effort to fulfill the need for decent and affordable housing while still being able to keep productive agricultural land from being converted.

3.1.2 Housing strategy

The provision of housing is intended to meet the needs of the community, both those with low income and those with high income. Rapid population growth, especially in urban centers with high land prices and housing costs, resulting in a shortage of housing stock to meet the needs or the price is beyond the reach of the community (Olotuah, 2012). The government realizes that meeting the need for shelter is a primary need in life (Shuid, 2016) who conducted research on the provision of settlements in Malaysia for low-income people through subsidies and the involvement of the private sector is part of the government's strategy. The decent housing provision program provides hope for low-income people to own a house. Not all people living in the city have the ability to buy a house, nor does the government have the ability to provide decent housing for all residents. In this case, the government opens opportunities for the private sector to invest in the provision of settlements.

Home ownership can be through several patterns, based on Housing and Settlement Statistics Data (BPS, 2016) there are several patterns in owning a house, including: (a) Buying from a developer is if the household obtains a residence / house directly from the developer (developer) either by cash payment or credit; (b) buying from a non-developer is if the household acquires a dwelling/house that is purchased not from a developer, but from an individual, cooperative/foundation, or other party that is not a developer. This includes those who bought a house on credit from an existing tenant by continuing to pay installments; (c) self-construction is when a household acquires a dwelling/house by building it themselves, whether the cost comes from their own money, loans/debts from individuals, loans/debts from financial institutions such as banks, or loans/debts from cooperatives; (d) others are inherited houses and grants.

Whichever pattern a household chooses is adjusted to its economic capacity, with the main objective being to have a house as a primary need. Comfortable settlements are intended for all people, regardless of economic conditions, because everyone has the right to enjoy a healthy environment. A comfortable settlement is a healthy residential environment and a quality environment. The fulfillment of settlements is evolving not only to meet the number of needs but to improve the standard of settlements (Myers et al., 2002).

When developing residential areas, not only focusing on the quality of buildings or house buildings, but must also pay attention to the availability of open space and green open space (Skalicky & Čerpes, 2019). In this case, the government as a regulator involves the private sector in meeting housing needs with a certain proportion, because the private sector is not only profit-oriented but also has a social function.

According to Housing and Settlement Statistics Data (2016), a healthy house is a house that meets the requirements of sufficient area, has good air circulation, sufficient sunlight, humidity and temperature, sanitation, bathroom, and a good kitchen. This definition is in line with the opinion of Skalicky & Čerpes (2019) that there are 4 aspects to realize a comfortable environment, including environmental aspects, social aspects, cultural aspects, and functional aspects of the area, as illustrated in Figure 5.

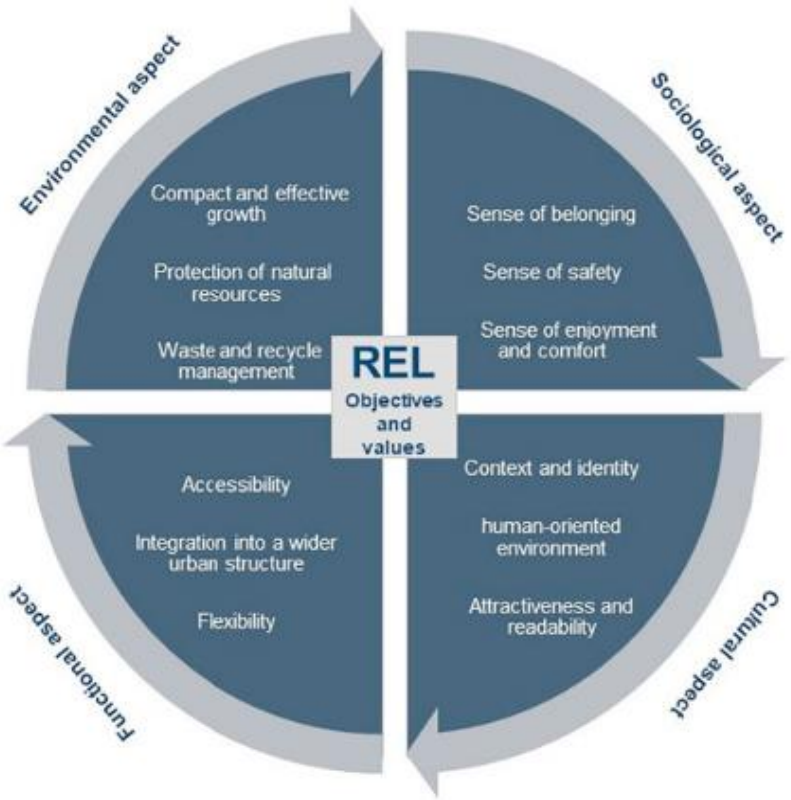


Fig. 5 Model for the development of a comfortable residential environment
(Comprehensive assessment methodology for liveable residential environment. Cities (2018)
Description: REL = Residential Environment Liveability

These four aspects are integrated and become one unit in the assessment of a livable environment that is taken into consideration in accordance with the economic capacity of households.

3.1.2 family planning

Family planning is a program to plan the number of pregnancies or children to have and when to have children. This program can contribute to slowing population growth. One of the countries that has implemented family planning in the form of limiting the number of children for married couples to 2 children is China, since 2016 (Li et al., 2019). In Indonesia, the family planning program has been implemented as part of the population policy and strategy launched by the Government in the 1970s. Limiting the number of children in a family is closely related to the family's ability to meet the needs of children, such as education, health, and employment, as well as to maintain women's health and improve the quality of family life. Family planning programs need to be continued to control population growth in the future.

The framework of the Family Planning program according to the results of Gaffikin & Engelman (2018) provides benefits for environmental sustainability, as illustrated in Figure 2.

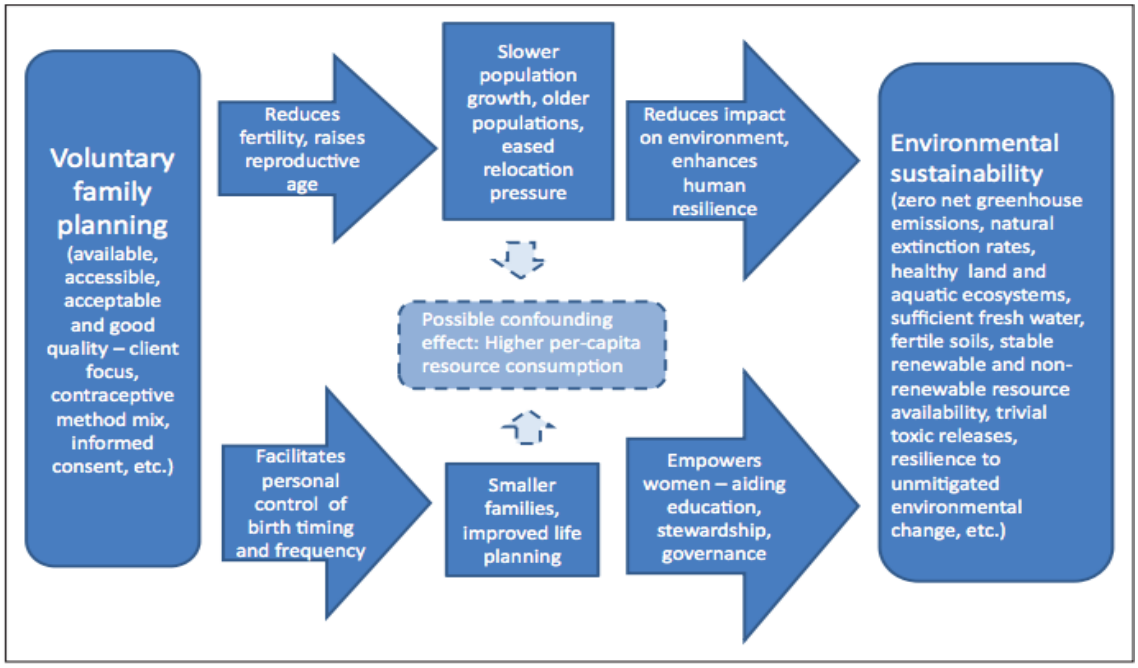


Fig. 6 Family planning framework in environmental sustainability
(Family planning as a contributor to environmental sustainability: weighing the evidence, 2018)

According to Gaffikin & Engelman (2018) in Figure 2 family planning can reduce births and increase reproductive age, or it can be explained that family planning can reduce population growth. Family planning program volunteers will receive services in regulating the timing and number of births, reducing the birth rate, and increasing reproductive age. The benefits of family planning are reduced birth rates and increased reproductive age which will significantly reduce population growth (Gaffikin & Engelman, 2018).

Several studies have found a positive relationship between women's empowerment to reduce fertility, spacing births, and preventing unwanted pregnancies (family planning) (Sangar, 2018). Women's empowerment can be through increasing the role of women in society from economic and social aspects. In the economic aspect, women who have education and skills will participate in becoming breadwinners to help the economic needs of the household. With the increasing role of women in the economy, they will think and plan the number of subsequent births and plan the number of family members. The form of empowering women to consciously participate in family planning includes education or training. Based on the results of research, family planning in women through the use of contraception or sterilization is more effective to implement (Sangar, 2018).

In Indonesia, according to the Indonesian Demographic and Population Census Data (2014), family planning or better known as Family Planning has been launched by the government since 1970 which is an effort to reduce population while improving maternal and child health. To further understand the Family Planning program, it is an effort to regulate the spacing of children, the distance between births and pregnancies, and the ideal age of childbirth (reproduction), using contraception. In general, the target for the Family Planning program is women aged 15 - 49 years who are women of productive age in reproduction as well as women who can contribute to the family economy as breadwinners.

Based on the Ministry of Health's Family Planning Statistics Data (2014), out of 8,500,247 couples of childbearing age, 93.66% of women used contraception, while only 6.34% of men used contraception. From this data, the role of women in family planning is very dominant, but it is necessary to increase the role of men in controlling the number of children in the family, to improve family quality, improve maternal and child health.

3.2 Impact of population growth on food needs

The second impact of population growth is the increasing demand for food. This is an interesting challenge because food is essential for an adequate standard of living. Recognition of the right to food in government policy is fundamental to the protection of human dignity, particularly in relation to food insecurity (Hadiprayitno, 2010). Guaranteeing the right to food for all is also in accordance with Article 25 of the Universal Declaration of Human Rights which says that everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or lack of livelihood in circumstances beyond his control (Dirman et al., 2018).

The dangers of rapid population growth have long been studied and debated. As early as 1798, Thomas Robert Malthus, an English economist, demographer and scholar, published An Essay on the Principle of Population, as it Affects the Future Improvement of Society, a pioneering work on the impact of population growth from an economic perspective (Strydom & Struweg, 2016). Malthus' theory states that population growth increases geometrically following a measuring series while subsystem (food) growth increases arithmetically following a counting series (Malthus, 1798). This means that population growth is linear and occurs faster than the earth's ability to provide subsystems (food) for humans. Malthus predicted that if population growth was not limited, famine and poverty would occur due to inadequate food fulfillment.

The next period in 1972, the debate was reignited by a number of academics led by American Professor Dennis Meadows with his much-discussed book, The Limits to Growth (Strydom & Struweg, 2016). In the book, Meadows et al. (1972) argued that

"If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity".

Refined through an updated edition in Limits to Growth: The 30 Year Update, Meadows et al. (2004) state that population and productive capital are the motors of social growth in societies that grow exponentially. Other entities, such as food production, resource use, and pollution, tend to increase exponentially not because they multiply themselves, but because they are driven by population and capital.

Based on this description, it is necessary to study the influence of population growth dynamics on food conditions in an effort to achieve food security and sovereignty. Food security is broadly defined in the 1996 World Food Summit Plan of Action with the following statement food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Programme, 2009).

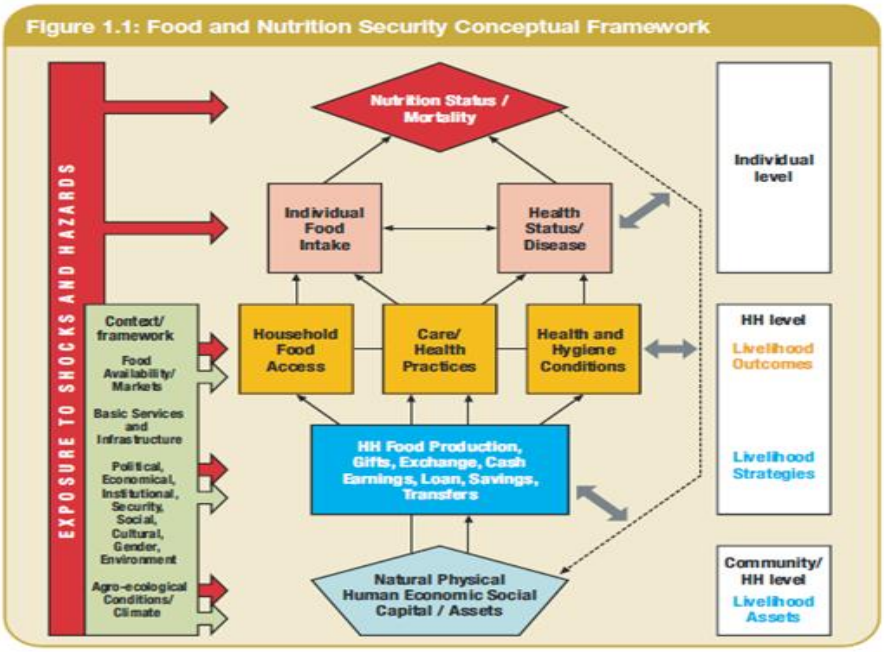


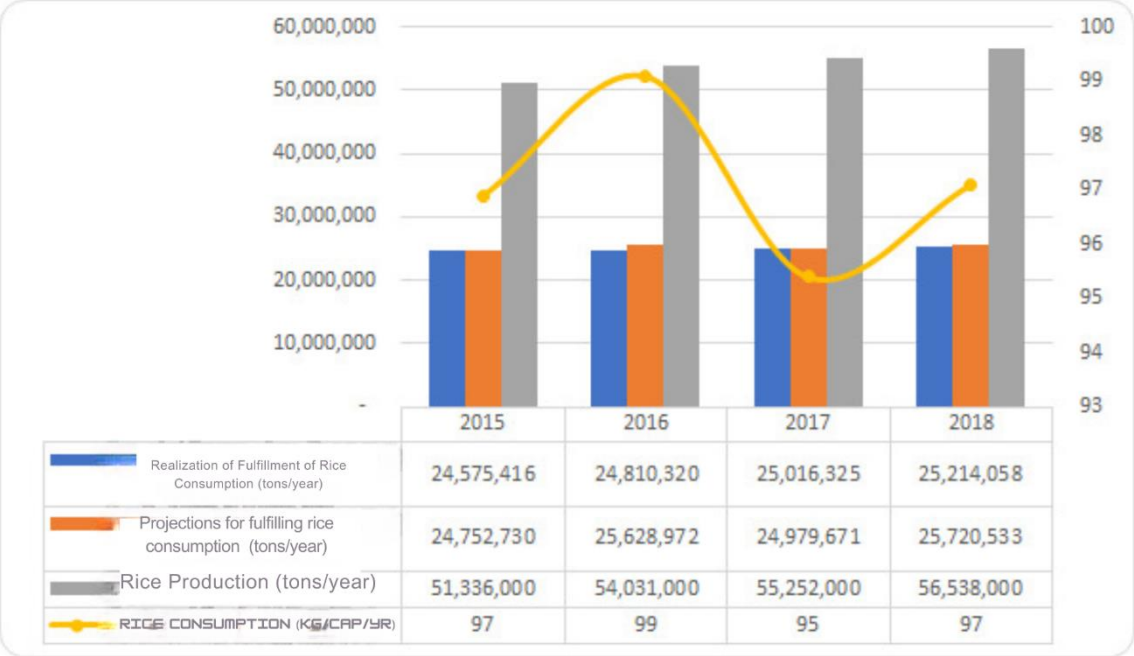
Fig. 7. Thinking Framework for the Concept of Food Security and Nutrition (World Food Programme, 2009)

The complexity of food security issues can be simplified by focusing on three distinct but interrelated dimensions: aggregate food availability, household food access and individual food utilization. Achieving food security requires addressing these three separate dimensions, ensuring that (World Food Programme, 2009): (a) the aggregate availability of physical food supplies from domestic production, commercial imports, food aid and national stocks is sufficient; (b) household livelihoods provide adequate access for all household members to food supplies through home production, market purchases, or transfers from other sources; (c) utilization of the food supply is appropriate to meet the special dietary and health needs of all individuals in the household.

Mostova (2017) has made a SWOT analysis for food security that includes a list of strengths, weaknesses, opportunities and threats in the context of the basic strategic groups of production, markets, resources and consumption. As a result, the main strategic directions that should be the foundation of a sustainable level of food security are to increase the volume of production, maintain a constant volume of imported foodstuffs, control over foreign trade policy to maintain an optimal ratio of exports and imports, improvement of market infrastructure, implementation of effective policies to manage state reserves.

Based on the Food Security and Nutrition Concept Thinking Framework according to (World Food Programme, 2009) and Mostova's (2017) SWOT analysis for food security, it is known that the fundamental thing towards food security is to ensure food availability which can be done through increasing the volume of food production. In this case, one of the efforts that can be made is through agricultural intensification and extensification. Through agricultural intensification, crop production can be increased on a fixed unit of land area. Agricultural intensification can be done starting from the use of superior seeds, tillage, balanced fertilization, integrated pest control, irrigation to marketing results by increasing the added value of agricultural products. Intensification and expansion are two important principles of commercial agriculture (Varkkey et al., 2018). In addition to these two things, food diversification also has an important role in food security, The results of the study (Adjimoti & Kwadzo, 2018) found that crop diversification has a positive effect on household food security status. Diversity of food grown through crop diversity can improve household food security. Food diversification can be done by socializing other types of staple foods besides rice. An example is sago, which is native to Indonesia. Sago is very

suitable for planting in Indonesia and has high productivity. This plant has the potential to be developed and become the main staple food besides rice.



	2015	2016	2017	2018
Realization of Fulfillment of Rice Consumption (tons/year)	24,575,416	24,810,320	25,016,325	25,214,058
Projections for fulfilling rice consumption (tons/year)	24,752,730	25,628,972	24,979,671	25,720,533
Rice Production (tons/year)	51,336,000	54,031,000	55,252,000	56,538,000
RICE CONSUMPTION (KG/CAP/YR)	97	99	95	97

Fig. 8. Rice production, fulfillment of consumption and rice consumption of the indonesian population
(Badan Ketahanan Pangan, 2019)

As a staple food source for the Indonesian people, rice is still the main food crop commodity that must be fulfilled. Figure 8 explains the relationship between production, consumption and fulfillment of rice consumption in Indonesia from 2015 to 2018 (Food Security Agency, 2019). Based on Figure 8, rice production tends to increase annually but the level of rice consumption per capita is still fluctuating. The decrease in the realization of rice fulfillment in 2017 occurred due to a decrease in per capita consumption. Rice production each year still exceeds the projected fulfillment of consumption, this means that there are still stocks that support national food security. The stock can be used as a preventive effort in the event of unwanted things such as natural disasters or crop failures.

3.3 Impact of population growth on sustainable transportation

The third impact of population growth that will be discussed is its effect on sustainable transportation. In urban areas, the tendency is to have a high population increase due to birth rates and urbanization. The level of urbanization implies an increasingly dense population which directly or indirectly reduces the competitiveness of regional transportation (Susantoro & Parikesit, 2004).

Phenomena that arise related to the imbalance of mobility demands include the increasing trend of private vehicle ownership and travel that is not matched by the addition of road network infrastructure resulting in congestion, delays, waste of energy and costs, as well as air and noise pollution (Brotodewo, 2010).

In the face of increasing mobility needs, a sustainable transportation system is needed. A sustainable transportation system is a transportation system that can accommodate the maximum possible accessibility with the minimum possible negative impact. A sustainable transportation system involves three important components, namely accessibility, equality and environmental impact (Aminah, 2018). In addition, sustainable transportation is defined as a transportation system whose fuel use, vehicle emissions, level of safety, congestion, and social and economic access will not cause negative impacts that cannot be anticipated by future generations (Richardson et al., 2000).

Rapid population growth has increased the mobility of people, leading to traffic congestion, due to the lack of mass transportation. For example, congestion in Jakarta is expected to get worse as 1,000 to 2,000 new motorcycles and 500 new cars appear on the road every day (Zuhro, 2015). One solution in managing the impact of population growth in the transportation sector is sustainable transportation management through transit oriented development (TOD). Transit-oriented development (TOD) is a planning approach that is being adopted in many cities as it favors reducing private vehicle use by developing mass transit stations around high-density mixed land uses and walkable/bikeable neighborhoods (Budiati et al., 2018).

Fig. 10. Example of TOD in Jakarta
(Novrizaldi, 2018)

Referring to Perda No. 1 of 2014 concerning the Detailed Spatial Plan and Zoning Regulations of DKI Jakarta Province, the TOD concept is part of the future spatial development plan of DKI Jakarta in Figure 10. The components contained in the development of the Transit Oriented Development (TOD) concept are as follows (Novrizaldi, 2018), (1) There is a circulation network (road); (2) Bus Rapid Transit and its stops (stops); (3) Pedestrian and cycling facilities to minimize the movement of motor vehicles 4; (4) Public facilities such as parks, schools, libraries, etc; (5) Parking lots.

Sustainable transportation systems make a positive contribution to the environmental, social and economic sustainability of the communities they serve. Transportation systems exist to provide social and economic connections, and people are quick to seize the opportunities offered by increased mobility (Schaefer, 1998). There are three main ways to reduce greenhouse gas emissions from transportation namely, avoidance means limiting travel by motorized modes. Especially at short distances, urban planning should prepare more for the convenience of using pedestrian paths so as to reduce carbon emissions produced by vehicles. For long distances, it can be facilitated by the convenience of mass transportation so that private vehicle users switch to using public transportation modes.

The change in question is to use a more environmentally friendly mode. Currently, technological developments have also penetrated the automotive world. This can be seen from the availability of vehicles that use solar energy or electricity so that they do not depend on mining materials that have the potential to produce a lot of carbon emissions. What is meant is to increase the energy efficiency of transportation modes and motor vehicle technology. For existing types of vehicles, improvements can be made in filtering combustion results so that the carbon emissions produced become less.

In addition to the provision of a TOD system, public awareness is needed to switch. As stated by (Cooley, 1994) that:

"The character of transportation as a whole and in detail, at any particular time and throughout its history, is altogether determined by its inter-relations with physical and social forces and conditions. To understand transportation means simply to analyze these inter-relationships. So far, attention has been fixed as much as possible on the simpler and more obvious conditions, the physical. We now approach the more complex question of the social relations of transportation. The need for the movement of things and persons underlies every kind of social organization, every institution whatever."

4. Conclusions

Population growth is a major challenge facing the world today. Indonesia as a developing country also faces the challenge of a large population with a projected population of 271,066,400 people in 2020, and is projected to still face population growth even with a decrease in the population growth rate through the implementation of appropriate population policies, including through family planning. Population control through family planning and the involvement of women needs to be focused on by the government because it will have a broad impact on the sustainability of the environment and life.

Population growth must be accompanied by a strategy to meet food needs by optimizing the earth's ability to support it. The concept of food security must be truly realized as one of the parameters of successful national development. To realize it, there must be commitment and active participation from the community and government as policy holders.

The activities carried out by residents to travel or not and by which mode will be chosen will affect fuel consumption which affects the amount of carbon emissions. Sustainable transportation management through Transit Oriented Development (TOD) can reduce the use of private vehicles so that the resulting carbon emissions will be reduced.

Acknowledgement
The authors would like to thank the IASSSF team for supporting the writing of this research.

Author Contribution
All author contributed fully to the writing of this article.

Funding
This research did not use external funding.

Ethical Review Board Statement
Not applicable.

Informed Consent Statement
Not applicable.

Data Availability Statement
Not applicable.

Conflicts of Interest
The author declare no conflict of interest.

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Biographies of Author(s)

Dewi Lestari, School of Environmental Science, Universitas Indonesia, Central Jakarta, DKI Jakarta 10430, Indonesia.
- Email: dewi.lestari93@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Nanik Ambar, School of Environmental Science, Universitas Indonesia, Central Jakarta, DKI Jakarta 10430, Indonesia.
- Email: nanik.ambar@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Lina Nidaul Lathifah, School of Environmental Science, Universitas Indonesia, Central Jakarta, DKI Jakarta 10430, Indonesia.
- Email: lina.nidaul@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A