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NUTRITION-SENSITIVE FOOD SYSTEM IN VIETNAM'S MEKONG DELTA: A LITERATURE REVIEW

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Executive Summary

Nutrition-sensitive agri-food systems is an approach that puts nutritionally rich foods and dietary diversity at the heart of overcoming undernutrition, overnutrition, and micronutrient deficiencies. A desk review of literature and databases in Vietnam was conducted to identify existing knowledge, gaps, and opportunities for deltaic food systems transformation towards healthy diets. The study was conducted under the OneCGIAR Initiative on Securing the food systems of Asian Mega-Deltas for climate and livelihood resilience (AMD), particularly work package 2 that seeks to ensure that deltaic food systems sustain and enhance nutrition security equitably, in a context of rapid change.

A total of 26 publications were identified and analyzed, of which 77% focused on the food environment/nutrition, especially consumption, food availability, access, and affordability; 54% focused on production, especially food production, land use, and soil management; and 46% focused on food supply chains.

Rice is still a major food, dominating the literature on production and consumption, and a primary source of nutrients for many. Agriculture in peri-urban and rural areas was an important source of fresh food for urban areas. Aquaculture, and fruit production were noted to face difficulties related to input, infrastructure and market access and availability. Food production in the Mekong is also affected by population dynamics (growth and migration), and climate and natural disasters. Such that, achieving the required quantity and quality of safe and diverse food while ensuring environmental management systems is a major concern.

Both formal and informal food supply chains play an important role in ensuring the livelihoods and nutrition of people in the Mekong Delta. Whereby traditional markets and street vendors are essential for access to diverse foods among consumers in urban, peri-urban, and rural areas. Urbanization and development of informal markets into formal markets (traditional or wet markets to hyper/supermarkets, convenience/ grocery stores) had mixed impact where available foods were more diverse, yet less accessible to the low-income groups and negatively affected the livelihoods of many small traders/retailers in traditional markets. Food safety remains a key concern in both supply chains. Households and small/medium enterprises in the value chains face challenges with infrastructure, technology adoption, and price fluctuations.

Nutrition interventions have been widely implemented yet nutrition knowledge remains quite limited. There is a lack of uniform gains in nutrition outcomes with respect to the growing inequities, especially those related to ethnic groups and regions. The daily intake of starchy staples has reduced, while the daily intake for most of the other food groups has increased. The average food intake for all food groups is higher in peri-urban and urban areas than in rural areas, except for vegetables. Furthermore, access and consumption of ultra-processed foods is a concern not just for urban areas but on the rise in rural areas as well.

Some of the implications and gaps identified from the review included: More efforts towards diversification of agriculture are needed, as well as supporting adoption of sustainable agricultural practices, and management and utilization of natural resources to improve food safety and nutrition. There is also a need to strengthen the focus and impact of nutrient-sensitive agriculture interventions, understanding trade-offs and leveraging entry points to improve nutrition, and adequately monitoring and evaluating impact on nutrition. Improvements in both formal and informal food markets should not only cater to the availability of safe, diverse, and high-quality foods but also ensure provision of nutritious and acceptable foods at affordable prices. An increase in transparency in the food system with increased capacity in food safety, efficient information systems and food labelling will contribute to participation in the food supply chains and increased awareness, promotion, and use of safe, nutritious, high-quality, and sustainably produced foods/ products. The transitions in the food environment warrant a more comprehensive understanding and monitoring of the drivers of food and nutrition insecurity and inequalities for different groups of people/ contexts. Actions improving production and supply of safe, diverse, nutritious, and high-quality foods, should be matched with an increased demand for and consumption of these food products. Awareness creation and use of behavioral change strategies can contribute to increased demand. The review of data sources found 25 primary datasets and 24 secondary datasets. Generally, diverse datasets related to food production, food processing & distribution, food price, incomes, food consumption, and environmental health are listed on the website of the General Statistics Office (GSO) of Vietnam. The large datasets included Rural, Agriculture, and Fishery Census, Vietnam Household Living Standard Survey, General Nutrition Survey, Nutrition Surveillance Profiles, and Vietnam Food Composition Table. Only 1 dataset conducted by the Alliance of Bioversity and CIAT in 2018 covers quite comprehensively all domains of food systems including food production; food processing and distribution; food access and consumption; food safety, and nutrition. Though several nutrition-sensitive agri-food system datasets were found, very few are publicly available.

1. Introduction

In recent years, the food system has attracted more attention from both policy makers and researchers (UNFSS, 2021). The “food system” refers to “everything (environment, people, inputs, processes, infrastructures, institutions, etc.) and actions that are involved in the production, processing, distribution, preparation and consumption of food, and the results of these actions, such as socio-economic and environmental impacts” (HLPE, 2017). This comprehensive concept emphasizes the shift from mainly focusing on “more food” to instead focusing on better diet quality and nutrition (Bene et al., 2019).

Nutrition is part of the agri-food system; however, ensuring food and nutrition security through increasing food production does not guarantee a reduction in the prevalence of malnutrition. A healthy, diverse diet plays a pivotal role in reaching the full potential at the individual and societal levels. A nutrition-sensitive agri-food system is an essential approach that puts nutritionally rich foods and dietary diversity at the heart of overcoming undernutrition, overnutrition, and micronutrient deficiencies. The national prevalence of stunting among children under five years of age has reduced in the past decade, standing at 19.6% while that for overweight and obesity is increasing and reported at 7% and 6% respectively. In the Mekong delta, stunting among children is at 12.4% (NIN, 2020). Agriculture is the only sector that can deliver the commodities necessary for nutritious and healthy diets at scale. The primary focus of agriculture in supporting nutrition-sensitive agriculture should be on the production, processing, storage, and marketing of diverse, nutritious, safe, and affordable foods. Therefore, a sustainable agri-food system for healthier diets must include diversity in both food production and consumption.

The Mekong Delta in southern Vietnam is home to more than 18 million people and produces the largest quantities of rice nationwide (52% of rice), 60% of fruits, and 70% of seafood. The region is reported to have 82 enterprises, 526 cooperatives, and 1,697,135 households engaged in agricultural production. In addition, there are 872 enterprises, 67 cooperatives, and 386,940 households involved in aquaculture (GSO, 2018).

In recent years, extreme weather events such as droughts, floods, saltwater intrusion, and sea level rise have increased in many provinces/cities of the Mekong Delta region. As a key agricultural production area of the country, the impact of these extreme weather phenomena poses grave threats on the food.

This study therefore reviewed the existing literature in Vietnam to identify and understand the scope and key impacts of nutrition-sensitive food system

interventions. The study was conducted under the OneCGIAR Initiative on Securing the food systems of Asian Mega-Deltas for climate and livelihood resilience (AMD), particularly work package 2 that seeks to ensure that deltaic food systems sustain and enhance nutrition security equitably, in a context of rapid change. Therefore, the study had a particular interest in interventions in the Mekong delta region.

2. Methodology

The study was a desk review that included identifying and reviewing literature and data on nutrition-sensitive food system interventions especially in the Mekong delta that show equitable and sustainable production and consumption of nutritious foods in the delta in the face of food system transition. In order to identify existing knowledge gaps and opportunities for deltaic food systems transformation towards healthy diets.

The literature search was limited in the last 15 years (2007) and focused on literature with at least 2 elements of the food system, where one of them was the consumer's nutrition. The elements were based on the food system conceptual frameworks, especially the food environment which is the interface between the food system and the consumer by HPLE (2017) and Turner et al. (2018). The elements used to summarize and present the findings of the review regarding the food system were food production, food processing, food supply chains, and natural resources. While the elements related to nutrition/ food environment included food availability, food accessibility, food affordability, food desire/ preference, food consumption, and nutrition status. Literature related to agriculture, food value chain etc., without clear inclusion of any of the selected elements of the food environment were excluded. Similarly, literature related to nutrition without a link to agriculture/ food system were also excluded.

First a long list of literature was developed from well-known bibliography databases that allow/enable a quick scan of bibliographies such as Scopus and Google Scholar (Scopus interface is considered more user-friendly than Web of Science). This initial scan with search terms returned 37 records. While we tried to make the stock-taking automated and systematic, we also expanded our list by referencing other reliable sources, including documents shared by experts from the CGIAR's Asian Mega Delta Initiative and documents found through the snowballing¹ technique. The focus/priority of this review was peer-reviewed

¹ Snowballing refers to using the reference list of a paper or the citations to the paper to identify additional papers

journal papers, conference proceedings, and book chapters. However, other types of grey literature were also considered wherever they are shown to be relevant. While 40 results were obtained in total, 26 documents were selected after filtering out those that are less relevant. A manual review of abstracts or keywords of the long-listed documents helped to determine whether or not the paper is relevant to be included. Below are details of the search strategy applied in the review.

Search strategy

- Sources of documents: peer-reviewed articles uploaded to Scopus (for compilation of literature)/Google Scholar (for compilation of data/database sources) + documents suggested/referred by the documents shown on Scopus (snow-balling technique) + grey literature from reputable research institutions, public agencies, and NGOs.
- Search terms: Automated search in Scopus to identify documents with the search terms that appear in either title, abstract, or keyword. The search terms for literature are ((food OR feed* OR &utria*) AND (Vietnam OR Mekong delta)). The search term for data compilation is: “Vietnam food and nutrition”
- Inclusion/exclusion criteria:
 - Dates: keep only documents dated from 2007-Present (15 years)
 - Language: consider documents in English only
 - Geographic coverage: Consider only literature and data that are specific to the Vietnam or Mekong delta
 - Topic: Included for review if the document shows relevance to food and/or nutrition topic, either directly (eg: rice, fish/aquaculture, vegetables...) or indirectly (irrigated water, drinking water...). The documents are excluded if no concrete results related to nutrition could be identified.

Details of recorded documents

After selecting the relevant documents, a Microsoft excel spreadsheet was used to input details extracted from the literature to serve the data analysis and findings synthesis. The main details analyzed included:

- Title of the document
- Author(s)
- Type of publication
- Year of publication
- Aims/purpose/objective

- Scope: region where research was focused
- Research methods
- Topic covered (main topic and sub-topic)
- Food group covered
- Key results/insights
- Gaps identified
- Implications of the results

3. Results from the literature review

A total of 26 publications were identified and analyzed. About 50% of the literature were journal papers, 23.1% were research reports, 7.7% were books, 3.8% were conference proceedings and 15.4 were other (discussion/working paper, profile). Most publications (92.3%) were published within the last 5 years.

Three types of research methods were identified: quantitative, qualitative, and mixed methods. Of these, 58% of the literature used mixed methods that applied both quantitative and qualitative techniques. The quantitative method was applied in 31% of the selected publications. In which, most publications used quantitative household survey methods to analyze different aspects of the food system and nutrition (Vuong et al., 2022; Harris et al., 2019; Kim, 2021). Some other publications applied other quantitative methods such as modeling or post-trial intervention (Timler et al., 2020; Di Prima et al. 2022). The remaining 11% of the publications used qualitative methods. These publications often used focus group discussions (FGDs), key informant interviews (KIIs), and in-depth Interviews (IDIs) methods to explore important topics in food system research (Owili, et al., 2021) or practices in food choice (Nguyen et al., 2021), as well as providing evidence on the effectiveness of nutrition-sensitive agriculture interventions at household level (Dai et al., 2022).

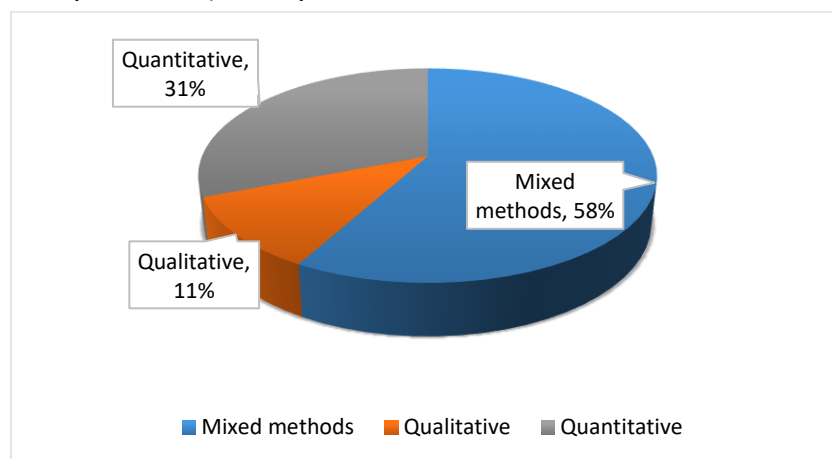


Figure 1 Methods used in the selected publications

In terms of data sources, both primary and secondary data were used in the literature. In which, 35% of publications used only primary data such as a household survey (Huynh et al., 2018; Genova et al., 2022; Vuong et al., 2022; Rocha et al., 2022), farming survey (Timler et al., 2019), 35% used only secondary data (FAO SAT - Harris et al., 2020; VHLSS - Kim et al., 2021; Burra et al., 2019; Fishery Statistical Data or Vietnam Forest Facts and Figures - Hernandez et al., 2020; FAO, 2011; Raneri et al., 2019) and 31% used both primary and secondary data.

3.2. Geographical scope

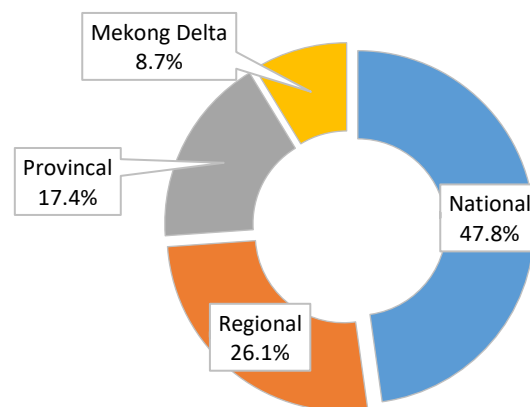


Figure 2 The geographical scope of the selected literature

Regarding geographic scope, most research focused on national (47.8%) and regional (26.1%) levels. Only four studies were conducted at the provincial level (17.4%) and 2 studies in the Mekong delta (8.7%) (MONRE and MARD, 2013; Vuong et al. 2022). The publication of MONRE and MARD referred to developing an appropriate strategy for socio-economic planning to mitigate and adapt to climate changes in the Mekong Delta. Meanwhile, research by Vuong et al. (2022) evaluated compounded impacts of household food insecurity and WASH on the self-reported physical and mental health of adults in the Mekong region. None of the studies focused on the village/village or commune level.

3.3. Food system topics

The selected literature covered six main elements of the food system defined by the food system frameworks by HPLE (2017) and Turner et al. (2018) that is, i) food production, ii) food supply chains, iii) food processing, iv) natural resource

management, v) food environment/nutrition and vi) climate change. The sub-topics under the main topics were also considered and analyzed.

The results showed that 77% of the publications focused on the food environment/nutrition (Figure 3). Much of the literature about food environment/nutrition emphasized consumption, food availability, access, and affordability (e.g., Trinh, et al., 2021; Burra, et al., 2019; Nguyen, et al., 2021; Hernandez et al., 2020; Kim et al., 2021; Huynh, et al., 2021; Timler et al., 2020) (Figure 4).

About 54% of the publications focused on the production with the main subtopics identified as food production systems, land use, and soil management (Espagne et al., 2021; Burra, et al., 2019; MNRE & MARD, 2013). Also, 46% of the publications focused on food supply chains, where they covered not only formal distribution and retail such as supermarkets, and retail but also traditional/wet markets and smallholder sellers (e.g., Trinh, et al., 2021; Hernandez et al., 2020; Huynh, et al., 2021; Burra, et al., 2019). Only a quarter (27%) of literature focused on food processing, 15% on natural resource management, and only 2 studies dealt with climate change (8.7%) (Espagne, et al., 2021; Singh, et al., 2019). Regarding the topic of resource management, water resources were mentioned and discussed, which showed the importance of water resource management in the Mekong delta (MONRE and MARD, 2013; Vuong, 2022).

The full consideration of all food systems elements helped illustrate the overall picture of the food system in the Mekong Delta region. Although none of the studies in the Mekong Delta region in the literature list covered all the above topics, there were three recent studies conducted by the team from the Alliance of Bioversity and CIAT that adequately covered all topics of the food systems in Vietnam in general (Burra, et al., 2019; Hernandez, et al., 2020 and Huynh, et al., 2018).

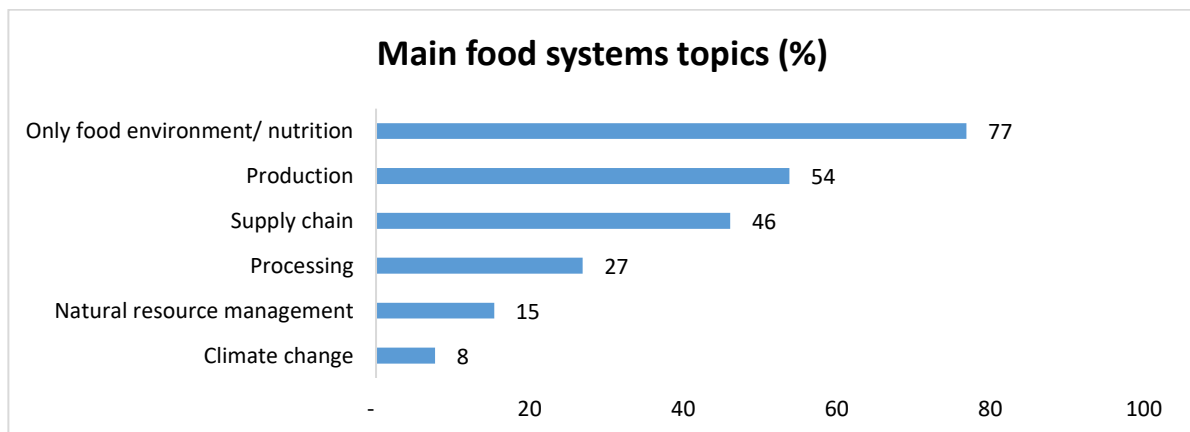


Figure 3 Main food system topics of the selected literature

Regarding subtopics in food environment/nutrition, 81% of the literature focused on food consumption, 73% on food affordability, 44% on food availability and 62% on food access, and 50% on nutrition status (Figure 4).

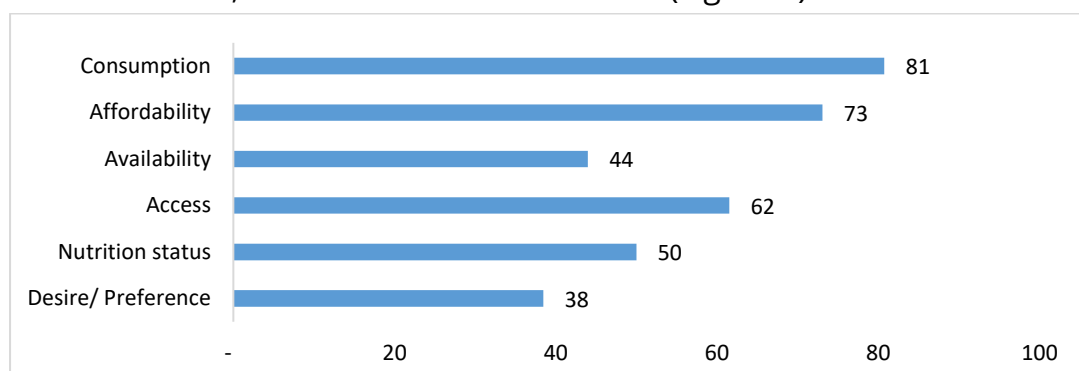


Figure 4 Sub-topics of food environment/ nutrition area of the selected literature

3.4. Food group covered

Regarding food groups, most (95.5%) publications mentioned more than one food group or considered food diversity (Figure 5). In which, the identified research mentioned and analyzed food diversity in the diet (Hernandez et al., 2020; Huynh, et al., 2021; Raneri et al., 2019; Kim et al., 2019 al., 2021, Di Prima et al., 2022). Other literature focusing on fruits and vegetables accounted for 69% (Hernandez, et al., 2020; Huynh, et al., 2021; Nguyen, et al., 2021; World Bank, et al., 2020). Nearly 58% of the literature analyzed the animal & aquatic foods and 54% of the literature focused on starchy staples (Trinh, et al., 2021; Burra, et al., 2019; Hernandez, et al., 2020; Huynh, et al., 2021). Less than 50% of the literature mentioned the remaining food groups ².

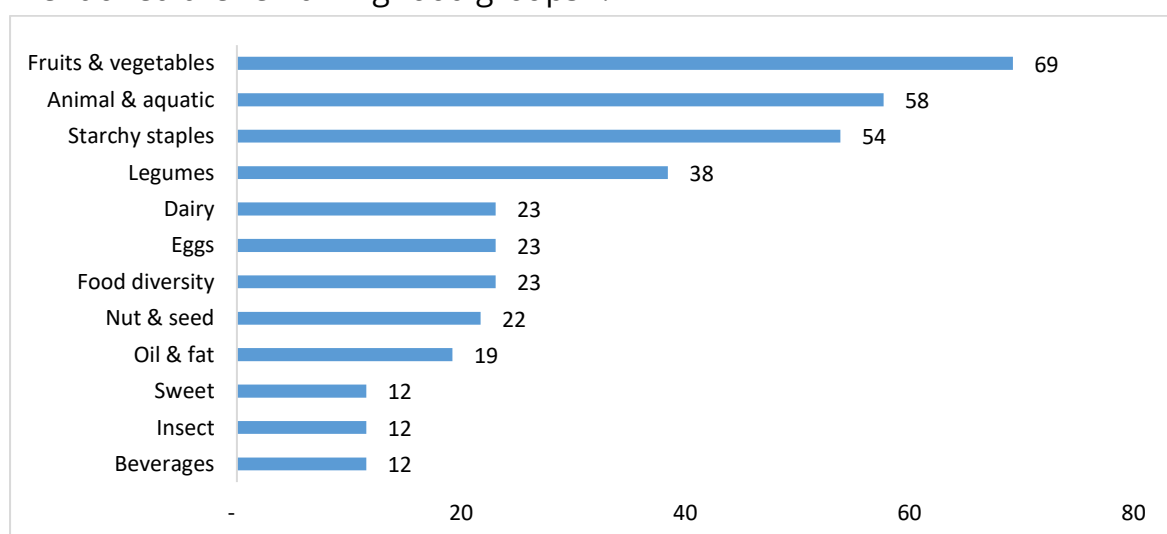


Figure 5 Food groups covered in the selected literature.

² Food diversity considering food diversity in general

*Food diversity: authors did not mention any specific food groups, but covered food/ dietary diversity in general

3.5. Key Results and discussion

Whereas Vietnam is at the beginning of its nourishment move, change is happening quickly. Undernutrition is falling, obesity is rising, and nutrition-related chronic diseases account for a significant burden of diseases and death (Nguyen, et al., 2021). In the Mekong Delta Region, the stunting rate among children under 5 years old reduced significantly from 28.2 % in 2010 to 12.4% in 2020. The same trend was observed for the prevalence of underweight and wasting. However, the rate of overweight and obesity increased nearly threefold from 2010 at 4.2% to 2020 at 12.7% (NIN, 2020). The daily consumption of rice and tubers has decreased from 1990 to 2020, while the consumption of all other food groups, especially meat, fish and eggs has increased (NIN, 2020).

Food production and nutrition

The identified literature largely focused on exploring different topics in food production including land use, soil management, production systems, climate adaptation, agricultural inputs (seeds, fertilizer, pesticides, etc.), and food safety in relation related to nutrition (diets, micronutrients, and nutritional status).

An analysis of the 2016 Vietnam Household Living Standard Survey (VHLSS) data showed that calorie production in the crops was dominated by 3 crops (rice, maize, and cassava) together accounting for more than 75% of total available calories from own production. Plain rice was the primary source of available protein, calcium, carbohydrates, iron, and zinc from own-produced food, while eggs contribute the most towards Vitamin A and fat availability (Kim et al., 2021). Agriculture in peri-urban and rural areas was an important source of fresh food for urban areas. In rural areas, the diets depended heavily on the locally produced food. However, even though they grew more food than in urban areas, their diets were less diverse for both adult men and women and children under 5 years of age (Huynh, et al., 2020). In the Mekong Delta region, although agriculture production in this area is the main source and exporter of food for the whole country, the malnutrition rate is still higher than other ecological regions (Le, et al., 2011). Reports indicate that land is an important factor for diet diversity, where households with larger agricultural land are more likely to have higher household dietary diversity scores. In fact, dietary diversity appears to grow with farm size. However, household dietary diversity of an ethnic minority group in An Giang

province of Mekong Delta region, showed that there was no difference in dietary diversity between households that owned farms and those that did not. (Le et al., 2023).

A modelling study of farmers in Mai Son district, Son La Province showed high nutrient system yields however the nutrient adequacy did not match because the farmers sold a greater proportion of their on-farm produced foods. Diversification with novel vegetables was estimated to have the potential to cover vitamin A requirements of 10 to 31 extra people per hectare and lead to greater income (25 to 185% increase) for some households (Timler et al., 2019). A case study of school gardening in the central of Vietnam also highlighted the success of adoption of home gardening by families and communities to improve the food security and dietary intake especially the vegetable intake among children (Bioversity International, 2018). In the Mekong Delta, aquaculture, and fruit production face difficulties such as a lack of market information, lack of interest/investment in sustainable agriculture (e.g., use of machinery or renewable energy), and increasing prices of agricultural inputs (chemicals, gasoline, fertilizers, pesticides, etc.) (Nghia et al., 2020). Besides, with increasing pressure to ensure national food security and increase food production (e.g., rice, fish, vegetables, and fruits), the population growth in the Mekong is at an increasing rate of growth. This, in turn, hinders the modernization of production facilities through resource consolidation and/or increasing income inequality (and the possibility of poverty) among the rural population (MONRE and MARD).

Climate and natural disasters affect food security through agricultural production. Three extreme natural events such as floods, rainfall, and storms reduce diet variety and household per capita calorie intake. Natural disasters also affected household dietary diversity. The results predicted that rice production losses due to floods, salinity intrusion, and climate change directly reduced the Food Security Index (Espagne, et al. 2021). This is a particular concern given the geography and agroecology of the Mekong delta region.

It was also noted that production-by-quantity targets need to incorporate quality, food safety, and environmental management systems, in order to address consumer and government concerns about food safety products, while minimizing risks for farmers and businesses (World Bank, 2016).

Food processing and nutrition

In Vietnam, Small and Medium Enterprises (SMEs) play important roles in food processing. The research on the impact of the ECOSUN project on food security

and chronic child malnutrition in northern Vietnam from 2015 to 2018 showed that the local food processing plant that was operationalized to serve as a stable purchaser created a value chain for local crops and contributed to successful partnership models, through private-public sector collaborations. The local small-scale food processing produced nearly 5 tons of instant fortified porridge that was supplied to marketing promotion activities, local vendors, and kindergartens. Besides, 30,000 sachet packs of VICA (*fortified with a premix of calcium, vitamin D3, magnesium, and zinc*) from com-minced were produced over two months (Rocha, et al., 2022). However, most small businesses or households involved in food processing still faced many difficulties such as a lack of food safety management infrastructure, lack of investment in cold chains, product preservation, etc., and a lack of capacity for food production to meet nutritional needs (World Bank, 2020; Owili, et al., 2021).

Furthermore, food fortification is a good strategy to enhance nutrition in remote and isolated areas or those heavily affected by natural disasters. Interventions in the food processing and fortification models in the Northern mountainous regions of Vietnam are a good example (Rocha, et al., 2022). However, it is necessary to consider regional cultural factors and the nutritional trade-offs of consumers when consuming ready-to-eat foods with readily available fresh foods, as well as enhancing local biodiversity.

Supply chain and nutrition

The food supply chain includes formal markets, informal markets, distribution, transportation, and food safety. It plays an important role in ensuring the livelihood and nutrition of people, especially in the Mekong Delta. Traditional markets and street vendors remained the most important outlets for consumers across urban, peri-urban, and rural areas (Nguyen, et al., 2021), despite the food safety concerns and increase in more formal markets. Meanwhile, urban households mainly purchased food from wet markets and specialized shops. Besides, the forms of temporary markets and street vendors played an important role in supplying fresh foods to low-income groups (migrants, workers, etc.). Interestingly, in the peri-urban areas, there is a transition in household food sourcing from their own production to purchases at the wet markets (Trinh, et al., 2021, World Bank, 2020).

In the past 10 years, the modern retail system has been expanded on a large scale with tens of thousands of stores including hypermarkets, supermarkets, convenience stores, and grocery stores. In urban and peri-urban areas, food and

beverage outlets appear more diverse than in rural areas, with a density of 1,000 people/store. Recently many traditional markets in urban areas were closed and replaced with supermarkets, convenience stores, and trade centers, which inadvertently negatively affected the livelihoods of many small traders/retailers in traditional markets. It also deprived the low-income group of access to fresh food at traditional markets. Despite their large-scale expansion, such modern retail chains only provided 10-20% of the total perishable products consumed in Hanoi and HCMC, while this channel had a wide selection of processed foods that were less healthy. These unhealthy foods (high in sugar and salt) also appeared in many convenience stores (Huynh, et al., 2021; Harris, et al., 2019; World Bank, 2020). Research showed that chemical residues in perishable products sold in supermarkets were not always lower than in traditional markets. About 80% of perishable products in urban areas were distributed through traditional markets from wholesale markets.

Food service at restaurants, schools, hospitals, industrial parks, canteens, public kitchens, or ready-to-eat catering establishments was the area of greatest concern about food safety. Most of the published food poisoning cases were from these areas (World Bank, 2020, Harris et al., 2019). There is high competition among restaurants/food companies that supply meals for schools, hospitals, and industrial areas. While those sectors have limited budgets for providing quality and safe meals, investing in reliable and safe food is not a priority, especially when there is no effective food safety law enforcement agency. The inspection by state agencies is only administrative, with limited inspection resources, which shows a huge gap between the quality announced on paper and the actual quality on the spot (World Bank, 2020). Food safety needs to be addressed because in rural areas, lack of clean water supply, food related diseases and lack of nutrition education are key risk factors affecting nutrition status in addition to lack of food (Dao and Pham, 2020).

Despite the huge market demand, the supply chain is easily disrupted by food quality, epidemics, technology adoption, and price fluctuations (Nghia, et al., 2022)

Natural resource management and nutrition

Different natural resources were discussed in the literature on food systems in the Mekong Delta region. These included water, land, and fishery, which can have diverse implications on food and nutrition security. Similar to other deltas in the world, water security plays an important role in the livelihoods of people in the Mekong Delta. Increasing demand for water use, water pollution, the construction

of many hydroelectric dams upstream, climate change, and sea level rise have created significant challenges for water resource management in Mekong Delta Region (MONRE and MARD, 2013, Trung, et al., 2014). An analysis from a cross-sectional survey of 552 households in the Mekong Delta found that household food insecurity and households using under 50 liters of water per person per day was associated with lower physical and mental health which were quantified using the physical health composite score ($p < 0.05$) (Vuong, et al., 2022). Another study done by Espagne shows that climate change, especially temperature increase has a negative impact on household income, especially on fishing households in the Mekong Delta. Thus, a strategy for sustainable land and water use management in the Mekong delta contributes to effective flood risk reduction or impact. This scenario allows the Mekong delta to respond flexibly to climate change and scale up food production more appropriately, contributing to improving the livelihoods and nutrition status of people in the region (MONRE and MARD, 2013).

Food environment and nutrition

Stunting in Vietnam has significantly decreased but is still above the 2020 target of 23%. Nutrition interventions have been widely implemented yet nutrition knowledge on infant and young child feeding, especially regarding exclusive breastfeeding up to six months of age and appropriate timing for the introduction of complementary food remains quite limited (Hernandez, et al., 2020). Vietnam lacks the uniform gains that would solve the growing inequities, especially those related to nutrition among ethnic groups and regions. The gap in stunting between its ethnic minority and the majority of Kinh ethnicity increased from 14.3 percentage points in 2010 to 16.4 percentage points in 2015 (Nkosinathi, et al., 2019). The rate of undernourishment among the general population is 11% in 2016, with the rate in rural areas (11.9%) higher than in urban areas (8.5%). There are also differences in malnutrition rate by region, the lowest in the Southeast (8.6%) while the highest in the Central Highlands region (15.6%) (Kim et al., 2021). This is a problem that is not only persisting but worsening and acting as a marker of inequities in nutrition and health care that affect ethnic minority women and children (Nkosinathi, et al., 2019).

Regarding food consumption, the daily intake of starchy staples has fallen, while the daily intake for most of the other food groups has increased over the past 4 decades. Three-quarters of children meet the minimum dietary diversity and have a minimally acceptable diet. Consumption of fruits and vegetables (combined) is still below the World Health Organization (WHO) recommendation (400 gr/day, in

Vietnam 251 gr/day), and around 80% of adults do not meet the WHO recommended daily intake (Hernandez, et al., 2020). Milk and milk products, white roots and tubers, and fruits are mainly consumed by relatively few, better-off households with high levels of dietary diversity (Kim, et al., 2021).

Rice is the most consumed food in Vietnam (300g/person/day). The average consumption of vegetables and starchy foods in rural areas was significantly higher, while the consumption of dairy, as well as meat, poultry, and fish in rural areas, was significantly lower than in rural areas. with peri-urban and urban areas (Huynh, et al., 2020). Overall, average food intake for all food groups was significantly higher in peri-urban and urban areas than in rural areas, except for vegetables. Children under 5 years of age in rural areas have significantly lower average dietary intake than those in peri-urban and urban areas (Huynh, et al., 2020).

Contrary to the common concern that urban households are the major consumers of processed foods, peri-urban and rural areas on average had higher consumption of ultra-processed foods than urban areas. The low-price levels of processed foods and the presence of processed foods even among the traditional convenience stores, those in closest proximity to rural households, offer potential explanations for this result. Regarding undernutrition, low retail diversity and a household's dependence on its own production have important implications for the high prevalence of child undernutrition in rural areas (Harris, et al., 2019; Nguyen, et al., 2021).

3.6. Implications of findings and identified gaps

Food production

Vietnam is at the forefront of rapidly renewing and modernizing its food system but still relies heavily on traditional practices and culture. There is a need to understand the trade-offs and impacts of the current and proposed/recommended practices, especially at the nexus of production systems, climate adaptation, natural resource management and nutrition. Such comprehensive research and high-quality and timely data can then support evidence-based decision and policy making, and development and promotion of sustainable, accessible, and contextualized technologies across the food system. This of particular importance in the Mekong delta region given its vulnerability to climate change.

Investment in agriculture is still biased towards increasing the production and productivity of essential grains (especially rice), thereby undermining the potential of agriculture to provide the diverse foods needed to ensure nutrition security for all (Nkosinathi, et al., 2019). This approach is not only detrimental to domestic staple food production, but it is also unsuitable for changing food needs and meeting the requirements for nutrient-rich foods, including animal protein, fruits, and vegetables. It's important that policies and interventions address the environmental, natural resource, nutrition, food safety, and food consumption considerations required to provide adequate nutrition for a diverse and growing population. Adoption of sustainable agricultural practices to improve food safety and nutrition for people, while reducing adverse environmental impacts from climate change and food system transformation is needed. This also includes exploring and addressing the cost-effectiveness of adopting safe, organic, integrated, or other farming systems by farmers, especially smallholders. In fact, despite the large export of rice by Vietnam, there are concerns over the low sustainability of natural resources for food production which impacts food security (Dao and Pham, 2020). However, inadequacies in access to innovation and technology prevent the food system in Vietnam from becoming safer, healthier, and globally competitive. There is also a need to strengthen the focus and impact of nutrient-sensitive agriculture interventions, leveraging entry points to improve nutrition, supporting farmers using sustainable practices, and adequately monitoring and evaluating nutrition impact.

The aquaculture value chain in the Mekong Delta plays an important role in local economic development. However, limited capacity in livestock and hatcheries, domestic feed development and production, investment in technology development and acquisition, and the establishment of economies of scale to reduce transaction costs are among the main factors. For the fishery value chain to realize its economic and nutritional potential, it is necessary to invest in and provide direct services – particularly in research and development, livestock and hatcheries, and support services, certification, and trade regulation.

Despite the progress in intensifying production systems and increasing the production and availability of starchy staples, there are areas of the food system that are lagging. Agriculture intensification has led to deforestation, water pollution, reduced soil health, soil erosion, and regional landscape degradation. Modernization of value chains has neglected small business producers or traditional markets and there are increasing concerns of food safety. In addition, malnutrition rates among children in the monoculture of rice and coastal areas

with shrimp monoculture were higher than in the diverse production areas (Le, et al., 2011). This necessitates a food systems approach that assesses the impact of the current practices on the environment, and food and nutrition security.

Food processing and supply chains

In addition to the formal food supply chains (official markets, supermarkets, convenience stores, etc.), informal value and supply chains (street vendors, flea markets, wet markets...) also play an important role in ensuring the livelihoods of traders, supporting the food environment of consumers in all areas, urban, peri-urban, and rural (World Bank, 2020; Huynh, 2018). Traditional markets have recently received much attention in the development strategy with a vision to 2030 by Ministry of Industry and Trade. However, investments to upgrade food outlets have generally decreased. The role of the central government and local authorities in developing policies and supporting investment in developing the infrastructure, organizational capacity, and capacity of actors is vital (World Bank, 2020). It is important that the upgrading of both formal and informal food markets does not only cater to the availability of safe, diverse, and high-quality foods but also provides foods at affordable prices, that are nutritious and acceptable. The food access by the vulnerable, low-income groups should not be compromised. Understanding and addressing the trends in food availability, affordability, and purchase in the different food markets towards healthier diets in the Mekong, as well as food marketing (especially of unhealthy foods) is underscored by the changes in population, land use and climate change.

Establishment of the Scaling Up Nutrition (SUN) business network to organize communication and advocacy to strengthen the responsibility of businesses in implementing the goals of the plan on nutrition and food systems can contribute to ensuring that supply chains also serve the vulnerable. Mobilizing businesses, charities, and relief organizations to increase support to synchronously implement actions to reduce malnutrition in poor areas and areas affected by climate change – such as the Mekong delta region. For example, this can include increasing the nutrition capacity and linkages of local value chain actors to identify and contribute to the nutrition needs (Harris, et al., 2019, Nkosinathi, et al., 2019). Furthermore, transparency in labeling, manufacturing processes and nutrient content of packaged/processed foods can contribute to awareness, promotion, and use of safe, nutritious, and high-quality foods/ products, as well as foods produced sustainably (Nguyen, et al., 2021). However, consideration of the needs and social, economic, and cultural contexts must be taken to ensure that

continued modernization or upscaling of the food system does not reduce the availability and affordability of nutritious food or negatively affect cultural identity. This is especially important for school populations, vulnerable populations, and ethnic minority groups.

In addition, it is necessary to adjust the relevant nutrition policies that are integrated into other sectors including agriculture, education, and food processing to make nutritious and healthy foods easily accessible while limiting entry to nutrient-poor, ultra-processed food (Harris, et al., 2019).

Food environment and diets

The ongoing transitions in the food environment that are impacting food access and consumption in both rural and urban areas warrant understanding and monitoring of the drivers of food and nutrition insecurity and inequalities for different groups of people/ contexts. This will contribute to targeted implementation and reduction of the inequality gap by addressing barriers and utilizing opportunities. For example, studies have reported the lack of knowledge of women and caregivers about the nutritional role of available foods. There are also prohibitions and customs that prevent the consumption of nutritious foods or limit the time for parents to provide diverse diets and optimal childcare (Nkosinathi, et al., 2019, Cam, et al., 2022). There is a need for thorough understanding of the drivers of food and nutrition insecurity and inequalities and monitoring of nutrition-related indicators across the food system. Not just rice and aquaculture production and value systems, but all foods that can provide a diverse and healthy diet in the Mekong. Followed by contextualized interventions that support diversification of production and supply chains, and of diets.

It is important that actions improving production and supply of safe, diverse, nutritious, and high-quality foods, are matched by an enhancement in the demand for and consumption of these food products in the Mekong and Vietnam as a whole. This requires awareness-raising and behavioral change strategies on nutrition and dietary diversity. Such holistic interventions will contribute to improved availability, affordability, access, and use of nutritious and healthy food. At the same time, strengthening the capacity and knowledge of nutrition, and nutrition-sensitive agri-food systems for actors participating in the food system is highly recommended (Nkosinathi, et al., 2019; Di Prima, et al., 2022).

Reports showed that the prevalence of overweight and obesity among adults and children is steadily increasing, especially in urban areas while the undernutrition rate (stunting, underweight) is relatively high among ethnic minority including the

Mekong Delta Region (Le et al., 2019). However, most of the nutrition sensitive agri-food systems interventions in Mekong Delta Region focus more on undernutrition with hardly any on overnutrition. Thus, future studies and interventions should also consider monitoring and addressing the unhealthy trend of diets in Mekong Delta Region. At the same time, addressing malnutrition among ethnic minority groups in Mekong Delta Region should not be neglected. Given the vulnerability of the Mekong delta to climate change, it is recommended that climate indicators are included into the agri-nutrition surveys and vice versa. This strengthens data-sharing and coordination mechanisms to enable monitoring and assessment of impacts on nutrition outcomes.

Policy implications

The negative effects of temperature rise on household income from livestock and fishing, weather shock on income from fruits as well as the economic downturn due to dependence on rice production show that the Mekong Delta needs specific policies and interventions to support the reconstruction of the agricultural sector (MONRE and MARD, 2013). Particularly, climate change should be considered when developing policies that promote employment transition and green agriculture that supports food and nutrition security (Espagne, et al.). Long-term vision (2100) and strategy for the safe, prosperous, and sustainable development of the Mekong Delta should include the point of view of not only reasonable socioeconomic and climate development (MONRE and MARD, 2013) but also ensuring the availability and access of nutritious foods by all people. Recommendations on strengthening intergovernmental cooperation and institutional arrangements, legislation, and financing options to drive transformation in agricultural policy, adequate land and water management, and investment rationalization industry by integrated planning and cost-benefit analysis (MONRE and MARD, 2013).

The integration of the food security strategy into the National Action Program Zero Hunger by 2025 to promote interdisciplinary cooperation between Agriculture and Health sectors to address children malnutrition issues has previously been recommended (Dao and Pham, 2020). This can particularly be targeted to include the poor and difficult areas in the Mekong Delta Region, and those vulnerable to the impact of climate change. This integration also necessitates increasing the awareness of nutrition security among the various actors and communities. A food systems approach should be also considered to

help policy makers gain insights into all the factors and interests that play a role in this region (Wageningen University & Research, 2021).

The principle of bottom-up approach should be applied in the implementation process of relevant policies in Mekong delta to achieve better outcomes on nutrition. A complete and sustainable food and nutrition monitoring information system is needed to ensure food security and nutrition security, and to enable fast decision-making on food security, especially in managing rice exports (Dao and Pham, 2020).

4. Data review

Reviewing relevant and available data sources provides important background information that enhances future nutrition-sensitive interventions. In total, 49 relevant data sources were identified for further review. Twenty-five of these were primary datasets and the remaining 24 were secondary datasets (i.e., data were re-analyses of primary data sources). The methodologies used to collect these data varied, with quantitative surveys, quantitative surveys, anthropometric assessments, focus, group discussions, and open-ended interviews.

Generally, diverse datasets related to food production, food processing & distribution, food price, incomes, food consumption, and environmental health are listed on the website of the General Statistics Office (GSO) of Vietnam, which includes the Multiple Indicator Cluster Survey (MICS) (2011, 2013 -2014); Vietnam Household Living Standard Survey (VHLSS) (2014, 2016, 2018, 2020); Rural, Agriculture, and Fishery Census (2011, 2016, 2021), and others.

Among these datasets, the Rural, Agriculture, and Fishery Census is the biggest survey that was conducted nationwide to collect basic information on rural, agriculture, and fishery to (i) assess current situations, do trend analysis, make plans, and strategies for developing the agricultural sector, rural areas and improving living standards of rural residents at the nationwide and local level; (ii) evaluate the outcome of some contents in the national target programs on industrialization, modernization of agriculture, rural and building the new rural society; ensure international comparison on indicators in the agricultural sector and rural areas; (iii) develop a database on agricultural and rural areas for depth-analysis, serve as a sampling frame for following periodical surveys.

Another big survey is the VHLSS which was conducted annually since 2011. However, the odd-numbered year surveys only collect data on demographics, employment, and income. The purpose of the VHLSS is to systematically monitor and supervise the living standards of different population groups in Viet Nam; to monitor and evaluate the implementation of the Comprehensive Poverty Reduction and Growth Strategy; and to contribute to the evaluation of the achievement of the Sustainable Development Goals (SDGs) and Vietnam's socio-economic development goals.

Datasets on food and nutrition are provided by several organizations including the National Institute of Nutrition (NIN), the United Nations International Children's Emergency Fund (UNICEF), the World Health Organization (WHO), and other agencies. In which, the biggest surveys related to nutrition in Vietnam are General Nutrition Survey (2009 – 2010, 2019 – 2020), Nutrition Surveillance

Profiles (2013), and Vietnam Food Composition Table (2007). Those datasets assessed the nutritional status, household food consumption, and related socioeconomic factors in children under 5. They also examined vitamin A supplementation and coverage, feeding practices, household food sanitation and safety knowledge, as well as health care use.

Up to now, only 1 dataset conducted by the Alliance of Bioversity and CIAT in 2018 covers quite comprehensively all domains of food systems including food production; food processing and distribution; food access and consumption; food safety, and nutrition.

Although there are a lot of data related to nutrition-sensitive agri-food systems in Vietnam, not much data is available for public access. The data review showed that very few institutional mandates aligned with the food loss and inorganic waste domain. Therefore, enabling access to data is crucial to inform relevant stakeholders and enhance their knowledge and capacity for decision-making related to nutrition-sensitive agri-food systems in Vietnam. Further details can be found in the Data Characterization Excel file.

Table 1. Key characteristics of the selected data sources

Characteristic	Distribution of the 49 data sources
Domain	Food production (23), Food processing and distribution (16), Food availability and access (2), Food and water safety (22), Nutrition (25), Environmental health (17), Sociopolitical context (17)
Method	Household survey (17), Multiple (8), Household census (3), Randomized Control Trial (4), Government Record (4), Mixed (1)
Geography	Region & Eco region (4), International (4), National (12), Province (14), District (2), Commune (6), City (1), Community (1)
Scope	National representative (30), Region (2), Province & Selected provinces (4), (District & Selected districts (4), City (5)
Total sample size	Min = 180 (district), Max = 16150000 (households)
Report type	Primary report (25), Secondary data (24)

5. Conclusion

The review of literature showed an array of evidence of efforts in different parts of the food system, especially food production, food supply chains, and the food environment/nutrition. A lot of progress has been made especially regarding starchy staples. There is still need for more comprehensive efforts to increase the availability and access of diverse diets. In addition, there are concerns that reflect a need for more nutrition-sensitive research and interventions in the areas of sustainable practices, formal and informal food markets, food safety, market and nutrition information, and the growing inequities in terms of participation, benefits and availability and access to diverse foods, especially those related to the poor, minority ethnic groups and vulnerable regions. This is crucial given the rapid changes in climate, land use, population, socio-economic development, and diets. While the review aimed to emphasize the nutrition-sensitive agri-food system situation in the Mekong delta, there was limited literature that met the inclusion criteria. This reflects the need for more documentation, assessments and interventions that take food systems approach.

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Annex 1. List of selected literature

No.	Document title/File name	Authors	Publication year	Main food system topic	Subtopic: food system
1	Climate Change in Vietnam's Impacts and adaptation	Etienne Espagne	2021	6. Climate change	Climate change's impact and adaptation on production; nutrition and food security
2	Diets, Food Choices, and Environmental Impacts across an Urban-Rural Interface in Northern Vietnam	Huong Trinh	2021	5. Food environment/ nutrition	Availability; access; affordability; preference; consumption
3	Vietnam Food Systems: Summary of available data	Dharani Dhar Burra	2019	1. Production 2. Supply chains 3. Processing; 4. Natural resource management; 5. Food Environment and Nutrition	1. Production: land use and soil; production system; climate mitigation/ adaptation; seeds or other inputs; food safety (farm level) 2. Supply chains: formal markets; informal markets; distribution and transportation; food safety 3. Processing: storage; value addition; packaging; traceability; food safety 4. Nature resource management: water; forests; (provide possible sub-topics based on the literature; links to food; delta level and not farm level) 5. Food environment/ nutrition: availability; access; affordability; preference; consumption
4	Vietnam Sustainable Food Systems Profile	Ricardo Hernandez	2020	1. Production 2. Supply chains 3. Processing; 4. Natural resource management; 5. Food Environment and Nutrition	1. Production: land use and soil; production system; climate mitigation/ adaptation; seeds or other inputs; food safety (farm level) 2. Supply chains: formal markets; informal markets; distribution and transportation; food safety 3. Processing: storage; value addition; packaging; traceability; food safety 4. Nature resource management: water; forests; (provide possible sub-topics based on the literature; links to food; delta level and not farm level) 5. Food environment/ nutrition: availability; access; affordability; preference; consumption

No.	Document title/File name	Authors	Publication year	Main food system topic	Subtopic: food system
5	Interactions between Food Environment and (Un)healthy Consumption: Evidence along a Rural-Urban Transect in Viet Nam	Trang Nguyen	2021	5. Food environment/ nutrition	5. Food environment/ nutrition: availability; access; affordability; preference; consumption
6	"Partial Food Systems Baseline Assessment at the Vietnam Benchmark Sites"	Huynh Thi Thanh Tuyen	2018	5. Food environment/ nutrition	5. Only food environment/ nutrition (>2 area): availability; access; affordability; preference; consumption
7	Rapid Diagnostic Assessment of the Food Systems and Food Safety Hazards	WorldBank, Rikolto, ABC and TAF	2020	1. Production 2. Supply chains 3. Processing	1. Production: production system 2. Supply chains: formal markets; informal markets; distribution and transportation; food safety 3. Processing: storage; value addition;
8	Determining Key Research Areas for Healthier Diets and Sustainable Food Systems in Viet Nam	Jessica E. Raneri	2019	2. Supply chains	Consumption
9	"Persistent Malnutrition in Ethnic Minority Communities of Vietnam Issues and Options for Policy and Interventions"	Nkosinathi V. N. Mbuya	2019	1. Production 2. Access	1. Production: Zero hunger, holistic program and new rural development programs 2. Supply chains: School milk"
10	An assessment of potential green and sustainable shrimp and dragon fruit supply chains in Bac Lieu and Binh Thuan provinces	Nghia Dai Tran	2020	2. Supply chains	2. Supply chains: formal markets, transportation
11	Food Systems Profile along a rural-urban transect in North Vietnam	Tuyen Huynh	2020	1. Production 2. Supply chains 3. Processing; 4. Natural resource management; 5. Only food environment/ nutrition (>2 areas)	1. Production: production system 2. Supply chains: formal markets; informal markets, distribution & transportation 3. Processing: storage; packaging 5. Only food environment/ nutrition (>2 area): availability; access; affordability; preference; consumption
12	Production, Consumption, and Food Security in Viet Nam Diagnostic Overview	Chungmann Kim	2021	1. Production	1. Production: production system 5. Only food environment/ nutrition (>2 areas):Consumption

No.	Document title/File name	Authors	Publication year	Main food system topic	Subtopic: food system
				5. Only food environment/ nutrition	
13	Exploring solution spaces for nutrition-sensitive agriculture	C. Timler	2019	1. Production 5. Only food environment/ nutrition	1. Production: production system 5. Only food environment/ nutrition (>2 areas): consumption"
14	"Home-Grown School Feeding: Implementation Lessons From a Pilot in a Poor Ethnic Minority Community in Vietnam"	Sabina Di Prima	2022	1. Production 5. Consumption	1. Production: production system 5. Only food environment/ nutrition (>2 areas): consumption "
15	Mekong delta plan	MONRE and MARD	2013	1. Production	1. Production: land use and soil; production system; food safety 4. Nature resource management: water (delta level) 5. Only food environment: availability; access; consumption"
16	Critical topics in Vietnam and Ethiopia's	Owili, J.	2021	1. Production 2. Supply chains 3. Processing; 5. Food environment	1. Production: production system; other inputs; food safety 2. Supply chains: distribution; food safety 3. Processing: storage; packaging; food safety 5. Food environment/ nutrition (>2 areas): affordability; consumption "
17	The Indirect Impact of Smallholder Vegetable Production on Children's Nutrition Outcomes in Rural Vietnam	Christian Genova	2022	1. Production 2. Supply chains 5. Nutrition	1. Production: vegetable production system 2. Supply chains: formal markets 5. Nutrition"
18	Household Food Insecurity in Regions of the Vietnamese Mekong Delta Prevalence and Risk Factors	Thuy Ngoc Vuong	2022	5. Only food environment/ nutrition	5. Only food environment/ nutrition (>2 areas): availability and food security (access; affordability, food consumption)
19	A food-system approach to addressing food security and chronic child malnutrition in Northern Vietnam	Cecilia Rocha	2022	1. Production 2. Supply chains 3. Processing;	1. Production: crop production system 2. Supply chains: formal markets; distribution and transportation 3. Processing: packaging, value addition, traceability

No.	Document title/File name	Authors	Publication year	Main food system topic	Subtopic: food system
				5. Only food environment/ nutrition	5. Only food environment/ nutrition (>2 area): availability; access; affordability; preference; consumption "
20	Nutrition transition in Vietnam: changing food supply, food prices, household expenditure, diet, and nutrition outcomes	Jody Harris	2020	2. Supply chains 5. Only food environment/ nutrition	2. Supply chains: formal markets 5. Only food environment/ nutrition (>2 area): availability; access; affordability; consumption"
21	Qualitative evidence for improved caring, feeding, and food production practices after nutrition-sensitive agriculture interventions in rural Vietnam	Dai Dinh Nguyen	2022	1. Production 5. Food environment/ nutrition	1. Production: production system 5. Only food environment/ nutrition (>2 areas): Consumption
22	Understanding maternal food choice for preschool children across urban-rural settings in Vietnam	Cam Nguyen	2022	5. Only food environment/ nutrition	availability; access; affordability; preference; consumption
23	Nutrition landscape and climate in Vietnam: Identifying climate service entry points	Pranav Singh	2019	5. Only food environment/ nutrition (>2 area) 6. Climate change	5. Only food environment/ nutrition (>2 area): availability; access; affordability; preference; consumption 6. Climate change
24	Household Dietary Diversity among the Ethnic Minority Groups in the Mekong Delta: Evidence for the Development of Public Health and Nutrition Policy in Vietnam	Le Ngoc Hiep	2023	5. Only food environment/ nutrition	5. Only food environment/ nutrition (>2 area): availability; affordability; consumption
25	Factors affected child malnutrition in agriculture region in the Mekong Delta	Le Canh Dung	2011	5. Only food environment/ nutrition	5. Only food environment/ nutrition (>2 area): availability; affordability; consumption
26	New challenges for food security in Vietnam	Dao The Anh	2020	1. Production 2. Supply chains 3. Processing; 4. Natural resource management;	1. Production: land use and soil; production system; climate mitigation/ adaptation; seeds or other inputs; food safety 2. Supply chains: formal markets; informal markets; distribution and transportation; food safety 3. Processing: storage; value addition; packaging; traceability; food safety

No.	Document title/File name	Authors	Publication year	Main food system topic	Subtopic: food system
				5. Only food environment/ nutrition (>2 area) 6. Climate change	4. Nature resource management: water; forests; 5. Only food environment/ nutrition (>2 area): availability; access; affordability; preference; consumption

Annex 2. List of data sources

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
1	2010 Micronutrient Survey	NIN, GAIN	2010	Nutrition	survey_HH	province	region		2112	2010 Micronutrient Survey
2	A Review of the Nutrition Situation in Vietnam 2009-2010	NIN	2009-2010	Food access and consumption; Food and water safety; Nutrition; Sociopolitical context	survey_HH	province	nat_rep	yes	94256	A Review of the Nutrition Situation in Vietnam 2009-2010
3	Agriculture in Vietnam and the Status of Pesticides Market	VIPA		Food production; Food processing and distribution; Food and water safety; Environmental Health		National	nat_rep			Agriculture in Vietnam and the Status of Pesticides Market
4	Alive & Thrive Baseline Survey	A&T	04/2010-06/2010	Food access and consumption; Food and water safety; Nutrition	multiple	commune	sel_province		3075	Alive & Thrive Baseline Survey
5	Alive & Thrive Endline Survey	A&T	2014	Food access and consumption; Food and water safety; Nutrition	multiple	commune	sel_province		4002	Alive & Thrive Endline Survey
6	Alive & Thrive Program Impact Pathway Analysis	A&T	2010-2013	Food access and consumption; Nutrition	mixed	commune	sel_province		2337	Alive & Thrive Program Impact Pathway Analysis
7	Animal Source Food Supplementation and Pregnancy in Vietnam	NIN	01/2011-05/2016	Food access and consumption; Nutrition	RCT	commune	District		451	Animal Source Food Supplementation and Pregnancy in Vietnam
8	Climate Change Impacts on Agriculture in Vietnam	FAO	2011	Food production; Environmental Health	proj	eco_region	nat_rep			Climate Change Impacts on Agriculture in Vietnam

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
9	FAO Statistical Yearbook 2014	FAO	01/2007-09/2013	Food production; Food processing and distribution; Food loss and inorganic waste; Food access and consumption; Food and water safety; Nutrition; Sociopolitical context; Environmental Health	records_gov	International	nat_rep			FAO Statistical Yearbook 2014
10	FAO-Aquastat_2011	FAO		Food production; Food access and consumption; Food and water safety; Environmental Health		eco_region	nat_rep	yes		FAO-Aquastat_2011
11	Food and Agricultural Import Regulations and Standards - Narrative. FAIRS Country Report Vietnam	USDA-GAIN		Food production; Food processing and distribution; Food access and consumption; Food safety; Sociopolitical context	records_gov	National	nat_rep			Food and Agricultural Import Regulations and Standards - Narrative. FAIRS Country Report Vietnam
12	Food systems profile along a rural-urban transect in North Vietnam	Alliance of BI&CIAT	2018	Food production; nutrition; Food processing and distribution; Food access and consumption; Food safety; Sociopolitical context	survey	province	City			Food systems profile along a rural-urban transect in North Vietnam
13	General Nutrition Survey 2009-2010	NIN	2009-2010	Food access and consumption; Food and water safety; Nutrition	survey_HH	province	nat_rep	yes	130010	General Nutrition Survey 2009-2010
14	General Nutrition Survey 2019 - 2020	NIN	2019-2020	Food access and consumption; Food and water safety; Nutrition	survey_HH	province	nat_rep	yes		General Nutrition Survey 2019 - 2020
15	Global Dietary Database	Tufts		Food access and consumption						Global Dietary Database
16	Global Estimates and Regional Comparisons of	WHO	2010-2015	Food access and consumption	multiple	International	nat_rep			Global Estimates and Regional Comparisons of

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
	the Burden of Foodborne Disease in 2010									the Burden of Foodborne Disease in 2010
17	Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition & Sustainable Development	IFPRI	2015	Food access and consumption; Nutrition; Sociopolitical context	multiple	International	nat_rep			Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition & Sustainable Development
18	Impact Evaluation of a Social Franchise Model Implemented by Alive & Thrive for Improving Infant and Young Child Feeding and Child Nutrition in Rural Vietnam	IFPRI	04/2010-08/2014	Food access and consumption; Nutrition	RCT	commune	sel_pro		4000	Impact Evaluation of a Social Franchise Model Implemented by Alive & Thrive for Improving Infant and Young Child Feeding and Child Nutrition in Rural Vietnam
19	Multiple Indicator Cluster Survey 2011	GSO	2011	Food access and consumption; Food and water safety; Nutrition; Sociopolitical context	survey_HH	province	nat_rep		13143	Multiple Indicator Cluster Survey 2011
20	Multiple Indicator Cluster Survey 2013-2014	GSO	12/2013-04/2014	Food access and consumption; Food and water safety; Nutrition; Sociopolitical context	survey_HH	province	nat_rep		13143	Multiple Indicator Cluster Survey 2013-2014
21	Nutrition status of children in Ban Pho and Thao Chu Phin communes, Lao Cai 2014	UNICEF	2016		focus_group	commune	province			Nutrition status of children in Ban Pho and Thao Chu Phin communes, Lao Cai 2014
22	Nutrition Surveillance Profiles 2013	NIN	06/2013-09/2013	Food access and consumption; Nutrition	survey_HH	province	nat_rep		99450	Nutrition Surveillance Profiles 2013

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
23	"Partial Food Systems Baseline Assessment									"Partial Food Systems Baseline Assessment
24	at the Vietnam Benchmark Sites"	Alliance of BI&CIAT	2020	Food production; nutrition; Food processing and distribution; Food access and consumption; Food safety; Sociopolitical context	Survey_hh	province	City			at the Vietnam Benchmark Sites"
25	Pesticide use in Vietnamese vegetable production: a 10-year study	Vietnam National University of Agriculture, Wageningen University	1999-2013	Food production; Sociopolitical context	survey_HH	District	sel_dist	yes, Dong Anh district of Hanoi	30-32 farms per monitoring period	Pesticide use in Vietnamese vegetable production: a 10-year study
26	Rural, Agriculture, and Fishery Census 2011	GSO	07/2010-07/2011	Food production; food processing and distribution; Food and water safety; 27Sociopolitical context; 28Environmental health	survey_census	National	nat_rep	yes	16,150,000	Rural, Agriculture, and Fishery Census 2011
27	Rural, Agriculture, and Fishery Census 2016	GSO		Food ²⁹ production; food processing ³⁰ ing and distribution ³¹ n; Food and water safety ³² ; Sociopolitical context; Environmental Health	survey_census	National	nat_rep	yes		Rural, Agriculture, and Fishery Census 2016
28	Rural, Agriculture, and Fishery Census 2021	GSO		Food production; food processing and distribution; Food and water safety; Sociopolitical context; Environmental Health	survey_census	National	nat_rep	yes		Rural, Agriculture, and Fishery Census 2021
29	South East Asian Nutrition Study	NIN	03/2011-05/2011	Food access and consumption; Nutrition	survey_HH	region	nat_rep		2872	South East Asian Nutrition Study
30	Statistical Data GSO-Administrative Unit and Climate	GSO	2013-2015	Food production; Environmental Health			nat_rep			Statistical Data GSO-Administrative Unit and Climate

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
31	Statistical Data GSO-Agriculture, Forestry, and Fisheries	GSO		Food production; Environmental Health			nat_rep			Statistical Data GSO-Agriculture, Forestry, and Fisheries
32	Statistical Data GSO-Health, Culture, and Life	GSO		Food loss and inorganic waste; Food access and consumption; Food and water safety; Sociopolitical context			nat_rep			Statistical Data GSO-Health, Culture, and Life
33	Sustainable Micronutrient Interventions to Control Deficiencies and Improve Nutritional Status and General Health in Asia food composition table for Vietnam	NIN	2013	Food access and consumption; nutrition	multiple	National				Sustainable Micronutrient Interventions to Control Deficiencies and Improve Nutritional Status and General Health in Asia food composition table for Vietnam
34	The food system transformation in developing countries: A disaggregate demand analysis for fruits and vegetables in Vietnam	University of Hohenheim, Stuttgart Germany	2005	Food availability and access; Food processing and distribution; Food and water safety	survey_hh	National	City		499	The food system transformation in developing countries: A disaggregate demand analysis for fruits and vegetables in Vietnam
35	The Role of Agricultural Biodiversity in The Diet: A Vietnamese Study	Bioversity	11/2015-12/2016	Food access and consumption; Nutrition; Environmental Health	RCT	District	District	maybe	180	The Role of Agricultural Biodiversity in The Diet: A Vietnamese Study
36	Vegetable Production in the RRD of Vietnam	Hanoi University of Agriculture, Wageningen University		Food production; Food access and consumption; Sociopolitical context	multiple	eco_region	region			Vegetable Production in the RRD of Vietnam

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
37	Vietnam Country Profile	World Bank	2009-2015	Food access and consumption; Food and water safety; Nutrition; Sociopolitical context; Environmental Health		National	nat_rep			Vietnam Country Profile
38	Vietnam Customs Statistics: Monthly Imports and Exports	VCS	May 2017	Food production; Food processing and distribution	records_gov	National	City			Vietnam Customs Statistics: Monthly Imports and Exports
39	Vietnam Household Living Standard Survey 2014	GSO	2014	Food production; Food processing and distribution; Food loss and inorganic waste; Food access and consumption; Food and water safety; Sociopolitical context; Environmental Health	survey_HH	province	nat_rep		46995	Vietnam Household Living Standard Survey 2014
40	Vietnam Household Living Standard Survey 2016	GSO	2016	Food production; Food processing and distribution; Food loss and inorganic waste; Food access and consumption; Food and water safety; Sociopolitical context; Environmental Health	survey_HH	province	nat_rep			Vietnam Household Living Standard Survey 2016
41	Vietnam Household Living Standard Survey 2018	GSO	2018	Food production; Food processing and distribution; Food loss and inorganic waste; Food access and consumption; Food and water safety; Sociopolitical context; Environmental Health	survey_HH	province	nat_rep			Vietnam Household Living Standard Survey 2018
42	Vietnam Household Living Standard Survey 2020	GSO	2020	Food production; Food processing and distribution; Food loss and inorganic	survey_HH	province	nat_rep			Vietnam Household Living Standard Survey 2020

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
				waste; Food access and consumption; Food and water safety; Sociopolitical context; Environmental Health						
43	Vietnam pre-conceptual micronutrient supplementation trial	NIN	10/2011-09/2014	Food access and consumption; Food and water safety; Nutrition	RCT	province	province	no	5011	Vietnam pre-conceptual micronutrient supplementation trial
44	Vietnam RDAs	NIN	2007	Nutrition	multiple	National	nat_rep			Vietnam RDAs
45	Vietnam's Sustainable food systems profile	Alliance of BI&CIAT	2020	Food production; Nutrition; Food processing and distribution; Food access and consumption; Food safety; Sociopolitical context	Profile	National	nat_rep			Vietnam's Sustainable food systems profile
46	Vietnamese Food Composition Table	NIN	2007	Food availability and access; nutrition						Vietnamese Food Composition Table
47	Vitamin D status and parathyroid hormone in an urban population in Vietnam		04/2009-10/2009	Nutrition	survey_hh	City	City	no	637	Vitamin D status and parathyroid hormone in an urban population in Vietnam
48	World Agricultural Outlook Database	FAPRI	May 2011	Food production	records_gov	International	nat_rep			World Agricultural Outlook Database

No.	Data Source	Organization	Date Collected	Domain	Method	Geography	Scope	Study Site	Total Sample Size	Data Source
49	World Rice Statistics	IRRI		Food production; Food processing and distribution; Food loss and inorganic waste; Food access and consumption; Environmental Health	multiple	National	nat_rep			World Rice Statistics



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The **Initiative on Asian Mega-Deltas** (AMD) aims to create resilient, inclusive and productive deltas, which maintain socio-ecological integrity, adapt to climatic and other stressors, and support human prosperity and wellbeing, by removing systemic barriers to the scaling of transformative technologies and practices at community, national and regional levels.

