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Toward a sustainable food system and agroecology transition in Vietnam

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Abstract:

Even with the impressive results of agricultural growth and food security during last nearly 40 years of Renovation, the Vietnam Socio-economic Development Strategy for 2021-2030 seeks to accelerate agricultural restructuring and develop a modernity-oriented agriculture. Vietnam also aims to improve the resilience and adaptability of the agricultural sector against climate change, and to align this sector with the processing industry, markets, export activities, and global value chains. In 2021, Vietnam has actively contributed to United Nations Food System Summit (UNFSS) dialogue with more than 1000 participants involved in National Dialogues. Vietnam is willing to contribute to the transformation of global food systems as a food-providing country that upholds "transparency, responsibility, and sustainability". This will serve to create comprehensive and sustainable breakthroughs for the entire system and will fulfill the 2030 Sustainable Development Goals (SDGs). For the solution, Vietnam wishes to become a Food Innovation Hub of Asia. Vietnam has made digital transformation a key priority in the agricultural sector and has encouraged the application of digital technology to agricultural production and business activities. Vietnam's food systems need to be transformed into green, sustainable, and low-emission agriculture and due attention should be given to agroecological production. Vietnam also commits to achieving nutrition security in 2030. A National Action Plan for a sustainable food system will be built.

Keywords: **agroecology, food system, sustainable, Vietnam.**

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1. Introduction

Vietnam is a country with a small land area of 33 million hectares, of which agricultural and forestry land takes up about 26.0 million hectares (with 10.3 million hectares of agriculture and close to 16.0 million ha is forestry land) with per capita agricultural land among the lowest in the world. Over the past few decades, Vietnam's food system has undergone landmark development stages since starting as one of the poorest countries in the late 1980s - early 1990s with 60% of the population living below the poverty line. Thanks to the "Doi Moi" - Renovation decision of the Party and State in 1986, Vietnam has basically escaped poverty and ensured a

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balance in terms of food in 2000. In 2020, the population of Vietnam reached 97.7 million people and with each year the population has increased by about 1 million people. Vietnam's agriculture plays a particularly important role in ensuring food security, social stability, and livelihoods for over 60% of the population living in rural areas contributing 14.85% of the country's GDP and about 35% of the workforce.

Up to now, Vietnam has become one of the most important food exporting countries that contribute to ensuring world food security. Over the past ten years, Vietnam has always been one of the top four rice exporting countries in the world. Not only stopping at essential food items, Vietnam has risen to become one of the two leading coffee exporting countries in the world. Vietnam is also a large and important exporter of seafood, cashews, and vegetables. It is estimated that 50% of food production in Vietnam is for export. Despite the impact of the COVID-19 pandemic, climate change, and natural disasters, Vietnam's agriculture has maintained a positive growth rate of 2.68% in 2020 and 2.9% in 2021. In addition to firmly ensuring food security, domestic food, and export of 6.15 million tons of rice in 2020, Vietnam's agricultural export turnover reached 41.53 billion USD. Particularly, in 2021, agricultural exports have established the record with 48.6 billion USD, contributing to national and world food security [1].

Although Vietnam has made great progress in reducing poverty, ensuring food security, and promoting economic growth as well as socio-economic development over the past 30 years, agricultural and rural communities continue to be among the poorest and most vulnerable, especially in the face of climate change, emerging diseases, and market fluctuations. The agriculture and food sectors, by far the most important source of livelihood for the people of Vietnam, urgently need continued efforts to reduce poverty and address the growing challenges facing agricultural development villages. Despite an overproduction of food, the challenges of child malnutrition and food accessibility remain high in some mountainous areas and ethnic minorities.

The impressive growth rate of the agricultural sector in recent decades with the strategy of high intensification has caused impacts on the environment, especially the pollution of soil and water resources due to the overuse of various agrochemicals, antibiotics, non-biodegradable waste generation, deforestation, biodiversity loss, erosion of native plant materials, soil and ecosystem degradation, and greenhouse gas emissions, which are all leading to large scale rural-to-urban migration. Vietnam's agricultural industry consists of mainly small-scale farmers with typical characteristics of limited labour productivity, fragmentation and consumption of products through intermediaries, few job opportunities, low wages for workers, and low agricultural movement. In addition, agricultural products are mainly raw, with only a very small amount of value-added content, which has not yet met food safety standards partly due to limitations in technological innovation and governance institutions.

Farmers have few conditions to access markets or learn market information. Although they participate in value chains - often it is only at the stage of providing raw materials and only a small role in adding value to agricultural products. A new form of Agricultural Cooperatives (according to the Cooperative Law 2012) has just been established thus the capacity to support farmers in market participation is still limited. Meanwhile, processing and exporting enterprises continue to dominate a number of key agricultural products and especially export markets.

In order to have integrated review of interlinkages between sectors such as agriculture, trade, health, and environment related food systems with an improved capacity to leverage changes, it is necessary to have a food system approach. Therefore, this article will address the following main questions: What are the problems of Vietnam's current food system? What are the solutions to achieve a sustainable food system? And finally, what are the roles of agroecology?

2. Method and research context

This article uses a review method based on desk study of scientific and grey literatures such as published guidelines of the Food and Agriculture Organization of the United Nations (FAO) and other UN agencies, Vietnam policy documents such as Vietnam's National Food System Action Plan: Food System Transition to Transparent, Responsible, and Sustainable Food Systems by 2030; Plan to Restructure Vietnam's Agriculture Sector for the period 2021-2025; National Target Program on Sustainable Poverty Reduction for the period 2021-2025; One commune - One product (OCOP) Program, National Action Program Zero Hunger by 2025; National Target Program for Socioeconomic Development in Ethnic Minority and Mountainous Areas to 2030; the Construction of new rural development to 2030, and the National Nutrition Strategy to 2030. It also benefits from an insider view into the United Nations Food System Dialogue process that took place globally and in Vietnam in 2021.

The UNFSS 2021 was an event called by the UN Secretary - General to World Leaders. In order to prepare for participation in the dialogue, the leaders of the participating countries have to form a consensus to promote collective action on food system transformation in order to achieve the 17 SDGs by 2030. In preparation for participation in the dialogue during the 2021 UNFSS, Vietnam organised National Dialogues including 2 rounds of National Dialogue and 3 Regional Dialogues at the northern, central and southern levels in June and July 2021. The National and Regional Dialogues have the following common goal: "Through open dialogue with stakeholders, identify the most important strengths, weaknesses and opportunities in the Vietnamese Food System in order to achieve Zero Hunger and Poverty Reduction objectives by 2030 and the 17 SDGs of the 2030 Agenda". The National Dialogues, with an interdisciplinary approach guided by the UN, were a great opportunity to evaluate Vietnam's recent achievements in agricultural production as well as poverty reduction and

nutrition improvement with multi-stakeholder participation.

3. Results and discussion

3.1. Diagnosis regarding Vietnam agriculture's changes since the Renovation

Over the past 30 years of Renovation, the state has had a number of policies to recommend technical advances with characteristics of agroecology, but there still exists a gap in integrated solutions including socio-economic interventions in order to support the connection between agroecological production and markets for agroecological products. Besides, up to now, Vietnam did not have a policy on the orientation of agroecology in general, but only a policy to encourage specific agroecological practices. Moreover, support policies have been inconsistent such that the impact on the output of the agricultural products has not been significant.

Vietnam needs to take drastic action to make progress in smartly adapting to the increasingly severe impacts of natural disasters and climate change, using natural resources efficiently and sustainably, increasing national capacity in the volatile commercial environment, and significantly improving and diversifying the sources of livelihood and income for farmers with the implementation of safeguards for residents and the environment in a sustainable way.

The COVID-19 pandemic has revealed some serious weaknesses and instabilities in global food supply chains. The pandemic has resulted in major disruptions to established supply chains as well as bottlenecks in the labour market, input material supply, agricultural production, agricultural processing, transportation, and logistics. The pandemic has severely affected human health, economies, trade, and social security on a global scale. It has also resulted in increasing rates of food and nutrition insecurity and poverty to re-emerge in many countries.

It is now clear that increasing scarcity of resources for agricultural production, combined with the global shocks of the COVID-19 pandemic and the impacts of climate change, are now the biggest challenges to food security not only in Vietnam but also for the world [2].

In Vietnam, the Prime Minister has issued a National Action Plan to implement the 2030 Agenda for Sustainable Development (Decision No. 622/QD-TTg dated May 10, 2017), including 115 specific goals corresponding to 17 SDGs. Vietnam is also the first country in Southeast Asia to commit to implementing the National Action Program Zero Hunger by 2025 to realise the SDG2 to eliminate hunger, ensure food security, improve nutrition, and develop sustainable agriculture in line with the National Target Program on Sustainable Poverty Reduction being implemented in Vietnam.

Currently, Vietnam is in the process of restructuring the agricultural industry towards increasing added value and sustainable development, optimising production costs, taking into account emerging factors such as liberalization trade, climate change,

disease risk, smart agriculture, and food loss control. The National Target Programs of New Rural Development, Sustainable Poverty Reduction, Socio-economic Development in ethnic minority and mountainous areas and many other programs and projects of the Government in the coming period have been implemented. There are new orientations to the development of highly local and indigenous food production systems such as the OCOP Program and attention to food safety and disease combined with the development of agricultural and rural tourism. These are expected to contribute to promoting the improvement of the food system in the intermediate term.

In order to promote the collective actions and integration of different activities related to the food system, a series of dialogues about food system transformation proposed by FAO (2018) [3] were organised. The theme of the dialogue was Vietnam's Food System Roadmaps to More Transparent, Responsible, and Sustainable Food Systems by 2030. Contents of the Food System Dialogues of Vietnam were taken from a national and regional perspective, which focused on five main action tracks to point out challenges, opportunities, and priority solutions that need to be selected in the current context: (1) Ensuring everyone has access to safe and nutritious food; (2) Shifting to sustainable consumption; (3) Promotion of sustainable food production; (4) Forming a competitive, inclusive, and equitable value chain; and (5) Increasing resilience to shocks, stress, and vulnerability.

Through the dialogues, the Government of Vietnam has become very aware that there must be close cooperation among nations and actors in the food industry to jointly create widespread and lasting changes across the whole system. These changes will also contribute to poverty reduction and ensure food and nutrition security in rural, remote and ethnic minority areas and for vulnerable groups like women and children. In addition, this is also an opportunity to connect and develop the key agricultural value chains of Vietnam in a transparent, responsible, and sustainable manner. Therefore, Vietnam welcomes and highly appreciates the call of the UN Secretary General for the UN Food Systems Summit in 2021 and this bold direction for food systems and joint efforts to achieve the SDGs by 2030.

3.2. Food system issues that Vietnam should tackle today

Vietnam's food system is diverse and faces many challenges. The dialogue also pointed to the potential for dual effects, which arise when multiple impacts occur together, especially for vulnerable communities. These are complex and interrelated issues that require multi-sectoral, multi-level, and multi-partner cooperation as well as appropriate policy tools and communication.

Forecasts and realities of climate change and global disaster risks in recent years show that Vietnam is one of the nation's most heavily affected by climate change. Floods, droughts, saltwater intrusion, pests, and diseases often occur causing a loss equivalent to 2% of the

annual GDP. The COVID-19 pandemic has caused fundamental breaks in the global food supply chain, and Vietnam is no exception. Indeed, the recent global pandemic poses a challenge to strengthen the resilience capacity of the food production and supply system.

Vietnam's food productivity and output over the past three decades has steadily grown. It is the result of the goal-oriented strategy to increase productivity and output. This also leads to the consequence that natural resources are reduced and accompanied by concerns about quality deterioration (nutrients and micronutrients), food hygiene, and safety. Excessive use of chemicals and inputs in production (herbicides, pesticides, antibiotics, fertilizers and irrigation) pollutes the environment and affects food quality and safety and causes an increase in the production cost of agricultural products thereby reducing the income of producers. Intensified production systems, inadequately controlled pollution and increased greenhouse gas emissions have degraded land, water, aquatic resources, and biodiversity while contributing to climate change. The inefficient, undiversified, and unsustainable production and use of natural resources have increased the vulnerability of food systems to markets, diseases, climate change, natural disasters, shocks, and risk pressures outside of the system. The rate of food loss and waste in Vietnam remains high. The less use and reuse of agricultural by-products leads to inefficient use of natural resources and increasing negative impacts on the environment. Meanwhile, financial incentives, skills, and the information needed to apply sustainable good production practices, climate-smart agriculture (CSA), and agroecological farming methods are limited.

There are still many problems in the production value chain and the market. The small, intensive, and fragmented food production system and the lack of economies of scale in value chains make it difficult to expand the adoption of advanced technologies, agroecological practices, and industrial processing systems in the country. Small scale producers, cooperatives, and small and medium-sized enterprises are often unable to meet the requirements of higher quality and value products for the domestic and export markets. This is due to restrictions on innovation such as weak access to market information, new technologies, technical support and training, as well as a lack of innovative financial services (especially technological and digital solutions) to provide credit, financing/borrowing, savings, insurance, and payment systems. The performance of new cooperatives and associations by industry is limited due to weak financial governance and weak linkages to the market and the private sector [4].

Limited investment in the management of stages from harvesting, post-harvest, food preservation, storage, and food processing, as well as limited investments into functional systems for traceability, increasing food loss and waste products, reducing options for value-adding and producing safe and nutritious food that limits access to higher-value markets domestically and internationally. Lack of

cooperation in production leads to low quality and added value, unequal distribution of benefits and responsibilities, and fragile supply chains. In addition, the rapid shift of the young workforce to other economic sectors not only leads to the risk of losing motivation to produce, create, apply technology, and digitise to transform the system, but also requires capital investment and mechanization to replace human labour forces. The gap of incentive policies for private sector investment in transport, logistics, storage, distribution and cold storage/transportation infrastructure limits the ability to connect to the market, increases transaction costs and reduces post-harvest quality. The capacity to implement and enforce international trade agreements and negotiations is still limited [5].

The rate of malnutrition in Vietnam is still high, especially for some regions with difficult natural and economic conditions such as the northern mountainous region and the Central Highlands due to limited access and availability of nutritious and affordable food for the poor and vulnerable [6]. In contrast, obesity rates in urban areas are rapidly increasing. Malnutrition of children, micro-nutrient deficits, and obesity create a triple burden on national nutrition security. This is because the majority of the population is not fully aware of and has not fully formed nutritionally balanced eating habits, especially for micronutrients [7]. Similarly, citizens are not paying enough attention to nutrition and health; not to mention changing awareness, habits, and trends of responsible consumption and green consumption, which aim to support and protect the livelihoods of the poor, fight against loss and waste, protect the environment, and diversify biology, and emission reduction. Further, they have not yet paid attention to the development, production, and use of local healthy foods rich in nutrients and micronutrients. There remains a large gap of information on nutrition and food safety causing difficulties for consumers due to weak systems of quality control, safety, traceability, and food integrity [1].

3.3. The strategy of Vietnam to tackle food system issues

In the political report, the Communist Party emphasised the orientation toward agroecology and a circular and green economy by 2030 [8]. In response to the food system issues, Vietnam needs bold and urgent collective actions to achieve progress in smart adaptation to increasingly serious impacts of disasters and climate changes, effective and sustainable use of natural resources, national capacity building in an unpredictable business environment, considerable improvement and diversification of livelihoods and income of farmers - together with implementation of sustainable social and environmental safeguards.

Agriculture is a key component in the Vietnamese food system. The development of Vietnam's agricultural sector towards a multi-purpose approach aims to: (a) continue to transform into an increasingly powerful supplier of agricultural commodities that serve the needs of volume and quality growing of domestic market as well as export;

(b) climate-smart adaptation, protection of resources, ecosystems and biodiversity; and (c) provide a sustainable source of livelihood while ensuring social security, especially for the poor in rural areas. This is demonstrated in many programs/action plans and strategies. The national strategy has been issued by the Government and the Ministry of Agriculture and Rural Development with the goal of Vietnam's agricultural brand being known as a "food supplier that is responsible, transparent and sustainable" [6].

Besides the Government's activities, there are many programs, projects, and investments in place such as the investments and initiatives being carried out in the food sector by the private sector, many multilateral and bilateral donors, national and international research and development organizations, as well as non-governmental organizations, industry associations and civil society groups.

In what follows, we discuss the specific groups of solutions that were proposed based on the results of National Food System Dialogues to address these challenging issues [9].

3.4. Solutions to promote food production towards agroecology and sustainability

The theoretical framework of agroecology:

According to M.A. Altieri (1995) [10], agroecology is a method of farming that is based as much as possible on the best use of nature's functions. Agroecology is the main content of sustainable agriculture and food system. According to FAO (2019) [11], a new agroecological concept is an integrated approach that simultaneously applies both ecological and social concepts and principles to the management of agro-food and agricultural systems. Agroecology seeks to optimise the interactions between plants, animals, humans, and the environment while paying attention to social aspects that need to be addressed in order to achieve a sustainable and inclusive food system [12]. The world tends to implement green economic strategies, circular economy, sharing economy, and knowledge economy to achieve sustainable development goals. Essentially, these strategies are aligned with agroecological principles.

Modern agriculture of the 21st century is a possible mix of agroecology and smart agriculture based on the application of digital agricultural tools. Agroecology, when combined with accurate intelligent management methods applying digital technology, can produce more products, more diversity, and better quality in parallel with the goal of sustainable agricultural production and environmental conservation.

Agroecology considers the environmental, social, and economic features, favourable environmental factors and processes, as well as their interactions that characterize diverse agricultural systems, which are guided by the principles and practices of agroecology. One can also recognise the great potential of collective action processes in agroecology to promote knowledge sharing and increase understanding, which enable behavioural change in agroforestry systems needed for sustainable agriculture to become a reality [13].

To guide countries in transforming food and agriculture systems, bringing sustainable agriculture on a large scale into the mainstream, and achieving Zero Hunger and many other SDGs, the FAO on agroecology has proposed the following 10 Elements [11]:

Diversity; integration; effective; resistance; recycling; co-creation and knowledge sharing (describing common features of agroecological systems, basic practices and innovative approaches); human and social values; culinary culture and traditions (situational characteristics); responsible governance; circular economy and mutual support (favourable environment).

The ten elements of agroecology are closely related and interdependent and have been further elaborated into 13 principles (or guides for action) as proposed by the High-Level Panel of Experts on Food Security [14].

Basically, agroecology is flexible in terms of scale (small-large) and nature (partially or fully integrated) thus helping to provide context-appropriate solutions and problem solving of local and regional issues. On the basis of the goal of protecting and exploiting the functional activities of the ecosystem (ecological services), agroecology will, therefore, have the advantage of succeeding on a larger scale. This agriculture is often based on knowledge co-creation, which combines science with the traditional knowledge and local practices of producers. By strengthening producer autonomy and adaptive capacity, agroecology empowers producers and communities to act as agents of change.

Technically, agroecology applies ecological principles in the design of production systems to enhance ecological benefits such as biological control, pollination, nutrient regeneration, soil and water conservation, etc., on different scales. Ecological processes will be promoted on the basis of technology application. Therefore, modern agroecological intensification can be combined with precision agriculture and the application of digital technology [15].

Agroecology is not new from a technical point of views. Agroecology can be seen in the scientific literature since the 1920s and has been embodied in the practices of family farmers, in grassroots social movements for sustainability, and in politics and public books of many countries around the world. Recently, agroecology has been discussed by international organizations and the UN as a strategic tool to achieve the 2030 goal of sustainable development. An interdisciplinary approach to agroecology will receive more attention. However, technological interventions will help agroecology to operate stronger and meet the increasing demand for food/high quality food increase of the people.

The agroecological transition approach proposed by FAO, and more globally the UN agencies, is considered as a solution for Vietnam's food system transformation [6].

How can agroecology be applied in Vietnam?

In Vietnam, in terms of the agricultural sector's goals and in addition to having the potential to ensure the goal of stabilizing

national food security and employment for the majority of the rural population, the agroecology transition can also meet the requirement of a buffer zone to help maintain the quality of the food, environmental quality, and support other economic and productive activities (including supplying production materials, receiving organic and inorganic waste sources, mitigating extreme weather events such as floods or natural disasters; and landscape, environment, cultural characteristics, etc.). By focusing on transitioning to agroecology, the agricultural restructuring program will contribute to crop diversification, improve farmers' capacity to ensure food security, provide safe products and food, enhance agricultural biodiversity, improve the resilience of production systems to climate change, and help Vietnam fulfil its international commitments on climate change adaptation and mitigation. Ensuring this transition implies paying attention to and support of the transformation of agricultural economic thinking to an ecological and green economy.

Since the Doi Moi period, Vietnam has applied several measures related to agroecology. Indeed, agroecology has evolved over the years with various types of engineering practices and is considered as a technological advancement [16]. The agroecological production models that have been developed in production and have supportive policies in Vietnam can be divided into 6 groups of methods: (1) Agroforestry, (2) Integrated Pest Management (IPM)/Integrated Pest and Human Management (IPHM), (3) Sustainable Rice Intensification (SRI)/Sustainable Rice Platform standard (SRP) and Vietnam Good Agricultural Practices (VietGAP)/ GlobalGAP, (4) Organic Farming, (5) Integrated Crop-Livestock System and Garden-Pond-Cage (GPC), and (6) Conservation Agriculture and Landscape Agriculture. However, corresponding pilot models in the context of Vietnam are often small in scale and lack effective connection with other systems like markets, industries, or services. Therefore, agroecological developments so far have not created a breakthrough motivation nor a widespread influence of the system.

The development of some specific agroecological schools are as follows:

1. Many models of agroforestry in Vietnam according to each ecological region have been developed in recent times. According to statistics of the International Agroforestry Organization, the area of agroforestry in Vietnam reached about 900000 hectares nationwide during 2013-2014 [17]. Currently, projects related to agroforestry are expanding in the northwest, north central, and central highlands.

2. For rice production, several systems of advanced farming practices have been recognised for technical progress, i.e., IPM, SRP, SRI, VietGAP and equivalent, climate-smart rice farming, and organic agriculture. Rice production currently accounts for less than 50% of the area. Currently, GIZ and World Bank projects in the Mekong delta and Korea in Thai Binh are continuing to expand these practices.

3. Regarding organic agriculture, according to the Ministry of Agriculture and Rural Development, the area of organic farming in Vietnam has increased from 53,350 hectares in 2016 to about 237,693 hectares in 2019. The whole country has 46/63 provinces/cities carrying out organic production. The number of farmers involved in organic production is 17,168. The number of organic production enterprises is 97 with 60 enterprises participating in exporting at a turnover of about 335 million USD/year [18]. The movement of PGS-certified organic production was developed in 2008 in a number of localities such as Hanoi, Ha Nam, Hoa Binh, and Ben Tre, which is suitable for smallholder farmers and has potential for expansion.

4. The integrated crop-livestock system has been incorporated into the concept of a GPC system, which is a system with a long history especially in the rural and mountainous areas of Vietnam. The integrated production system includes Crops - Gardens + Aquaculture - Ponds + Barns. There are some other similar concepts such as Forest - Garden - Pond - Cage system and Forest - Garden - Pond - Cage - Rice, which are considered agroforestry models. Due to the trend of intensive and specialised farming, these GPC systems have decreased in the delta, but this system is developing in mountainous or difficult areas due to the ability to diversify products and reduce risks.

5. Conservation agriculture, which is a sustainable farming method suitable for sloping land in mountainous areas, uses ground cover with vegetation and plant waste. CIRAD's ADAM project (France) ended in Son La, stopping in the form of technical models.

6. Landscape agriculture is a new approach that applies ecological principles to the whole sub-region (such as valley, communes, district...) to achieve sustainability goals. Currently, projects of the World Bank and Sustainable Trade Initiative for Coffee and Pepper in the Central Highlands are applying this method.

Vietnam's modern agricultural production in the coming period will have to promote smart agroecology based on the application of innovations of agroecological systems combined with innovative management methods. In order to achieve this outcome, an incentive policy needs to be built. At the same time, focus should be placed on collecting, preserving, and developing genetic resources of indigenous precious plants and animals as breeding materials both in the form of farmer households and gene banks. It's necessary to support farmers to preserve precious plant varieties and animals by encouraging the development of local varieties into specialty products, improving production economic value, and helping people live with agricultural production. Research and technical assistance policies need to focus on encouraging the adoption of more sustainable agroecological production systems (e.g., agroecological practices, agroforestry, etc.) and afforestation, especially on infertile and coastal areas.

Production systems in diverse

agroecological regions with harsh conditions require investment in combination with associated industries (e.g., storage, processing, purchasing and distribution of products, etc.). It is necessary to pilot and to scale up climate-smart models to reduce greenhouse gas emissions from agriculture and contribute to increased carbon storage. Government should have incentives for the expansion of the model of nutrition sensitive agriculture in mountainous and difficult areas in order to overcome child malnutrition. It is also necessary to encourage the model of urban agriculture in the direction of agroecology combined with rural tourism to contribute to ensuring urban food security and improving the environment. Enterprises and producers must also apply agricultural economic thinking, apply agroecological technologies that possibly combine with precision agricultural production to optimise production costs and ensure income for producers.

3.5. Solutions to increasing resilience to vulnerability, shocks, and pressures of risks

Vietnam's agriculture has had an important strategic change from thinking about agricultural production to developing the agricultural economy, i.e., moving from high-yield agriculture to high-tech, ecological, responsible, sustainable agriculture and by initiating digital transformation, moving from single-sector development to multi-sectoral integration, from single-value to multi-value integration, and output connection and multi-agent connection. Vietnam has been and continues to improve mechanisms and policies to promote actions that transform agroecological product value chains with "favourable nature" as the basis, people-centred, and responsible for climate change. This activity should adhere to the principle of the 3 P's (People, Planet, and Prosperity or people, protect the green and prosperous planet) to unlock all potentials to transform the food system from production to distribution and consumption to contribute to implementing the SDGs and contribute to the global fight against climate change.

Agriculture is the livelihood of the majority of the population in rural and mountainous areas who are vulnerable to natural disasters and epidemics. Investments in broad-based education and technical assistance are therefore needed to help vulnerable farmers, new cooperatives and small enterprises adopt good agricultural practices (GAP) and increase resilience (e.g., Climate Smart, Agricultural and Landscape management, Integrated Pest Management...), which integrates the indigenous knowledge of all farmers to reduce emissions, reduce soil erosion and increase biodiversity agricultural studies. In addition, policies and regulations should be reviewed that help enable farmers to diversify into more resilient and sustainable crops and systems and accelerate the development and adoption of improved varieties that are better adapted to the impacts of climate change and natural disasters. Also, government should support the training in basic business management and risk planning, and adoption of digital tools to strengthen the financial resilience of vulnerable male and female farmers, new

cooperatives, and small enterprises in the food system [6].

Government should be interested in increasing systematic data collection using digital and geospatial information to learn and develop better land use plans.

The development of mechanisms and policies is sorely needed to help strengthen the coordination of the agricultural sector and the hydro-meteorological forecasting bloc at all levels in co-developing and disseminating agricultural recommendations to producers through the application of information on weather and climate (climate data, season term forecast, month, and 10 days). At the same time, support should be given to training and guidance on applying weather and climate information to agricultural production and disseminating production recommendations through existing digital technology platforms. In addition, digital application like channels for aggregating, analysing, and sharing information about weather forecast according to local characteristics should exist so that farmers have contingency plans with predictable shocks. It is necessary to promote research, mechanisms, and policies to implement agricultural insurance based on weather indicators and expand insurance coverage to help vulnerable farmers transfer production risks. At the same time, a communication campaign should be built to raise awareness about the benefits, rights, and obligations of buying agricultural insurance so that producers can choose the right product.

The One Health approach with multidisciplinary collaboration ensures synergies and cost-benefits that need to be scaled up when building, developing, and implementing innovations [6].

3.6. Solutions to improve the competitiveness and inclusiveness of the agroecological food value chain

In order to upgrade agroecological food value chains for a better connection between agroecology production and consumers, different policies should be reviewed.

Firstly, the agricultural land use policy is the most discussed. Accumulating and concentrating land into medium-sized farms is one solution to create a premise for larger-scale production, forming a generation of professional farmers who own family businesses, and applying innovative production techniques to increase productivity and efficiency while saving resources. Farms are supported by links, cooperation within the framework of agricultural cooperatives, and by digital transformation services to increase efficiency. Agricultural land-use policies and regulations need to be improved to make it easier for farmers to diversify to create more sustainable and agroecological diversified production systems such as shifting from intensive rice or maize farming to more sustainable systems with mixed crops (e.g., rice-shrimp, organic fruits and vegetables, agroforestry systems, livestock farming systems, conservation agriculture, VAC, etc.). These transformation systems need long-term development strategies, systematic management interdisciplinary,

and integration of scientific and local knowledge to avoid the risk of spontaneous transformation that could cause an imbalance in food supply and demand or an inefficient use of land resources.

Secondly, it is necessary to promote a sustainable production and to increase market access with high quality requirements through the application of mechanisation and precision farming to increase efficiency and reduce post-harvest losses. The government should issue incentives to promote research, development, and adoption of improved varieties that are better adapted to the impacts of climate change and disasters in collaboration with the private sector.

Cooperatives, trade associations and other associations play an important role in the value chain; however, their activities are not commensurate to their role due to resource and governance constraints. Policies and investments need to be updated to provide technical assistance and encourage cooperatives and professional associations to enhance skills, capacity, innovation, governance, and market linkages with the private sector.

Vietnam is a country with a relatively high rate of food loss and waste. Therefore, it is necessary to develop innovative food preservation, processing, and supplementing processes. These processes are needed to improve the availability of safe, healthy, nutritious food. Government policies should encourage Public-Private Partnership (PPP) and private sector investment in critical food system infrastructures (roads, transport, distribution and cold chain systems, transportation, etc.), digital systems (transformation, logistics systems), traceability systems, and finance to improve the competitiveness of the value chain.

Public policy should enhance manufacturing compliance, innovative product traceability and insurance systems, use digital technology to help manufacturers and businesses better meet customer requirements, and provide market specific parameters in terms of food quality and safety. Policies and education programs should be developed to strengthen the financial resilience of vulnerable groups, youth, new cooperatives, and small enterprises in the food system to create opportunities for young people in food systems, especially in innovation and use of digital technology. Further, the development and implementation of risk strategies, insurance products and services, and business management plans are essential.

Promoting digital transformation will create opportunities for digital economic activities that help manage value chains more effectively and sustainably. According to recent research, digitalisation can actively support the agroecology transition [19]. The first concrete benefit is that farmers can access more information to make more accurate production decisions, reduce production costs, increase labour productivity, increase production efficiency, and reduce environmental pollution [20]. Through digital platforms provided by enterprises or by the state, the connection with production input

services such as seeds, fertilisers, pesticides, mechanisation services, credit loans, access to digital agricultural extension, weather and climate forecasting services, plant protection services, storage, transportation, harvesting services, access to information on buyer demand, market standards, and price information will be improved [21]. These information sources are collected, stored, updated and aggregated in the form of an open database that is centrally managed and provided by the Ministry of Agriculture and Rural Development together with businesses for all people. Farm households, large farms, cooperatives, or production enterprises can also apply the production technologies of precision agriculture to apply automation technology to optimise each part of the production process with fertilising, watering, pesticide treatment, etc., to ensure food safety and reduce environmental pollution with the support of digital platforms. The next opportunities are in the post-harvest stage, value chain management, traceability, information retrieval, and sales through e-commerce with digital platforms provided by businesses. These platforms can also take care of logistics and transportation. With advanced digital technologies such as Blockchain, Internet of Things (IoT), Artificial Intelligence (AI) being developed by Vietnamese businesses, farmers can access at an affordable cost.

3.7. Solutions to ensure access to safe and nutritious food and transition to lower food loss, food waste, and sustainable consumption

Easy access to safe and good quality food, especially in rural areas and for low-income and vulnerable groups that face many difficulties, is paramount. Therefore, it is necessary to have solutions to support access to a multi-level and multi-sector food system in order to reduce malnutrition, stunting, and persistent poverty in the northern and central mountainous regions and in the Mekong delta, especially among ethnic minorities, to increase access to healthy food at affordable prices through coordinated and innovative policies, technologies, and interventions with the private sector, applying strategic investment, policy, training and education programs especially between the Zero Hunger Program, the Agricultural Restructuring Plan, the National Nutrition Strategy, Target Program on New Rural Development and the Paris Agreement Implementation Plan on Climate and the SENDAI Framework for Action Framework Implementation Plan on Disaster Risk Reduction.

It is necessary to review and update policies, education, and communication programs, especially mass media, social media and private sector partnerships to promote safe and nutritious food production, a healthy and balanced diet, as well as limiting unhealthy foods and reducing rates of overweight and obesity especially in urban areas. Support to school meals, education programs, and school food environments will promote healthy and nutritious diets.

Market policies, regulations, and solutions need to be identified to promote agroecological production and increase demand for healthy and nutritious food. These solutions should strengthen policies, standards, and

regulations for unhealthy food marketing, nutrition labelling, and product origin labels. They should also effectively enforce policies on fortification of food and improve food safety systems with increased evidence, risk-based management, and communication about the causes, risks and impacts of food safety problems. Finally, they should develop innovative insurance and certification systems to provide transparency and information to consumers.

It is necessary to increase investment in research and application of organic food production and in food rich in nutrients (biofortification). Public policy should promote the sustainable use of safe and nutritious foods by taking advantage of the growing global demand and willingness to pay by developing research and interventions. Food safety interventions should be tailored to specific agricultural value chains. Support for better linkage and coordination among food safety actors, food safety initiatives and projects are essential. Finally, it is strongly suggested to start using technology to reduce unhealthy processed foods through the cooperation and investment of actors in food technology, government, and the private sector.

Regarding the transition strategy to sustainable consumption, one needs to take advantage of mass media and social media to promote systematic and innovative communication and education programs that themselves promote healthy and nutritious diets, educating consumer consciousness in consuming products and services that effectively meet their needs, all while minimising negative impacts on the environment, society, and economy. Strengthening training and education programs to promote healthy, nutritious diets will benefit consumption in food systems in rural and ethnic minority communities in mountainous areas, especially women and children. In addition, improved policies, technologies and private sector interventions are needed to provide healthier, more accessible and affordable food, especially in rural areas, policies, standards and regulations on nutritional food labelling and product origin.

The Government should develop and complete legal documents on consumer protection law. Promote the business network with the role of support and responsibility to consumers. Building a transparent information environment about businesses - food - consumers is necessary. The Government should also develop a policy on consumer responsibility for the use of food in order to avoid loss, waste, and not affect the environment; all towards building a culture of sustainable food consumption.

Some cross-cutting issues can also be identified such as policies prioritising gender equality, participation, and social inclusion where special attention is given to the most vulnerable and disadvantaged groups affected by shock and risk pressures. For example, financial initiatives, especially financial technology solutions, make lending and credit, savings, insurance, and payments more efficient.

These four strategic solutions have been identified and integrated into the development of the National Action Plan. It is essential to have a roadmap for the transformation of a sustainable food system and the transition to agroecology that covers all levels. It is a tool to coordinate actions of all actors in the food and food system sectors and to mobilise investments and contributions from domestic and foreign organizations.

Beyond the National Action Plan, a monitoring tool with a set of indicators will be necessary for the realisation of the food system transformation in Vietnam to 2030 [22].

4. Conclusions

The integrated food system transformation approach promoted by UNFSS is considered as an appropriate framework to improve the sustainability of Vietnam's food system. After identifying the main challenges facing Vietnam's food system, the National and Regional Dialogues have resulted in a number of joint initiatives and solutions needed for the food system transformation. These dialogues have been critical in specifying the different solutions and orientations to help transform food system and the agricultural sector. As discussed in this article, a set of 4 strategic solutions were identified and integrated into the development of the National Action Plan of sustainable food system transformation. This plan is a tool to coordinate the actions of all actors in the food system and mobilise investments and contributions from domestic and foreign organizations. As part of it, the agroecology transition will be a key approach to a more transparent, responsible, and sustainable food system by 2030. The agroecological approach has been demonstrated as an instrumental pillar to improve the production component of Vietnam's food system and to move from a single-sector development to multi-sectoral integration, from single-value to multi-value integration, as well as output connection and multi-agent connection in the coming years.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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