SUSTAINABLE AGRICULTURE DEVELOPMENT: ECONOMICS AND ENVIRONMENT ASPECTS IN VIETNAM

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Abstract

Over the past three decades of agricultural renovation since 1989, Vietnam has made great strides in boosting agricultural development. Its agricultural production value, added values, product volume, and exports have grown significantly. However, the growth model was mainly extensive manner, natural resources intensive-driven; Growth of this sector tends to slowly down due to spontaneous and small-scale production model, weak technological application in agro-forestry-fisheries, the stagnation of expansion of arable lands, scarcity of water resources, advancing environment degradation, negative impacts of climate change, competition between food crops and bio-energy crops in the use of limited natural resources, rapid urbanization and a declining agricultural labor force. This study analyzes the current development of sustainable agriculture in Vietnam toward economics and environmental aspects; based on this analysis, the study gives some policy implications boosting sustainable agriculture development in Vietnam in the next period.

***Keywords*:** Economics aspect; environmental aspect; sustainable agriculture development.

1. Introduction

Agriculture in Vietnam has changed dramatically, especially since the Doi Moi (1989, in the agriculture sector), its productivity increased significantly due to mass adoption of new technologies, mechanization, chemical use, specialization and government policies that favored maximizing production. Although these changes have had many positive effects and reduced many risks in farming, there have also been significant costs. Arresting among these are soil depletion, groundwater contamination, problems of quality and food safety remain-resulting in low export prices and concerns among domestic consumers, the decline of family farms, continued neglect of the living and working conditions for the farmer, increasing costs of production, and the disintegration of economic - social conditions in the rural area.

Previous studies also showed that agricultural growth has been slowing down and that added value created in the sector as well as benefits to farmers do not match the efforts

made. Meanwhile, the growth in population, the process of industrialization and urbanization as well as the complexity of climate change makes the resources devoted to agricultural production shrunk seriously, significant impact on food production and satisfy to food demand for both the domestic and export market. The gap between the current status of agricultural production and the new requirements for development is huge; agriculture development is facing the pressure to reform the sector towards sustainable development accompanied by greater benefits to farmers. Addressing these challenges requires coordinated responses and concerted efforts among all stakeholders, including the public and private sectors.

This study analyzes the current development of sustainable agriculture in Vietnam toward economics and environmental aspects; based on this analysis, the study gives some policy implications boosting sustainable agriculture development in Vietnam in the next period. The structure of the article consists of five parts, including (i) introduction; (ii) conceptual framework; (iii) methodology and data; (iv) The current state of sustainable agriculture development in Vietnam: economics and environmental aspects; and (v) conclusion and policy implications.

2. Conceptual framework

Sustainable development has come to the forefront of scientific debate and policy agenda. The World Commission on Environment and Development, known as the Brundtland Commission (1987) proposed the most extended definitions for sustainable development and since then has rightfully gained its place in the vision, mission, and strategy of organizations, locals, and governments. Sustainable agriculture is widely discussed and is viewed in the international forum as essential for the transition towards global sustainable development. Sustainability in agriculture relates to the capacity of an agroecosystem to predictably maintain production through time. A key concept of sustainability, therefore, is stability under a given set of environmental and economic circumstances that can only be managed on a site-specific basis. If the perspective of sustainability is one of bias against the use of biological and chemical technology and espouses a totally natural ecosystem, then agriculture as a practice is already excluded. If on the other hand, the perspective of sustainability is one of preservation of non-renewable resources within the scope of the agricultural enterprise, then the objective is not only achievable but good business practice and good environmental management. An equally unnatural and parallel phenomenon has been the exponential growth in human population, with associated demands for both food and shelter, which have often exceeded the natural carrying capacity of the land. Based on the premise that human population growth will not be constrained as a result of food shortages due to overriding social values, in this context technology play the key role in sustainable agriculture, including (i) increase agricultural productivity; (ii) sustainable; (iii) the basis for sustainable agriculture (Luu and Nguyen, 2017).

A scale system for evaluating the sustainable development of agriculture as well as measuring its economic pillar and environment is very diverse, coming from situation of

each region, local and national production system. In this study, the criteria for evaluating the development of sustainable agriculture is used on the basis of criteria proposed by the evaluation framework for sustainable development proposed by the United Nations (2001), EU Commission (2003) and Vietnam (2012) associated with the targets by previous scholars (Strauss, 1986; Alves-Serodio, 1998; Haddad and Bouis, 1991; Von Braun, 1997; De Haen, 1997; Swaminathan, 1991; Gillis et al., 1992; Reijntjes et al., 1992; Becker, 1997; Smith and McDonald, 1997; Herzog and Gothsch, 1998; Sands and Podmore, 2000; Zhen and Routray, 2003; Rasul and Thapa, 2003; Nambiar et al., 2001; Trisorio, 2004; Rao and Roger, 2006; Van Cauwenbergh et al., 2007; Pretty et al., 2008; Gafsi and Favreau, 2010; Hayati et al., 2010; Castellini et al., 2012; Hřebíček et al., 2013; Van Pham and Smith, 2014; King, 2016; Latruffe et al., 2016).

The indicators for assessment of the economics aspect, including: (i) production and growth rate of the sector (growth of the production value and GDP should remain stable in long-term and avoid fluctuations or shocks come from outside including weather, markets and institutions is a manifestation of the sustainable development); (ii) The efficiency of growth (productivity growth of resources, including labor, land, water, capital, and total production factors (TFP); (iii) The restructuring of the agriculture sector (the structure of the sector, agicultural enterprises development). The indicators for the assessment of the environmental aspect, including: (i) Resource depletion (measure the impact of agricultural production on the decline in the quantity and quality of the agroecological. Decline in the forest area with no relationship to expand agricultural land; nutrient balance of land, water quality, and air quality are maintaining stabability and does not tend to decline annually are expressions of developing sustainable agriculture; (ii) Greenhouse gas emissions (measure volume and speed of equivalent CO2sq discharged into the environment due to the operation of agricultural production without increasing which mark the expression of a sustainable agricultural development).

3. Methodology and data

According to Bell and Morse (2001), sustainability indicator selection divided into two broad methodological paradigms, including top-down (expert-led) and bottom-up (community-based). This study also applies expert-led indicator selection in choosing economics and environmental indicators of sustainable agriculture development in Vietnam.

Data used in the study was collected mainly from General Statistics Office of Vietnam and the Ministry of Natural Resources and Environment in the period 1990-2016 and other related reports, in constant 2010 prices. Capital reserve (K) was accounted for a depreciation rate of 5%/year (Tran, 2005).

4. The current state of sustainable agriculture development in Vietnam: economics and environmental aspects

4.1 Economics aspect of sustainable agriculture development

Production and growth rate of the sector

For the past 30 years (1990-2016), agricultural and rural areas have still continued playing an important role in the economy with approximately 70.4 % of Vietnamese

population live in rural areas, above 60% of the household depends on agriculture sector as the main economic activity and above 47% of labors in the agricultural sector. The contributing ratio of the sector has plummeted rapidly from 39.1% in 1990, down to 24.5% in 2000, 19.0% in 2010 and 16.3% in 2016. Despite the decline of contributing ratio in GDP volume, the growth of the sector is generally rather more stable than others; while labors in this area have a tendency to reduce proving that the productivity of agricultural labors has improved.

The growth rate of agricultural production averaged 4.8% in the period 1990- 2016. The high growth rate after Decree 10 reached 4.5% in the period 1990-2016. From the period 1991-2000, Vietnam began to have the redundant production to export compared to the previous insufficient domestic period in supply. However, then the growth rate of production value tended to reduce markedly, averaged at 3.57%/year in the period 2001-2016. The decline in the value of agricultural production in that period resulted from the impact of international economic integration, an unstable growth model driven, inefficient exploitation of comparative advantages, while investment went down and the products were becoming more and more difficult to compete in the market, the sources for the explosion of agricultural production growth was no longer sustainable in both quantity and quality.

Although the value of total production has steady growth, real GDP value didn't show the efficiency of production. The proportion of GDP was hardly improved compared to the production value of the agricultural sector, that proves the efficiency was reduced from 89,3% in 1990 to 73,1 % in 2000 and 69,1% in 2016. This result is due to the productivity of almost land, labor, fertilizers and other static factors that are gradually tipping; the saturation makes an increment of production more expensive.

The GDP agricultural growth rate was estimated to reach 3.68% in the period 1990-1995, 3.98% in the period 1996-2000, 3.86% in the period 2001-2005, 3.53 % in the period 2006-2010, and 2.77 % in the period 2011- 2016. In general, the period of 1990-2016 agricultural GDP increased 3.53%/year averaging. The growth rate of agricultural production was rather low but stable in comparison to other economic sectors. Agricultural growth recorded beginning periods resulted from the positive impact of innovating policies, land, and potential crop productivity, but due to the restrictions on productivity, investment, the impact of international economic integration in the later period the rate of growth went down. Since 2006, because of the impact of the world economic crisis, both industry and services sector has faced many difficulties making the growth rate remarkably recline, the only agriculture has still remained increasing rate, that helps reduce the difficulties in the economy. However, in the period 2009-2016, the production and consumption of agriculture still faced a lot of difficulties, the growth rate seemed to level off due to less investment and policy support, negative effects of the climate change.

The efficiency of growth

Although the productivity of agricultural labor (agricultural GDP per capita labor) is improving in the recent period, it is still lower than the whole economy and compared with the industry and services sector. The average agricultural labor productivity was

estimated to reach 9.0 VND million/person/year in the period 1990-1995, and about 10.39 VND million/person the period 1996-2000, amounted to 12.41 VND million/ person in period 2001-2005, in the period 2006-2010 reached 14.48 VND million/ person and 17.42 VND million/person during the period 2011-2016. The proportion of labor in agriculture is still high, the scale of agricultural production is small, transferring the rural economy and agricultural production towards higher value, but slowly, decreasing social investment in agriculture, the low quality of the agricultural labor force is factored causing a slow labor productivity improvement.

In Vietnam, land productivity has increased by 40% in the period from 2004-2016 on all crops in terms of quantity and thus the next major efforts should focus on activities which improve quality and diversification into products of high-value crops to create more value on the same unit of production area. Approximately 80% of the water reserve is used for agricultural production, creating significant pressure and more and more increasing toward the available water resources of the country consists of nearly 80% irrigated areas devoted to rice, crops, maize, coffee, and rubber, but each plant accounted for only 3% of area irrigated nationwide (Organisation for Economic Co-operation and Development, 2015).

ICOR of the agriculture sector is maintained at a relatively low and stable rate in the period 1990-2016, ICOR in agriculture tends to increase slightly and was estimated to reach 3.5 in the whole period. The average ratio during the period 1991-1995 is at 2.2, rising to 4.0 period 1996-2000, during the period from 2001 to 2005 increasing by 4.2, in period 2006-2010 period reducing to 3.7 and remaining stable at 4.8 in period 2011-2016. The increasing trend of ICOR in recent period shows that investment efficiency tends to decline, the cost of capital for growth is becoming more expensive.

The transformation of TFP and other factors with agricultural growth in the period 1990-2016 were fairly clear. The volatility of TFP, the quality factor of growth was instability due to fluctuations in the business cycle of the economy in five quite distinct periods:

Period 1991-1995: The contribution of the labor factor is dominant, the contribution of capital is quite significant when initially be unleashed on land use, open market economy, while the contribution of TFP recorded initially shown the initial success of the innovation process, open economy, exports and FDI rapid growth. The contribution of capital, labor, and TFP in this stage was estimated to reach 1.4, 2.5 and 0.3, respectively. Period 1996-2000: Trend evolutions of factors contributing to agricultural growth in Vietnam are quite stable under the same scenario as the previous period. Capital contributed increasingly (1.4 to 3.5) due to the intensive investment of production inputs such as fertilizers, pesticides, mechanization, irrigation infrastructure, new varieties from the producer. The contribution of the labor was downturn due to the impact of the restructuring of labor to the industry and services sector (2.5 to 2.3). Meanwhile, TFP contributed negatively (0.3 to -1.8) due to the impact of the Asian economic and financial crisis. Period 2001-2005: Continued to expand production trends and the role of the factors which is crucial, but fell (3.5 to 2.3) by the productivity of capital gradually tipping factor. The contribution of the labor factor fell sharply (from 2.3 to 0.7) due to the strong

movement of labor into the industrial sector and services. TFP gradually been recorded and has grown rapidly (-1.8 to 0.9) along with the general recovery of the economy. Period 2006-2010: The agricultural sector and the economy are strongly influenced by the global financial - economic crisis. Agricultural growth and its growth factors are falling, capital reduction (2.3 to 1.2), labor rose sharply (f0.7 to 2.1) and TFP (0.9 to 0.3). Period 2011-2016: TFP rebounded along with the recovery of the economy (0.3 to 1.4) serves as the impetus for growth in the capital and labor factors gradually tipping and the sharp decline in the growth rate.

The restructuring of the agricultural sector

The structure of agriculture is moving away from traditional manufacturing with mainstream cultivation to develop animal husbandry, handicrafts, and services. However, the level shifting is very limited during the period 1990-2016 when, average crop subsector accounted for 75.40%, while livestock accounts for 22.40%, while services account for only 2.20 % of GDP of the agricultural sector. This structure shows a lack of sustainable growth model when the manufacturing industry is still the dominant crop sector, resource intensive, causing pressure to ensure sustainable development in this sector. Crop sector only grew by 2%/year because rice is still the main crop, although rice production rose sharply, but the added value is not high, both in production and processing, both in absolute value and relative value, and also under the strong impact from climate change makes production of rice and many staple crops decline. The livestock sector has changed slightly, from 19.2% in the period 1990-1999 tends to increase the average of 23.1% in the period 2000-2009, since then the proportion contributed livestock industry continues to grow, the period 2010-2016 reached 26.1%. However, the growth rate is not stable, mainly due to the impact of the epidemic, concerns about the quality of consumers will prohibit the use in livestock, food safety, and the relative price decline. Service industry almost no transformation, or even decline, the average ratio from of 2.7 in the period 1990-1999, down to 2.0% period 2000-2009, and down 1.7% in the period 2010-2016.

A number of agricultural enterprises tend to increase the period 2006-2016, average 6.91%/year and 1,740 enterprises in 2016 compared with a total of 581,085 enterprises of the whole country, accounting only 0.3%. Number of businesses too small means that the driving force for the growth of the industry will restrict and develop enterprise will be one of the key policy focuses on improving capacity through appropriate policies aimed at increasing investment by enterprises. Also, among the agricultural enterprises as the end 2016, there are 138 state enterprises after innovation, acquisitions, and with the management and ownership of resources, along with the access policies more favorable, this group of enterprises should be interested in improving the efficiency of operation. Regarding the quality of business: In total 1,740 agricultural enterprises as of 2016, there are 81.85% of the enterprises are micro and small enterprises with capital below 20 VND billion and only 17.90% with a capital of 20 VND billion. Similarly, more than 95% of agricultural enterprises are micro and small scale under 200 employees and only 5.0% are medium and large enterprises. The scale of limited capital and labor will make the constraint to take advantage of economy of scale, business difficulties, as well as weak competitiveness.

4.2 Environment aspect of sustainable agriculture development

Degradation of natural resources in agricultural production activities

Conversion of forests to agricultural land is mainly due to the expansion of the area of production of export commodities such as coffee and natural rubber. This is especially serious in the Central Highlands where nearly 79% of new rubber plantations grown on natural forest land (Organization for Economic Co-operation and Development, 2015). But, in the period 1995-2016, while GDP growth rate of 3.5%, the area of agricultural land growth rate increased 1.84% to the same period shows that agricultural growth was less dependent on arable land, land productivity has improved during this period showed positive expression of sustainable development.

Evaluation of the quality status of land in the agricultural sector and rural areas still responds well to the agricultural production, residues of plant protection products and heavy metal are still lower than the threshold according to the standard criteria of the Ministry of Natural Resources and Environment (2008). According to statistics, only about 30% of land resources are good quality, the mainly alluvial soil in the Red River and Mekong Delta, 50% of the remaining area is weak on the soil fertility, is classified as poor soil with low nutrient, high penetration; sour; salty; high aluminum; and gray. Addition, unsustainable practices of land use caused consequences initially for quality agricultural land, the land area is degraded tends significantly with more 50% of the land area affected, particularly in agriculture takes 100 thousand to 120 thousand hectares each year (Ministry of Natural Resources and Environment, 2014).

Production and crop yields have led to the rising demand for fertilizers and plant protection chemicals. In Vietnam, the efficiency of fertilizer use is only reached averaged 45-50% with nitrogen, 25-35% of phosphate and 60% of potassium, the rest is lost and inefficient use, which makes land environment agriculture tends pollution, ecological imbalance, soil acidification, and loss of production capacity. The estimated risk of 50% protein, 50% potassium and approximately 80% of the phosphorus surplus from fertilizer use improper techniques; addition, farmers still use many kinds of unquality fertilizers and plant pesticides, which are not guaranteed, registered, clones labeling and incorrect volumes in packaging on the market were directly or indirectly pollute the soil environment, emissions of greenhouse gases and simultaneously increasing production costs (Ministry of Natural Resources and Environment, 2015).

Along with land degradation, the status of early saltwater intrusion, deep infiltrate, and high salinity occurred and maintained commonly in a long time in the provinces of the Mekong Delta decline the area of productive land, causing serious impact to ensure national food security. Depth saltwater intrusion combined with declining water resources in downstream significant influence to many lands in agricultural areas such as in the central region, each year about 120 thousand hectares of rice were flooding and over 62 thousand hectares of crops were flooding; at Northwest in just 6 months of the rainy season every year, the amount of soil loss account for 75-100% of the total erosion of the year, remaining below the 25% of soil erosion occurred in the period of transition from the dry to the wet season or from the wet season to the dry season (Ministry of Natural Resources and Environment, 2014).

Unsustainable activities in agricultural production make water quality in some areas has phenomenal local pollution as the water contains suspended solids, organic matter, heavy metals and microbial contamination. Groundwater quality in rural areas depends on the geological characteristics of the reservoir, permeability and leakage surface water from animal husbandry, agriculture, and villages as well as the change of purpose land use and unreasonable water extraction. Based on self-washed and cleaned up ability, the environmental status of water remains within the limits permitted by the standards of the Ministry of Natural Resources and Environment (2014). However, groundwater in some areas has signs of organic pollution (NO3-, NH4+), heavy metals (Fe, As) and particularly microbial contamination (Coliforms, E.Coli). A few parameters have exceeded the allowed level and tend to deteriorate, annual estimated that up to 50% - 70% of inorganic fertilizer could not be absorbed by plants, and release to the environment (Ministry of Natural Resources and Environment, 2014). Addition, the wastewater from operations of intensive agriculture practices contains harmful ingredients such as plant protection chemicals, chemical fertilizers have caused the risk of environmental contamination soil, groundwater and surface water in the areas around (Ministry of Natural Resources and Environment, 2015).

Air quality in the rural areas is quite good, a lot of areas have no signs of the population; however, in some rural areas in the Central Highlands, where the air is affected by the coffee processing, while in other areas, farmers often burn straw and other biomass in the field causes the haze in the areas around. The burning of the straw outdoor is not controlled burning process, in which outputs are mainly gases such as CO_2, CO, NO_x, dust and aldehyde compounds, which has caused adverse effects to the health. Meanwhile, the farm is also one of the sources of increased pollutant air in rural areas due to disposal waste is a ineffective way and tend more and more serious fact (Ministry Natural resources and Environment, 2015).

Greenhouse gas emissions from agricultural production

Sources of emissions of greenhouse gases (GHG) in agriculture are mainly methane (CH_4), nitrous oxide (N_2O), carbon monoxide (CO) and oxides of nitrogen (NO_x) from operations breeding, cultivation, agro-processing. Total GHG emissions in agricultural production were estimated to reach 56.7 million tons of CO_2 equivalent in 2000, 88.35 million tons in 2010, 466.0 million tons in 2020 and 760.5 million tons in 2030 (Ministry of Natural Resources and Environment, 2014; Nguyen and Dinh, 2014).

Rice cultivation is the main source of greenhouse gas emissions in agriculture, including traditional practices such as irrigation, flooded practice, organic fertilizers have caused serious greenhouse emissions (50.49%), arable agricultural land (26.95%), use of chemical fertilizers (9.69%), burning of waste on the farm (2.15%). GHG emissions from burning agricultural waste were estimated to reach equivalent to 2.8% by 2020, 7 million hectares of rice cultivation with an output of about 41.2 million tons, an equivalent 41.3 million ton emission of straws. Currently, farmers' practices in burning straw still maintain commonly when there is only 38.7% of households have treatment of straws after harvest (Ministry of Natural Resources and Environment, 2014; Nguyen and Dinh, 2014). Each

year, the livestock sector dismisses about 75-85 million tons of waste gases, of which CO2 accounted for 9%, 37% CH_4, 65% NO_x and remaining of H_2S, NH_3, H_2S and NH_3, which is about 30-40 times higher than the permitted threshold. CO_2 from livestock, mainly arising from the combustion of fuel to run machinery used for cattle and poultry feed. CH_4 arising mainly from the fermentation of food in the rumen of ruminant animals and feces of cattle. Greenhouse gas emissions from livestock tend to increase and is estimated to reach 24.36 million tons by 2020; factors such as the quantity and weight of cattle, and the quantity and quality of feed, methods of control and waste treatment in animal husbandry will effect on the facts (Ministry of Natural Resources and Environment, 2015).

5. Conclusion and policy implications

The growth model was mainly extensive manner, natural resources intensive-driven by the agricultural sector in the period 1990-2016 in Vietnam has expanded its environmental footprint. Therefore, policies should focus on the next period, including:

Apply irrigation charges and environmental taxes for farmers, agricultural businesses to cover operating and maintenance costs to help reduce the state budget and improve the motivation of irrigation enterprises in the supply of higher irrigation service quality.

Strengthening surveillance, compliance, and enforcement of the Law on Environmental Protection (2014). Strengthening education and extension services to help farmers understand the benefits of implementation of the regulations on the environment, reducing production costs through reduced use levels of chemicals in production activities.

Develop market of hi-tech and organic agriculture, aim to supply needs of food and nutrition security and adaptation to climate change, urbanization, and industrialization as well as help solve the problem of natural resources, meet the requirements of the market, food hygiene and safety, improve economic efficiency.

Control greenhouse emissions in rice cultivation, control of plant areas by concentrating in areas which are intensive, effective, productive, and favorable for scientific and technological adoption. Converting inefficient rice areas for other purposes. Promote the transfer sustainable agriculture technologies to farmers, such as improved rice intensification the package solution "1 Must Do, 5 Reductions", IPM, VietGap, GlobalGap, organic rice, high-tech agriculture, agriculture 4.0.

Monitoring of greenhouse gas emissions in the livestock, control the number and weight of livestock and poultry; Improved quality of livestock feed, change the feed ration, using cake nutrition in order to improve productivity and reduce their emissions of greenhouse gases.

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