

Chapter 2

Interlinked Transformations of Agri-food System in Vietnam: A Case Study of Lychee Fruit Production in Luc Ngan District, Bac Giang Province

*Pham Bao Duong*¹

and

*Nguyen Thi Thiem*²

Abstract:

Conducting survey of three groups of actors in Vietnam's lychee value chain, including 60 producers, 15 collectors, 15 processing units, focus group discussion, and deep interviews, this study demonstrates that the production and consumption of lychee in Luc Ngan has undergone transformation to better meet the needs of domestic and international markets. The primary transformations identified include: (i) Moving from individual producer households into groups and cooperatives; (ii) Changing the structure of lychee varieties to provide off-season products; (iii) Moving from traditional production to manufacturing to follow quality standards; (iv) The export market, formerly dominated by China, is now moving to Europe, Japan, and Australia; (v) Shifts from supplying raw and preliminary products to processed and packaged products; (vi) Lychee producers changing from traditional, direct consumption to e-commerce to adapt to the circumstances of the COVID-19 pandemic. The study analyzed the scale, trends, and challenges of implementing these transformations for different actors in the lychee value chain. The proposed policy implications include: Building lychee production areas according to different market directions and varieties; concretizing specific policy mechanisms for attracting enterprises' investment in agriculture for Luc Ngan lychee products; establishing central policies to support the development of agricultural connections into specific policies to support the production, processing, and consumption of lychee products according to the lychee value chain; promoting research and transfer of early and late ripening lychee varieties; disseminating information on output and export markets for Luc Ngan lychee products; and developing specific policies to support and

¹ Vice President, Vietnam National University of Agriculture.

² Lecturer, Faculty of Economics and Rural Development, Vietnam National University of Agriculture.

promote the transformation of lychee in the direction of expanded connections, production according to technical standards, and different export market directions.

Keywords: Transformations, Lychee products, VietGAP, GlobalGAP, Lychee value chain

1. Introduction

Five interlinked transformations of agri-food system in developing countries have occurred in last three decades (Reardon and Timmer, 2014), including (i) urbanization; (ii) diet changes; (iii) transformation in post-harvest supply chain segments; (iv) rural factor markets (land, labor, and capital); and (v) capital-led farm technology intensification (purchased inputs and machinery). The agri-food system in Vietnam has been experiencing these five transformations, creating major changes in the production, processing, consumption, and value chains of Vietnamese agricultural products.

Modern lychee can be considered a descendent of Vietnamese lychee, which was planted in the northern provinces, including Bac Giang, Hai Duong, and other provinces (DAFF, 2013). The climate of northern Vietnam is characterized by short, dry, and slightly cold winters, and long, hot summers with high rainfall and humidity (FAO, 2002). The lychee harvest season in Vietnam is between May and July each year. It is usually divided into two stages of early crops (starting between mid-May and mid-June) and late crops (starting between June and July), which is also the potential export season. Bac Giang is the largest lychee planted area in Vietnam (around 44.81%). Luc Ngan is a key lychee production area in Bac Giang province associated with the brand “Luc Ngan lychee.” Luc Ngan lychee is trademarked in eight countries, with a total area of Vietnamese Good Agricultural Practices (VietGAP) and Global Good Agricultural Practices (GlobalGAP) of over 12,000 ha (Luc Ngan District People’s Committee, 2021), accounting for nearly 80% of the GAP lychee area in the province. Lychee has been grown in Luc Ngan district since the late 1990s. According to the stages of development, lychee producers have evolved practices to better adapt to the market, consumers, and the socioeconomic context of locality and nation.

This report investigates the study area of Luc Ngan district, Bac Giang province with three specific objectives:

- To illustrate the circumstances of the agri-food evolution of lychee production in Luc Ngan district, Bac Giang province, Vietnam as a case study.

- To examine effects of these transformations on the actors in lychee production value chains.
- To propose policy implications to advance inclusive agri-food value chains in Vietnam.

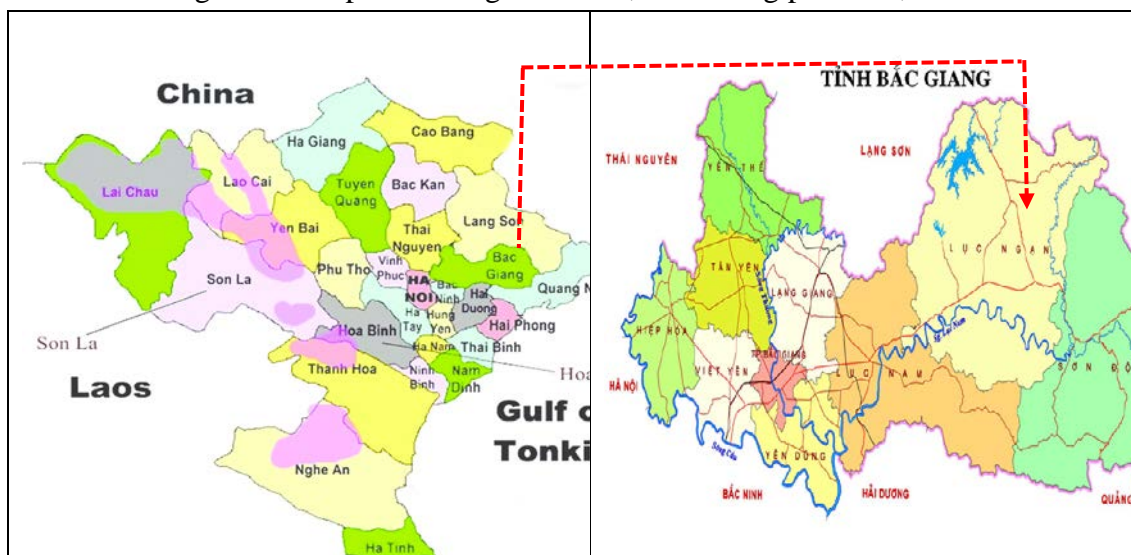
2. Methodology

2.1. Introduction to Luc Ngan district, Bac Giang province

Luc Ngan is a mountainous district of Bac Giang province, with a natural area of 103,253.05 ha, 31,757 ha of agricultural production land, and 51,992 ha of forest and forestry land area. The district is geographically adjacent to Vietnam’s Lang Son province (Figure 2-1), where border trade occurs with China. This is a favorable feature for the export of Luc Ngan lychee to the Chinese market.

Luc Ngan district has strengths in agricultural development overall, particularly fruit trees, such as lychee, oranges, tangerines, and pomelos. In recent years, agricultural producers in Luc Ngan have altered crop types, seed structure, and production techniques to meet the needs of new consumers and markets.

Figure2-1 Map of Luc Ngan district, Bac Giang province, 2021



Source: Luc Ngan District Electronic Portal (2021).

2.2. Research methodology

The study used both primary and secondary data. Secondary data were collected from published reports and articles on interconnected transformations in the agri-food system in Vietnam, and lychee production and consumption in Bac Giang province, Luc Ngan district. Primary data were collected through field surveys employing the tools detailed below.

2.2.1. Study site selection

Surveys were conducted at three locations, with a wide variety of five interconnected transformations in lychee production in Bac Giang province, including a production area primarily dedicated to Chinese export, a production area for export to Europe and Australia, and a production area predominantly for domestic consumption.

Site 1: Lychee production for exporting to China.

Site 2: Lychee production for exporting to EURO, Australia, the US, and Japan.

Site 3: Lychee production for domestic consumption.

2.2.2. Samples for survey

Questionnaire survey

The questionnaire survey was conducted with three groups of actors in the lychee value chain, including 60 lychee producers (20 at each study site), 15 lychee collectors (5 at each study site), and 15 lychee processing units (5 at each study site); thus, the total number of survey samples is 90 respondents at the three selected research sites.

The data collected reflects the scale, transformative trends, challenges, advantages, and solutions that respondents have taken to convert processes from traditional techniques to different approaches that adapt to urbanization, dietary changes, changes to post-harvest segments of the supply chain, rural factor markets (land, labor, and capital), and capital-led farm technology intensification (purchased inputs and machinery).

Focus group discussion

A focus group discussion was conducted in a location where one of the five transformations of the agri-food system has been ongoing. Group discussions involve seven to 10 people representing lychee fruit producers, collectors, processors, local

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

administrators, and agricultural extension officers. The study conducted three group discussions at three selected research sites. The contents of discussions examined the characteristics of the transformations in form, size, content, effects on the actors, local support, and policies.

In-depth interviews

Some typical cases were identified through focus group discussions and questionnaire surveys. Interviews included discussions of the scale and form of transformations and their impact. The research team conducted in-depth interviews with these representative producers to best meet the objectives of the study. Five in-depth interviews were conducted with production households, agricultural cooperatives, and local officials.

3. Circumstances of Agri-food Transformations in Lychee Production in Luc Ngan District, Bac Giang Province

3.1. Policy directions for concentrated production

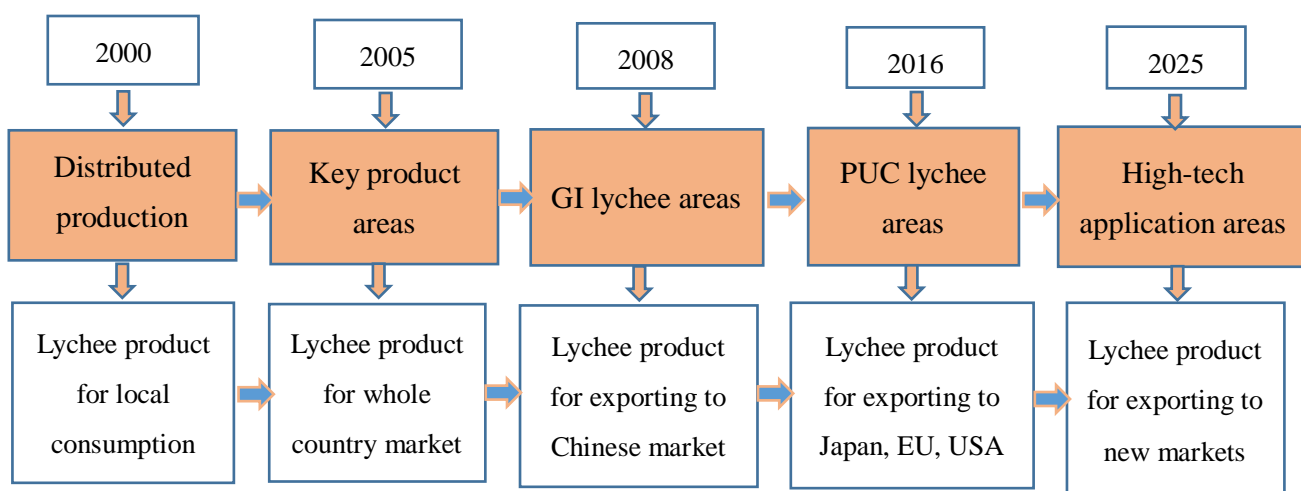
Lychee has been grown by households in Luc Ngan since the late 1990s; however, production was scattered and fragmented at that time and was primarily for local consumption. After 2005, as market demand for lychee products increased, the People's Committee of Luc Ngan district issued policies to support the planning of lychee growing areas. The local authority allowed farm households to convert many areas of low-efficient rice and cassava to lychee cultivation. In addition, the local government registered for a geographical indication (GI) for lychee products in 2008. Immediately after Luc Ngan lychee was granted a GI, the People's Committee of Luc Ngan District coordinated with the lychee production and consumption association constituents to manage and plan production areas in accordance with the GI in the district.

According to the General Plan on Agricultural Development in Bac Giang province of 2020, with orientation to 2030, the lychee area is identified as a key product production area of Luc Ngan district, Bac Giang province. To meet consumers' demand for high-quality products, the locality planned its lychee area to include high technology application. The region also applies technological advancements and transfers to traditional production regions in the locality. A high-tech lychee area in Hong Giang and

Thanh Hai communes of Luc Ngan district, with an area of 800 ha and expected output of 8,000 tons, will be completed in 2025.

Consequently, from distributed production in the late 1990s and early 2000s, lychee-producing households have been shifting to concentrated production according to key product (2005) and production areas according to GIs (2008) and production unit codes (PUCs) for export (2016) and high-tech applications (2025) (Figure 2-2).

Figure 2-2 The transformation from distributed lychee production to a specialized lychee production area over the years



Source: Authors' compilation based on the literature review and field survey (2021).

By 2021, Luc Ngan district has key lychee areas with GI in 17 communes of the district and high-tech lychee areas in Hong Giang and Thanh Hai communes. In particular, 81 PUCs for growing lychee for export to markets in China, Japan, the US, Australia, and the EU have been recognized, of which, 18 codes are eligible for export to US and European markets, 36 codes are eligible for official export to China, and 27 codes are eligible for official export to the Japanese market (Luc Ngan District People's Committee, 2021). One household is the group leader of each PUC, with three to five other member households that are strictly appraised and supervised. In a lychee area, a place that is granted a PUC with high technological standards will have a higher selling price and more favorable consumption.

At present, the shift from small-scale lychee production to concentrated production using commodity regions on a large scale has developed; however, many challenges remain that require solutions in the future in terms of infrastructure. In addition, the planning stops at the production stage, which is not associated with solutions for

processing and consuming lychee products.

3.2. Moving from individually producing households to groups and cooperatives

Before 2015, in Luc Ngan district, there were two types of organizations involved in lychee production and consumption, including households and cooperatives. By 2015, the condition to be granted a certificate of production according to GAP standards and PUCs, is that production households must form groups (joint groups) or participate in cooperatives. GAP certificates and PUCs are only issued to cooperative or household groups, not to individual households with small lychee areas. Therefore, in 2015, in Luc Ngan district, the three forms of production and consumption organization of lychee included households, cooperatives, and household groups. The trend of households participating in cooperatives and groups increased over the years from 2015 to 2020. To strengthen connections and advance lychee consumption, in 2017, the People’s Committee of Luc Ngan district and local professional agencies guided the establishment of five cooperatives, which included 374 household groups with 2,700 members. Accordingly, the number of household groups and cooperatives continuously increased in the period 2015–2020 (Table 2-1).

Table 2-1 Types of lychee production forms in Luc Ngan district (2000–2020)

Production organization forms	Units	2000	2005	2010	2015	2018	2019	2020
Household	HHs	12,946	20,300	-	28,000	-	-	11,483
Household group	Groups	-	-	-	120	743	795	825
Cooperative	Coops	-	-	10	18	20	25	30

Source: Statistical yearbook of Luc Ngan district (2005, 2010, 2020).

In addition to joining groups of households and cooperatives, at present, the GI for Luc Ngan lychee products is only being assigned to Luc Ngan lychee production and consumption association. The association has 30 branches producing and consuming lychee with more than 900 members, and 468 production groups with 3,800 members.

The development of household groups and cooperatives contributes to connecting producing households to cooperate and collaboratively develop the

production and consumption of lychee products, thereby contributing to the improvement of economic efficiency in lychee production, advancing quality, and meeting new markets and consumer demands (In-depth interviews with cooperative leaders, Luc Ngan, 2021). In addition, when participating in these groups, farmers receive support from organizations and government policies to improve their competitiveness. The cooperatives have enough area and output to supply the market, actively negotiate and sign contracts to supply regular products, and commit to ensuring product quality and food safety. Lychee processing and exporting enterprises cannot buy products from thousands or hundreds of single households with small-scale farms and without traceability; therefore, enterprises often sign contracts and associate with household groups and cooperatives. Luc Ngan lychee producers who seek to export their products must join cooperatives and unions to be able to sell the same type of product on a large scale, and ensure origin and quality assurance certification.

A fundamental limitation in converting from individual production households to household groups and cooperatives is the connection to the production stage (In-depth interviews with cooperative, Luc Ngan, 2021). Lychee producers join collaborative groups and cooperatives primarily to be granted PUCs and production standard certifications such as VietGAP and GlobalGAP. The district has not attracted enterprises to join the chain and conduct the final stages of production, processing, and consumption. Currently, in Luc Ngan district, there are only 13 enterprises purchasing and consuming lychee, and there are no lychee production enterprises. Some businesses associate with cooperatives and cooperative groups to export and consume lychee at commercial centers and supermarkets, but mass-production has not yet been realized. When exporting a large amount of lychee to the Chinese market, there are only a few businesses associated with producers to negotiate contracts, identify PUCs, and provide traceability stamps. There are also multiple remaining small-scale lychee producers who have not joined cooperatives and groups. Better support to attract such households to join groups, cooperatives, and association in production and consumption of products is necessary in the coming years.

3.3. The changing structure of lychee varieties to provide off-season products (early ripening and late ripening lychee varieties)

In recent years, consumers prefer off-season (early and late ripening) lychee products and are willing to pay a higher price. In the 2000s, Luc Ngan lychee were harvested in the

main season. During the harvest period, the supply of lychee is higher than the demand, leading to difficulties with consumption and lower prices. To reduce production pressure in the main season and meet consumers' demand for off-season products, producers have shifted some main season areas to produce early and late ripening lychee. The spread of the crop and the early change of seasons are critical for balancing the consumption of lychee products.

Early ripening lychee is a variety that can be harvested from May 5 to May 30 annually. Early ripening lychee has a wider adaptability than main and late ripening varieties. The main varieties of lychee have a concentrated ripening time from June 1 to June 30. Late ripening lychee varieties are primarily found in Thanh Ha (Hai Duong) and Luc Ngan (Bac Giang). Late ripening lychees can be harvested from June 30 to July 10.

The area of early ripening lychee in Luc Ngan district expanded from 4,200 ha in 2015 to 6,280 ha in 2020 (Table 2-2). Currently, the provincial Department of Agriculture and Rural Development is directing the construction of models to improve and quickly replace lychee varieties by grafting cuttings of early ripening and very early lychee varieties directly onto the existing main-season lychee roots. The results demonstrated that lychee trees grew, and developed well and quickly for harvesting.

Table 2-2 Variation of lychee area and production in Luc Ngan district by different varieties

Indicators	Units	2000	2005	2015	2018	2019	2020
1. Total area of lychee	Ha	9,095	14,280	19,670	28,353	24,825	23,684
Early ripening variety	Ha	0	0	4,200	6,000	6,215	6,280
Main season variety	Ha	9,095	14,280	15,470	22,353	18,610	17,404
2. Total lychee production	Tons	62,237	95,204	133,485	200,456	157,207	165,000
Early ripening variety	Tons	0	0	29,156	43,740	40,149	45,844
Main season variety	Tons	62,237	95,204	104,329	156,716	117,058	122,700
3. Productivity							
Early ripening variety	Tons/ha	-	-	6.94	7.29	6.46	7.3
Main season variety	Tons/ha	6.84	6.67	6.74	7.01	6.29	7.05

Source: Statistical yearbook of Luc Ngan district (2005, 2010, 2015, 2020).

The proportion of lychee varieties in Luc Ngan is currently considered to be unreasonable, as it focuses on main crop varieties (over 80% of the area). Early and late ripening varieties have very limited areas, causing difficulties in labor allocation for harvesting, preserving, processing, and consumption, and reducing economic efficiency for producers. Particularly, GAP standards for lychee only focus on early-ripening and main-season varieties but not late varieties.

There are currently over 20 lychee-growing countries, of which Asian countries have the largest share, accounting for about 95% of total world production, of which China and India account for about 57% and 24%, respectively. Vietnam's output accounts

for about 6%, ranking third in production. Global lychee production was estimated at 2.6 million tons/year in 2015. Lychee production is primarily concentrated in the Northern Hemisphere, with large quantities harvested from May to July, in major producing countries of China, India, Vietnam, Thailand, and Taiwan. There is less lychee production in the Southern Hemisphere, and is harvested from November to February, primarily from Australia, South Africa, Madagascar, and Mauritius (Vietnam Trade Office in Australia, 2015). In particular, the lychee season in Vietnam is the same as countries such as China, Taiwan, Thailand, India, and the US. Luc Ngan’s lychee products have a shorter harvesting season compared with countries such as China and Thailand (Table 2-3).

Table 2-3 Comparison of the harvest season of Luc Ngan lychee with lychees in other countries in the world

Country	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
China												
Taiwan												
Vietnam												
Thailand												
India												
Israel												
Mexico												
US												
Australia												
South Africa												
Madagascar												
Brazil												

Source: Vietnam Trade Office in Australia (2015).

Future studies and the transformation of a more suitable variety and harvest structure could prolong the harvest time from April to July. Currently, some localities in Vietnam have early ripening lychee products for harvest in April. The government and local authorities must encourage producers to change varieties of lychee to balance the off-season and main-season and better meet the needs of the market in two directions. (i) Bring early (April) and late (July) ripening varieties to the locality and (ii) Plan lychee

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

areas according to a rational seasonal structure of early ripening, main crop, and late ripening areas, providing technical and infrastructure support for each region.

3.4. Moving from traditional production to manufacturing according to quality standards

Luc Ngan is a key lychee production area in Bac Giang province, and is associated with the brand “Luc Ngan lychee,” with trademark protection in eight countries, with a total area of VietGAP and GlobalGAP of over 12,000 hectares (Bac Giang Department of Agriculture and Rural Development, 2019), accounting for nearly 80% of the lychee area in the province. Luc Ngan is a key lychee production area of the province and the whole country, according to VietGAP and GlobalGAP models. The growers of lychee under GAP standards include households, household groups, and cooperatives with large lychee growing areas, safe production areas, convenient consumption markets, and access to information. Lychee production according to GAP standards was introduced into Bac Giang province in 2005, with a scale of 15 hectares in Hong Giang commune in Luc Ngan district under the support of the Provincial People’s Committee and the DANIDA project (Denmark). In 2015, this model of lychee production according to VietGAP standards was replicated in Luc Ngan district, primarily in Hong Giang, Quy Son, and Giap Son communes with a scale of 10,474 hectares. VietGAP lychee growing area increased by 3.41%/year on average during the period 2015–2020, primarily due to the conversion of non-GAP lychee growing areas to VietGAP standards (Table 2-4). During this period, the GlobalGAP standard in lychee production was also introduced and put into practice in Luc Ngan district. In 2015, the lychee area was tested by the US and granted the Irradiation Reporting and Accountability Database (IRADS) PUC, with an area of 218 hectares, and was granted a GlobalGAP certificate (People’s Committee of Luc Ngan District, 2015, 2016). Remarkably, 2019 is the first year that Luc Ngan began to produce organic lychee products, with an area of 20 hectares. The quality of organic lychee has many outstanding advantages and potential for widespread development.

According to the (GAP) quality standards, the selection and use of inputs has completely changed in comparison to previous traditional production. Some pesticides that were once commonly used by producers for lychee are no longer in use, according to GAP standards. Previously, producers used single fertilizers (nitrogen or phosphorus), and now they use NPK synthetic fertilizers. Herbicides cannot be used for lychee farms according to GAP standards. In the past, pesticides were sprayed individually per

households, and spraying times were dispersed and prolonged, but is no longer in practice. Currently, when following GAP standards, local agricultural extension officers and cooperative technicians guide production households to spray simultaneously, as planned. Plant protection drugs are made according to the 4 right principles (“nguyên tắc 4 đúng”) of the right drug, the right time, the right volume, and the right way. The use of inputs for lychee production, which was formerly unregulated, is now monitored by household groups, cooperatives, and export enterprises.

Table 2-4 Variation of lychee area and production in Luc Ngan district by different quality standards

Indicators	Units	2005	2015	2016	2017	2018	2019	2020
1. Area of lychee divided according to quality standards								
VietGAP	Ha	15	10,471	10,717	10,918	11,218	11,317	11,700
GlobalGAP	Ha	0	100	218	218	218	298	318
2. Production of lychee by quality standards								
VietGAP	Tons	90.08	65,100	55,289	34,962	89,210	64,828	81,928
GlobalGAP	Tons	-	699.3	1,565	915	1,744	1,940	2,385
3. Lychee yield according to quality standards								
VietGAP	Tons /ha	6.01	6.22	5.16	3.2	7.95	5.8	7.0
GlobalGAP	Tons /ha	-	6.99	7.18	4.2	8.00	6.5	7.5

Source: Statistical Yearbook of Luc Ngan District (2005, 2015, 2020).

Regarding trademarks, lychee products of Bac Giang province currently own 1,174 trademark registration certificates, including two GIs, four certification marks, and 60 collective marks. Bac Giang is one of the leading provinces in the country in terms of industrial property diplomas for products, including agricultural products. Luc Ngan lychee is the first Vietnamese product to be protected as a GI in Japan (Online newspaper of the Socialist Republic of Vietnam, 2021).

Regarding the quality of lychee fruit produced according to technical standards, for producers, the covers of lychee are important for attracting customers. According to the results from the survey of the production households, buyers often choose bunches of lychee with bright colors, big and round fruit, and no evidence of locusts. About two-thirds of farmers noted that GlobalGAP and VietGAP lychee products are more beautiful than non-GAP lychee. The results of group discussions with some producers also

indicated that lychee products using GAP standards are lighter in color, have smaller seeds, thicker pulp to eat, sweet and cool, and limit fruit stem borers. In addition, the size of VietGAP lychees is more uniform than non-GAP lychee products.

Lychee fruit storage time determines the quality (freshness) and value of the lychee; therefore, preserving lychee products is of critical importance to producers. Production households noted that lychee products according to GAP standards stay fresh longer than traditional lychee products, which also helps to reduce the post-harvest loss rates. This is also a positive outcome to help non-GAP households realize the importance of GAP to advance the transformation of the lychee production process.

The perceived benefits of households that converted from traditional production to GAP technical standards include: (i) Stable and higher prices compared with traditional lychee product production (42.5% surveyed households); (ii) GAP lychee products are guaranteed for consumption by enterprises (30% of surveyed households); and (iii) GAP lychee products can be exported. Households also emphasized the difficulties of applying technical standards, such as strict adherence to technical processes and increased care workers. These challenges are also the primary reason why households are reluctant to convert production to GAP standards (Table 2-5).

To shift from traditional production to quality standards cultivation, the locality has implemented many initiatives to support producers. District leaders have invited experts from the US, Portugal, and Israel to work locally to appraise, inspect, supervise transfer, and implement techniques according to GlobalGAP standards. The local authorities use the budget to support producers' conversion, resulting in VND 40 million/ha of traditional lychee converted to GlobalGAP. This fund is used to buy labor protection and input materials for production. Bac Giang Plant Protection Sub-Department supports the transfer, training, and dissemination of production techniques according to GAP standards.

Table 2-5 Reasons for the transformation, challenges, and local support for production households applying GAP standards

Indicators	Number of surveyed households	Percentage (%)
1. Total number of surveyed production households	60	100
Households with lychee area converted to VietGAP	13	21.7
Households with lychee area converted to GlobalGAP	11	18.3
Non-converted households (non-GAP)	36	60.0
2. Reasons for converting from traditional lychee to GAP standards		
Lychee product consumption is easier and guaranteed by enterprises.	12	30.0
GAP lychee price is stable and higher than traditional lychee production price.	17	42.5
GAP producers are transferred production techniques.	3	7.5
GAP producers are located in a planning area that is facilitated by the locality.	5	12.5
Producing lychee according to standards that are easy to export.	6	15.0
3. Household challenges when converting to GAP standards		
Manual care labor is higher than traditional production.	5	12.5
GAP producer must strictly follow the technical process.	17	42.5
Difficulty in harvesting because of challenges hiring workers.	2	5.0
4. Local support for GAP producers		
The locality supports GAP producers with 50% of standard plant protection drugs.	18	45.0
Support through advice on production techniques and care processes.	9	22.5
Fertilizer support.	3	7.5

Source: Survey on households producing Luc Ngan lychee (2021).

In 2018, the district's Agricultural Extension Station held 115 training courses on lychee production techniques according to VietGAP and GlobalGAP standards for 5,175 participants. Monthly technical guidelines for lychee care are also issued. The District People's Committee organized the first issuance of certificates of lychee production according to VietGAP standards in 2018 to over 22,341 households with an area of 11,123 hectares in 332 villages in the district (Luc Ngan District People's Committee, 2018). Regarding irrigation, experts from the Institute of Agrochemical Soil were invited to test the groundwater samples of Luc Ngan to ensure quality. These technical standards (GAP) are only recognized for a period of 1 year; thus, producers must register to be appraised and inspected annually to be certified with the new GAP standard. Producers are unfamiliar with this condition, leading to reluctance to switch.

Local support currently focuses on the input stages of production, such as supporting materials and providing technical guidance on input use (more than 50% of surveyed households). Meanwhile, techniques for harvesting and post-harvest preservation have not been highlighted and must be considered in the future (Table 2-5).

Survey results also indicate that a large number of households and lychee areas remain that are not producing according to technical standards and need to be converted to meet export-oriented consumer demand. The survey results reveal that 60% of surveyed households had not yet converted to technical standards (Table 2-5). Households do not participate in production according to technical standards primarily based on reluctance to follow strict technical processes. The management of lychee production areas according to recognized quality standards has not been well implemented. Many households spontaneously intercropped fruit trees into lychee production areas according to other quality standards, making it difficult to control the use of pesticides for fruit trees.

Accordingly, to shift and develop lychee production in Luc Ngan district according to quality standards in the coming years, transformations must be promoted from both sides, through producers and with the support from local authorities, focusing on training initiatives to increase producers' capabilities and awareness regarding the benefits and role of lychee production according to quality standards. Along with this is exceptional planning and management of lychee production according to quality standards. Implementation of supporting producers to accumulate and concentrate the lychee production scale by region. At the same time, the locality must continuously advise households on emerging technical advances and legal procedures to produce lychee according to quality standards.

3.5. The export market, formerly China, is now moving to Europe, Japan, and Australia

The export market for Luc Ngan lychee mainly depended on China from 2010 to 2015; however, after 2015, according to the orientations of the Vietnamese government and local authorities, producers have shifted to more demanding markets with higher selling prices such as Japan, Australia, the USA, and Europe (Interview with local officials, 2021). In 2014 and 2015, the local authorities issued a number of policies to promote lychee exports and expand to new markets, for propaganda, promotion, and product introduction, organizing surveys and market research to identify the direction for products, strictly managing and controlling the market, and hosting trade promotion conferences. As a result, beginning in 2015, lychee was exported to countries such as Japan, Australia, the US, and Europe (Table 2-6).

Table 2-6 Changes in export lychee quantity by markets over the years

Unit: Tons

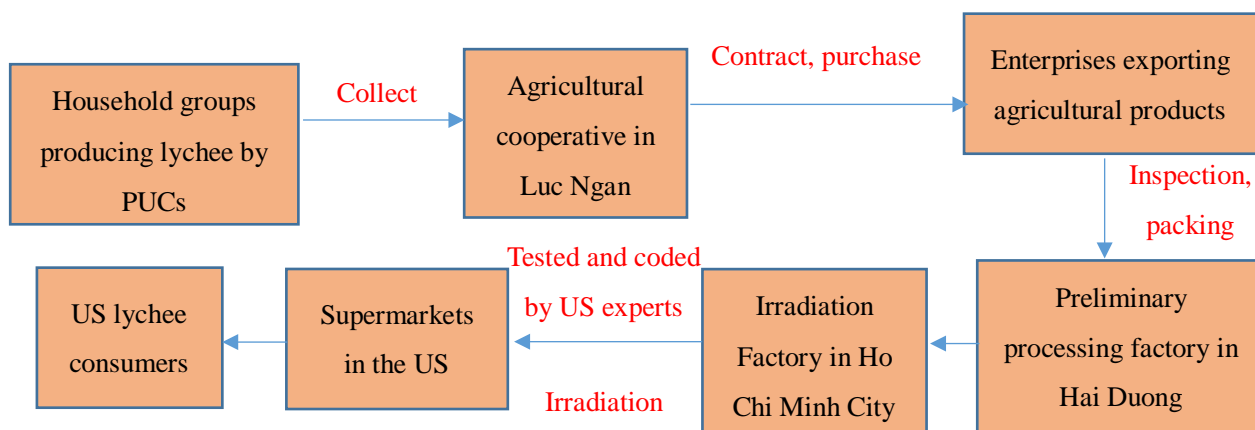
Indicators	2015	2018	2019	2020
1. Total production of lychee	136,500	151,060	102,921	115,500
2. Total export volume of lychee	42,300	68,240	55,948	52,241
Chinese market	41,300	67,340	55,228	51,310
Japanese market	0	28	37	42
Australian market	0	23	25	28
US, Europe, and other markets	1,000	849	658	861

Source: Statistical Yearbook of Luc Ngan District (2016–2020).

Figure 2-3 outlines the processes of the export of Luc Ngan lychee to US, Australian, and Japanese markets. At present, the conditions to ensure the quality of lychee exports to international markets are not uniform. Lychee products exported to US and Australian markets must be treated with irradiation technology. For the French market, lychee products are exported according to SO₂ fumigation technology. For the Malaysian market, products are preserved using manual technology, and cooled by ice. The current extenuating difficulty in exporting lychee to these markets is the requirements for

irradiated products. After harvest, lychees are transported to Ho Chi Minh City for irradiation, after which, the lychee is frozen for export to the US, Japan, and Australia. Completing all stages of irradiation requires about 4 days, significantly reducing the quality of lychee. In addition, the transportation cost from Bac Giang to Ho Chi Minh City for irradiation is exceedingly high, even higher than the cost of transportation to the US, as analyzed by An Hien (2020). This reduces the competitive advantage of lychee and immediately caused lychee from Vietnam, in general, and of Bac Giang, in particular, to lose advantages in the first year in the US and some other countries.

Figure 2-3 The processes of exporting Luc Ngan lychee to US, Australian, and Japanese markets



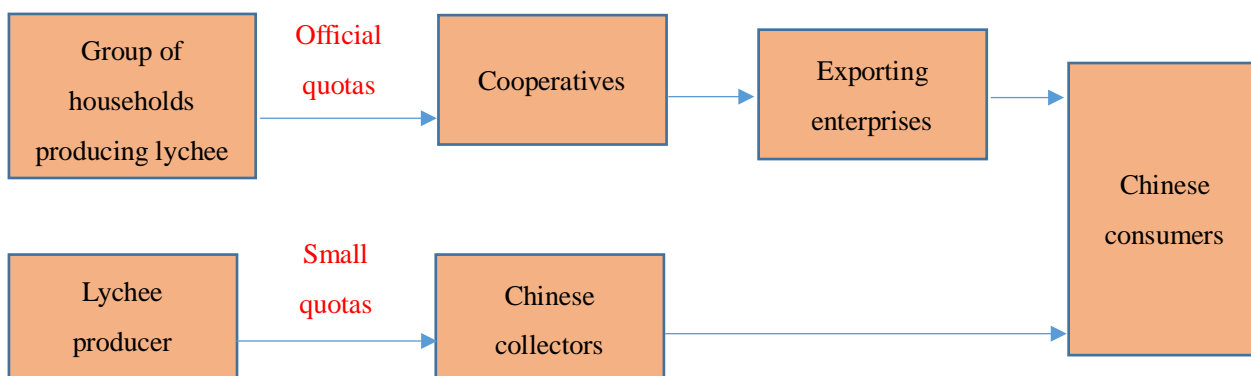
Source: Interviews with cooperative officials and local officials, Luc Ngan (2021).

For the Chinese market, there are two forms of exporting, which include official and small quotas. For official export, it is required that lychee products must have at least VietGAP certification and be purchased through exporting enterprises (Figure 2-4). However, a large volume of Luc Ngan lychee is exported to China via small quotas. According to unofficial-quota export, technical standards are not strictly required and are collected through Chinese traders. Under the unofficial-quota system, households do not need to join groups or cooperatives, and businesses can still consume products. Therefore, lychee producers who are reluctant to transform continue to primarily rely on the Chinese market.

Before 2015, lychee was predominantly exported to the Chinese market through unofficial channels, and Chinese traders purchased lychee products. At its peak, there were more than 300 Chinese traders in Luc Ngan. At its highest, in 2019, there were 388 Chinese traders monitoring and purchasing lychees in Luc Ngan (Luc Ngan District

People’s Committee, 2019).

Figure 2-4 The process of exporting Luc Ngan lychee to the Chinese market



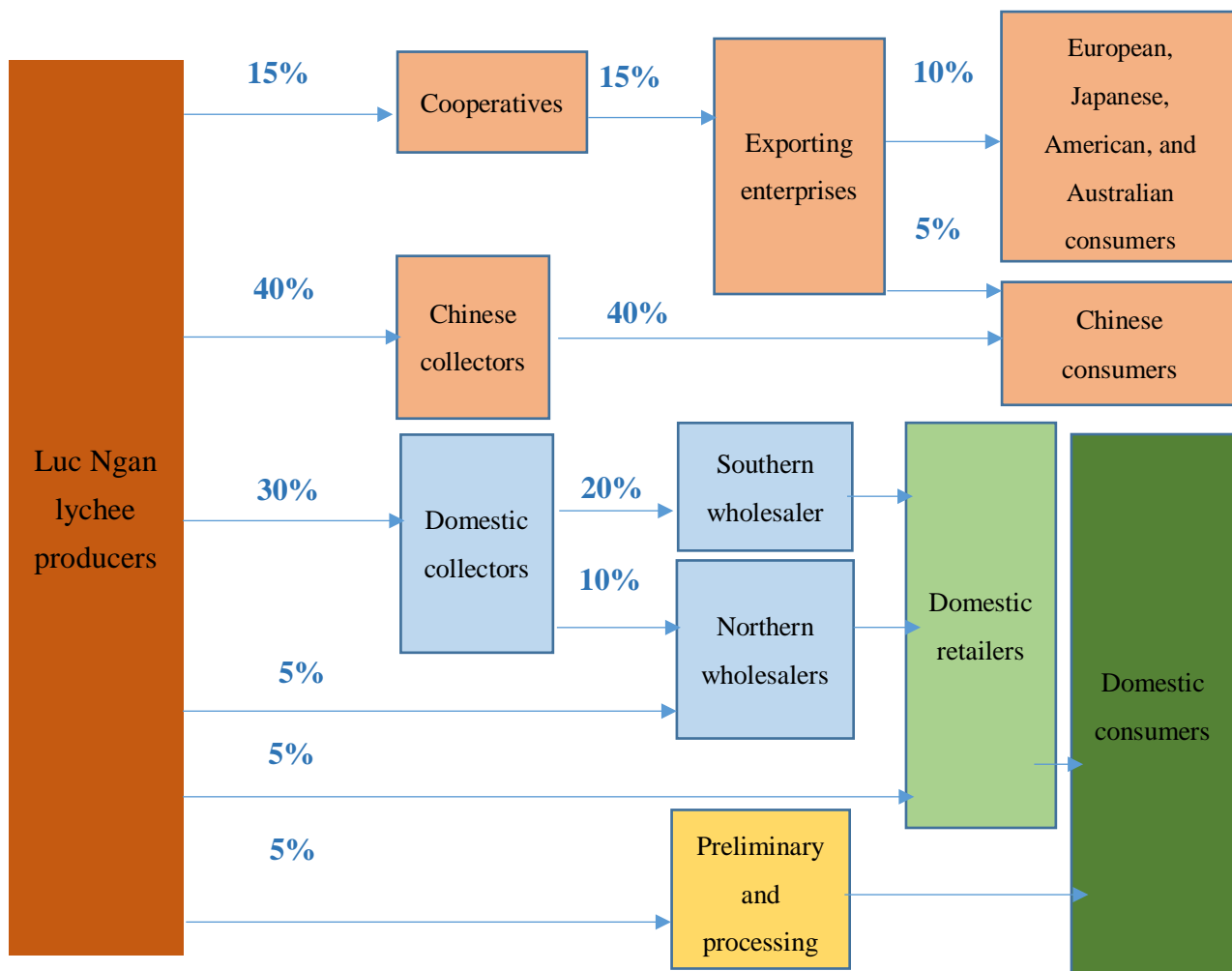
Source: Interview with cooperative officials and local officials, Luc Ngan (2021).

Lychee is exported to the Chinese market in fresh, rather than frozen, form; therefore, Chinese traders and exporting enterprises only buy lychee before 10:00 a.m. daily, to manage with customs clearance procedures at the Lang Son border gate. After 10 a.m., if the producers want to consume lychee, they will sort and sell them at local markets, processing units, and collectors for the domestic market.

From 2019, exported lychee products account for 55% of total lychee production (Figure 2-5). Domestic consumption quantity accounts for 45% of total outputs. The Chinese market remains the dominant market, accounting for 70% of lychee exports. Before 2018, 100% Luc Ngan lychee output was exported to China by unofficial quotas. After a Letter of Agreement was executed between the governments of Vietnam and China, from 2019, Luc Ngan lychee was exported to China through official quotas, meeting the requirements of standards and quality. However, the rate of official export remains low, currently accounting for about 5% of Luc Ngan lychee production.

In Luc Ngan district, there are six main lychee distribution channels, of which four are for domestic consumption and the remaining two are for foreign markets (Figure 2-5). Most of the distribution channels are through domestic and Chinese traders’ collection activities, particularly products exported to Japan, the US, Australia, and those exported to China through official quotas are through cooperatives and export enterprises. The sales channel figure also indicates that Luc Ngan lychee products are primarily sold for fresh consumption, and products for processing only account for 5% of outputs. The lychee used for processing is usually of the lowest quality and is produced on a small scale (Group discussions, 2021).

Figure 2-5 Distribution channel of Luc Ngan lychee products

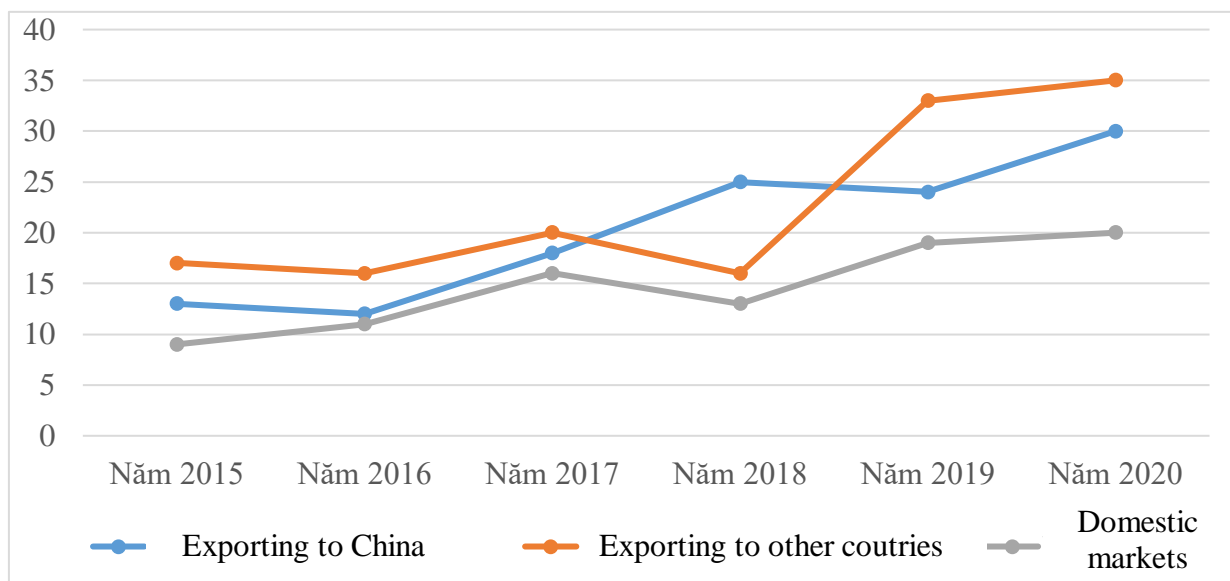


Source: Survey of lychee production and trading units (2021)

The lychee average farm-gate price sold at the locality to all markets has increased over the years. The export price to the markets of Japan, Europe, the EU, and Australia is the highest level, reaching 35,000 VND per kilo in 2020. The export price of lychee is 1.5 to 2 times higher than the domestic price of lychee (Figure 2-6).

Figure 2-6 Average price of lychee by different markets in the period (2015–2020)

Unit: Thousand VND/kg



Source: Survey of lychee production and trading units (2021)

Producers selling lychee to export enterprises through cooperatives are guaranteed through economic contracts with stable prices and outputs. However, at present, only about 15% of Luc Ngan lychees are sold through this channel (Figure 2-5). Distribution channels through collectors are exchanged through oral agreements, leading to price squeezing, or agreements between producers and collectors being broken (In-depth interviews with producers, 2021).

Links among lychee producers in consumption in Luc Ngan are very limited. Individual households search the market independently and contact traders to sell their products. Producers do not have the right to set a selling price, which is primarily determined by enterprises and collectors. This suggests that Luc Ngan lychee producers lack influence to negotiate consumption prices with buyers and businesses (Group discussions, 2021).

The conversion of lychee areas for export to new markets such as Europe, Japan, the US, and Australia is not only the need of producers to sell at higher prices, but also the orientation of local authorities to reduce dependence on the Chinese market. Local authorities have implemented several policies to support the transformation and orientation of new export markets, such as planning lychee production areas with GlobalGAP standards, organizing trade promotion activities, introducing lychee products in other countries, and assisting producers with irrigation technology, inputs for

production, and credit capital. Trade promotion activities for Luc Ngan lychee fruit are conducted at central and local levels, including trade promotion activities under the Free Trade Agreement between Vietnam and the EU (EVFTA). In 2021, Luc Ngan lychee were exported to the EU market for the first time under this Agreement. Luc Ngan lychee products are also used for quick meals on Vietnam Airlines' international flights to promote product quality to international tourists.

Survey results indicate that this shift is slow, and export volume to new markets has increased only slightly over the years (Table 2-6). Three reasons are identified below.

(i) Vietnam's post-harvest preservation technology and logistics have many limitations, as noted. After being harvested for up to 4 days, fresh Vietnamese lychees are frozen for export, and the transportation cost from Bac Giang to Ho Chi Minh City is exceedingly high.

(ii) The second difficulty of this market is required irradiation, factory standards, quality of raw materials, and product quality; therefore, Luc Ngan lychee must apply Israel's modern processing technology to bring frozen lychee products into the most demanding markets in the world. This is a challenge for lychee exporters in terms of capital investment.

(iii) Apart from production requirements according to GlobalGap standards, lychee products exported to the US, Europe, and Japan must also meet other strict standards, such as the stalk of the lychee fruit being cut short to less than 15cm, the lychee leaves being removed, and a lychee fruit box of no more than 38 cm in height. In addition, there must be enough information regarding the products, packing facility, exporter, and importer on the lychee packaging. Meanwhile, China's lychee exports through unofficial channels do not attend to product quality standards; therefore, Luc Ngan lychee producers still prefer to sell products to Chinese traders rather than new markets with strict standards.

Therefore, in addition to macro policies at central and local levels, it is necessary to conduct educational initiatives to encourage producers to transition lychee to new markets.

3.6. Raw and preliminary products shift to processed and packaged products

Processed lychee products developed in Luc Ngan in 2010, and are primarily dried lychee products. As of 2015, processing output is higher and more products have been added, including juiced pulp, canned pulp, and frozen pulp. The total production of processed fresh lychee in Luc Ngan district is about 22,100 tons. Processing through drying is about

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

19,750 tons of fresh lychee using more than 300 local kilns. Dried lychee products are predominantly exported to the Chinese market. The selling price in Dong Dang, Lang Son reaches 40,000–60,000 VND/kg. Processing through freezing and canning is about 2,350 tons. Agro-processing companies process frozen and canned lychee products. Products processed by these enterprises are exported to Korean, Japanese, US, and European markets (Luc Ngan District People's Committee, 2015). In 2020, the total production of processed lychee was over 3,000 tons, mainly dried (over 2,400 tons) by lychee drying kilns in the district. Processed by pressing juice, separating canned pulp (over 650 tons), is mainly exported to European, Australian, Korean, and Russian markets through agricultural product processing companies such as Import-Export Food Joint Stock Company Global (squeezing canned juice, separating canned pulp), Rong Do Trading and Service Co., Ltd. (separating pulp), and VIFOCO Import-Export Joint Stock Company (Luc Ngan District People's Committee, 2020).

Across Bac Giang province, there are currently more than 3,000 lychee drying kilns and six small-scale lychee pre-processing and processing units (Luc Ngan District People's Committee, 2020). Lychee fruit has high seasonality, short harvest time, and is difficult to preliminarily process, package, and preserve; therefore, with this number of processing units, only a very small portion of lychee production can be processed locally.

To improve the quality of preservation, processing, and packaging of lychee products, in 2019, Bac Giang province piloted the development of a process of fumigating lychee with methyl bromide gas in Luc Ngan district. Accordingly, activities were conducted, such as selecting suitable units and locations for implementation, and instructions on technical procedures for harvesting, preliminary processing, and packaging of products to meet the requirements of the Japanese market. In addition, the locality has conducted research and application of technology to preserve and improve the quality of Luc Ngan lychee using Modified Atmosphere Packaging (GreenMAP) film, Japan's CAS technology, and Juran technology (Israel) to ensure that lychee products retain their shape, taste, color, nutrition, and extended shelf life to meet export standards. GreenMAP film technology was developed by the Institute of Chemistry (under the Vietnam Academy of Science and Technology). This packaging helps lychee products not be affected by chemicals and retain freshness three times longer than usual. Nevertheless, this entire process has only been piloted. To develop lychee production by improving quality and adding value, it is necessary to replicate this model; however, this requires a considerable amount of capital. Technology development associated with large capital investment is difficult for lychee producers, as they cannot access large loans to

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

invest in modern equipment. Therefore, to apply these technologies, producers need to strengthen linkages in household groups, cooperatives, and enterprises to develop stronger financing capabilities.

In 2020, Bac Giang piloted a project to preserve lychee products according to VietGAP, GlobalGAP, MAP atmospheric packaging, and CAS technology from Japan. The model of a membrane house for lychee with a total area of 1,000 m² was implemented in Quy Son commune. This project is implemented at Global Food Import and Export Joint Stock Company, and this technology promises to help retain color, nutrition, and extend lychee fruit shelf life, ensuring export standards.

However, in Luc Ngan district, there are currently only three logistics enterprises for the packaging and preservation of fresh lychee products. During the main season, these businesses operate at full capacity but cannot serve all the PUC needs (Luc Ngan District People's Committee, 2020).

3.7. Lychee producers changed from traditional, direct consumption to e-commerce to adapt to the COVID-19 pandemic

The 2021, lychee production occurred in a special context, with unprecedented difficulties and challenges when the COVID-19 pandemic broke out in Bac Giang province just before the time of lychee harvest. In Luc Ngan district, COVID-19 patients appeared in some residential areas during the lychee harvest, greatly affecting the harvesting and consumption of lychee. According to the report of the People's Committee of Luc Ngan District, the 2021 lychee crop of the whole district included 15,450 ha of lychee, with an output reaching 144,826 tons (Luc Ngan District People's Committee, 2021). Adaptive implementation solutions were applied in product consumption with the support of the government, line ministries, local authorities, and producer efforts.

The local government implemented COVID-19-free zoning of safe lychee cultivation, prior to the time of product harvesting. Provincial authorities set up a quarantine point, prohibiting unrelated people from entering the lychee growing area since the pandemic, and COVID-19 had not yet broken out. The competent department divided traffic for vehicles dedicated to transporting lychee to consumption points and border gates. Local specialized agencies perform inspections and issue certificates of safe lychee shipments to the markets for consumption. The locality allowed 190 Chinese traders to enter Vietnam to buy Luc Ngan lychees.

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

The government of Luc Ngan district held six meetings to work with Vietnamese traders who purchase lychee to learn about difficulties and problems and offer solutions to support the harvest and consumption of lychee in 2021. In June, the district cooperated with the provincial Department of Industry and Trade to display, promote, and introduce lychee products at the “Online conference to promote lychee consumption in 2021.” Within the framework of the conference, local authorities opened Bac Giang lychee stalls on domestic and foreign e-commerce platforms, cut the ribbon to release the fleet of lychee trucks to be used in domestic and international markets in 2021 (Luc Ngan District People’s Committee, 2021).

Specific activities have been conducted, including purchasing and selling lychee products through six major e-commerce platforms in Vietnam, including Sendo, Voso (Viettel Post), Tiki, Shopee, Lazada, and Postmart (Vnpost). On June 6, 2021, these six e-commerce platforms simultaneously opened lychee product sales. This is the first year that Luc Ngan lychee is officially opened for sale on e-commerce platforms (Luc Ngan District People’s Committee, 2021). Consumers in 63 provinces and cities of Vietnam can order and receive Luc Ngan lychee products at home from only 6 hours to 48 hours post-harvest. The delivery vehicles in and out are well ventilated and disinfected according to pandemic requirements and food safety and hygiene. E-commerce platforms instruct lychee producers to use livestream, and self-publish lychees on Facebook, TikTok, and Senlive to increase sales orders. The program “Online lychee stall” attracts thousands of orders every day, covering over 60 provinces.

The survey results indicate that producers altered consumption patterns and received local support; however, this primarily refers to large-scale producers, according to GAP technical standards and predominantly in Hong Giang commune (Table 2-7).

Table 2-7 Difficulties in product consumption due to the impact of the COVID-19 pandemic and local support, according to survey respondents

Indicators	Number of survey respondents	Percentage (%)
I. Difficulties in product consumption due to the impact of the COVID-19 pandemic		
Consumption is difficult because the number of traders and buyers decreased compared to years prior to the pandemic.	53	58.89
Low price	25	27.78
Lack of harvesting labor because workers from outside the locality cannot enter the lychee areas.	4	4.44
II. Solutions of survey respondents		
Divide lychee into different harvesting times, according to different orders and markets and harvest earlier.	36	40.00
Comply with disease prevention standards as recommended by the Ministry of Health to consume products, test for COVID-19.	15	16.67
Classification of lychee products according to different standards for consumption (classes 1, 2, 3).	10	11.11
Link to consumers of lychee products and actively contact traders for consumption.	4	4.44
Self-drying lychee at home.	4	4.44
Follow quality standard to maintain a stable market.	3	3.33
III. Local support for the consumption of lychee products		
Create favorable conditions for traders to come and buy locally; welcome Chinese traders 21 days in advance to quarantine.	54	60.00
COVID testing support for lychee sellers, carriers, and collectors.	21	23.33
Harvesting support for households where people have to be isolated due to the pandemic.	11	12.22
Support primary processing and processing units to increase capacity and raise consumption.	6	6.67
Support the consumption of lychee products on e-commerce platforms.	4	4.44

Source: Survey of lychee production and trading units (2021).

4. Concluding Remarks and Policy Implications to Develop Inclusive Agri-food Value Chains in Luc Ngan District, Bac Giang Province, Vietnam

4.1. Summary

Research has shown that all stages in the value chain of Luc Ngan lychee have experienced a strong transformation from the beginning of production in the late 1990s to the present. The main transformations include: (i) Moving from individual producing households to groups and cooperatives; (ii) Changing the structure of lychee varieties to provide off-season products (early and late ripening lychee varieties); (iii) Moving from traditional production to manufacturing according to quality standards; (iv) Transitioning the export market from China to Europe, Japan, and Australia; (v) Shifting the supply of raw and preliminary products to providing processed and packaged products (GreenMAP); and (vi) Transforming from traditional, direct consumption to e-commerce to adapt to the COVID-19 pandemic.

To transform from distributed lychee production to concentrated production according to planning areas, the local government planned and formed some concentrated lychee production areas, including distributed production in the late 1990s and early 2000s, lychee-producing households have been shifting to concentrated production according to key product areas (2005), production areas according to GIs (2008), and according to PUCs for export (2016) and high-tech application areas (2025). However, many challenges remain in terms of infrastructure that must be solved in the future. In particular, current planned areas stop at the production stage, which is not associated with solutions for processing and consuming lychee products.

Before 2015, individual households organized lychee production. After 2015, lychee producers tend to form groups of households and cooperatives to be granted PUCs, and produce according to GAP quality standards. However, many small-scale lychee producers have not joined cooperatives and groups. In the future, there should be enhanced support to attract producers to join groups or cooperatives. Another considerable barrier in this transformation of production is that the locality has not yet attracted agribusinesses to participate in lychee production. The number of enterprises associated in production, processing, and consumption also remains very small.

Since 2005, lychee producers have converted some areas of main season lychee to early and late ripening varieties; however, the current main crop area still accounts for over 70% of the total area of Luc Ngan lychee products. The output harvested in the main

season is high, putting pressure on processing and consumption of products. Producers have a high demand for early and late ripening lychee varieties to put into production; however, there is currently a scarcity of varieties in the market.

Producers of Luc Ngan lychee began converting to production according to domestic quality standards in 2005 (VietGAP) and international quality standards in 2015 (GlobalGAP). At present, the area and output of lychee produced according to international standards accounts for just over 2% of the total; a very low rate, making it difficult to expand Vietnamese lychee products to the world market.

Export of lychee products from Luc Ngan still depends on the Chinese market, with over 70% of export volume. The market expansion to other countries is promoted from both local authorities and producers; however, due to strict requirements on product quality and activities of preserving, handling, packaging products for export, and accompanying costs, are barriers to exporting to these markets.

The local authorities have piloted a number of processes for preserving, handling, and packaging products according to high quality standards for product consumption; however, locally processed (primarily dried) lychee products currently account for a very small proportion. Refined and processed products using high technology are limited. A number of small-scale local processing establishments have only rudimentary and manual equipment.

E-commerce has been launched to replace traditional and direct methods of lychee consumption in the context of the pandemic, and new promotional activities have received considerable government attention at all levels. Lychee producers are still more familiar with the traditional method of consumption, which was substantially impacted during the pandemic.

The study also demonstrates that small-scale producers and actors in the lychee value chain are considerably affected in production and business, particularly in product consumption. Lychee products are primarily sold at free markets, and producers are often forced to price and weigh. Meanwhile, access to government support policies for small households is limited.

Overall, the actors in the current Luc Ngan lychee value chain have changed in terms of production scale, production techniques, input use methods, and product consumption. However, at the production stage, the current techniques focusing on inputs, harvesting, and post-harvest preservation have not yet been addressed. At the processing stage, the scale is small, the equipment is manual, the products are processed monotonously, and the value is not high. At the consumption stage, depending on the

Chinese market, meeting quality standards for more demanding markets faces multiple obstacles.

4.2. Policy Implications

4.2.1. Building lychee production areas according to different market directions and variety structures

Currently, Bac Giang province has planned to develop high-tech lychee production areas and key lychee areas; however, lychee areas have not been clearly planned according to market directions corresponding to different PUCs and technical standards, such as VietGAP and GlobalGAP. The structure of early ripening, main season, and late ripening varieties has not been properly planned. Currently, the area of Luc Ngan lychee is primarily concentrated in the main season, putting pressure on the market and consumption during the peak harvest period. According to the planning areas, it is necessary to develop appropriate infrastructure systems, such as local and field transportation, electricity, and irrigation systems.

4.2.2. Concretize specific policy mechanisms to attract enterprises' investment in agriculture for Luc Ngan lychee products

The Bac Giang local government must develop detailed strategic policies to attract business investment in agriculture based on the national government's general policy to attract enterprises' investment in production, processing, and export of Luc Ngan lychee. The number of enterprises investing in this field in Luc Ngan district is currently very low.

4.2.3. Concretize central strategies to support agricultural into specific policies to support interconnections of production, processing, and consumption of lychee products according to the evolving lychee value chain

Currently, Luc Ngan lychee is focused on the production stage by localities and establishments, not in the processing and consumption stages. The lychee harvested in the main season in large quantities is primarily consumed in the form of fresh products at a low price. Localities must develop strong orientations and policies to promote the

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

development of the processing industry. In particular, it is necessary to fully develop a system of packaging, handling, and post-harvest preservation in Luc Ngan and Bac Giang to conduct the local production, harvesting, packaging, and inspection processes. This will ensure fresher quality and reduce transportation costs.

4.2.4. Promote research and transfer of early and late ripening lychee varieties

Early and late ripening varieties are in high demand for local lychee producers; however, research centers and institutes have not developed programs or projects to experiment with crossbreeding to develop these varieties. Producers themselves search for varieties floating on the market, though quality is not guaranteed, which could affect production efficiency.

4.2.5. Promote information on output and export markets for Luc Ngan lychee products

Local specialized departments must provide adequate and timely information to producers and purchasing, processing, and exporting units, forecasting information about export markets for lychee products, such as China, the USA, Japan, Australia, and the EU.

4.2.6. Develop specific policies to promote and support the transformation of lychee in the direction of connections, production according to technical standards, and different export market directions

The markets for lychee products have frequent changes in demand. Although quality standards in the Chinese market today are not strict, in the future, Chinese consumers are expected to demand higher quality; therefore, it is necessary to prepare and adapt now because lychee is a perennial crop.

References

An Hien. 2020. “Nghịch lý: Phí vận chuyển nội địa đắt hơn đi Mỹ, Pháp” (Paradox: Domestic shipping is more expensive than going to the US, France). (<https://plo.vn/kinh-te/quan-ly/nghich-ly-phi-vanchuyen-noi-dia-dat-hon-di-my-phap-923210.html>: accessed on July 21, 2021)

Sakata, Shozo ed. 2022. *Development of Inclusive Food Value Chain in the Mekong Region*. BRC Research Report. Bangkok Research Center. JETRO Bangkok / IDE-JETRO.

Bac Giang Department of Agriculture and Rural Development. 2019. *Báo cáo tình hình sản xuất vải, Bắc Giang năm 2019* (Report on the situation of lychee production, Bac Giang in 2019)

DAFF. 2013. *Final report for the non-regulated analysis of existing policy for fresh lychee fruit from Taiwan and Vietnam*. Department of Agriculture, Fisheries and Forestry. Australian Government.

FAO. 2002. *The crop in ASIA and the Pacific*. FAO Regional Office for Asia and the Pacific. Bangkok. (<https://www.fao.org/3/ac681e/ac681e.pdf>: accessed on July 21, 2021)

Luc Ngan district electronic portal. 2021. *Điều kiện tự nhiên, tài nguyên thiên nhiên huyện Lục Ngạn* (Natural conditions and natural resources in Luc Ngan district), (https://lucngan.bacgiang.gov.vn/chi-tiet-tin-tuc/-/asset_publisher/NcFo8oq32kHk/content/-ieu-kien-tu-nhien-tai-nguyen-thien-nhien-huyen-luc-ngan: accessed on July 21, 2021)

Luc Ngan District People's Committee. 2015-2021. *Tình hình sản xuất và tiêu thụ vải thiều từ năm 2015-2021* (Summary report on production and consumption of lychee in 2015-2021)

Online newspaper of the Socialist Republic of Vietnam. 2021. “Vải thiều Lục ngạn và câu chuyện bảo hộ chỉ dẫn địa lý tại Nhật Bản” (Luc Ngan litchi and the story of geographical indication protection in Japan), (<http://baochinhphu.vn/Kinh-te/Vai-thieu-Luc-Ngan-va-cau-chuyen-bao-ho-chi-dan-dia-ly-tai-Nhat-Ban/427618.vgp>: accessed on July 21, 2021)

Reardon, T. and P. Timmer. 2014. “Five Inter-linked Transformations in the Asian Agrifood Economy: Food Security Implications.” *Global Food Security*. Vol. 3. Issue 2. 108-117.

Statistics Office of Luc Ngan District. 2005, 2010, 2015, 2020. *Statistical yearbook of Luc Ngan District*. Luc Ngan District.

Vietnam Trade Office in Australia. 2015. *Báo cáo nghiên cứu “thị trường trái vải của Úc và các giải pháp xúc tiến xuất khẩu trái vải Việt nam vào thị trường này* (Research report "Australia's lychee market and solutions to promote Vietnamese lychee exports to this market). Sydney April 2015. (<http://vietnamtradeoffice.net/wp-content/uploads/2016/07/2016.07.10-Lychee-Research.pdf>: accessed on July 21, 2021)