JSSEW
Journal of Sustainability, Society, and Eco-Welfare
JSSEW 2(2): 141-158
ISSN 3025-1524

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

Acceleration of stunting reduction: Advancing social and environmental well-being through policy, education, and environmental management

Samuel Evan Firdaus [1]*, Precious Douglas Maulana[1]
[1] *School of Environmental Science, Universitas Indonesia, DKI Jakarta 10430, Indonesia.*
*Correspondence: samuel.e@ui.ac.id

Received Date: December 16, 2024 Revised Date: January 25, 2025 Accepted Date: January 31, 2025

ABSTRACT

Background: Stunting is a serious public health problem in Indonesia, especially in East Nusa Tenggara/*Nusa Tenggara Timur* (NTT) Province, which has a high prevalence. Based on the 2021 Indonesian Nutritional Status Survey (SSGI), there are 15 districts in NTT with stunting rates of more than 30%, even in South Central Timor and North Central Timor Regencies, the prevalence reaches more than 46%. The main factors contributing to stunting include malnutrition, poor sanitation, and consanguineous marriage practices. **Methods:** This study uses a literature review approach by applying the Social Ecological Model (SEM) to analyze risk factors and intervention strategies. The data used include empirical studies and policies related to stunting in NTT. **Findings:** The analysis shows that poor sanitation, such as access to clean drinking water which only reaches 86.79% and access to proper sanitation of 73.7%, is correlated with high stunting rates. Data also show that low milk consumption, with an average consumption of only 30 kilocalories per capita per day in Southeast Asia, contributes to the high prevalence of stunting of 31%. In addition, maternal education levels and the practice of washing hands with soap after feeding children are significantly associated with stunting. Social assistance programs such as the Family Hope Program/*Program Keluarga Harapan* (PKH) have reached 64% of beneficiaries but have not been effective in reducing stunting rates because there is still inaccuracy in targeting recipients. **Conclusion:** Accelerating stunting reduction in NTT requires a multi-sectoral approach involving improving sanitation infrastructure, increasing access to nutrition, health education, and optimizing social assistance programs. Monitoring and evaluation of policy implementation need to be improved to ensure the effectiveness of the interventions carried out. **Novelty/Originality of this article:** This study highlights the relationship between environmental factors, cultural practices, and policy effectiveness in accelerating stunting reduction in NTT. The SEM approach used offers a holistic perspective in understanding the complexity of the problem and designing more effective intervention strategies.

KEYWORDS: drinking water, East Nusa Tenggara, environmental, sanitation, stunting.

1. Introduction

In 2015, 193 Member States adopted the 2030 Agenda for Sustainable Development as a standard of the United Nations (UN). To promote peace and prosperity for both humans and the planet, the Agenda has identified 17 Sustainable Development Goals (SDGs) and 169 goals. Of the 17 goals, many address health indirectly (e.g., zero hunger [SDG2], clean water and sanitation [SDG6]), while SDG3 focuses directly on health, with the goal of "ensuring healthy lives and improving well-being for everyone at all ages" (Dieleman, 2020). Health is an engine of economic growth (Nefiodow, 2014). Women's health, mothers, and children in

Cite This Article:
Firdaus, S. E., & Maulana, P. D. (2025). Acceleration of stunting reduction: Advancing social and environmental well-being through policy, education, and environmental management. *Journal of Sustainability, Society, and Eco-Welfare, 2*(2), 141-158. https://doi.org/10.61511/jssew.v2i2.2025.1496

particular, is fundamental to economic development (Halkos & Gkampoura, 2021). Healthy children are the pillars of a healthy and developing society as reflected in the Sustainable Development Goals agenda. Children's health influences economic growth directly (Attansio et al., 2021) and indirectly in various ways (Esen et al., 2021). Directly, children's health plays an important role in building the foundation for human resource investment and reducing the economic burden of disease (Matingwina, 2018; Saif & Anwar, 2023).

Indirectly, this affects people's future income through the impact that health has on education, such as schooling and cognitive ability, which in turn affects economic growth (Fanzo & Davis, 2021). Malnutrition in children manifests in three forms: Undernutrition, which includes stunting (height for age), wasting (weight for height), and underweight (weight for age), overnutrition (overweight and obesity), and micronutrient-related malnutrition. Child nutritional anthropometry is the most significant challenge facing children and nations, making it the primary concern. According to WHO global estimates (2021), around 149.2 million children under the age of 5 suffer from stunting, 45.4 million are affected by wasting, 20.5 million are underweight and 38.9 million are too heavy for their height.

The global health community has been slow to recognize the challenges faced by most low- and middle-income countries (LMICs) (Popkin et al., 2023) who face the double burden of malnutrition (DBM) – the coexistence of undernutrition (namely micronutrient deficiencies, underweight, stunting and wasting in children) with overweight/obesity as well as non-communicable diseases related to diet. Stunting is a condition of malnutrition in children which is measured based on height for age which is more than two standard deviations below the median WHO Child Growth Standards (Zaba et al., 2022). Stunting in children has detrimental consequences such as decreased cognitive abilities, language, and academic achievement. In addition, children with stunting have an increased risk of serious chronic diseases related to nutrition (Rekha et al., 2023).

There are three estimated sources of domestic health expenditure, namely government, private expenditure, and prepaid private expenditure. The sum of expenditures from these three domestic sources and the DAH equals the sum of health expenditures. This means that these four funding sources are mutually exclusive and complete when combined. Health spending in the government is calculated as the sum of social insurance and public health initiatives, as well as other programs (Attanasio et al., 2021). Current estimates are that 2.28 billion or more children and adults are overweight and more than 150 million children are stunted (Popkin et al., 2023). There are several studies illustrating the double burden of undernutrition (child stunting/wasting and micronutrient deficiencies) and overweight/obesity affecting countries, households, and individuals (Speich et al., 2023; Barth-Jaeggi et al., 2023). Stunting is a condition of failure to grow in children as a result of chronic malnutrition so that the child becomes too short for his age or when someone is shorter than the average height of other people (of his age) in general. Stunting is one of the most serious public health problems and is one of the most serious and challenging public health problems worldwide (Chowdhury et al., 2023) (Williyanarti et al., 2022). Despite being relatively unknown in many countries, stunting still affects 165 million children globally, with 90% of them living in Africa and Asia (Berhanu et al., 2023). This is a cause for great concern in developing countries. The disease is largely irreversible due to inadequate nutrition and repeated attacks of infection during the first 1000 days of a child's life.

Sixty-eight percent of the world's population will live in urban areas by 2050 (Sharma et al., 2023) and approximately 90% of this increase will occur in small towns and/or cities in Africa and Asia (Speich et al., 2023). Small towns and cities are also the areas where the majority of the world's poor live today (Gayawan & Egbon, 2023). Degradation of natural resources and pollution often coincide with rapid and unplanned urbanization. The costs of urbanization also arise from the waste that many urban food systems operate in, including excessive use of fertilizer, excessive use of antibiotics for animal growth, and untreated human waste (Raja et al., 2021).

School children may experience a decline in their physical and cognitive development due to school-age malnutrition. This limits educational levels and weakens the impact of educational interventions on social development. This can even directly and indirectly threaten the health and survival of future generations, as malnourished children reach adolescence and reproductive years in nutritionally and educationally disadvantaged conditions. This is also harmful to the child's development. It has lifelong negative effects on health, ability to work, and quality of life.

Early stunting in women is associated with a lower age at birth and fewer pregnancies and children. Productivity and economic growth are impacted by stunting. Up to 3% of a country's gross domestic product could be lost due to stunting, as estimated by economists. The World Bank estimates that a 1% loss in adult height due to childhood stunting results in a 1,4% loss in economic productivity. It is estimated that stunted children earn 20% less money than their peers as adults.

It is among the first in a series of studies represented by a growing literature focused on understanding the dimensions of the problem as well as its causes, consequences, and possible solutions. Analysis has shown several reasons for this health crisis, many related to the nutritional transition stage dominated by reduced physical activity and increased access to less healthy and processed foods and drinks. However, there is a gap regarding how to translate this evidence into effective action. Malnutrition is a condition where a person is found to lack nutrients. His nutritional status is below average standards. Nutrients can include protein, carbohydrates, and calories.

Stunting is caused by multi-dimensional factors and is not only caused by malnutrition experienced by pregnant women and children under five, so treatment must also be multi-actor. The most decisive intervention to reduce the prevalence of stunting is carried out in the First 1000 Days of Life of children under five (Sangalang et al., 2022). The 1000 HPK period is important because if during antenatal care or the delivery process risk factors are found in the mother and treatment is not given according to standards, the baby could be born with LBW or experience other complications such as neonatal asphyxia or neonatal sepsis and its complications so that the baby's quality of life suffers. low and could be one of the causes of stunting in the future.

Through the development of a nutrition-focused agricultural strategy, the Ministry of Agriculture and the National Food Agency will strategically invest in selecting the most nutritious foods to ensure that the sector contributes to bettering nutrition. Proposes that it is essential. The important role that animal-source foods (ASFs) play in promoting healthier growth and cognitive development is important in low- and middle-income countries, as FSW is a rich source of macronutrients, especially for children. There is broad consensus among nutrition experts specializing in (LMIC). Encompasses superior protein content and an assortment of vital nutrients that enhance physical and intellectual development (Oginawati et al., 2023). The condition of malnutrition or stunting is related to milk consumption and the family's income level. However, there is limited empirical evidence to suggest that dairy products help counteract stunting, particularly at the national level. High-income countries, older children, and children less susceptible to stunting are often the only regions where randomized controlled trials (RCTs) for treating dairy products meet the gold standard (de Beer, 2012; Iannotti et al., 2013). A comprehensive analysis of the Multinational Demographic and Health Survey (DHS) from 49 LMIC countries investigated the association between stunting and children's ASF consumption in the past 24 hours (Headey et al., 2018; Haile & Headey, 2023). The study found that children who consumed one or more PASI products earlier in the day had a lower risk of stunting, but dairy intake showed the greatest reduction in stunting for all types of dairy products. It was also found that there was a strong correlation (Dror & Allen, 2011; Dror & Allen, 2014). Other recent literature has highlighted the fact that households with cows in rural areas are generally more likely to feed their infants dairy products than households without cows, as dairy production and consumption are inseparable. The purpose of our investigation into this relationship is to uncover additional causation evidence (Hermawan et al., 2023). Table 1 shows the relationship between stunting prevalence milk consumption and income level.

Table 1. Relationship to Stunting Prevalence

Regions	Many countries	Number of observations	Average stunting prevalence (%)	Averagemilk coznsumption (kilocalories per capita per day)	Average GDP per Capita (US$)
Central Asia	4	12	16	256	4917
Eastern Asia	2	18	9	152	4619
LAC	19	138	16	146	5630
Northern Africa	5	30	19	158	3238
South-eastern Asia	9	61	31	30	3296
Southern Asia	7	35	28	137	3137
Sub-Saharan Africa	37	193	31	60	1716
Western Africa	8	37	18	189	5146
Total	91	524			

(Hailey & headey, 2023)

The means of the main variables and the distribution of sampling across the region are presented in Table 1. Stunting is most common in Southeast Asia, South Asia, and SSA, while stunting is least common in East Asia. Low milk consumption is thought to be a factor in the high stunting rates observed among Southeast Asia and SSA, where the per capita milk supply is the lowest. South Asia may be a special case, as most countries in the region, including India, have relatively high milk consumption, but also very high levels of stunting. However, despite the relatively widespread consumption of dairy products in India, poor child health, very poor laundry conditions, and other nutritional factors contribute to the high rate of stunting in India. This may explain why the average price is so high (Headey and Palloni, 2019; Spears, 2018; Headey et al., 2016). Moreover, in countries like India, milk consumption among children is far from widespread. DHS 2015-2016 states that only half of children have consumed dairy products in the past 24 hours. Through various processes, environmental factors can have a major impact on the likelihood and severity of stunting, although they are not the only factors.

Extreme weather events such as droughts, floods, and other climate-related disruptions can impact agricultural productivity and jeopardize food security and vulnerable communities' access to a variety of nutrient-dense foods. Results from Lloyd et al., (2019), show that in a poverty scenario, 110 million children under the age of five will experience stunting in 2030, compared to 83 million children in a prosperity scenario, if climate change does not occur. Stunting related to climate change is estimated to impact 570,000 people in a good or low climate change scenario and more than 1 million people in a bad or high climate change scenario. Based on these two socio-economic scenarios, the estimated impact of climate change on stunting is higher in rural areas than in urban areas. The environment of an area is also determined by its geographical location. Each geographic region has different environmental problems, such as dry climates that are prone to drought, or places that are vulnerable to floods or landslides. Low rainfall and challenging geographical conditions increasingly hamper the community's ability to obtain clean water. In hilly areas, for example, water is scarce, and access to drinking water is correlated with a person's defecation habits (Aprihatin et al., 2020). Food security and food diversity are affected by soil damage and depletion. Decreased soil quality causes food availability to decrease and plants become less nutritious, so children are at risk of experiencing malnutrition and inadequate nutritional intake. Each of these elements affects children's nutrition and overall health, which ultimately has an impact on stunting (Pradhan et al., 2023).

High levels of exposure to air pollution in the home and environment are placing stress on many children in India, potentially hindering their ability to grow linearly (Dimitrova et al., 2022). In Jakarta, air pollution is the cause of premature death, death due to disease, and death due to disability. This disease has a large correlation with lung cancer and other non-communicable diseases (NCDs), such as chronic respiratory and cardiovascular diseases.

The adverse impact on human health puts enormous pressure on the country's economy and health system with the increase in health insurance services based on dispersion structure analysis of health-related indicators (Akbar, 2023). It has been proven that there is a link between air pollution and children's health and development, and research shows that children are especially vulnerable to the effects of pollution on their organs. Stunting occurs more often due to the impact of air pollution. The lung development of children under five years is directly impacted by air pollution. Exposure to air pollution, especially particulate matter, can worsen inflammation and respiratory diseases, which in turn disrupts children's growth development and nutrition. The most dangerous air pollution, namely fine particulate matter (PM2.5), can disrupt the growth of young children's lungs, disrupting their ability to breathe and affecting their general growth and development. Air pollution increases the likelihood of respiratory illnesses such as pneumonia, which increases the risk of malnutrition and decreased nutrient absorption, all of which worsen stunting (Jolly et al., 2023).

The Conditionally Cash Transfer (CCT) programs are commonly utilized to alleviate poverty and inequality by placing conditions (also referred to as conditionality) between beneficiaries and the CCT program (Armand & Caneiro, 2018). Poor households are encouraged to promote good behavior in both education and health under these conditions (Carter & Enfield, 2019). When it comes to health requirements, compliance primarily affects the elderly, pregnant women, chronically ill people, and children. The main child health requirement that requires compliance is the postnatal clinic visit, which is required to be attended once a month, but at least six visits per year are considered compliance (Rukiko et al., 2023). Through immunizations and health and nutrition training for mothers, it supports the promotion of health care for children. These programs have been acknowledged to contribute to the improvement of child health and the reduction of health problems caused by malnutrition, including childhood growth retardation. A robust change analysis theory is necessary, but it remains a challenge to achieve this.

From the time children are young, health is one of the main measures of a country's well-being. Optimal levels of child health provide both short-term and long-term benefits. Immediate benefits include reducing the burden on health infrastructure, while long-term benefits ensure a better future and development in terms of increased social and economic capital (Vishwakarma et al., 2021). Inbreeding is a term used to describe marriages between blood relatives. Large parts of North Africa, Central Asia, West Asia, and South Asia are also common areas of inbreeding (Kaiser, 2016).

Although inbreeding is thought to increase the risk of child mortality due to carrying recessive genes (Dorsten et al., 1999; Saggar & Bittles, 2008), there has been no comprehensive research on how consanguinity affects children. Such studies of kinship tend to be limited by restricted samples, few results, or both. In addition, most of these studies do not control for non-random selection into kinship relationships.

In Indonesia, cases of protein-energy deficiency are one of the most common nutritional problems in young children. The stunting rate in East Nusa Tenggara is still high. According to the Indonesian Nutrition Status Survey 2021, stunting cases are still being reported in 15 districts of East Nusa Tenggara. Red status is characterized by regions where stunting affects more than 30% of the population. The 15 districts are South Central Timor, North Central Timor, Alor, Southwest Sumba, East Manggarai, Kupang Regency, Rote Ndao, Bel, West Manggarai, West Sumba, Central Sumba, Sabu Raijua, Manggarai, Lembata and Malacca.

Even in South Central Timor and North Central Timor, the prevalence is more than 46 percent. Meanwhile, the remaining seven districts and cities, including Ngada, East Sumba, Nagekeo, Ende, Sikka, Kupang City, and East Flores, are in yellow status with prevalence rates between 20 and 30 percent. Three areas are approaching red status, including Ngada, East Sumba, and Nagekeo. NTT does not have a single area with green status. This means that the prevalence of stunting ranges from 10 to 20 percent. Apart from that, blue status applies if the stunting rate is less than 10%.

Based on e-PPBGM records, the proportion of stunted babies in the NTT region has decreased since 2018. This value is far below the national and NTT averages which reached 30.8% and 42.6% respectively. Meanwhile, the proportion of weak and underweight babies has increased since 2018. However, the proportion of children with low birth weight has fluctuated between 2018 and 2022 and is still much higher than the national which was only 17.7 in 2018.

In this regard, customary law has its own rules that allow for blood-related marriages. As regulated by indigenous communities such as in Manggarai, East Nusa Tenggara. The *Ruteng Pu`u* indigenous people call such blood-related marriages "*Tungku*". Inbreeding "*Tungku*" is a Manggarai customary law that allows inbreeding. There are several types of "*Tungku*", namely as (a) *Tungku cu or tungku dungka* is an inbreeding between the children of the two siblings. In other words, *Tungku Cu* is a marriage between cousins, which is between children of siblings who still have one parent and still have one grandmother. (b) *Tungku neteng nara* is a marriage in which there is a blood relationship between the child of a female cousin and the child of a male cousin. (c) *Tungku anak rona musi* is a blood marriage with the family of the relatives of the giver of the Iaki-Iaki wife-in-law. This kind of blood marriage still has the application of paca (payment) but the *paca* set is a continuation of their parents' marriage; it is not too demanding.

Several complex factors, such as inadequate nutritional intake, limited infrastructure, and inbreeding, are the causes of stunting in East Nusa Tenggara (NTT) Province. Poor access to quality food and a lack of knowledge about the importance of nutrition for child development may be contributing factors to the high stunting rate in NTT. However, the lack of infrastructure in remote areas can make it difficult for locals to distribute nutritious food or reach their targets. In addition, inbreeding, which still occurs in many communities in NTT, can increase the risk of stunting by increasing the likelihood of genetic defects. Therefore, addressing stunting in NTT needs to be done through a combination of measures, such as improved infrastructure, increased access to nutrition education, and more sustainable marriage practices (Lapak et al., 2021).

2. Methods

The research was conducted using literature review research techniques. The literature research method includes a series of activities related to data collection, reading materials, documenting research results, and processing. This method was chosen because it considers the following functions: verifying the problem being investigated and highlighting the importance of understanding the problem or hypothesis being examined in the research. By doing this, the researcher can gain insight into the past of the problem.

Afterward, it provides an overview and considers the variables that will be used to achieve the researcher's goals. Therefore, the research is conducted in a specific direction and without any bias. Ultimately, this allows researchers to better understand the topic they are studying. Researchers can objectively evaluate the research topic in this way. Many publications related to the subject matter are used to collect data and narratives. Various theories and Models were used in similar studies, and this research adopted the Social Ecological Model (SEM).

2.1 Social Ecological Model (SEM) for stunting reduction in toddlers

Bronfenbrenner's approach, known as the Social Ecological Model (SEM), is a popular paradigm for comprehending and resolving complicated public health problems, such as child stunting. According to SEM, a complex web of interrelated elements that exist at several levels—individual, interpersonal, institutional, community, and policy—influence a person's health-related behaviors. Because stunting reduction has multiple causes and necessitates comprehensive interventions, this makes it extremely relevant. This theory focuses on various aspects including identifying risk and protective factors; and designing multi-level interventions

To identify risk factors and protective variables for toddler stunting, the model evaluates nutritional expertise, feeding skills, personal hygiene, and healthcare accessibility on an individual basis. The theory looks at interpersonal relationships regarding nutrition and hygiene, including family dynamics, caregiver behaviors, and social support networks. The model looks at community norms about child health, food security, accessibility to nutrient-dense foods, and water sanitation facilities. At the institutional level, it evaluates the standard and availability of childcare centers, health services, and instructional initiatives that support healthy lifestyles. Reviewing national and municipal policies on dietary guidelines, food fortification, maternal health, and early childhood development initiatives is the goal at the policy level.

SEM directs the creation of interventions that address several levels at once by comprehending the variables impacting behavior at each level. As an illustration at the individual level, namely educating and coaching caregivers on nutrition, encouraging sanitary habits, and supporting responsive feeding practices. At the interpersonal level through providing mothers with access to community-based support groups, encouraging societal norms surrounding healthy eating, and encouraging cooperation between families and healthcare professionals. At the community level, initiatives include creating community gardens to provide access to a variety of foods, enhancing access to clean water and sanitation, and encouraging local leaders to push for improved health services. Institutional level: bolstering health care networks to offer high-quality antenatal and postnatal care, promptly identifying and treating stunting, and incorporating nutritional counseling into regular physical examinations. At the policy level: Pushing for national laws that support breastfeeding, inexpensive, nutrient-dense foods, and maternal health; providing funding for early childhood development initiatives. Third, evaluation and monitoring, SEM places a strong emphasis on the value of ongoing observation and assessment. Interventions can be modified and enhanced for increased efficacy by monitoring shifts in risk and protective factors at various levels and their effect on the decrease of stunting.

3. Results and Discussion

Stunting and child development are major development foci, which are often studied and targeted as separate issues (Perkins et al., 2017). Initially, a critical review of research from different fields highlighted significant differences in the methods used to investigate the relationship between childhood stunting and child development. However, these differences make it difficult to distinguish learning outcomes. Current efforts to gather quantitative evidence on the relationship between stunting and child development should be viewed with caution and subjected to critical reflection. To address this issue, it would be beneficial to establish consistent methods for measuring and evaluating the impact of stunting on child growth.

While research has shown a correlation between childhood stunting and reduced development, there are still important questions to be answered despite differences in study design and outcome metrics. In terms of development, which parts of a child's development are more vulnerable and when? What is the relationship between stunting and development? How do they influence each other? Is it possible to reverse stunting? Due to knowledge gaps, we should be cautious before drawing general conclusions about the impact of stunting on child development. Further research using rigorous research designs will improve our understanding of important aspects of human capital formation.

Synergistic or additive effects may arise from improving various aspects of the early childhood environment that are important for child development. When designing integrated nutrition programs that consider both nutrition and psychosocial aspects, it is important to assess the impact of psychotherapy on child development and its long-term effects. Further investigation is needed to determine if the program is working. In addition, there should not be a one-size-fits-all approach to gross and fine motor development, cognition, and psychosocial development in the prenatal phase compared to the early

postnatal period. There is still a lot of uncertainty about what will happen after this period, especially regarding the potential for growth catch-up and its consequences. Various journals have researched stunting with various factors influencing the behavior of meeting nutritional needs in stunted children under five. Below are the results from some published journals.

Gizaw et al. (2022) revealed that environmental intestinal dysfunction, animal waste in the home, unexpected defecation, inadequate food intake, and drinking water sources can all contribute to stunting in children. The purpose of the study was to evaluate the relationship between enteric illnesses, EED, and poor sanitation in children ages 24-59 months living in rural northwest Ethiopia. Analytical observational research using a cross-sectional research design was the methodology used in this study. 224 randomly chosen toddlers between the ages of 24 and 59 months who lived in rural parts of the eastern Dembiya subdistrict made up the study's sample. The study's variables included inadequate food intake, unsanitary conditions, animal waste in the environment, open defecation, E. coli contamination of drinking water, intestinal parasites in children, and diseases associated with environmental enteric dysfunction (Gizaw et al., 2022).

To determine the prevalence and risk factors for stunting in children between the ages of 24-59 months in the Lemo area of Southern Ethiopia in 2021, Woldesenbet et al. (2023) conducted a study. Analytical observational research with a cross-sectional research design was the methodology used in the study. 415 toddlers who were selected at random made up the study's sample. The toddler's age, the mother's educational background, the accessibility of water, environmental sanitation, hygienic habits, open defecation, and instances of mothers not washing their hands before feeding their children were the variables in this study. According to research, there is a significant correlation between the incidence of stunting in toddlers and the mother's educational attainment, the availability of appropriate toilets, the unsafe disposal of children's waste, and the practice of mothers not washing their hands with soap after feeding their kids (Woldesenbet et al., 2023).

The causes of stunting can be described from the results above, concluded with several other literature as follows (Akram et al., 2023; Aprilia et al., 2022). First, inadequate food intake and the occurrence of disease infections. Second, inadequate food intake is caused by a household/family's lack of access to nutritious food and poor parenting practices. Third, poor parenting practices, including the mother's lack of knowledge regarding health and nutrition before and during pregnancy, as well as after the mother gives birth. 60% of children aged 0-6 months do not receive breast milk exclusively, and 2 out of 3 children aged 6-24 months do not receive adequate supplementary food with breast milk. Fourth, there is still a lack of household/family access to nutritious food. This is due to low family food security where families produce limited nutritious food ingredients. Apart from that, the price of nutritious food in Indonesia is still relatively high, which is also one of the causes of the lack of access to nutritious food according to several sources. Five, the lack of adequate health services, including ANC-Ante Natal Care (which provides maternal and child health support during pregnancy), postnatal care, and early education, persists. Child presence is low in Posyandu, children do not have adequate access to immunization services, pregnant women do not receive enough iron supplements, and access to quality early education services remains limited (Only 1 in 3 children aged 3-6 years old) registered with Early Childhood Education Services. Sixth, lack of a right of entry to clean water and sanitation. In Indonesia, one out of every five households experiences defecation in open spaces, and approximately 30% of them are deprived of clean drinking water.

For the administration of the health sector, especially mothers and children, the East Nusa Tenggara Provincial Government has issued Regional Regulation Number 1 of 2016 concerning the Implementation of Maternal and Child Health. This regional regulation generally regulates the provision of guaranteed guarantees and protection for the implementation of maternal and child health. The purpose of enacting this Regional Regulation is guaranteed access and quality of referral services; availability of affordable and quality referral facilities; handling of all mothers giving birth, cases of obstetric emergencies, and newborn babies; availability of competent health personnel; availability

of medicines, vaccines, and health supplies; achieving a reduction in maternal and child mortality; a change in community behavior in favor of Maternal and Child Health/*Kesahatan Ibu dan Anak* (KIA); and ensuring optimal growth and development of children according to their potential.

Maternal and child health is very important to pay attention to because it is an important factor in seeing the prevalence of stunting. To overcome this, the East Nusa Tenggara Provincial Government has also issued a Roadmap and Regional Action Plan for the Acceleration of Reducing Stunting and Maternal Mortality Rates/Infant Mortality Rates in East Nusa Tenggara Province as outlined in Governor Regulation Number 71 of 2022. The results of this analysis were compared with Presidential Regulation Number 72 of 2021 and BKKBN Regulation Number 12 of 2021. The results of the analysis can be seen in Table 2.

Table 2. Policy analysis of East Nusa Tenggara Province in alleviating stunting

Aspect Analysis based Presidential Regulation Number 72/2021 and BKKBN Regulation No. 12 of 2021	Central Policy	Existing Conditions of East Nusa Tenggara Province Policy	Implementation of East Nusa Tenggara Province Policy	Solution
Targets and Outputs (Output) Pillar 1 Commitment and leadership vision	Holding coordination meetings for a minimum of 1 year at the provincial level Availability of governor's policies/regulations regarding district/city authority in reducing stunting Budget for reducing stunting Establishment of Stunting Reduction Acceleration Team/*Tim Percepatan Penurunan Stunting* (TPPS) at the district/city level	Coordination meetings at the provincial level are held once every semester Governor's Regulation Number 71 of 2022 concerning Roadmap and Regional Action Plans for Accelerating the Reduction of Stunting and Maternal Mortality Rates/Infant Mortality Rates in East Nusa Tenggara Province The budget for handling stunting is 66 billion rupiah TPPS has been formed	Coordination meetings at the provincial level were not fully attended by all districts/cities Implementation of Governor Regulation Number 71 of 2022 has not been carried out according to target Budget absorption for handling stunting is still at 60% The TPPS that was formed has not been running optimally	Monitoring and evaluation under Bapperida District leadership needs to carry out regular monitoring and evaluation Budget refocusing as follows: Specific interventions aimed at approaching 25% Sensitive interventions are aimed at approaching 70% Coordination, mentoring, and technical support directed to + 5% Continuous socialization and assistance by the Provincial TPPS regarding the main tasks and functions of the Regency TPPS
Pillar 2 Targets and Outputs: Increased Communication, behavior change and community empowerment	Implementation of annual stunting prevention campaigns Coverage of households using improved drinking water sources	The stunting prevention campaign is coordinated by the Health Service and the Communication and Informatics Service	The campaign carried out has not had a big impact The quality of water consumed by the community is	Regular monitoring and evaluation from the Regency TPPS The sustainability of the program needs to be evaluated by the PUPR Service

	Coverage of groups of family beneficiaries (KPM) of the Family Hope Program (PKH) who take part in family capacity-building meetings Availability of trained assistants The role of religion in communicating behavior change to reduce stunting	Coverage of adequate drinking water sources reaches 86,79% and sanitation reaches 73,7% Coverage of beneficiary family groups/*Keluarga Penerima Manfaat* (KPM) of the Family Hope Program/*Program Keluarga Harapan* (PKH) reaches 64% Accompanying staff is available The role of religion has not been encouraged massively	not monitored regularly The aid funds received by the community are not used for proper nutritional consumption needs The accompanying staff does not meet the required qualifications Religious education already exists but does not touch stunting alleviation	It is necessary to ensure that the beneficiary is the right one Recruitment of accompanying personnel and strengthening the capacity of accompanying personnel Socialization, regular assistance by district, sub-district, and village TPPS
Targets and Outputs (Output) Pillar 3 Convergence of Specific Interventions and Sensitive Interventions in ministries/agencies, provincial Regional Governments, district/city Regional Governments, and Village Governments	Percentage coverage of Specific and Sensitive Interventions	All districts and cities have carried out specific and sensitive interventions	All specific and sensitive intervention activities do not provide an instant impact	Increased coordination and synchronization from the provincial to district, sub-district, and village levels, as well as other related OPDs (Ministry of Public Works and Public Housing/*Kementerian Pekerjaan Umum dan Perumahan Rakyat* (PUPR), Social Service/*Dinas Sosial* (Dinsos), Education Service/*Dinas Pendidikan* (Disdik), and Regional Development Planning Agency/*Badan Perencanaan Pembangunan Daerah* (Bapperida))
Pillar 4 Targets and Outputs increase food and nutritional security at the	Percentage of village coverage that implements KPRL	All districts and cities have implemented KPRL regulations	Area coverage of sustainable food houses has not yet reached 60%	The Provincial TPPS Team is improving program coordination and synchronization

individual, family, and community levels	(Sustainable Food House Area)			with the Food Security Service
Targets and Outputs (Output) Pillar 5 strengthening and developing systems, data, information, research and innovation	Monitoring and evaluating the acceleration of stunting reduction in districts/cities at least twice Availability of data on families at risk of stunting through the Family Information System (SIGA)	Routine monitoring and evaluation is carried out twice a year in conjunction with other programs Family Information System is available	Existing monitoring and evaluation does not monitor the overall reduction in stunting prevalence The existing Family Information System cannot be displayed periodically	Improved coordination, synchronization, evaluation, and monitoring functions by the Provincial TPPS Team Recruitment of permanent data input staff, The Provincial Working Group Team assists with data collection and processing Procurement of standardized measuring instruments

(Processed Results from the Roadmap and Regional Action Plan for the Acceleration of Reducing Stunting and Maternal Mortality Rates/Infant Mortality Rates in East Nusa Tenggara Province, 2023)

Stunting that occurs in a child under five will have a broad impact on his growth and development. If stunted toddlers are not given appropriate interventions such as inadequate nutritional intake, and inadequate parenting patterns, in an environment with poor health services, these toddlers will easily get sick, the risk of infection will increase, and ultimately will experience malnutrition and poor nutrition which causes Growth Faltering or failure to grow, so that later they grow into stunted teenagers. Malnourished toddlers have a three times higher risk of becoming stunted compared to toddlers with poor nutrition. As they grow, teenagers not only become stunted teenagers but also have micronutrient deficiency problems such as anemia. Adolescence is a period where the second phase of rapid growth occurs and prepares adolescents for the next period, namely adolescence, so they require adequate nutritional intake to meet the needs of this rapid growth.

If this stunted teenager is a woman, then this stunting process will continue after she becomes an adult woman of childbearing age who is also stunted, including when she becomes a pregnant woman who is also stunted and tends to remain stunted in old age. Healthy teenagers when they marry, become pregnant, and have children correspond to the maturity of their reproductive organs, so that they become healthy mothers who give birth to healthy children with optimal growth and development according to their potential.

This process will continue, mothers who are stunted and malnourished are at risk of suffering various complications during pregnancy and childbirth, including increased maternal mortality rates, having babies who are at risk of being born with low birth weight (LBW), and at risk of experiencing various complications. including asphyxia and neonatal sepsis are frequent causes of neonatal death in NTT. In the next process, babies with various complications, if they do not receive adequate nutritional intake, balanced parenting patterns, and health services that do not meet standards, will develop into stunted toddlers. This will be an endless "vicious circle" and will continue to happen in NTT. Stunting has long-term and short-term effects that greatly influence the generation and future of NTT, because it not only affects their health, but also growth and development also has a broad impact on the NTT economy in the future (Nadhiroh et al., 2023).

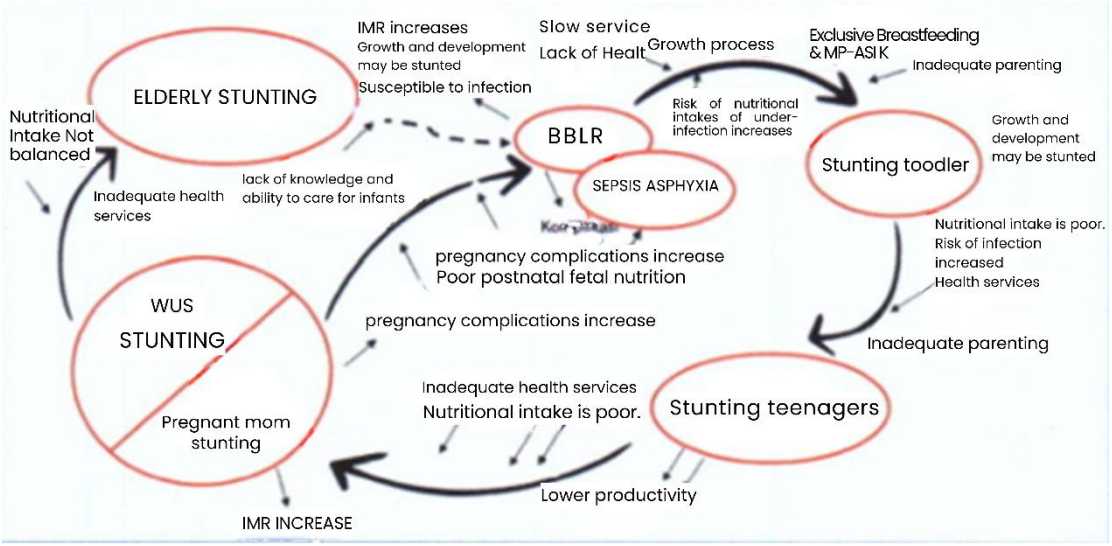

Fig 1. Cause and Effect Relationship between Stunting & IMR in NTT
(Roadmap and Regional Action Plan to Accelerate Reduction of Stunting and Maternal Mortality Rate/Infant Mortality Rate in East Nusa Tenggara Province, 2023)

For this purpose, alternative investment opportunities can generally be categorized as either nutrition-specific or nutrition-sensitive. The primary target is to eliminate the underlying factors that lead to malnutrition in undernourished babies and youngsters. Examples include micronutrient supplementation for pregnant women and children, promotion of optimal nutritional practices in breastfeeding and complementary feeding, and prevention and management. Nevertheless, nutritionists suggest that increasing the 10 most effective specific nutrition interventions by 90% in countries with the highest burden of malnutrition would only address 20% of the burden (Rukiko et al., 2023). The importance of strengthening nutrition-focused investments that tackle key causes of undernourishment, such as food insecurity and poverty, is increasing. This is needed. One example is food and agricultural policy. This can influence various determinants of malnutrition, including household income, food security, and food quality (Ruel et al., 2018).

In addition, viral diseases and environmental cleanliness are factors that contribute to stunting in children under five (Aprihatin et al., 2020), and inadequate sanitation can exacerbate this problem by spreading germs and ignoring hygiene standards, thereby increasing the possibility of disease—contagious which can cause stunting in children under five. Contaminated water, poor sanitation, and limited access to clean water can cause intestinal infections and diarrheal diseases, which can interfere with nutrient absorption and increase the risk of malnutrition. Nutrient absorption during digestion can be hampered by infectious diseases (such as diarrhea and worms) caused by poor hygiene and sanitation. Babies suffering from some viral disorders may experience weight loss. Stunting can occur if this disease lasts a long time and is not treated with adequate nutrition to help the healing process. Stunting can be caused by prolonged illness caused by vector-borne diseases such as malaria, which is spread by insects and impacts appetite and nutrient absorption. Children who do not have access to preventive care or health services may be more susceptible to infections and illnesses that hinder their development.

According to a study by Gizaw et al. (2022), children's nutrition and food access have an impact on the problem of stunting. According to the research, 19% of households in the study area experience severe food insecurity, which is 47% of all food insecure households. For children who consumed four or more food groups, the minimum diet score was 69 percent. The food groups most frequently consumed by people are grains, tubers, or tubers (97%); beans, legumes, or nuts (90%); and milk and milk products (74%). 33% of 224 children experienced stunting, of which 5% and 27% experienced severe and moderate stunting (Gizaw et al., 2022).

A study conducted by Woldesenbet et al. (2023) revealed several factors related to stunting in children. This includes children whose mothers throw their children's rubbish into the open; children living in homes without proper toilets; children living in families without access to clean water; children whose mothers do not wash their hands with soap and water; and children whose mothers have no formal education. According to the survey, 33.5 percent of children aged between 24 and 59 months experienced chronic malnutrition or stunting (Woldesenbet et al., 2023). Based on GWR analysis, research in 2021 revealed that only four factors including the number of poor people, level of education, number of health facilities, and access to health facilities were important in impacting stunting in children (Yudono et al., 2021).

Cash transfer programs through beneficiary families and family hope programs often do not reach their intended targets properly, creating inefficiencies in resource allocation. In alleviating stunting in East Nusa Tenggara, it was revealed that the cash transfer program still suffers from problems in identifying beneficiaries who need financial support. Factors such as technical incompetence, lack of accurate data, and lack of transparency can hinder the effectiveness of the program. This is not only detrimental to the beneficiaries who should be receiving assistance but also creates the potential for misuse and abuse of public funds. Therefore, serious efforts are needed to improve the design, implementation, and monitoring of cash transfer programs so that they can have a positive impact on their original purpose.

When compared to East Nusa Tenggara province, the Environmental Quality Index of East Nusa Tenggara province was 71.85 in 2021. The Environmental Quality Index of East Nusa Tenggara province is slightly above the National Environmental Quality Index. This shows that the environment of East Nusa Tenggara Province supports life in East Nusa Tenggara Province. In addition, with improved access to drinking water and sanitation, stunting should decrease further.

The role of people and science is crucial in overcoming stunting, especially in the context of improving children's nutrition and health. Humans as agents of change must understand the importance of a balanced diet, health care, and nutrition education to prevent stunting from an early age. In this case, science plays an important role in producing in-depth research and information on the factors that cause stunting, as well as effective intervention strategies. Considering that the Human Development Index of East Nusa Tenggara Province stands at 66.68 (BPS NTT, 2023), the population must first be built at the human level, starting with increasing awareness of the importance of schooling, accelerating school graduation, and improving accessibility to education.

By utilizing science, we can develop stunting prevention programs that are evidence-based and locally appropriate. In addition, knowledge of appropriate feeding practices and current medical approaches can guide communities and health workers in providing optimal care to children. Therefore, collaboration between people, science, and relevant institutions is necessary to create holistic solutions to address stunting and improve children's overall quality of life.

4. Conclusions

The findings of this study show that several factors influence the behavior of children under 5 years who are stunted in meeting their nutritional needs. Several environmental factors that are associated with the occurrence of stunting include the availability of clean toilets, the habit of washing hands with soap after feeding children, the presence of animal waste in the residence, environmental disorders of intestinal function, and sources of drinking water. Stunting in toddlers is also influenced by infectious diseases and environmental sanitation. The source of drinking water proved to be the most important aspect based on this systematic review. Research has revealed a significant association between inbreeding and stunting in children. Inbreeding has been shown to have both positive and negative impacts based on previous research. Neglect due to lack of proper nutrition results in poor health outcomes for children born from inbreeding.

It was also found that air pollution, food security, and climate change are variables related to this problem. Children under five years of age need appropriate interventions to combat stunting, including increased counseling, community education on health hygiene practices, clean and healthy behavioral practices that facilitate the creation of good environmental sanitation conditions and reduce the threat of infectious diseases originating from the environment, and an adequate diet. Monitoring and evaluation of cash transfers also need to be improved. This is because cash transfers such as the beneficiary family program and the family hope program have not significantly reduced the stunting rate. Beneficiary data collection must be carried out with a more measurable system. Officers who conduct data collection must be equipped with good social skills.

The level of regulation implementation in East Nusa Tenggara Province to reduce the prevalence of stunting is also not optimal. Starting from the implementation side of the regulations, the budget absorption side, and also harmonizing community access to water and sanitation. Although access to water and sanitation is already quite good, the supervision and evaluation level needs improvement. Therefore, we can intervene in the relationship between stunting and child development, just as we intervene in their growth in old age. The complex correlation of stunting with various aspects of child development provides a great opportunity to evaluate and refine interventions aimed at various interrelated factors in childhood. Overall, the role of humans to intervene in stunting reduction is closely related to scientific development. Not only infrastructure development should be pursued, but human development by increasing interest in education. Increasing the number of graduates from school and shortening the school-leaving period of the population will increase the population's time for further exploration and research to address stunting.

Acknowledgement
The authors gratitude goes to Dr. Herdis Herdiansyah and Dr. Sri Setiawati Tumuyu in the Human Life and Environmental Systems course for all the materials and discussion opportunities for the development of science.

Author Contribution
Conceptualization, S.E.F.S., and P.D.M.; Methodology, S.E.F.S.; Data Collection, S.E.F.S.; Data Curation, P.D.M.; Formal Analysis, S.E.F.S., and P.D.M.; Writing – Original Draft, S.E.F.S., and P.D.M.; Writing – Review & Editing, S.E.F.S., and P.D.M.; Supervision, S.E.F.S.; Final Editing, S.E.F.S., and P.D.M.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The authors declare no conflict of interest.

References

[BPS NTT] Badan Pusat Statistik Provinsi Nusa Tenggara Timur/ Central Statistics Agency of East Nusa Tenggara Province. (2023). *Infografis Indeks Pembangunan Manusia Provinsi Nusa Tenggara Timur.* Badan Pusat Statistik Provinsi Nusa Tenggara Timur. https://ntt.bps.go.id/indicator/26/46/1/-metode-baru-indeks-pembangunan-manusia-ipm-menurut-kabupaten-kota.html

Akbar, D. D. (2023). Pollution and stunting (Case study at DKI Jakarta). *Jurnal Pendidikan Bahasa, 10*(2), Oktober 2023. https://doi.org/10.36232/jurnalpendidikanbahasa.v10i2.4899

Akram, R., Sultana, M., Ali, N., Sheikh, N., Sarker, A.R. (2018). Prevalence and Determinants of Stunting Among Preschool Children and Its Urban–Rural Disparities in Bangladesh. *Food and Nutrition Bulletin, 39*(4), 521-535. https://doi.org/10.1177/0379572118794770

Aprihatin, Y., Barlian, E., Fatimah, S., Yanti, E., & Amaita. (2020). Impact of Environmental Sanitation and Infection Disease as a Determining Stunting Factor for Children. *Jurnal Kebencanaan, Geografi dan Pendidikan Geografi Sumatera, 4(*2), 209–211. http://sjdgge.ppj.unp.ac.id/index.php/Sjdgge/article/view/336

Apriliana, T., Keliat, B.A., Mustikasari, Primasari, Y. (2022). A contributing factor to maternal pregnancy depression is the occurrence of stunting in toddlers. *Journal of Public Health Research, 11*, 2738. https://doi.org/10.4081/jphr.2021.2738

Armand, A., & Carneiro, P. (2018). Impact evaluation of the conditional cash transfer program for secondary school attendance in Macedonia. *Impact Evaluation Report* (Report No. 69). International Initiative for Impact Evaluation (3ie). https://3ieimpact.org

Attanasio, O., Cattan, S., Meghir, C. (2021) Early Childhood Development, Human Capital, and poverty. *Annual Rev Econ. 14*. https://doi.org/10.1146/annurev-economics092821-053234

Barth-Jaeggi, T., Speich, T., Havugimana, C., Bayisenge, F., Kimenju, S., Omondi, W., Pasha, S.F., Islam, S., van Zutphen-Küffer, K.G., van den Berg, S., Barjolle, D., Pannatier, M., Prytherch, H. (2023). Nutrition transition, the double burden of malnutrition, and urbanization patterns in secondary cities of Bangladesh, Kenya, and Rwanda. *BMC Nutrition, 9*, 125. https://doi.org/10.1186/s40795-023-00782-1

Berhanu, A., Garoma, S., Arero, G., Mosisa, G. (2022). Stunting and associated factors among school-age children (5–14 years) in Mulo district, Oromia region, Ethiopia. *Sage Open Medicine.* https://doi.org/10.1177/20503121221127880

Carter, B., Roelen, K., Enfield, S., & Avis, W. (2019). *Social protection topic guide*. The Institute of Development Studies and Partner Organisations. https://hdl.handle.net/20.500.12413/14885

Chowdhury, M.H., Aktar, M.F., Islam, M.A., Khan, N.M. (2023). Factors associated with stunting status among under-5 years children in Bangladesh: Quantile regression modeling approach. *Children and Youth Services Review. 155,* 107199. https://doi.org/10.1016/j.childyouth.2023.107199

de Beer, H., 2012. Dairy products and physical stature: a systematic review and meta-analysis of controlled trials. *Economics & Human Biology 10,* 299-309. https://doi.org/10.1016/j.ehb.2011.08.003

Dieleman, J.L. (2020). Health sector spending and spending on HIV/AIDS, tuberculosis, and malaria, and development assistance for health: progress towards Sustainable Development Goal 3. *Lancet, 396,* 693–724. https://doi.org/10.1016/S0140-6736(20)30608-5

Dimitrova, A., Marois, G., Kiesewetter, G., Rafaj, P., Pachauri, S., KC, S., Olmos, S., Rasella, D., & Tonne, C. (2022). Memproyeksikan dampak polusi udara terhadap stunting pada anak di India—sinergi dan keseimbangan antara mitigasi perubahan iklim, pengendalian kualitas udara sekitar, dan akses memasak bersih. *Surat Penelitian Lingkungan, 17*(10). https://doi.org/10.1088/1748-9326/ac8e89

Dorsten, L. E., Hotchkiss, L., & King, T. M. (1999). The effect of inbreeding on early childhood mortality: Twelve generations of an Amish settlement. *Demography, 36,* 263–271.

Dror, D.K., Allen, L.H., 2011. The Importance of Milk and Other Animal-Source Foods for Children in Low-Income Countries. Food Nutr. *Bull, 32*(3), 227–243. https://doi.org/10.1177/156482651103200307

Dror, D.K., Allen, L.H., 2014. Dairy product intake in children and adolescents in developed countries: trends, nutritional contribution, and a review of association with health outcomes. *Nutrition Reviews, 72*(2), 68–81. https://doi.org/10.1111/nure.12078

Esen E, Çelik, Keçili, M. (2021). Economic growth and health expenditure analysis for Turkey: evidence from time series. *Journal of the Knowledge Economy, 13,* 1786-1800. https://doi.org/10.1007/s13132-021-00789-8

Fanzo, J., & Davis, C. (2021). The multiple burdens of malnutrition. In *Global food systems, diets, and nutrition* (Palgrave Studies in Agricultural Economics and Food Policy). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-72763-5_5

Gayawan, E., Egbon, O.A. (2023). Spatio-temporal mapping of stunting and wasting in Nigerian children: A bivariate mixture modeling. *Spatial Statistics. 58*. https://doi.org/10.1016/j.spasta.2023.100785

Gizaw, Z., Yalew, AW, Bitew, BD, Lee, J., & Bisesi, M. (2022). Stunting pada anak usia 24–59 bulan dan kaitannya dengan sanitasi, infeksi usus, dan disfungsi usus lingkungan di pedesaan barat laut Ethiopia. *Laporan Ilmiah, 12*(1), 1–11. https://doi.org/10.1038/s41598-022-23981-5

Haile, B., & Headey, D. (2023). Growth in milk consumption and reductions in child stunting: Historical evidence from cross-country panel data. *Food Policy, 118*, 102485. https://doi.org/10.1016/j.foodpol.2023.102485

Halkos, G., Gkampoura, E.C. (2021). Where do we stand on the 17 Sustainable Development Goals? An overview of progress. *Economic Analysis and Policy, 70,* 94–122. https://doi.org/10.1016/j.eap.2021.02.001

Headey, D., Hirvonen, K., Hoddinott, J., 2018. Animal Sourced Foods and Child Stunting. *American Journal of Agricultural Economics, 100*(5), 1302–1319. https://doi.org/10.1093/ajae/aay053

Headey, D., Hoddinot, J., Park S. (2016). Drivers of nutritional change in four South Asian countries: a dynamic observational analysis. *Maternal & Child Nutrition, 12*(S1), 210–218. https://doi.org/10.1111/mcn.12274

Headey, D., Palloni, G., 2019. Water, Sanitation, and Child Health: Evidence From Subnational Panel Data in 59 Countries. *Demography, 56,* 729–752. https://doi.org/10.1007/s13524-019-00760-y

Hermawan, D., Kurniasari, D., Sandayanti, V., Sari, N., Listyaningsih, E. (2023). Relationships of deworming drug consumption and animal protein intake with stunting. *Parasite Epidemiology and Control, 23.* https://doi.org/10.1016/j.parepi.2023.e00326

Iannotti, L., Muehlhoff, E., Mcmahon, D., 2013. Review of milk and dairy programs affecting nutrition. *Journal of Development Effectiveness, 5*(1), 82–115. https://doi.org/10.1080/19439342.2012.758165

Jolly, S.P., Chowdhury, T.R., Sarker, T.T., Afsana, K. (2023). Water, sanitation, and hygiene (WASH) practices and deworming improve the nutritional status and anemia of unmarried adolescent girls in rural Bangladesh. *Journal of Health, Population and Nutrition, 42*, 127. https://doi.org/10.1186/s41043-023-00453-8

Kaiser, J. (2016). When DNA and culture clash. *Science, 354,* 1217–1221. https://doi.org/10.1126/science.354.6317.1217

Lapak, M.M.M.M., Sendratari, L.P., Wirawan, I. G. M. A. S. (2021). Eksistensi Budaya Kawin Tungku Di Kalangan Pemuda Manggarai Kecamatan Cibal Nusa Tenggara Timur Sebagai Sumber Belajar Sosiologi Di SMA. *Journal Pendidikan Sosiologi,* 3(3), https://doi.org/10.1016/s2542-5196(19)30144-5

Lloyd, S., Bangalore, M., Chalabi, Z., Kovats, RS, Hallegatte, S., Ronberg, J., & Valin, H. (2019). Potensi dampak perubahan iklim terhadap stunting pada anak melalui pendapatan dan harga pangan pada tahun 2030: model tingkat global. *Kesehatan Planet Lancet, 3*(S1). https://doi.org/10.1016/s2542-5196(19)30144-5

Matingwina T. (2018). *Health, academic achievement, and school-based interventions*. Intech. https://dx.doi.org/10.5722/intechopen.764331

Ministry of Environment and Forestry. (2022). *Indonesian Environmental Status* https://ppkl.menlhk.go.id

Ministry of Health. (2022). *Indonesian Nutrition Status Survei*. https://layanandata.kemkes.go.id/katalog-data/ssgi/ketersediaan-data/ssgi-2022

Nadhiroh, S. R., Micheala, F., Tung, S. E. H., & Kustiawan, T. C. (2023). Association between maternal anemia and stunting in infants and children aged 0–60 months: A systematic literature review. *Nutrition, 115*, 112094. https://doi.org/10.1016/j.nut.2023.112094

Nefiodow L. (2014). Health: The economic growth engine of the 21st century. *ICU Manage Pract, 14*(4), 1–6. https://healthmanagement.org/c/icu/issuearticle/health-the-economic-growth-engine-of-the-21st-century-1

Oginawati, K., Yapfrine, S.J., Fahimah, N., Salami, I.R.S., Susetyo, S.H. (2023). The associations of heavy metals exposure in water sources to the risk of stunting cases. E*merging Contaminants, 9*. https://doi.org/10.1016/j.emcon.2023.100247

Perkins, J.M., Kim, R., Krishna, A., McGovern, M., Aguayo, V.M., Subramanian, S.V. (2017). Understanding the association between stunting and child development in low- and middle-income countries: Next steps for research and intervention. *Social Science and Medicine, 193*. https://doi.org/10.1016/j.socscimed.2017.09.039

Popkin, B.M., Corvalan, C., Grummer-Strawn, L.M. (2020). Dynamics of the Double Burden of Malnutrition and the Changing Nutrition Reality. *The Lancet, 395*(10217), 65–74. https://doi.org/10.1016/S0140-6736(19)32497-3

Pradhan, I., Pradhan, J., Kandapan, B. (2023). Caste-based analysis of multidimensional early childhood poverty in India: Patterns and determinants. *Children and Youth Services Review, 155,* 107220. https://doi.org/10.1016/j.childyouth.2023.107220

Raja, S., Sweeney, E., Mui, Y., Frimpong–Boamah, E. (2021). *Local Government Planning for Community Food Systems—Opportunity, Innovation, and Equity in Low- and Middle-Income Countries*. FAO.

Rekha, S., Shirisha, P., Muraleedharan, V.R., Vaidyanathan, G., Dash, U. (2023). Wealth inequalities in nutritional status among the tribal under-5 children in India: A temporal trend analysis using NFHS data of Jharkhand and Odisha states - 2006-21. *Dialogues in Health, 2*. http://dx.doi.org/10.1016/j.dialog.2023.100135

Ruel, M.T., Quisumbing, A.R., Balagamwala, M., 2018. Nutrition-sensitive agriculture: What have we learned so far? *Global Food Security, 17,* 128–153. https://doi.org/10.1016/j.gfs.2018.01.002

Rukiko, M.D., Mwakalobo, A.B.S., Mmasa, J.J. (2023). The impact of the Conditional Cash Transfer program on stunting in under five years poor children. *Public Health in Practice,* 6. https://doi.org/10.1016/j.puhip.3.100437

Saggar, A. K., & Bittles, A. H. (2008). Consanguinity and child health. *Paediatrics and Child Health, 18,* 244–249. https://doi.org/10.1016/j.paed.2008.02.008

Saif, S., & Anwar, S. (2023). Unraveling the South Asian enigma: concurrent manifestations of child anthropometric failures and their determinants in selected South Asian countries. *BMC Nutrition, 9*(120). https://doi.org/10.1186/s40795-023-00771-4

Sangalang, S.O., Prado, N.O., Lemence, A.L.G., Cayetano, M.G., Lu, J.L.D.P, Valencia, J.C., Kistemann, T., Borgemeister, C. (2022). Diarrhea, malnutrition, and dehydration

associated with school water, sanitation, and hygiene in Metro Manila, Philippines: A cross-sectional study. *Science of the Total Environment, 838*, 155882. http://dx.doi.org/10.1016/j.scitotenv.2022.155882

Sharma, N., Shastri, S., Shastri, S. (2023). Does urbanization level and types of urban settlements matter for child stunting prevalence in India? Empirical evidence based on nighttime light data. *Cities, 140*. https://doi.org/10.1016/j.cities.2023.104388

Spears, D., (2018). Exposure to open defecation can account for the Indian enigma of child height. *Journal of Development Economics, 146.* https://doi.org/10.1016/j.jdeveco.2018.08.003

Speich, C., Barth-Jaeggi, T., Musard, C., Havugimana, C., Nwokoro, C., Gakuba, E., Zamil, F., Sécula, F., Thönnissen, C., Six, J., Kraemer, K., van Zutphen, K.G., Sonnevelt, M., Tshering, P.P., Erismann, S., van den Berg, S., Winter, S., Johnson-Chadwick, V., Pannatier, M., Gavin-Smith, B., Barjolle, D., Prytherch, H. (2023). Nutrition in City Ecosystems (NICE): Protocol of a multi-sectoral development project to improve food and nutrition security of secondary city populations in Bangladesh, Kenya, and Rwanda. *Front Public Health 11*. https://doi.org/10.3389/fpubh.2023.1081535

Vishwakarma, D. Sharma, S.K, Puri, P. (2021). Linkages between consanguineous marriages and childhood stunting: Evidence from a cross-sectional study in India. *Children and Youth Services Review, 122.* https://doi.org/10.1016/j.childyouth.2021.105922

Williyanarti, P.F., Wulandari, Y., Nasrullah, D. (2022). Behavior in fulfilling nutritional needs for Indonesian children with stunting: Related culture, family support, and mother's knowledge. *Journal of Public Health Research. 11*(4), 1–5. https://doi.org/10.1177/22799036221139938

Woldesenbet, B., Tolcha, A., & Tsegaye, B. (2023). Water, hygiene and sanitation practices are associated with stunting among children of age 24-59 months in Lemo district, South Ethiopia, in 2021: Community-based cross-sectional study. *BMC Nutrition, 9*(1), 17. https://doi.org/10.1186/s40795-023-00677-1

Yudono, A., Purnomo, J., & Damayanti, R. (2021). Regresi Tertimbang Geografis Faktor Risiko Stunting di Kabupaten Malang, Indonesia. *Forum Geografi, 35*(1), 1–13. https://doi.org/10.23917/forgeo.v35i1.12273

Zaba, T., Conkle, J., Nyawo, M., Foote, D., Myatt, M., (2022). Concurrent wasting and stunting among children 6–59 months: an analysis using district-level survey data in Mozambique. *BMC Nutrition, 8*(1), 15. https://doi.org/10.1186/s40795-022-00508-9

Biography of Authors

Samuel Evan Firdaus, School of Environmental Science, Universitas Indonesia, Jakarta DKI 10430, Indonesia.

- Email: samuel.e@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Precious Daouglas Maulana, School of Environmental Science, Universitas Indonesia, DKI Jakarta 10430, Indonesia.

- Email: premaulana@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A