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Tra Vinh province's agricultural development toward a Green Economy

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Abstract

A green economy or a clean economy is an economy in which a market-oriented development policy uses the foundation of traditional economies with the goal of ensuring the harmony between the economy and the ecological environment. The basic growth strategy of the green economy is to protect the environment, develop clean production technology and clean energy, and quickly achieve sustainable growth or green growth. Agricultural development in the direction of a green economy is agricultural development based on applying green technology in production, ensuring a green and sustainable food supply while minimizing negative impacts and creating positive impacts that are beneficial for the environment. Therefore, assessing the status of agricultural development

toward a green economy is one of the crucial components of proposing a system of green economic development solutions for each locality. The study was carried out to select and appropriately apply green agricultural growth assessment indicators to Tra Vinh province's specifics, analyze agricultural statistical data, and report environmental impacts, survey results of 196 agricultural production households, 100 state managers and experts. Research results show that despite certain efforts, the electrical energy productivity of Tra Vinh's agricultural sector is still decreasing, and the process of restructuring agricultural production towards a green economy is still slow.

Keywords: Agricultural Development, Green Economy, Tra Vinh Province

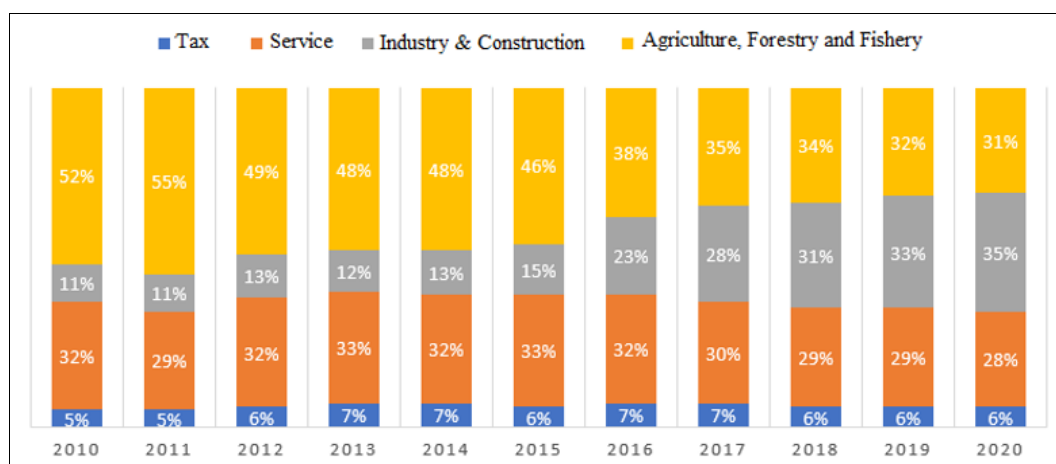
JEL classification codes: O14, O21, O33, Q18

1. Introduction

According to Linh and Hang (2021) ^[6], in Vietnam, the development of green economy initially forms a system of legal documents for the implementation. Vietnam has developed a renewable energy development strategy to 2030, view to 2050; building a legal framework on economical and efficient use of energy in production and daily life; implement energy labeling for production materials products and consumer equipment. In the agricultural sector, Vietnam has issued guiding documents, guidelines and regulations on "green" standards for agricultural, forestry and fishery production. Initial application and practical effect for production and business. Until 2018, 7 ministries have issued Green Growth Action Plans. In 2019, the whole country had 34 provinces and centrally-run cities that developed and implemented green growth action plans at the provincial and city levels.

Tra Vinh province is one of 13 provinces and cities in the Mekong Delta with 65km of coastline, and a natural area of 239,078 hectares, accounting for 5.77% of the area of the Mekong Delta. Tra Vinh has great natural conditions and resources, favourable for developing marine and coastal economic sectors. From in 2011 - 2020, Tra Vinh's GRDP increased by 9.96%, reaching \$2,766 million in 2020. Tra Vinh has succeeded in economic restructuring, with the agricultural GRDP ratio decreasing from 52.46% in 2010 to 45.92% in 2015 and 30.72% in 2020 (see fig 1). Although the agricultural sector's contribution to the GRDP decreased in the right direction, the growth rate of the agricultural sector still reached an average of 2.67% per year.

Agriculture in Tra Vinh province has made certain development steps. However, whether Tra Vinh's agriculture has really developed in the direction of a green economy, has Tra Vinh's agricultural development in recent years really contributed to the implementation of the national strategy on green growth, it is necessary to have research depth. Therefore, assessing the status of agricultural development in Tra Vinh province towards green economy is really necessary.



Source: Tra Vinh Statistical Office (2021) ^[13]

Fig 1: Economic restructuring in Tra Vinh province in the period 2010 - 2020

2. Literature review and theoretical framework

Agriculture is one of every country's vital material production industries. Agriculture will produce and provide food, food for human life, and a part of raw materials for industrial production. Agriculture is understood in a narrow sense, purely agricultural, including crop production and animal husbandry. Broadly, agriculture also includes ancillary services of crop production, animal husbandry and, in particular, forestry and fisheries. Agricultural development is understood as "the process of mobilizing the agricultural sector to transform agriculture in the direction of industry and modernity, transforming subsistence agriculture into commodity agriculture and, above all, agricultural production." commercialize and build clean and organic agriculture to meet the goals of sustainable development" (Tranh, 2012) ^[15].

Agricultural development in the direction of a green economy is understood as developing from "brown" agriculture to "green" agriculture. It is developing agriculture based on applying knowledge, methods and new farming techniques to maintain and improve productivity and profitability and ensure a sustainable food supply while minimizing negative impacts and creating beneficial impacts on the environment. To develop agriculture toward organic agriculture, high-tech agriculture, smart agriculture that adapts to climate change, and ecological agriculture. Organic agriculture is an agricultural production method in which all production processes are based on inherent natural biological laws (Dang *et al.*, 2012) ^[11]; Eco-agriculture "involves building the strengths of natural ecosystems into agricultural systems, purposefully disturbing the production of food and fibre. Overall strategies include planting healthy plants with good defences, preventing pests, and increasing beneficial organisms' population. This is achieved by improving environmental conditions both above grounds and soil" (Magdof, 2007) ^[7].

High-tech agriculture is "agriculture that applies high technologies to form efficient and environmentally friendly agricultural production processes, creating breakthroughs in productivity and quality of agricultural products to serve the increasing needs of society while ensuring sustainable agricultural development" (Hai & Ngoc, 2018) ^[5].

Smart agriculture adapted to climate change (FAO, 2011) ^[2] is agriculture that increases productivity, and resilience (adaptation) in a sustainable way, reduces/eliminates (mitigation) development of greenhouse gas emissions, and

enhances national food security and development goals. Smart agriculture that adapts to climate change has an intersection with high-tech agriculture in increasing the application of high technology in industrial production, but different in purpose and requirement, which emphasizes adaptation to climate change, reducing greenhouse gas emissions.

Criteria for assessing agricultural development toward green economic development

Organization for Economic Cooperation and Development (OECD, 2014) ^[9], in the document on indicators to assess green growth in agriculture, once mentioned a set of indicators to measure green growth in the agricultural sector. There are 15 indicators presented corresponding to 3 topics of environmental and resource efficiency, natural capital, economic opportunity, and policy response. Indicators reflect carbon yield, energy productivity, water use intensity, nutrient cycling and balance, water resource, forest resources, aquatic resources, land resources, wild resources, government policy communicated to producers, and taxes related to the environment in agriculture. This set of indicators is mainly used in assessing the country's green agriculture internationally.

In the small and medium-sized enterprise manual, the Small and Medium Enterprise Development Fund (SMEDF, 2019) ^[10] mentioned the criteria associated with green growth in the fields of agriculture, forestry, and fishery. The groups of green criteria mentioned include:

1. The group of output products (high-quality products, use of new materials, use of new energy)
2. Group of criteria on innovation (new technology, new equipment, high technology)
3. Environmental criteria group (emission reduction, use of clean technology, clean energy, renewable energy),
4. Group of criteria for production activities with low energy consumption and low emission, group of criteria of corporate governance capacity
5. Group of criteria for job creation and gender factors
6. The above criteria are mainly used in the evaluation, selection and approval of new projects and new enterprises operating in agriculture, forestry, and fisheries.

To assess the current situation and propose solutions to promote green economic development in agriculture, Tung

and Ngoan (2014) ^[16] once named five actions and five outcome indicators as potential indicators.

Action indicators include:

- Number of policy documents, plans approved issued and implemented related to promoting sustainable agriculture;
- Government support encourages farmers to invest in green agriculture and get a certified farm and friendly products;
- The percentage of the agricultural budget devoted to environmental objectives;
- The ratio of support for producers towards environmental goals to total support for agricultural production;
- Approved policies related to the restriction or elimination of barriers to trade in technologies and services required for a transition to green agriculture.

The resulting indicators include:

- Percentage of land area under different forms of green agriculture
- Refusal to use agrochemicals is a result of the transition to green agriculture. Number and percentage of farmers switching to green agriculture
- Increase the proportion of payment for environmental services in total farm income
- Number of agricultural extension officers trained in green agriculture practices
- Number of businesses established in rural areas, especially local organic farming enterprises, providing off-farm employment opportunities.

The criteria for evaluating agricultural development in the direction of a green economy proposed according to the economic characteristics of Tra Vinh province include four groups of evaluation criteria:

1. Criteria reflecting the increase in green agricultural GRDP along with changes in agrarian economic structure towards green economy: Annual growth in agricultural GRDP; change in the structure of the agricultural sector that allows to excelling regional advantages and adapt to climate change; The degree of shifting to organic agriculture, ecological agriculture, high-tech agriculture, converting small-scale and fragmented agricultural production to large-scale agricultural production...
2. Criteria to evaluate the efficiency of saving, protection and conservation of natural resources: The reduction in the rate of energy consumption for agricultural production compared with agricultural GDP and Energy productivity (GRDPNN/1 unit) energy use); Effective land use for agricultural development towards green economy: Allocating land to use for different purposes of green agriculture (organic agriculture, ecological agriculture, high-tech agriculture); The rate of reduction in the rate of saline soil, the percentage of land affected by erosion, the ratio of degraded land to the total amount of agricultural land; Efficient use, regeneration and protection of water sources: Ratio of clean water for agriculture/total clean water; Amount of irrigation water/irrigated area; Water shortage, saline water; Groundwater depletion rate; Numbers of farms that have implemented plans for water circulation and reuse; Effective use of land and forest resources: Rate of forest

land; natural forests, self-planted forests, mangrove forests; Rate of protection forest combined with aquaculture; Ratio of revenue from non-timber forest products; Proportion of revenue from products from wood chips, timber, wood from planted forests, and forest products with origin labels. Criteria for evaluating results of protection and conservation of natural resources: index of wild resources; Amount of biodiversity; Ratio of aquatic resources/biosafety limit.

3. Criteria for assessing emission reduction results: Carbon productivity (GDP/unit emission imported from agriculture); The ratio of emissions of CO₂ (Carbon), CH₄ (Methane), N₂O (nitrogen oxide) from agricultural production to agricultural GDP; The reduction in the amount of solid waste in agriculture (plant protection product packaging, fertilizer packaging, straw, rice husk, corn cob, grass, solid waste from livestock); The average reduction in the rate of chemical fertilizers and pesticides used per hectare of agricultural land; Number of farms/households that refuse to use chemical pesticides.
4. Criteria for assessing actions to develop agriculture towards green economy: Number of approved, promulgated and implemented policy documents and plans related to green agriculture; Number of projects and programs to encourage and support farmers to switch to green agriculture; Number of projects and programs to support agricultural tools, exploitation methods, etc. to protect resources and biodiversity; Number of afforestation projects; Number of biosphere conservation projects; Number of projects on collection, recycling and management of agricultural waste; Number of projects to build and improve carbon storage tanks; Number of days - participants in an extension program on green agricultural practices; Number of movements launched related to green agriculture; Percentage of agricultural production establishments and households receiving support for green agriculture transformation; Environmental tax fluctuations; Credit rate for green agriculture.

3. Methodology

To assess the status of agricultural development in Tra Vinh province toward a green economy, the author has compiled statistics from many sources based on criteria to evaluate agricultural development in the direction of a green economy following the characteristics of Tra Vinh province mentioned above. At the same time, the author also conducted a survey using a questionnaire for agricultural production households, agricultural enterprises and state management officials and experts on green agricultural development and in-depth interviews with two state management of agriculture officials.

Statistical analysis was performed based on secondary data sources such as results of the mid-term rural and agricultural survey in 2020 from the General Statistics Office; Tra Vinh Provincial Statistical Yearbook 2020; Statistical Yearbook 2020 of the General Statistics Office; Report on the environmental status of Tra Vinh province in five years (2016 - 2020). The method's focus is to calculate the indicators of energy productivity and emissions per unit of production value.

Descriptive statistical analysis based on survey results: 196/234,817 agricultural production households; 17/20

agricultural enterprises; 100 state managers and experts (From 1 - very poor to 5 - very good). The focus of implementing the method is to evaluate the results and levels of the parties' efforts to develop Tra Vinh's agriculture in the direction of a green economy (such as, method to handle pesticide packaging of agricultural production households in Tra Vinh, methods to handle agricultural wastes of production households).

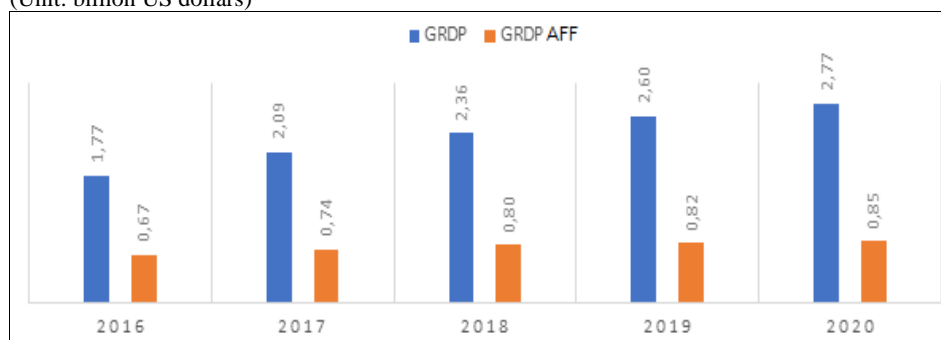
4. Results

4.1 Assess the increase in the value of agricultural

products corresponding to the change in the agricultural economic structure towards a green economy

Changes in the structure of the agricultural sector: In the period 2011 - 2020, although the proportion of GRDP contribution of Tra Vinh agriculture in the province's GRDP decreased from 52.46% to 30.72%, the value of industry products agriculture is still growing (\$0.67 billion in 2015 to \$0.85 billion in 2020). The production value of the agricultural sector in Tra Vinh province increased by an average of 2.67% per year. The average growth rate in 2010 - 2015 reached 3.88%, and in 2016 - 2020 reached 1.47%.

(Unit: billion US dollars)



Source: Tra Vinh Statistical Office 2021 ^[11]

Fig 2: Agricultural GRDP vs GRDP of Tra Vinh province

The agricultural sector's internal structure is transformed to reduce the proportion of agricultural and forestry production and increase the proportion of fishery production. As a result, the average annual growth rate of fisheries is 4.15% (in the period 2010 - 2015) and 7.91% (in the period 2016 - 2020), while the average growth rate of agricultural and

forestry production value is respectively 3.69% and 9.21% (in the period 2010 - 2020); -1.74% and -0.53% (period 2015 - 2020). The above structural change in the agricultural sector is consistent with promoting marine economic advantages and adaptation to climate change in Tra Vinh.

Table 1: Agricultural growth in Tra Vinh province

	Value of agricultural production (millions of dollars) Calculated at comparative price in 2010			Average growth rate (%/year)		
	2010	2015	2020	2010 2015	2016 2020	2010 2020
Agriculture	655,46	785,76	719,76	3.69	-1.74	0.94
Forestry	8,62	13,39	13,09	9.21	-0.53	4.24
Fishery	267,38	327,60	479,25	4.15	7.91	6.01
AFF	931,46	1.126,75	1.212,10	3.88	1.47	2.67

Source: Tra Vinh Provincial People's Committee (2021) ^[13]

Converting from traditional agriculture to developing organic agriculture and high-tech agriculture: Although the number of agricultural production facilities converting from conventional agriculture to organic agriculture, ecological agriculture, and high-tech agriculture is not fully recorded, based on the proportion of land used for high-tech agriculture (Table 2), this conversion rate is still prolonged. The whole province has only 19,059 hectares (10.26%) of agricultural production land with high technology applications. There is 1.47% of agricultural land with the application of farming techniques according to VietGap and GlobalGap standards. 32.1% of surveyed households said they applied farming techniques according to VietGap and GlobalGap standards. According to statistics of the province's agricultural sector, by 2020, the whole province had nearly 1,200 hectares of rice cultivation applying new technologies, using new varieties and hybrid rice with high yield and high quality associated with applying new farming techniques. Compared with the province's total rice-growing area of 205,144 ha, the rate of hi-tech application area is

only 0.6%. In 2016, there was one agricultural production facility successfully applied 4.0 technology in rice farming in Tra Vinh. This technology was researched by Nguyen Thanh My (RYNAN Smart Fertilizers Joint Stock Company), providing machinery and equipment, smart fertilizers and guiding farmers to implement. The technology applies monitoring buoys and cloud computing to measure salinity, temperature, and pH for rice production. Farmers can monitor or control the entire production process on smartphones. In addition, there are 12 other hi-tech application models in the whole agricultural sector and in the province, which are evaluated as very effective. However, "the number of establishments deploying and replicating the application of high-tech agricultural models is minimal." Transforming from small-scale and fragmented production to large-scale production to promote agricultural development towards a green and sustainable economy: In 2010 - 2020, Tra Vinh's agricultural sector made many efforts to promote farms and large field models. As of July 1, 2020, according to the General Statistics Office (2020) ^[31],

the results of the mid-term agricultural survey 2020, Tra Vinh has 591 farms, including 33 farming farms, 20 livestock farms, 538 aquaculture farms (corresponding to 2.87% of the total number of farms in the country, 11.6% of the total number of farms in the Mekong Delta region). The ratio of farms/rural households in Tra Vinh is 25.17%, higher than in the Mekong Delta (14.45%) and higher than in the whole country (12.21%). Tra Vinh has 15 communes (17.65% of total communes) with large fields, higher than the entire country (12.68%). However, the total number of agricultural households in Tra Vinh province participating in the large field model is only 3,122 (equivalent to 1.33% of the total number of rural households), lower than the whole country (1.94% or 327,326 rural households participating in

large field model).

4.2 Effective use and level of savings, protection and conservation of resources

Use of electricity for agriculture and electrical energy productivity in agriculture: The statistics in Table 2 show that the annual electricity consumption for agriculture doubled (in 2017), and nearly doubled (in 2018). However, the electricity consumption rate for agriculture decreased in 2019 and 2020. With electricity consumed for agricultural production increasing from 751,239,674 Kwh (2016) to 1,083,696,149 Kwh (2020), productivity in agriculture has decreased from \$22.64/Kwh to \$4.81/Kwh.

Table 2: Electricity consumption rate for agricultural production and electrical energy productivity of Tra Vinh agricultural industry in the period 2016 - 2020

	2016	2017	2018	2019	2020
Total Power Consumption (KWh)	751,239,674	834,165,008	942,201,736	1,010,972,301	1,083,696,149
Electricity Consumption for A-F-F (KWh)*	29,595,463	59,542,687	113,685,175	147,515,930	176,860,358
Increase (%)	-	101.19	90.93	29.76	19.89
Electricity consumption rate for A-F-F (%)	3.94	7.14	12.07	14.59	16.32
GRDPAFF (thousand dollars)	669,993	738,227	798,057	824,011	849,834
Increase (%)	-	10.18	8.10	3.25	3.13
Electrical energy productivity of the AFF sector USD/kwh Increase (%)	22.64	12.40	7.02	5.59	4.81
	-	-45.23	-43.38	-20.43	-13.98

Source: Calculation from data of Tra Vinh Provincial People's Committee (2021b) ^[14] Report on development status of Tra Vinh province (*Data of Tra Vinh Power Company)

Land use towards green economy: According to the People's Committee of Tra Vinh Province (Fig 2), as of August 2021, the province has 19,059 hectares of hi-tech agricultural production. Among those, there are 4,840 hectares applying semi-automatic irrigation and spraying technology; 2,721 hectares produced according to Viet Gap and Global Gap standards; 11,492 hectares of intensive and high-density aquaculture; 6.55 hectares of net house technology and hydroponics application. In addition, according to information from Tra Vinh Newspaper, as of October 2021, Tra Vinh has 200 hectares of organic rice and 1,294 hectares of organic coconut.

The organic coconut model is supported by the agricultural sector of Tra Vinh province to develop with the standard of "no chemical fertilizers, no raising livestock or poultry in the coconut garden, no building toilets in the garden. Instead, the source of nutrients for the coconut garden is organic fertilizers and micro-organisms." In recent years, Tra Vinh has made specific efforts and successes when supporting and promoting the transformation of agricultural production methods toward green agriculture. However, current data shows that the proportion of land used for green agriculture development is relatively low.

Table 3: Agricultural production area of Tra Vinh province in 2020 towards green economy

	Criteria	Area (ha)	percent (%)
A	Total area of agricultural production land (agriculture, forestry, and fishery)	185,138	100
B	Area of high technology application	19,059	10.29
1	Area of application of semi-automatic irrigation and spray technology	4,840	2.61
2	Production area matched VietGap and Globalgap standards	2,721	1.47
3	Area of intensive aquaculture and high-density intensive farming	11,492	6.21
4	Area of application of net house technology and hydroponics	6.55	-

Source: Tra Vinh Provincial People's Committee (2021b) ^[14]

According to data from the General Statistics Office, in 2020, the forest cover rate of Tra Vinh province reached 4.0%. It is low compared to the overall forest cover rate of the Mekong Delta (4.9%) and very low. Compared to the whole country (42.0%). The planted forest area of Tra Vinh Province accounts for 68.48% of the total forested area, which is higher than the Mekong Delta region (68.13%) and exceptionally high compared to the whole country (29.96%). However, the area of "newly planted forest" accounts for only 1.09%, lower than the entire country (1.84%) and lower than the region (2.96%).

Protection and conservation of natural resources and biodiversity: According to the People's Committee of Tra

Vinh province (2021) ^[14] report, the protected forest land of Tra Vinh is 6,925 ha, and the mangrove forest land is 8,691.98 ha. Most of the mangrove forest area is used in combination with forestry and fishery production. Tra Vinh's coastal mangrove resources are considered a "green wall" that prevents and limits the harmful effects of storms and waves, supporting the sea reclamation process, expanding the natural area through the roots of pioneering species such as coriander, amaranth, holding and compacting alluvium, accelerating the sedimentation rate and helping the alluvial flats form quickly. ". In the past years, Tra Vinh has not harvested timber, only recovered forest products due to dead trees and forest wood products

due to construction works.

Table 4: Tra Vinh forest land area compared to the region and the whole country in 2020

	Total forested area (Thousand ha)	Natural forest area (Thousand ha)	Planted forest area (Thousand ha)	Newly planted forest area (Thousand ha)	Forest cover rate (%)
Tra Vinh	9.2	2.9	6.3	0.1	4.0
Mekong Delta	250.4	79.8	170.6	7.4	4.9
Whole country	14,677.2	10,279.2	4,398.0	270.4	42.0

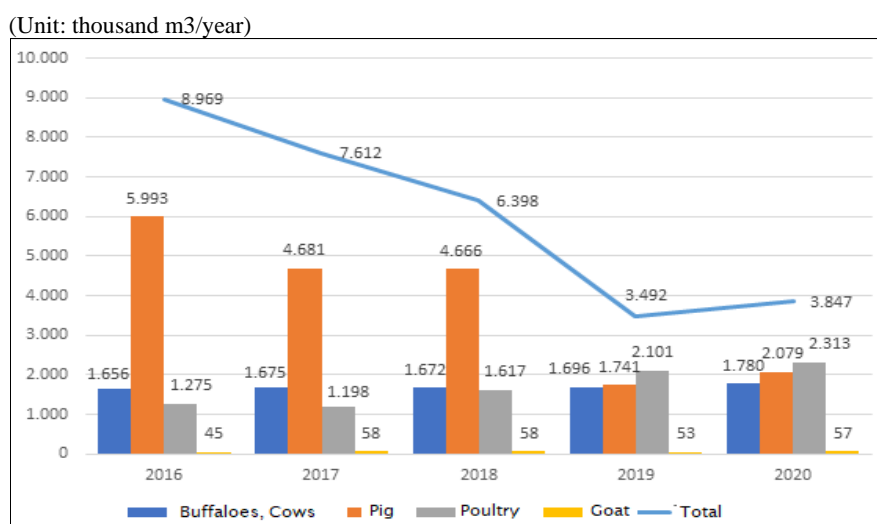
Source: General Statistics Office (2021) ^[4]

As a result, Tra Vinh's timber output in 2020 is 77.9 thousand m³ (equivalent to 9.67% of timber harvested in the whole Mekong Delta region and equal to 0.45% of the country's logging output).

As mentioned above, with nearly 8.7 thousand hectares of the submerged forest, Tra Vinh's wetland ecosystem has a large amount of plant and animal biomass, a place to breed, nurture and provide food for fishes and crabs, shrimps and many species of great economic value. In addition, mangroves help replenish the land, protect coastal areas, and create habitats for many wildlife species. According to the status assessment report of the People's Committee of Tra Vinh province, the terrestrial flora of Tra Vinh includes a relatively high proportion of algal blooms and woody plants only concentrated in a few common families and also common in other provinces of the Southwest region. Aquatic flora: The composition of algae species was recorded in the water bodies of Tra Vinh province with a total of 147 species belonging to 50 genera, 25 families, six orders belonging to the *Diatomeae* and Blue-green algae. Plants of conservation value: 65 species are globally threatened (according to the IUCN Red List), of which three are assessed as endangered (according to the list of threatened plants in Vietnam).

Diversity of vertebrate fauna: fish (including 386 fish species, belonging to 101 families, 50 orders), amphibians (9 species recorded), reptiles (30 species found), birds and mammals (159 bird species belonging to 49 families, including 72 species of waterfowl). Invertebrate fauna: terrestrial includes 53 species in 8 butterfly families, and benthic invertebrate fauna comprises 171 species. According to Tra Vinh's self-assessment results, "the current status of biodiversity resource degradation in the province mainly focuses on fisheries. Forest resources are well conserved and are on the way to recovery and development. The remaining resources are still in reasonably stable condition. However, the radical fishing method (regardless of the size) of coastal residents rapidly reduces the reproduction of many species and causes the extinction of some species, including valuable species. In addition, "the marine ecosystem is also heavily threatened by waste pollution, sedimentation and oil spill pollution, pollution by waste from activities and domestic debris as the living environment of the sea. As a result, most marine species were affected, many marine species decreased in number, and biodiversity was significantly lost.

4.3 Emission reduction results



Source: Tra Vinh Technical Center for Natural Resources and Environment (2021) ^[12]

Fig 3: Livestock wastewater flow in Tra Vinh area

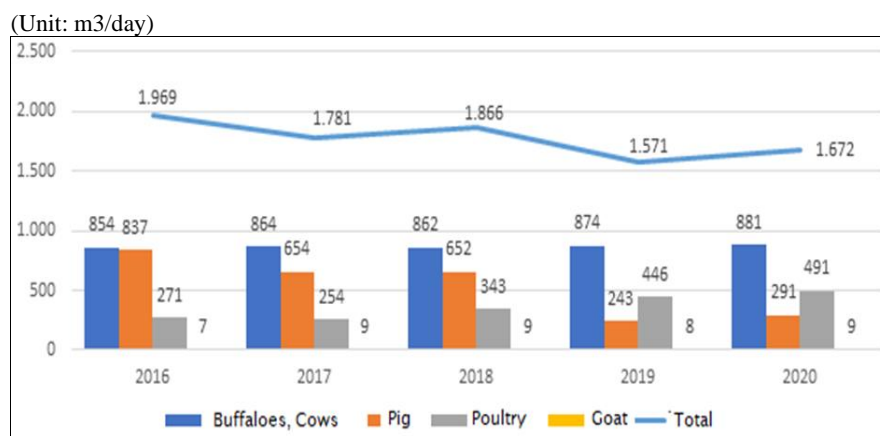
The amount of wastewater from livestock activities in Tra Vinh province decreased sharply in 2017, and 2019 but increased slightly in 2018 and 2020. The amount of wastewater from livestock production activities is affected by the number of animals. The total amount of wastewater from livestock in 2020 will decrease by 2,811 thousand m³ compared to 2016. Before 2019, the most significant amount of sewage is generated from pig farming. In 2019, the number of pigs raised decreased 62.69% (from 319,620

heads to 119,258 heads) and the amount of wastewater generated also decreased by 62.69%.

According to the definition of hi-tech agriculture, as mentioned above, the application of high technology to agricultural production is efficient but environmentally friendly. However, transforming hi-tech agriculture in Tra Vinh province has not yet seen the effect of saving electricity and water and reducing wastewater. There is an opinion that "the amount of water consumed and discharged

by livestock and aquaculture establishments with high technology application is higher and more expensive than traditional production establishments." In aquaculture, in addition to the amount of wastewater in each discharge (shrimp farming: discharge one time/crop; snakehead fish farming: discharge on average once a week (about 30 to 50% each time) and discharge discharged at the end of the harvest), sludge is also the cause of pollution of canals and canals. According to a Center for Technical Resources and Environment report of Tra Vinh province, the average amount of sludge per hectare of cultivated land per crop has increased from 91.245 million m³/ha/crop in 2016 to 113.57 million m³/ha/crop.

Emissions: According to Tra Vinh Center for Natural Resources and Environment Technology, emissions from farming activities are negligible (the average amount of discarded agricultural by-products is about 12,811 tons/year; it was recovered, reused or recycled about 10,248 tons/year). While emissions from livestock are volatile, in 2020, they decreased by 297m³/day compared to 2016. It is estimated that the value of agricultural production is negligible in terms of emissions generated from crop production (cultivation, livestock) calculated per m³ of emissions in 2020 is 1,180 USD.



Source: Tra Vinh Technical Center for Natural Resources and Environment (2021) ^[12]

Fig 4: Emissions generated in livestock

Solid waste and pesticide residues: According to the environmental status report of Tra Vinh province, the average amount of chemical fertilizers used is 151,734 tons, and the average amount of pesticides used is about 1,380 tons. The survey results of agricultural production households show that 52% of the surveyed agricultural production households apply biogas technology to waste treatment in livestock, and 57.7% of the households apply "3 down, 3 up", "1 right, 5 down" techniques; 79.6% of

households use chemical fertilizers; 68.9% of agricultural production households use chemical pesticides; 79.6% of surveyed households reported that there is a collection point for pesticide packaging in the locality. Compared with the statistics on agriculture and rural areas of the General Statistics Office, Tra Vinh has 70.59% of communes that have collection points for pesticide packaging. In comparison, the whole country has only 50.63%.

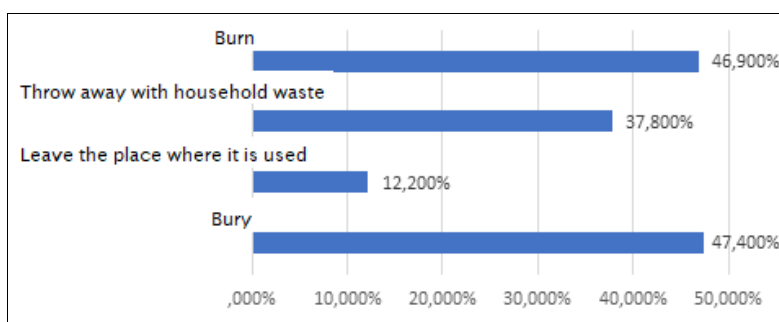


Fig 5: Method to handle pesticide packaging of agricultural production households in Tra Vinh

Although, Tra Vinh's number of collection areas for pesticide packing is much higher than the whole nation. However, the survey data shows that the habit of handling pesticide packaging as reflected in the fig 5 prove that the collection areas not really effective and Tra Vinh

environment still be damage from pesticides for agricultural production. For agricultural wastes (straw, straw, rice husks, corn cobs, corn stalks..), agricultural households mainly choose the method of reuse as organic fertilizer or as animal feed (Fig 6).

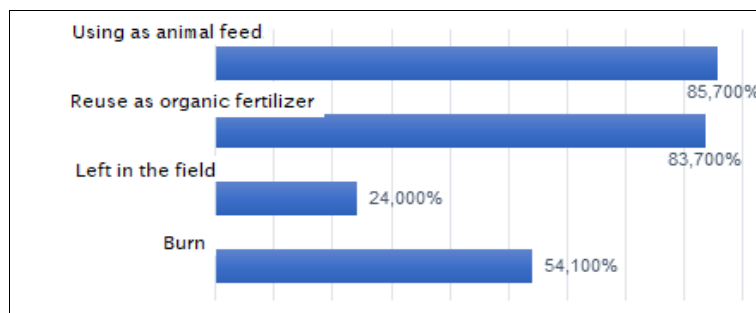


Fig 6: Methods to handle agricultural wastes of production households

The survey results on the opinions of state management agencies about the environmental friendliness of Tra Vinh's

agricultural production especially waste treatment, were the weakest (Table 5).

Table 5: Assessment of environmental friendliness of agricultural production in Tra Vinh (Unit: %)

	Very Poor	Poor	Normal	Good	Very Good
Environmentally friendly production technology	1.01	3.03	39.39	53.54	3.03
Environmentally friendly products	1.01	4.04	36.36	51.52	7.07
Reduce the level of waste, emissions	1.00	4.00	59.00	32.00	4.00
Waste treatment	1.00	22.00	63.00	13.00	1.00

4.4 Tra Vinh's efforts in agricultural development towards green economy

Regarding agricultural restructuring, Tra Vinh Provincial Party Committee issued Resolution No. 17-NQ/TU, dated September 15, 2014, on leadership in restructuring Tra Vinh province's agricultural and rural economy to 2020; Directive No. 28-CT/TU, dated June 19, 2015 on strengthening leadership in restructuring the agricultural sector towards enhancing added value and sustainable development; Resolution No. 05-NQ/TU, dated November 3, 2016 on leadership in restructuring the agricultural economy in the province. In 2016, the People's Council of Tra Vinh province issued Resolution No. 15/2016/NQ-HDND, dated December 8, 2016, on promulgating many policies to support the restructuring of the agricultural sector in Tra Vinh province until 2020. In 2018, through Decision No. 2540/QD-UBND dated December 24, 2018, the Provincial People's Committee approved the Project on restructuring the agricultural sector of Tra Vinh province to 2020, with an orientation to 2030. Restructuring the agricultural sector "in line with the strategy and plan for socio-economic development, environmental protection for sustainable development in the Mekong Delta and the province to proactively adapt to climate change and regional and world economic integration." The goal of agricultural restructuring in Tra Vinh with the growth rate of GRDP of the entire agricultural sector is 3.08%/year; the proportion of agriculture in the province's GRDP structure accounts for 30%; structure of production value in each field: agriculture 62.3%, and forestry 1.5%, fishery 36.2%. Although, as mentioned above, the actual agricultural GRDP growth rate in the period of 2019 - 2020 reached an average of 3.19% per year, the proportion of agricultural GRDP in the province's GRDP in 2020 reached 31%.

On transforming agricultural production towards green and sustainable production: To support and promote agricultural production according to VietGap standards, on November 9, 2015, Tra Vinh province issued Decision No. 28/2015/QĐ - People's Committee on policies to support the application of Good Agricultural Practices in Tra Vinh province in the period of 2015 - 2020. The list of supported items includes

13 items (Growing vegetables; Growing edible mushrooms; Planting fruit trees; Growing rice; Raising pigs, beef cattle, goats; Raising poultry and waterfowl; Raising black tiger shrimp, white leg shrimp; Raising catfish, snakehead fish; Raising clams; Preliminary processing of vegetable products; Preliminary processing of products fruit products; Preliminary processing of aquatic products) with requirements on the scale and 6 conditions to receive support (including conditions on contract or product consumption plan, and support only when the product is produced met VietGap standards). As a result, most production households do not have access to the policy because the production scale is still small and fragmented, there is no plan to link and consume products, and they do not meet the conditions for support. In addition, implementing Decision 490/QĐ-TTg of the Prime Minister, Tra Vinh province has also been implementing the program one commune, one product (OCOP) following Decision 1905/QĐ-UBND dated September 27, 2018, of Tra Vinh province. As of mid-2020, in Tra Vinh province, the rate of communes having registered for the program is 74.47%, and the rate of communes having registered with products is 27.69%. Compared with the Mekong Delta (41.07% of registered communes, 39.92% of registered communes have qualified products) and the whole country (40.64% of registered communes, 35.94% of registered communes have qualified products), the percentage of communes registered with Tra Vinh's OCOP program is very high, but the number of communes with successful products is still low.

Regarding emission reduction from agricultural production: Tra Vinh province is recognized by the Ministry of Agriculture and Rural Development as one of 48 cities and provinces (76.1% of the provinces) that have issued separate guiding documents to implement policies to support livestock households (Ministry of Agriculture and Rural Development, 2021^[8]). This guidance includes support for the construction of biogas plants and bio-buffers according to Decision No. 50/2014/QĐ-TTg dated September 4, 2014. In addition, the issued documents include Decision No. 48/2016/QĐ-UBND dated 24/11/2016; Decision No. 2240/QĐ-UBND dated 7/11/2018. Policy content: One-time

support of 50% of the value of the biogas plant to treat livestock waste. The support level is not more than \$218.84 / 1 work / 1 household; A one-time support of 50% of the value of biological padding for livestock waste treatment. However, the support level is not more than \$218.84/household. As a result, by 2020, Tra Vinh province has successfully supported the construction of 7,864 biogas projects (corresponding to 14.32% compared to the whole country, 54,947 works); According to the plan in 2019, the province will support 89 models using bio-cushion. However, up to now, there is no summary data on the number of supported bio-cushion models, while the whole country supports 112,174 models.

Tra Vinh province has successfully implemented the program "Together with farmers to protect the environment." The Plant Protection Department organized the program, the Ministry of Agriculture and Rural Development and Loc Troi Group in collaboration with the Plant Protection and Plant Protection Sub-Departments of 22 southern cities and provinces. "After more than five years of implementation, Tra Vinh agricultural sector has organized more than 650 training courses to guide farmers to use pesticides safely and effectively. The province encourages farmers to collect pesticide packages and place them in proper storage tanks. The province also distributed more than 25,000 brochures and 652 posters to propagate environmental awareness in rural communities. As a result, farmers collected over 2,700 kg of used pesticide containers, put them in storage tanks and transported them for destruction following regulations. Every year, one or two models of flower-banked rice fields are built, creating a beautiful landscape for the countryside and attracting natural enemies to control harmful insects, thereby reducing from 1 to 2 times of spraying pesticides".

Regarding credit policies to support agricultural development toward a green economy: In 2018, Tra Vinh province issued credit support policies to encourage businesses to invest in agriculture and rural areas. The maximum support level is 1 billion VND. The supported requirement does including required for project development toward green agriculture. In addition, the Bank for Social Policies also has 13 lending programs with preferential policies, including loans for agricultural production, and the preferential lending policy has not mentioned investment requirements for green agriculture. According to rural and agricultural statistics, Tra Vinh's ability to access loans to support agricultural and rural development is relatively high. The number of rural households with loan needs is 18.26%, and the number of households receiving loans is 77.63%, higher than that of the Mekong Delta (needs is 15.22%; receiving a loan is 72.27%) and the whole country (needs 17.57%, receiving 76.22%).

5. Conclusions and recommendations

A green economy or a clean economy is an economy in which a market-oriented development policy uses the foundation of traditional economies with the goal of ensuring the harmony between the economy and the ecological environment. The basic growth strategy of the green economy is to protect the environment, develop clean production technology and clean energy, and quickly achieve sustainable growth or green growth (Linh & Hang, 2021)^[6].

Although the share of agricultural GRDP in GRDP decreased, Tra Vinh's agricultural GRDP increased every year. The structure of the agricultural sector changed in an appropriate direction to promote the advantages of the marine economy and adapt to climate change. High-tech agricultural models and green agricultural transformation have been implemented but not replicated. The rate of land used for agricultural development in Tra Vinh province in the direction of a green economy is still low.

The electrical energy productivity of Tra Vinh province's agricultural sector has decreased over the years because the electricity consumption rate for agricultural production has increased much faster than the growth rate of agrarian GRDP. Mangrove land (accounting for 94.57% of the forested land area) is used in combination with forestry - fishery production, contributing to promoting the advantages of Tra Vinh province. Mangrove forests are likened to "green walls" to block wind and storms and create conditions for natural forests to develop. The mangrove ecosystem has been helping Tra Vinh maintain and develop biodiversity. However, traditional agricultural production practices and methods (low proportion of high-tech agriculture) and other pollution problems still lead to the decline of marine resources.

Wastewater from agricultural activities has decreased over the years (primarily due to the decrease in the number of pigs raised). Although the number of biogas plants to treat livestock waste in Tra Vinh supported built under project 50 accounts for 14.32% of the total number of projects constructed nationwide, the amount of emissions Livestock production has not tended to decrease steadily. If emissions from farming are negligible, the net agricultural production value per m3 of emissions in 2020 is \$1,180. Although Tra Vinh province has 70.59% of communes with collection points for pesticide packaging while the whole country has only 50.63%, farmers' habit of handling waste after use is still mainly focused on burning and burying methods. These methods cause harmful impacts on the environment and do not promote agricultural development toward a green economy.

The assessment of experts and state managers about the environmental friendliness of agriculture in Tra Vinh province is the weakest stage of waste treatment. Although Tra Vinh province has made efforts to promote agricultural development toward a green economy, the results are unsatisfactory. Agricultural production in Tra Vinh province is still mainly according to traditional production methods. Production behaviour is still affected by habits. Linkages between production households and supply chain linkages are still weak. The transformation toward a green economy in the agricultural sector in Tra Vinh province is still complex because the production scale is still small. The number of farming enterprises decreases, and the number of households participating in large fields is low. The linkages between production and consumption of products are still weak, and access to capital to invest in converting to organic agriculture, high-tech agriculture, and ecological agriculture face difficulties.

To promote agricultural development toward a green economy, Tra Vinh needs to strengthen monitoring and statistics to monitor the amount of electricity, water, and natural resources used in production by businesses and agricultural households. Monitoring fluctuations in energy productivity of the farming sector; Strengthen the

measurement, assessment, monitoring and statistics of emissions from agricultural production. Monitor fluctuations in agricultural production value per unit of emissions; Strengthen the management and systematic evaluation of hi-tech agricultural transformation models (focusing on applying high technology to increase production efficiency and paying particular attention to environmental impact before encouraging replication).

The province needs to strengthen agricultural extension, propaganda and education of green consciousness in agricultural production and guide green practices in agriculture. The province also needs to enhance encouragement and support to replicate high agricultural models and complete policies to support good agricultural practices and promote the attraction of enterprises to invest in the agricultural sector, encourage and support agricultural enterprises and households to participate in large fields and supply chains. The province also needs to continue strengthening environmental impact monitoring and more effectively implement environmental tax and fee policies.

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