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Review

A Systematic Literature Review on the Role of Human Ecology Higher Education Institutions in Policy Development for Food and Nutrition Security in the Philippines

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Abstract

The issue of Food and Nutrition Security (FNS) in the Philippines has been exacerbated by the COVID-19 pandemic and persistent social, environmental and agricultural problems. To address this concern, the involvement of Higher Education Institutions (HEIs) is explored by reviewing the local policies in the Philippines. Applications and recommendations on how human ecology can address the complex problem of FNS were then noted. This systematic literature review used a framework synthesis approach wherein the Australian National University (ANU) Transdisciplinary Framework was used to check if the stated policies, applications, and recommendations were aligned with the framework components, which are interactive, integrative, change-oriented, systemic, context-based, and pluralistic. This transdisciplinary framework is expected to promote policy change and development related to FNS. After that, 38 articles were included in the review. Upon the review, no local policies fit all of the ANU Transdisciplinary Framework's components. Nonetheless, these policies mostly separately address food security and nutrition security. However, there are still no established responses to the concern of FNS as an integrated concept of food security and nutrition security. HEIs contribute to developing FNS-related policies by intensifying advocacy for integrating food and nutrition security and improving FNS-related research and programs.

Keywords— food and nutrition security, higher education institutions, policy, human ecology, framework synthesis review

1 Introduction

The concept of food and nutrition security integrates both the issue of food security and nutrition security to ensure good health and nutrition in the community. This can be made possible by acquiring sufficient food and clean water to maintain a healthy life, preventing disease development [1]. Food and nutrition security (FNS) focuses on sustaining the food supply and ensuring that the food produced is loaded with nutrients that address nutrient deficiencies [2]. FNS is composed of four (4) pillars identified as food availability, food access, food utilization, and food stability. First, food availability pertains to food supply concerning production, net trade, and stock levels [3]. Second is food access, which tackles the economic, physical, and sociocultural perspective of food resources, i.e., food prices, incomes, expenditure and markets [3]. Third, food utilization refers to feeding practices, food preparation, diet diversity, and food distribution [3]. The balance and stability of these three pillars refer to food stability, the fourth component of the FNS pillars [3].

In the Philippines, malnutrition was determined by looking at the prevalence of stunting, underweight, and wasting. As of 2019, about 29.0% of Filipino children are stunted, 19.0% are underweight and 6.0% are wasted [4]. Statistics that have improved since 2008 are still considered alarming and should be given significant attention from the public health sectors [5]. In addition, it could not be denied that this progress can be put at risk due to the late COVID-19 pandemic [6]. The COVID-19 pandemic increased the number of households experiencing food insecurity and malnutrition due to economic contraction brought by numerous restrictions, i.e., quarantine [6].

Furthermore, the pandemic caused a disturbance in food supply systems due to slower economic activity, which resulted in higher unemployment rates and increased poverty in different parts of the world [7]. This high unemployment rate resulted in difficulty in food acquisition because of decreased purchasing power among households. In the Philippines, different responses were made to adapt to heightened challenges in FNS during the pandemic, including the conduct of community pantries, the provision of subsidies, and the provision of food relief that the Philippine government quickly made. However, these responses did not address the nutritional perspective of the FNS concept, as some of the food provided during the pandemic was not fit for the nutritional needs of the people. Common food items in the food packs provided were canned foods and dry goods, i.e., instant noodles and instant coffee which are high in salt and sugar [8]. Additionally, the Department of Social Welfare and Development also admitted that they found difficulties in incorporating nutritious food in relief packages they provided during the pandemic [9].

The long-term interplay of climate change and agricultural problems also contributed to the country's FNS concern [10]. The Philippines is vulnerable to disasters, i.e., typhoons, droughts, volcanic eruptions etc., that have been exacerbated by climate change and have impacted the FNS situation in the country [6]. These disasters disrupt food production through damage to agricultural lands, affecting the national food supply [10]. Aside from this, climate change is also implicated in producing less nutritious food due to high carbon dioxide levels being deposited in the soil, causing the crops to lose their minerals and protein content [11].

To address the country's FNS concern, several policies and interventions are being implemented by the national government and local government units (LGUs). Higher Education Institutions (HEIs) are known to influence the creation and implementation of policies related to FNS. HEIs are important players in solving FNS-related problems by offering training and bachelor courses on Food Science, Food Technology, and Nutrition and conducting research that guides policymakers [12]. Sapitula [13] noted that various modalities and strategies by local State Colleges and Universities (SUCs) could become instruments in formulating options to solve food security. However, as suggested in the definition of FNS earlier, food security differs from FNS. Currently, few to no local studies in the Philippines tackle how local HEIs can potentially help in policy development to solve the food security and nutrition security problems at the same time [14, 15]. Human ecology, as an approach, can explore the human-environment systems that sustain FNS by providing frameworks

for policy development [16]. Currently, four (4) human ecology HEIs in the country can potentially contribute to policy development regarding FNS concerns (Figure 1).

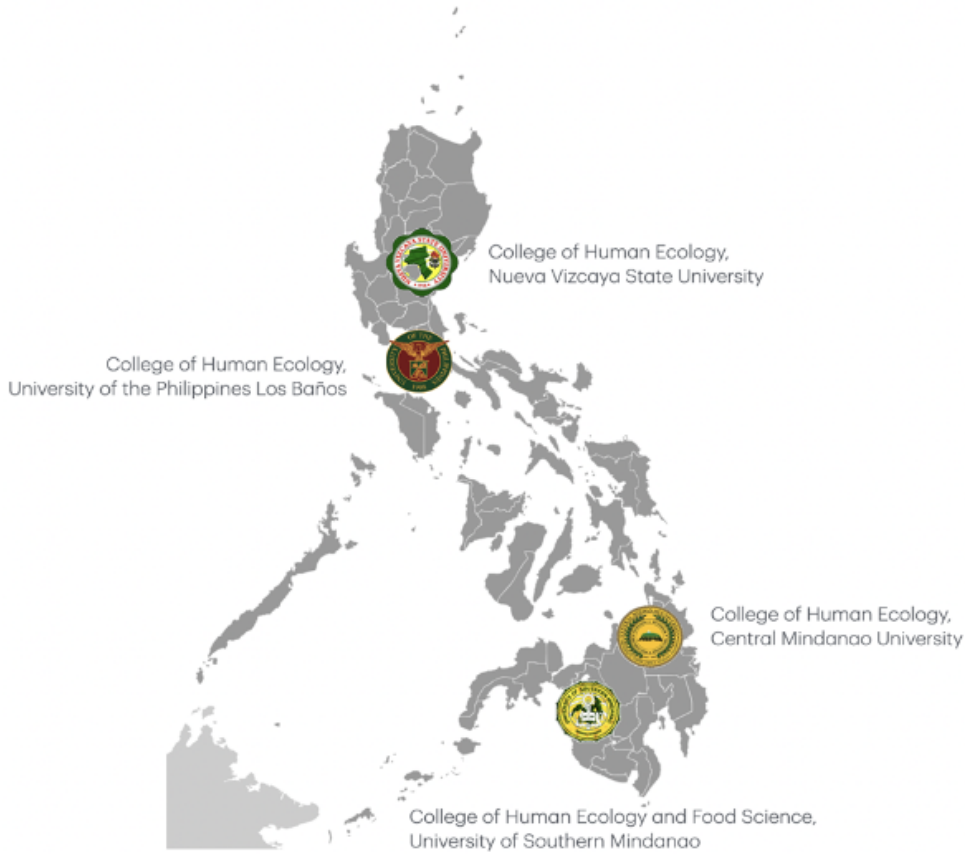

Figure 1.
State College Universities (SUCs) with College of Human Ecology

This systematic literature review was done to examine how HEIs can potentially address the problem of FNS through the use of human ecology in policy development by answering the following objectives:

(1) What are the existing policies related to FNS in the Philippines?
(2) How do human ecology HEIs help influence policy development promoting FNS?
(3) How can we improve the role of human ecology HEIs in addressing challenges to FNS?

2 Methodology

2.1 Research Design

The study utilized a systematic literature review (SLR) to answer its objectives. The framework synthesis approach was used to analyze the data from various articles to determine existing policies addressing FNS-related problems in the Philippines. The framework synthesis processes used in this study were aligned with the study of Brunton [17], albeit adopted with some modifications (Figure 2). The framework synthesis approach is a pragmatic and flexible approach where existing framework components are used for policy mapping and analysis [18]. Different studies have used framework synthesis, including the effect of political commitment and nutrition [19]. The

main goal of the framework synthesis is to organize the information according to the framework components used in a study. For example, in the study of Baker [19], the data gathered were aligned to five (5) components synthesized by the authors by integrating different theories and frameworks. The integrated framework used in the study of Baker [19] was known as power of actors, political and societal contexts, framing, issue characteristics, and capacities and resources in which these components have their factors that will serve as a basis for data organization.

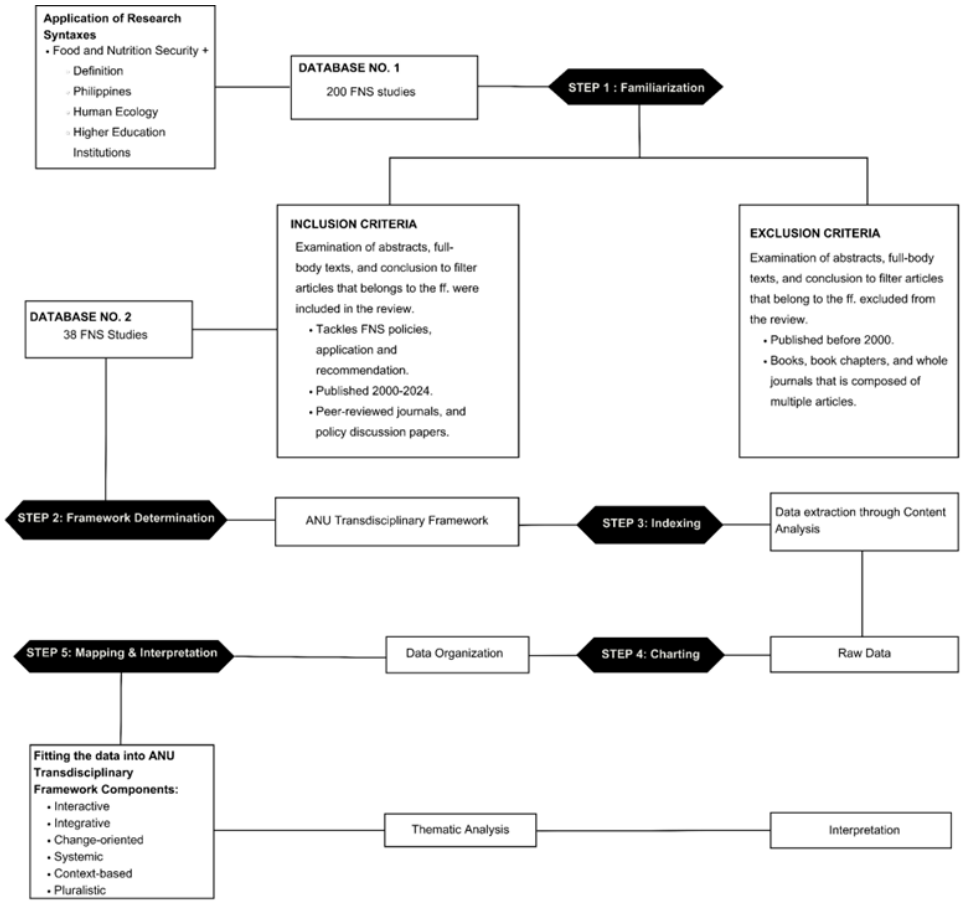

Figure 2.
Framework Synthesis Approach. Adopted from Brunton [17] with some modifications.

In this research, the transdisciplinary framework of the Australian National University (ANU) was used as the reference framework for the review (Figure 2) [20]. This framework comprises six (6) components: interactive, integrative, change-oriented, systemic, context-based and pluralistic. This framework provides a perspective where different disciplines are integrated to address complex societal problems like FNS which can endorse policy change and development [20].

This concept can be seen in the study of Mitrano [22], where transdisciplinary problem-solving was used to explain the issue of plastic pollution. This application of transdisciplinary problem-solving involves people across multiple disciplines, including policymakers. This is a way of making connections that can influence policy decisions concerning plastic pollution [22]. In addition, research [21] demonstrates the utilization of the ANU Transdisciplinary Framework in a case study of identifying challenges and problems within a university to provide a better understanding which can further promote policy improvements [21].

On the other hand, this study similarly utilized the ANU Transdisciplinary Framework with Baker's study [19]. This starts with organizing the policies that have been gathered into the components of the ANU Framework. This allowed each component to tackle different perspectives on

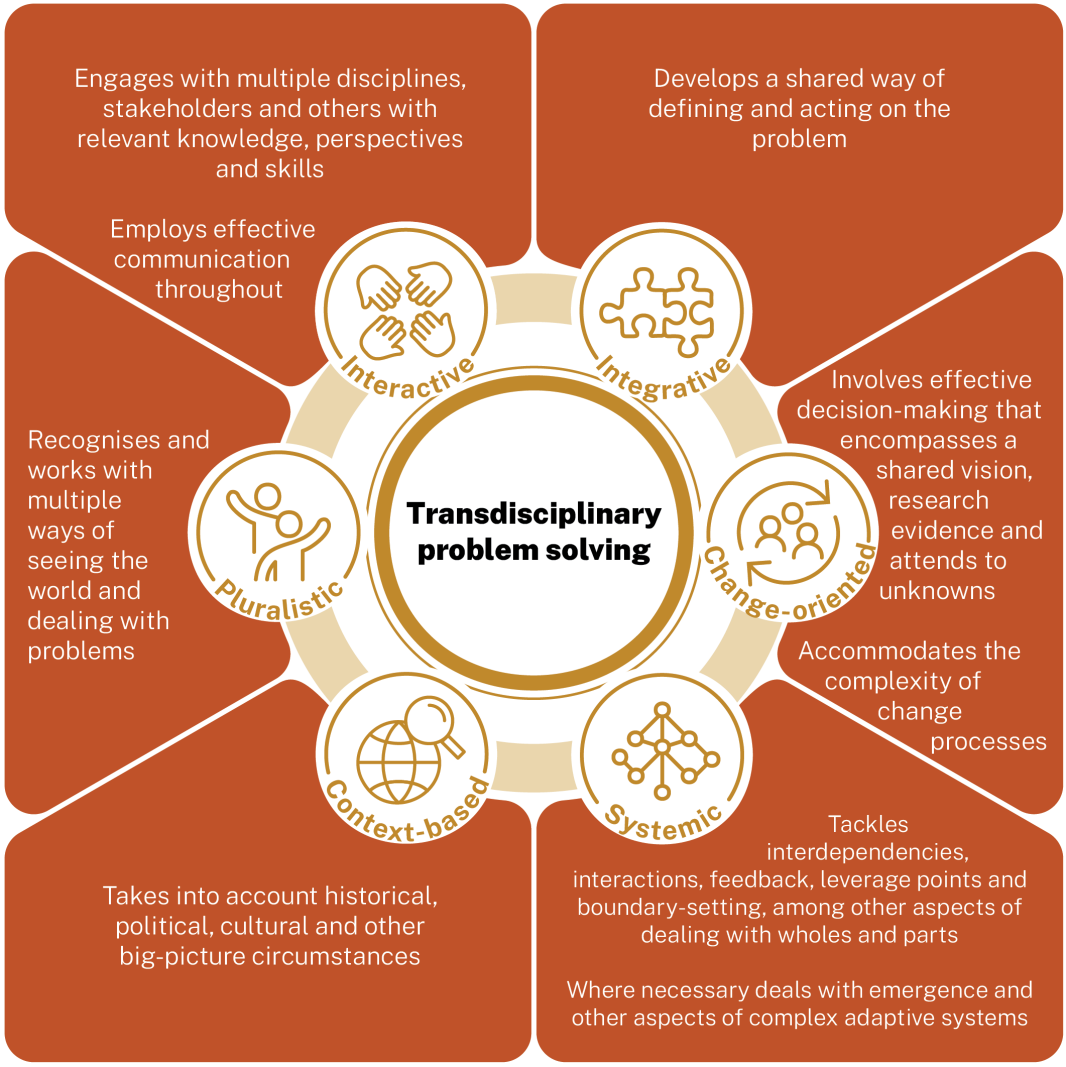

Figure 3.
ANU Transdisciplinary Framework. Design credit: The figure was designed by Alice Wetherell from the Population Health Exchange (PHXchange) in the National Centre for Epidemiology and Population Health at ANU. Republished from Bammer [21] under CC-BY-ND-NC-4.0

existing FNS-related local policies. The definition of each component in the ANU Transdisciplinary Framework in application to the characteristics of FNS-related policies is displayed in Table 1.

Stages of framework synthesis (Figure 3) were followed in doing this SLR, which are composed of (1) familiarization, (2) framework selection, (3) indexing, (4) charting, and (5) mapping & interpretation [17]. Overall, this SLR provided an overview about the existing policies and identified areas of improvement through the application of human ecology by aligning the existing policies to the framework components of the ANU Transdisciplinary Framework.

2.2 Data Collection

Before the first stage of framework synthesis, the research syntaxes to search the articles were determined first. In this study, four (4) research syntaxes were identified to search for articles in Google Scholar. These four (4) research syntaxes explore the FNS in its definition, its situation within the Philippines, its interrelation with human ecology and the influence of HEIs regarding policy development. There are four syntaxes used in the study: (1) FNS definition, (2) FNS Philippines, (3)

Table 1. Topics Covered per ANU Framework Component with modifications from Bammer [21]

Terms	Definition
Interactive	Participation and engagement of different disciplines (educational, political, social etc., in developing such policies
Integrative	Answers how the policy is fit to address the FNS issue through integrating it to the different definitions of FNS
Change-oriented	Factors that were considered in making such policies and how they are transformed by the existing policies
	Process of adaptation of the community when the policies became implemented.
Systemic	Consideration and connection of the policies to the food systems such as food accessibility and food prices
Context-based	Consideration and connection of the policies to culture, environment, & economy of the community covered by such policies
Pluralistic	Relevance of policies to different views and values such as ethnic groups, religion who have specific beliefs when it comes to food and diet

FNS human ecology, and (4) FNS higher education institution (HEI). Data extraction happened on the 3rd of June 2024 where 200 studies were included in the database. These 200 studies came from the ten (10) documents comprising each page on Google Scholar. A total of five (5) were used for each syntax. Most of these are qualitative studies that tackle the four research syntaxes. Google Scholar was chosen as the search engine because studies can be accessed for free. All of these studies were encoded in Google Sheets, including their title, abstract, citation, and link to the copy of the entire paper.

In the familiarization stage of the framework synthesis, encoded studies in the datasheet were analyzed, from the title to the abstract and then to the entire paper. The title, abstract, and full paper were assessed and checked to see if they fit the study's inclusion criteria. If the study title did not fit the provided inclusion criteria, it was immediately excluded from the review. Inclusion criteria included studies published after 2000 to 2024, written in English, and tackled FNS from the perspective of policies, challenges, and human ecology. Studies that were reviewed were peer-reviewed journals and policy papers. Book and book chapters were excluded.

With framework determination, the authors agreed to use the ANU Transdisciplinary Framework. The components of the ANU Transdisciplinary Framework served as a basis for organizing the different FNS-related policies gathered from the review. Table 1 served as a guide in aligning policies with each ANU Transdisciplinary Framework component.

Following the framework determination, data extraction was the indexing stage based on the framework synthesis stages. Significant data from shortlisted articles were extracted at this stage, especially regarding the studies' policies. In the indexing stage, a review guide with questions was used to note the data that went under thematic analysis whereas the data was analyzed.

2.3 Data Processing and Data Analysis

The last two stages of framework synthesis comprise the data processing and data analysis stages. Charting, the fourth stage of the framework synthesis involves the organization of data extracted during the indexing stage. The data was mapped according to the ANU Transdisciplinary Framework during the last stage. Consequently, the data was then subjected to thematic analysis and interpreted.

2.4 Discussion

Following the familiarization stage, 38 studies were short-listed from the 200 initial studies. Studies that are included in this review can be seen in Table 2. These studies discuss either of the following: policies, application of human ecology, and recommendations to improve the use of human ecology in solving FNS related concerns. Local policies went under the indexing stage, which is matched in the ANU Transdisciplinary Framework's components as displayed in Supplementary Material Table S1. Aside from local policies, the application and recommendations extracted from the studies concerning policy development and improvement aligned with the ANU Transdisciplinary Framework's components. Thereafter, the gathered data were organized, thematized, and interpreted.

Table 2. Overview of the FNS related documents included in the review

Author (Year)	Title	Code
Aclaro-Naranjo, Mana-ay, Honculada-Genove, & Entea (2018) [23]	Nutrition Intervention as Service Learning: Silliman University's Indigenous Food Security in Philippine High Risk Calamity Areas	A1
Angeles-Agdeppa (2002) [24]	Food and nutrition security and poverty alleviation in the Philippines	A2
Berry, Dernini, Burlingame, Meybeck, & Conforti (2015) [25]	Food security and sustainability: can one exist without the other?. Public health nutrition	A3
Capanzana & Aguila (2020) [26]	Philippines case study: government policies on nutrition education	A4
Cistulli, Rodríguez-Pose, Escobar, Marta, & Schejtman (2014) [27]	Addressing food security and nutrition by means of a territorial approach	A5
Davila (2018)	Human ecology and food systems: Insights from the Philippines	A6
Davila, Dyball, & Amparo (2018) [28]	Transdisciplinary research for food and nutrition security: Examining research-policy understandings in Southeast Asia	A7
Dioula, Deret, Morel, Vachat, & Kiaya (2013) [29]	Enhancing the role of smallholder farmers in achieving sustainable food and nutrition security	A8
Dyball, Davila, & Wilkes (2020) [16]	A human ecological approach to policy in the context of food and nutrition security	A9
El Bilali, Callenius, Strassner, & Probst (2019)	Food and nutrition security and sustainability transitions in food systems	A10
Esteban (2015)	Achieving Food Security: Policy Lessons from the Philippines	A11
Galang (2022) [30]	Is Food Supply Accessible, Affordable, and Stable?: The State of Food Security in the Philippines	A12
Govender, Pillay, Siwela, Modi, & Mabhaudhi (2017)[31]	Food and nutrition insecurity in selected rural communities of KwaZulu-Natal, South Africa—Linking human nutrition and agriculture	A13

Continuation of Table 2

Author (Year)	Title	Code
Heidhues, Atsain, Nyangito, Padilla, Ghersi, & Vallée (2004) [32]	Development strategies and food and nutrition security in Africa: An assessment	A14
Holmer, Miso, & de Lima (2013) [33]	Community-based vegetable gardens in rapidly urbanizing areas of the Philippines: impact on gender equity and food and nutrition security	A15
Honculada-Genove (2020) [34]	Nutrition security through sustainable home garden food production initiatives	A16
Javier, Malabad, Maniego, Sumangue, & Duante (2022) [35]	Determinants of the Youth's Nutritional Status in Selected Areas in the Philippines and Opportunities for Program Development and Engagement	A17
Jideani (2020) [12]	Research, development and capacity building for food and nutrition security in sub-Saharan Africa	A18
Keatinge, Yang, Hughes, Easdown, & Holmer (2020) [36]	The importance of vegetables in ensuring both food and nutritional security in attainment of the Millennium Development Goals	A19
Machado, Gabriel, Soar, Neves, & Oliveira (2020) [5]	State Plan for Food and Nutrition Security: potentialities and limitations	A20
McDermott, Aït-Aïssa, Morel, & Rapando (2011) [37]	Agriculture and household nutrition security—development practice and research needs	A21
McMichael (2018) [38]	Integrating nutrition with ecology: balancing the health of humans and biosphere	A22
Nordin, Boyle, & Kemmer (2013) [39]	Position of the Academy of Nutrition and Dietetics: Nutrition security in developing nations: Sustainable food, water, and health	A23
Palanog, Calayugan, Descalsota-Empleo, Amparado, Inabangan-Asilo, Arocena, ... & Swamy (2005) [40]	Zinc and iron nutrition status in the Philippines population and local soils	A24
Pangaribowo, Gerber, & Torero (2013) [41]	Food and nutrition security indicators: a review	A25
Pousga, Bello, Francis, & Boly (2019) [42]	Assessing Food and Nutrition Training in Burkina Faso Using the 'Auditing Instrument for Food Security in Higher education (AIFSHE)	A26
Qureshi, Dixon, & Wood (2013) [43]	Public policies for improving food and nutrition security at different scales	A27
Ramachandran (2018) [44]	Food & nutrition security: Challenges in the new millennium	A28
Rola, Ranola, Macandog, & Rola (2015) [9]	Technological and institutional challenges to food security in the Philippines	A29

Continuation of Table 2

Author (Year)	Title	Code
Savoie-Roskos, Hood, Hagedorn-Hatfield, Landry, Patton-López, Richards, ... & Mann (2013) [45]	Creating a culture that supports food security and health equity at higher education institutions	A30
Sidaner, Balaban, & Burlandy (2014) [46]	The Brazilian school feeding programme: an example of an integrated programme in support of food and nutrition security	A31
Simelane & Worth (2013) [47]	Food and nutrition security theory	A32
Solon (2020) [48]	Food fortification in the Philippines: Policies, programmes, issues, and prospects	A33
Solon (2006) [49]	Good governance for nutrition in the Philippines: elements, experiences, and lessons learned	A34
Talukder, Haselow, Osei, Villate, Reario, Kroeun, ... & Quinn (2006) [50]	Homestead food production model contributes to improved household food security and nutrition status of young children and women in poor populations. Lessons learned from scaling-up programs in Asia (Bangladesh, Cambodia, Nepal and Philippines)	A35
Tirado, Cohen, Aberman, Meerman, & Thompson (2010) [51]	Addressing the challenges of climate change and biofuel production for food and nutrition security	A36
Walls, Johnston, Tak, Dixon, Hanefeld, Hull, & Smith (2018) [52]	The impact of agricultural input subsidies on food and nutrition security: a systematic review	A37
Zamora, de Guzman, Saguiguit, Talavera, & Gordoncillo (2013) [53]	Leveraging agriculture to improve nutrition in the Philippines	A38

End of Table

3 FNS-Related Policies in the Philippines

3.1 Interactive

This section enumerates policies involving the collaboration and interaction of different government agencies and institutions. An example of this is the creation of different councils assigned to formulate and implement the policy related to FNS.

For instance, Executive Order No.86 s. 1999 (EO86 s. 1999) created the National Council on Food and Council of Food on Security, which was assigned to implement the FNS-related policies [31]. Similarly, Executive No.101 s. 2020 (EO101 s. 2020) crafted the National Food Policy to end hunger, achieve food security, improve nutrition, and sustain agriculture [31]. In addition, science-based approaches to improving agricultural knowledge, production, and resources were explored by small-scale farmers, farmers organizations, and scientists through *Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura* (MASIPAG) to prioritize the needs of the Filipinos [53]. Aside from these collaborations, various seminars and workshops were also conducted to address the FNS issue in the Philippines. An example is the *Kasapatan at Ugnayan ng Mamamayan sa Akmang Pagkain at Nutrisyon* (KUMAIN). KUMAIN was held to enhance awareness and collaboration between government agencies, private sectors, civil society groups and development partners [31].

This interaction of government agencies and communities brought interactive policies, pro-

grams, and projects that address the problem of FNS in the Philippines. The Social Reform and Poverty Alleviation Act (RA 8425) aimed to improve the FNS situation through social services, promotion of growth, income, and employment of Filipinos by providing services related to science, technology, and social science [24]. RA 8425 was meant to help the marginalized to alleviate financial burden which hinders achieving FNS. The alleviation of financial burden addresses the problem of poverty which is considered a major cause of food insecurity and further malnutrition concerns [54]. In relation to this, the Philippine Plan of Action was released through Presidential Decree No. 491 (PD 491), which prioritizes nutrition as the primary concern of the government [49]. This led to the government's development of programs and projects concerning food and nutrition security through improving agricultural production, fortification programs, micronutrient supplementation, food assistance, and nutrition education [47]. With these, LGUs coordinated with the local agricultural sectors and farmers to distribute farm inputs, e.g., fertilizer, seeds, and pesticides and check and improve agricultural infrastructures. Aside from this, assistance is also provided, both in-kind and financially, to support the farmers in ensuring a food supply [9, 33, 34, 53, 55].

Likewise, LGUs also engaged with health institutions wherein Barangay Nutrition Scholars were created according to Presidential Decree No. 1569, known as Barangay Development Approach for Nutrition Improvement of Rural Poor (PD 1569). Under this law, indigenous workers were provided with various trainings, including their being instruments for the implementation of nutrition-related programs at the Barangay Level [18, 26]. Health institutions also promoted breastfeeding by conducting informative lectures and seminars highlighting the importance of breastfeeding to infants due diligence to Executive Order 51 s. 1986, which is known as National Code of Marketing of Breastmilk Substitutes, Breastmilk Supplements and Other Related Products (EO 51 s. 1986) and "The Rooming-In and Breastfeeding Act of 1992" (RA 7600) [49].

On the other hand, HEIs also hold FNS-related projects and programs in their locality. Examples of these are Nutrition and Food Security Program (Siliman University), Allotment Garden Program of Cagayan De Oro City (Xavier University), and Service-Learning Project (Siliman University) [23, 33, 35]. SUCs have also contributed to training agricultural skills to increase farm productivity and improve farm management under *Sanayan sa Kakayahang Agrikultura* (SAKA) [35].

3.2 Integrative

Existing challenges in FNS are complex, especially in fast-growing urbanization and modernization [16]. An integrated approach to addressing these challenges is listed in this section. This starts with the science and technology approaches in addressing the concern of FNS. Here, integrated policies are described where different disciplines such as science, media, economics etc., are used to address the FNS concern.

The production of genetically modified crops (GMOs) was seen as a means to potentially improve food production together with the nutritional properties of food by continuous development and application of genetic engineering [56]. Fortification programs under Agriculture and Fisheries Modernization Act (RA 8435), Food Fortification Program of the Philippines (RA 8976), and Salt Iodization Law (RA 8172) are well-known science-integrated approaches in addressing nutritional perspective of FNS [49]. This involves the incorporation of micronutrients such as vitamin A, iron, iodine, thiamine, and riboflavin into Filipino food staples such as rice, flour, pandesal, salt, margarine and chip snacks by the *Sangkap Pinoy* Program. This addition of micronutrients tends to address the "hidden hunger" or micronutrient deficiency in the country [48]. Fortified foods are used in government feeding programs in schools under the Department of Education (DepEd) under *Masustansyang Pagkain para sa Batang Pilipino* (RA 11037) [26]. Science-integrated approaches do not only apply to diet modification but also to agriculture. The use of organic fertilizers is highlighted in a private initiative called "Bio-Intensive Gardening" which aims to promote sustainable agriculture

without compromising the environment [53].

Entrepreneurship also supports farmers by directly procuring their harvest by providing market access like KADIWA, conceptualized by the Department of Agriculture under *Sagip Saka* Act [31]. The Comprehensive Agrarian Reform Program (CARP) also offers basic services like equitable land access for farmers to become self-reliant entrepreneurs [9]. Aside from this, FNS is also being integrated with education systems by conducting school feeding programs, developing materials for nutrition education, and using media materials like radio programs and magazines to inform the community about FNS [26, 53]. Similarly, the conduct of nutrition-related programs in DepEd public schools is covered by PD 491 through the Accelerated Hunger and Mitigation Program (AHMP), school nutrition program, HAPAG-ASA Integrated Nutrition Program and RA 11037 [26, 30, 46, 53]. These programs enable educators and students to relate food security to nutrition security [26, 30, 49, 53].

At the barangay level, the integration of governance and FNS policy was evident in PD 1549, which allowed indigenous workers to be Barangay Nutrition Scholars to aid in implementing nutrition-related programs at barangay level [26, 48]. Home economics was also used as a way of addressing persisting FNS problems in the country through home and community gardening, animal farming, livestock production, creation of improved nutritious recipes composed of locally available vegetables or herbs, cooking demonstrations, and food preservation to address the FNS problem after natural calamities [23, 33, 34, 48, 49].

3.3 Change-Oriented

Addressing the different needs of the community that affect the FNS status should also be covered by the FNS-related policies. For example, to address the community's need for manpower to implement nutrition-related programs, community members can respond to community needs by becoming Barangay Nutrition Scholars through PD 1569 [26, 48]. Meanwhile, for economic needs of the family, enabling the members of the community to have a sustainable livelihood along with improving their FNS status is considered a change-oriented policies.

KADIWA markets help the farmers sell their products, benefiting producers and consumers. Products sold in the KADIWA markets have relatively lower prices than in public markets. This is because the KADIWA products are directly bought from the farmers [31]. Likewise, the Comprehensive Livelihood and Emergency Employment Program (CLEEP) under Executive Order 776 s. 2009 (EO 776 s. 2009) includes *Gulayan ng Masa* Integrated Services for Livelihood Advancement (ISLA). These programs serve as an instrument for the improvement of the economic status of Filipino fisherfolks [53]. Furthermore, financial assistance provisions can also contribute to the economic status of Filipino families, as stated in Sustainable Livelihoods through Cooperatives, RA 8425, and RA 8435 [9, 24, 30, 48]. SAKA can also be considered a change-oriented policy because it supports the out-of-school youth in pursuing FNS-related business ventures after discovering a high prevalence of malnutrition among the youth [35].

In addition, farmer needs were also one of the important considerations in policy development. Strengthening farmer support services improves food and nutrition security because they can be considered potential producers of nutritious food [4]. Farmer support can be expressed by improving agricultural infrastructure like irrigation systems, handing in formal land entitlements, income increase, insurance protection assistance and funding for farm inputs, research for development of farm technologies, and providing training to enhance their agricultural skills and farm management. Local policies that cover the stated farmer support are SAKA, *Sagip Saka* Act, MASIPAG, Productive Capacity Improvement of Civil Society Groups in the Philippine Agriculture Sector and Establishment of Safety Net Measures against Volatile Prices, Masagana 99, CARP, Credit Programs for Farmers, Philippine Crop Insurance Program, Food Staples Sufficiency Program, Magna Carta of Small Farmers, Rice Sufficiency Program, and Rural Farm Schools Act (RA 1068) [9, 31, 35, 48,

53, 55]. These policies tend to provide support for farmers to give them capability to produce a sustainable supply of nutritious food for the country. However, despite the promising components of these policies, agriculture remains stagnant because of the slow growth of factors that affect food production. Thus, the government should seek solutions to achieve long-term productivity through research and development [57].

On the other hand, nutritional needs according to the preferred diet of the community are also addressed by change-oriented FNS policies. *Operation Timbang* and EO 776 s. 2009 identifies the localities and individuals needing nutritional interventions to improve their nutritional status [53]. Recommended and limited food consumption according to Filipino diet needs are also included in addressing the community's nutritional needs. For example, fortification programs such as RA 8172 and RA 8976 [40, 48, 53] are crafted to address the prevalence of micronutrient deficiency. Fortified foods from these programs are used in school feeding programs under RA 11037 and School Nutrition Programs [40, 48, 53]. Micronutrient deficiency was also addressed by providing micronutrient powder supplementation to prevent the 5-year-old and maternal mortality rates, aligning with the aim of revised standards for child growth [40]. Breastfeeding was promoted to sustain the infant's diet by providing all the nutrients that the infant can attain through the consumption of breastmilk [48]. Along with this, the limitation on consumption of sugary beverages due to implementation of Tax Reform for Acceleration and Inclusion Law (RA 10963) helps to decrease lifestyle-related diseases such as obesity and diabetes [26]. Programs and policies to meet society's nutritional needs are still profoundly rooted in PD 491 [48].

3.4 Systemic

Food systems affect food and nutrition security in terms of accessibility and availability. The systemic relationship between how food production affects food prices and how the prices influence the quality & food consumption of Filipinos entails the indispensable relationship between food systems and FNS [42]. Thus, most policies listed under the systemic component are concerned with improving food production and making nutritious food accessible.

Consideration of the needs of farmers and consumers was crucial in crafting policies that sustain food production and food supply. Properly implementing these policies could help stabilize the food systems, making them more accessible and affordable. Science and technology improved agricultural production by exploring GMOs that could address agricultural challenges such as natural calamities, pest infestation, etc. It will also help address nutrition security for crops having certain nutrients that respond to nutrient deficiencies [56].

Aside from the agricultural perspective of the food system, policies that support home gardening, community gardening and animal farming impacted the food system. This makes access to nutritious food easier in the comfort of families' communities and households. An excellent example is RA 8435, which promoted organic, chemical-free vegetables and fruits and raised small animals at home [24]. Similarly, private initiatives like Homestead Food Production of Helen Keller International and projects led by HEIs had the same concept of sustaining food supply all year round, even during calamities [53].

Likewise, the conduct of feeding programs under PD 491, School Nutrition Program, RA 11037 and *HAPAG-ASA* Integrated Nutrition Program made access to nutritious food more convenient. Healthy meals based on those prescribed for pregnant & lactating women and children were served at their tables [26, 30, 40, 48, 53]. With these initiatives, incorporating locally produced food in food consumption was crucial in creating sustainable food systems and diets encompassing the relation of agriculture and dietary planning to achieve FNS.

3.5 Context-based

Economic, cultural, and environmental challenges should be aligned in developing FNS-related policies. The creation of livelihood activities through implementing the KADIWA market program of the Department of Agriculture, EO 776 s. 2009, and Sustainable Livelihood through Cooperatives improves families' economic status, giving them a chance to achieve FNS [9, 30, 53]. Under these policies, livelihood development was conducted through training, credit assistance and utilizing the included components of the program itself, such as gardening and animal farming. "Bio-intensive gardening," a private initiative, not only helped improve the community's economic conditions but also highlighted the importance of cultural conditions in achieving FNS.

On the other hand, RA 7600 broke the stigma related to breastfeeding, protecting both the mother and child from being misjudged and harassed [48]. Cultural preferences in diet should be given attention because they affect FNS in shaping community diets, whereas this diet should be culturally accepted for it to become effective [58, 59]. Policies such as Healthy Food and Beverage Choices in Schools and DepEd Offices (DepEd Order 13 s. 2017) increased the availability of healthy food options in schools and DepEd Offices while also considering cultural orientations of the students and employees was a good example of a context-based policy [26].

Besides cultural and economic considerations, policies addressing environmental concerns were noted, especially when climate change threatens achieving FNS [50]. Several policies responded to this environmental concern by reducing the environmental impact on agriculture, leaning toward more organic agricultural practices, conservation of forests and watersheds, self-sufficiency programs and workshops on effectively responding to natural calamities [9, 23, 33, 55].

3.6 Pluralistic

In deeper cultural consideration, pluralistic refers to fitness of the policy in different groups separated by professionalism, ethnicity, and religious beliefs. An example of pluralistic FNS-related policy is "Bio-intensive Gardening" which involves neighborhood and school teachers conducting gardening training that enhances their organic gardening skills [53]. Another is the School Nutrition Program, along with DepEd Order 13 s. 2017, which considers the students' religious beliefs regarding the food being served in schools, respecting their diet restrictions and limitations given by their religion [26, 53].

4 Human Ecology HEIs and FNS-Related Policy Development

The literature review shows that few studies have pointed to the role of human ecology HEIs in policy development and directions. Among the few literature that emerged, FNS-related policies involve the application of human ecology to address the complex challenge of FNS in the country [16]. Policies reviewed in the article were analyzed to determine how human ecology is applied in these policies. Such applications were listed and aligned with the different components of ANU Transdisciplinary Framework.

Within the interactive perspective of human ecology application in policies involves the collaboration of institutions in implementing and developing programs and projects under a certain policy. HEIs provide programs and projects that policymakers can refer to as a guide during policy development [12, 23, 42, 46]. BIDANI or the Barangay Integrated Development for Nutrition Improvement was a joint effort among major state colleges and universities to improve household nutrition [9]. HEIs also communicated with LGUs to implement FNS-related projects and programs. They conduct seminars and workshops to inform communities about FNS — its current situation and challenges [9, 23, 46].

Engaging the community members in different development programs led to their active par-

ticipation in other FNS-related projects and programs—this interaction within neighborhoods led to the successful implementation of various policies [26, 32, 33, 60]. Furthermore, integrating one program into another enhanced the collaboration of different institutions within the community [32]. The involvement of other community members as representatives from different sectors and the contribution of women were also noted in creating and developing FNS-related policies [9, 12, 60]. Thus, it could be said that the interaction of different institutions is crucial in making policy effective or ineffective [55].

The integration of FNS-related policies was also seen across the studies. Disciplines integrated with FNS-related policies are science and technology, home economics, education, environmental planning, and social planning were evident [9, 12, 23, 24, 30, 42, 50, 53]. The contribution of science and technology, as mentioned earlier, improves food systems and nutritional status through producing GMOs and fortified foods [24, 30]. Home economics impacted FNS-related policies through applications in skill sets and knowledge generation on gardening, animal farming, cooking, etc., [23, 24, 32, 48, 52]. Meanwhile, conducting seminars, workshops, and development programs, i.e., human resource development, disaster management, and capacity building justifies integrating FNS policies with education, social planning, and environmental planning [9, 23, 24, 32, 53]. In addition, human ecology research is also applied to examine the effectiveness of FNS-related policies and tools through research and focus group discussion [16, 42, 55]. These integrated programs helped improve the quality of life of people and addressed the different demands of the community regarding FNS [31].

Social planning is also applied in the conduct of social services. It was crucial to provide assistance, training, and services that help the community create livelihood activities and address their economic needs. This justifies the need for food policies to be integrated into social services side by side, focusing on food production and nutrition programs [38]. Diet planning is also used to address the community's nutritional needs through diet modification during feeding programs [9, 44].

Meanwhile, environmental planning helps address the issues within the food system, especially in finding ways to decrease food prices and enhance access to nutritious food. This stabilizes the food systems by responding to the concerns of farmers and community needs concerning food access [9, 12, 23, 32][1,24,29,49]. The same goes for home economics whereby livelihood activities help the food system to be sustainable and, thus, enable the community to attain a healthy and well-balanced diet [23, 24, 33, 50, 53].

Applying human ecology to existing policies helps address the environmental, cultural, and economic needs to make FNS-related policies change-oriented, context-based, and pluralistic. Besides, the application of human ecology also contributes to improving food systems by enabling policies to underscore systemic approaches through the interaction of institutions and communities and integrating different disciplines to address FNS.

5 Recommendations to Enhance Human Ecology's Role in the Development of FNS-Related Policies

Several recommendations were made to improve the role of Human Ecology in policy development related to FNS. There is a need for the continuous involvement of different sectors such as the Department of Health (DOH), Department of Agrarian Reform (DAR), Department of Trade and Industry (DTI), Department of Science and Technology (DOST), Department of Agriculture etc., with the private sector, public and civil society group with regards to FNS related policy development [31]. This could help foster interaction among different fields to develop a transdisciplinary policy in achieving FNS [55].

HEIs should continue collaborating with LGUs in FNS-related programs and projects to guide

and inform policymakers about the current FNS situation in the country. Meanwhile, SAKA partners with different state colleges to provide agricultural skills training to improve farm productivity and management. These local projects and programs done by the SUCs displayed positive results in community engagement and attaining its goals of achieving FNS [23, 33, 34, 35].

HEIs can also provide integrated programs and projects. In contrast, the concept of FNS should be framed from the confluence of different disciplines to address other contributing factors outside nutrition and agriculture [25, 27, 53, 55]. HEIs can also integrate FNS concepts into their curriculum and require students to develop FNS-related programs and projects as an output in their courses [35]. Programs and projects should be aligned with the community needs, which can include providing equitable access to FNS institutions and infrastructure; developing healthy diets for different age groups; conducting training, workshops and seminars that will support and accommodate farmers to enhance their agricultural skills for the improvement of food systems [16, 25, 27, 38, 61].

These programs should address social marginalization and poverty, major hindrances to achieving FNS [16]. In short, it should also respond to the economic demands of the potential participants and beneficiaries. Environmental-related lectures that tackle the relationship between environmental concerns and FNS can also be explored. This will initiate other activities such as enhanced disaster risk management, environmental planning for conservation and preservation of natural resources, etc., for resiliency, preparation, and management of environmental consequences of climate change [25, 27, 43, 53]. To be effective, programs and projects developed by HEIs should be culturally fit to the beliefs and perspectives of various groups of people with different ethnicities, religions, and professions [12, 16, 25, 36, 53].

6 Conclusion

None of the local policies discussed fit in all of the ANU Transdisciplinary Framework components. In addition, there are still no local policies that address food and nutrition security in an integrated manner. Yet, all of them have promising components and provisions that could potentially solve FNS-related problems. While data on Human Ecology HEIs role in FNS policy development are few, these documents point to the interactive participation and discussion of different sectors and civil groups regarding policy development. Human Ecology's potential lies in its integrated approach to FNS. HEIs collaboration across multiple sectors is critical in developing FNS-related projects and programs. Similarly, improvement in research facilities, training, and partnerships would enable HEIs to better contribute to crafting effective and higher-quality FNS-related projects and programs.

Supplementary Material

Table S1. Identified FNS-related policies aligned with ANU Transdisciplinary Framework

Statements and Declarations

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability

The data are available upon request from the authors.

Author Contributions

R.J.P.D., **J.M.S.A.**, **K.R.F.**, **C.D.P.**, **M.E.T.M.**, & **M.B.D.**: conceptualization, methodology, data analysis, article writing, data gathering; **M.C.D.D.** & **S.L.A.**: article writing, data organization, data analysis, review & editing.

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