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STRATEGIES FOR UPGRADING THE CHILI VALUE CHAIN IN THE MEKONG DELTA, VIETNAM

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Abstract

The study was conducted to help supporters and chain actors better understand the status of chili production, processing, distribution, and market requirements for chili products for upgrading the chili value chain in the MD. With such goals, 389 interviews were conducted including chili farmers, collectors, wholesalers, trading companies, processing factories, retailers, local facilitators, chili cooperatives and cooperative groups. The three provinces of Dong Thap, An Giang, and Tien Giang were chosen as research sites. They have the largest area and production of chili in the MD (representing 90% of the total chili area and 91.4% of total chili production in the MD). Through a literature review of the agricultural value chain in general and chili in particular, the research framework was developed for the study. Qualitative and quantitative researches are applied to address the objectives of the study. The main methods for analyses include descriptive statistics, value chain approach, and upgrading strategies of GTZ tools (2007), Data Envelopment Analysis (DEA), Tobit regression and financial efficiency. The main results of the study are (1) the key markets for chili distribution are in Asia and Europe with different requirements of chili quality standards; (2) The results of market concentration analysis by GINI Lorenz coefficient indicate that farmers are decentralized and have almost non-financial and technical barriers. In contrast, the intermediary stage consisting of the collector and wholesaler show higher concentration; (3) In chili production, the technical efficiency (TE), the efficiency of resource allocation (AE) and cost-effectiveness (CE) are still low because many inputs are wasted although the efficiency of scale is quite reasonable, (4) the chili value chain in the MD has still many actors, so the added value of each actor is low and chili quality is limited. As a result, these are leading to a low market efficiency, (5) Based on the chain bottlenecks and SWOT analysis, there are two strategies for upgrading the chili value chain proposed – the chili quality improvement strategy and the technology investment strategy with total of 9 groups of solutions.

Keywords: Chili, strategy, value chain

1. Introduction

1.1 Rationale

Chili cultivation has contributed to the policy of rationally changing crop structure in the MD, which helps to improve production value per hectare, and thus increase income for farmers in the MD, Vietnam. Therefore, chili is identified as one of the important crops in some provinces in MD such as Dong Thap, An Giang and Tien Giang where chili is suitable to grow.

The results of many previous studies showed that although chili cultivation is more profitable than some other vegetables, the chili value chain in the MD is facing many difficulties such as (i) In the production state: the chili area is small and fragmented; the chili farmers' production technique is limited; more diseases on chili are caused by climate change; chili farmers are still limited in the application of Good Agricultural Practices (GAP) standards; (ii) In the collection stage: chili drying has not ensured food hygiene and structure safety yet; (iii) In the processing stage: logistics for preliminary processing, processing and storage are shortage of and use of outdated technology; (iv) In the distribution stage: the selling price is unstable; chili is mainly exported to China illegally; and (v) local support: the provinces focus only on the main crop of the year instead of spreading the chili crop. In addition, chili production is increasing the cultivated area uncontrollably, with even rice farmers switching to chili cultivation spontaneously while the chili export channels have not been developed officially in the long run. These problems lead to chili oversupply and thus reduce chili price.

The value chain (VC) approach has been developed by many authors including Porter (1985), Gereffi and Korzenniewiez (1994), Kaplinsky (1999), Kaplinsky and Morris (2001), Gereffi and Memodovic (2003), Feller *et.al.,* (2006), GTZ Eschborn (2007), Fabe *et. al.,* (2009), Habib (2011), Fearne *et. al.,* (2012), Dollar and Kidder (2017). The approach of these authors has been applied by developed countries for decades to bring products to the market effectively. Especially, the approach of GTZ Eschborn (2007) is interesting for international organizations for the stable and sustainable development of agricultural products in developing countries such as Vietnam. This approach to research Vietnam's agri-products elaborates on a method to help chain actors realise their roles and responsibilities in producing and distributing agri-products according to market requirements in terms of quantity, quality, and competitive prices. In addition, results from the VC studies of agricultural products help policy makers to develop reasonable macroeconomic and micro-economic policies for developing the local economy (GTZ, 2007). This is also why the approach of the GTZ value chain analysis is chosen to suggest solutions for the chili VC problems in the MD.

1.2 Research objectives

1.2.1 Overall objective

The study aims to analyse the current situation of the chili value chain in the Mekong Delta in order to find the bottlenecks of the chili value chain, and then to develop strategies for upgrading the chili product value chain in the Mekong Delta. 1.2.2 Specific objectives

- Analysing market requirements of the chili product.
- Assessing the status of chili production, processing and distribution, and analysing the chili production efficiency in the Mekong Delta.
- Analysing the chili value chain in the Mekong Delta.
- Proposing strategies and solutions to upgrade the chili value chain in the Mekong Delta.

1.3 Research questions

- What are the market requirements for chili products compared to that of at the present?
- What is the situation of chili production, processing and distribution? How are production efficiency and factors affecting production efficiency?
- How is the status of the chili value chain in the Mekong Delta?
- What are the internal and external advantages and disadvantages of the chili value chain in the Mekong Delta?
- What strategies, strategic solutions and governance implications can help to upgrade the chili value chain in the Mekong Delta?

1.4 The novelty of the study

At present, there are many studies related to the VC of agricultural products. However, there are few studies on the chili VC that combine both the VC approach with other quantitative analysis methods such as Data Envelopment Analysis (DEA), Tobit regression and market concentration analysis. Therefore, this is one of the studies contributing to the new approach that relates to VC analysis combined.

The research results show that the information of the chili VC in the Mekong Delta is updated in detail from input to output. The factors affecting chili production efficiency are analysed, they are compared with all three efficient coefficients at the same time: TE, AE, and CE (instead of only concerning about financial efficiency), this is a new point to detect more specific bottlenecks in the chili VC, thereby proposing solutions to improve production efficiency that meet the market requirements in terms of quantity, quality and price of chili.

In addition, there are few studies combining these different approaches to detect bottlenecks in the production stage that affect the operation of the following stages in the VC as well as efficiency in the whole chain. As a result, the proposed solutions from this study can change the production and business thinking of actors participating in the chain (in three stages: production,

processing and distribution) as well as that in management of local authorities at all levels. This is also a new point that has not been studied before in chain upgrading activities in Vietnam.

2. Literature Review

2.1 Summary of document overview

In general, there are three main approaches in studying a VC, namely the Filière method (chain method), Porter's analytical framework and the global approach. In this study, we will refer to the VC approach of GTZ (2007) because this approach is suitable for the current situation of agricultural products in the MD, Vietnam – the VC is a business activity related to chain actors involving in the stages of the whole chain, from providing inputs to selling the product to buyers. In addition, strategies for upgrading a product VC are based on (i) analysis of market requirements for agri-products, (ii) analysis of the product's VC, and (iii) SWOT matrix analysis (Henricks, 1999; Houben *et. al.,* 1999). Particularly, the analysis of the SWOT matrix has been widely applied by scientists and enterprises in the process of formulating strategies and solutions to develop local agricultural products as well as to upgrade VC of agricultural products because the tool is simple and useful (Kotler, 1988; Wilson and Gilligan, 1997; Thompson and Strickland, 2001). However, the VC approach has not helped researchers to have more detailed assessments of the market, production efficiency, and factors affecting the production efficiency of farmers. Thus, this study will combine several different analytical approaches in order to identify bottlenecks of the chili VC in the MD, and then propose strategies and solutions for upgrading the chili VC effectively. The following table summarises the main references related to the study.

Table 1: The theoretical connotations related to the study

Topic	Contents	Authors
1. The value chain approaches and the value chain framework	- There are many definitions of VC in which the most general one is "a set of activities carried out by many different people (input suppliers, collectors, processors, companies, wholesalers, retailers) to produce products and then sell them to domestic consumers and export". - The VC analysis framework consists of 3 basic steps: (1) mapping the VC; (2) Quantifying and describing the VC in detail; and (3) Chain economic analysis. Depending on the research objectives of each chain, the content can add appropriate analytical methods such as SWOT analysis, financial ratio analysis, etc. - In addition, through the literature review, issues related to the study will be inherited from the literature review such as the market organization model of Ghana and India, the seasonal schedule for risk management of Bangladesh, the orientation of some solutions to develop the VC in Vietnam.	- GTZ (2007) - Vo Thi Thanh Loc and Nguyen Phu Son (2016) - Le Van Gia Nho *et.al.,* (2012) - Vo Thi Thanh Loc *et.al.,* (2014) - SDRP (2014) - Yooyen *et.al.,* (2014) - JICA (2015) - AFE (2015) - MiDA (2014) - Spire (2013) - Nguyen Quoc Nghi (2015) - La Nguyen Thuy Dung (2017)

Topic	Contents	Authors
2. Upgrading the value chain	- Upgrading the VC is to determine the strategic vision, upgrading strategies, support and VC sustainable development solutions of a product. The objective of the vision is to improve the value and added value of the entire chain. There are four basic chain upgrading strategies: (1) Quality improvement; (2) Technology investment; (3) Cost reduction; and (4) Redistribution strategy. In addition, one more strategy can be applied - reducing actors participating in the chain by promoting vertical and horizontal links. Depending on the specific product chain analysis, one strategy or combined strategies are conducted. - It chain bottlenecks should be determined to propose strategic solutions for chain upgrading by 3 issues: production, market and policy.	- GTZ (2007) - Vo Thi Thanh Loc, Nguyen Phu Son (2016) - Vo Thi Thanh Loc *et.al.,* (2009) - Zuhui Huang Zhejiang (2009) - J.W.H. van der Waal *et.al.,* (2011) - ANSAB (2011) - Le Van Gia Nho *et.al.,* (2012) - Nguyen Phu Son *et.al.,* (2018, 2020).
3. The production efficiency (PE) and factors affecting to PE	The production efficiency of farmers is measured by 3 criteria: technical efficiency, economic efficiency and distribution efficiency analysed by the DEA model with 7 input variables: (1) Area; (2) Breed; (3) Fertilizers; (4) Plant protection drugs; (5) Petrol for irrigation; (6) Labor; and (7) Hours of machine use. In addition, analysis of the scale efficiency along with production efficiency will help to make recommendations on the rational use of inputs. The Tobit regression model is used to develop the efficiency indicators analysed from the DEA model to assess the factors belonging to the characteristics of the household, socio-economic conditions, etc… affecting the production efficiency. There are 13 factors affecting the production efficiency proposed: (1) Gender; (2) Age; (3) Ethnicity; (4) Production experience; (5) Education level; (6) Technical training; (7) Number of main labors of the household; (8) Join the Cooperative/Cooperative Group; (9) Capital loan; (10) Local support; (11) Area; (12) form of planting; and (13) Number of chili crops.	- Quan Minh Nhut (2013, 2014) - Angui Christian Dorgelès Kevin Aboua (2017). - Nguyen Phu Son (2009, 2010, 2018) - Dang Hoang Xuan Huy (2011), Quynh, N.T.C. and Yabe, M. (2014); Lliyasu (2015); Le Van Thap (2016); - Lam A. Nguyen *et.al.,* (2017) - Haji (2006) - Basanta (2004) - Nguyen Quoc Nghi (2015) - La Nguyen Thuy Dung (2017)

Source: Synthesized through the literature review, 2019

2.2 The research framework

Through a literature review of the theoretical approaches (Table 1) and researches related to the VC of agricultural products in Vietnam and abroad, the research framework of the study is developed and presented in the Figure 1 below.
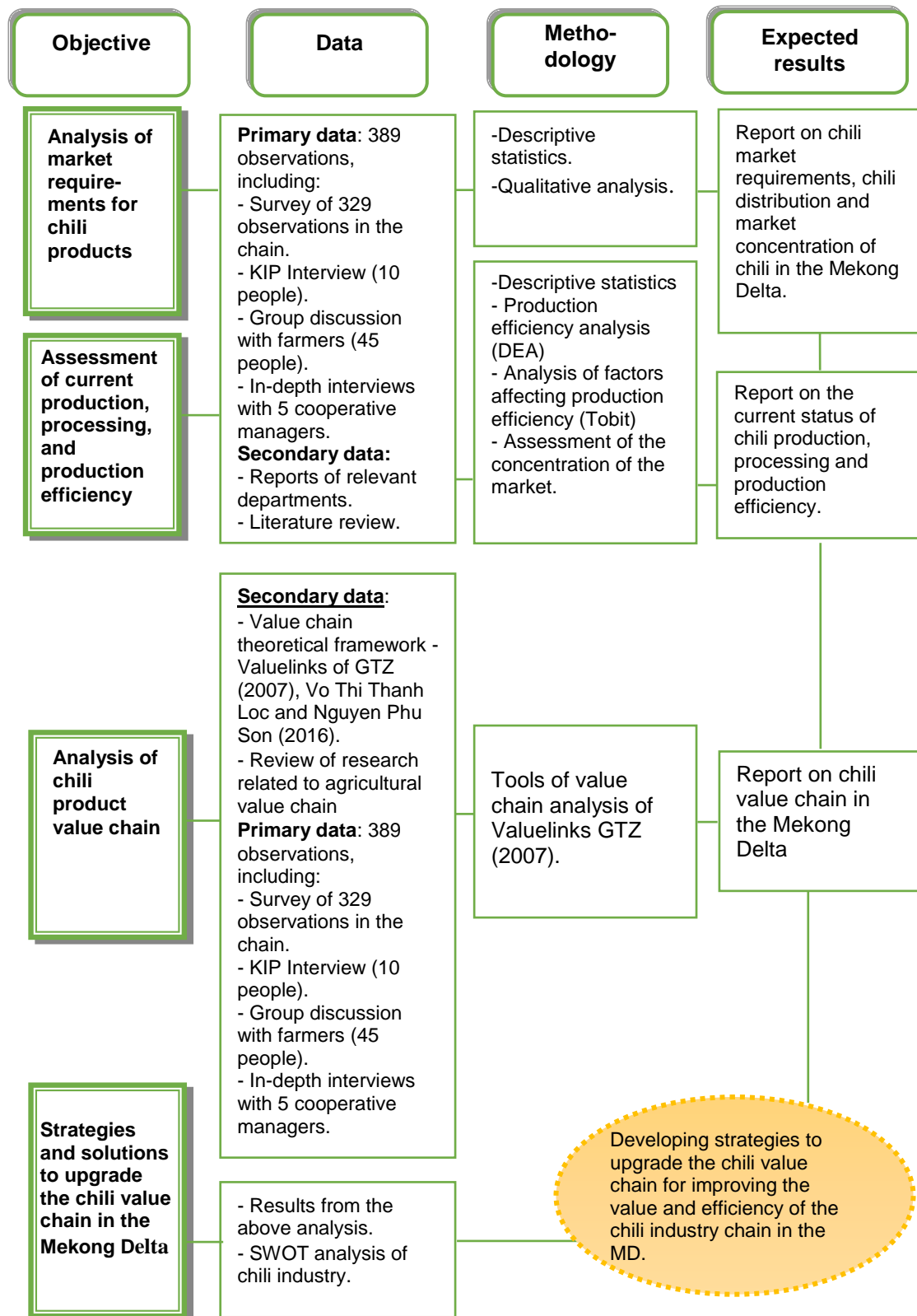
Objective	Data	Methodology	Expected results
Analysis of market requirements for chili products	**Primary data**: 389 observations, including: - Survey of 329 observations in the chain. - KIP Interview (10 people). - Group discussion with farmers (45 people). - In-depth interviews with 5 cooperative managers. **Secondary data:** - Reports of relevant departments. - Literature review.	-Descriptive statistics. -Qualitative analysis.	Report on chili market requirements, chili distribution and market concentration of chili in the Mekong Delta.
Assessment of current production, processing, and production efficiency		-Descriptive statistics - Production efficiency analysis (DEA) - Analysis of factors affecting production efficiency (Tobit) - Assessment of the concentration of the market.	Report on the current status of chili production, processing and production efficiency.
Analysis of chili product value chain	**Secondary data**: - Value chain theoretical framework - Valuelinks of GTZ (2007), Vo Thi Thanh Loc and Nguyen Phu Son (2016). - Review of research related to agricultural value chain **Primary data**: 389 observations, including: - Survey of 329 observations in the chain. - KIP Interview (10 people). - Group discussion with farmers (45 people). - In-depth interviews with 5 cooperative managers.	Tools of value chain analysis of Valuelinks GTZ (2007).	Report on chili value chain in the Mekong Delta
Strategies and solutions to upgrade the chili value chain in the Mekong Delta	- Results from the above analysis. - SWOT analysis of chili industry.		Developing strategies to upgrade the chili value chain for improving the value and efficiency of the chili industry chain in the MD.

Figure 1: Research framework

Source: Author's suggestion

3. Theoretical Foundations and Research Methodology

3.1 Theoretical foundations

The content of this section outlines some concepts related to GTZ's global value chain approach (2007), GTZ's VC analysis tools (2007), and agri-product value chain analysis in Vietnam of Vo Thi Thanh Loc and Nguyen Phu Son (2016). The set of tools for the VC analysis includes VC diagram, VC economic analysis, VC logistics analysis, risk analysis, SWOT matrix analysis and development of the VC upgrading strategies. Besides the global approach of GTZ (2007), according to Dealtry (1992), Hill and Westbrook (1997) and Haberberg (2000), SWOT analysis combines strengths, weaknesses, opportunities and threats/challenges of the actors participating in the chain in order to propose strategic solutions for upgrading the chili VC. Based on these strategic solutions, suitable strategies will be selected to upgrade the chili VC in the MD. According to the approach of GTZ (2007) explained by Vo Thi Thanh Loc and Nguyen Phu Son (2016), there are 4 strategies to upgrade the agri-product VC including: (1) Strategy for quality improvement; (2) Technology investment strategy; (3) Cost reduction strategy; and (4) Redistribution strategy.

3.2 Research Methodology

3.2.1 Approach methods

Through the review of the theoretical framework and studies in section 2, the main research approach of the study is a combination of the GTZ's Valuelinks approach (2007), production efficiency analysis by DEA and financial efficiency analysis, and analysis of factors affecting production efficiency by Tobit regression analysis. Particularly, the analysis of market requirements for chili products is only based on the results of interviews with commercial actors of the chili VC in the MD.

3.2.2 Research sites

Two indicators – chili area and volume - are used to choose the research sites in the MD. The three provinces of Dong Thap, An Giang, and Tien Giang were selected as the study sites because the chili area and production of these provinces account for 90% of the total area and 91.4% of total chili production in the Mekong Delta (Table 2).

Table 2: Area, yield and production of chili in the Mekong Delta in 2019

Provinces	Area (ha)	Yield (ton/ha/year)	Production (ton)	% Area	% Production
1. Dong Thap	3,235	17.1	55,372	25.0	26.2
2. An Giang	4,582	14.8	67,812	35.4	32.1
3. Tien Giang	3,837	18.2	69,848	29.6	33.1
4. Soc Trang	741	11.1	8,220	5.7	3.9
5. Vinh Long	401	13.3	5,329	3.1	2.5
6. Tra Vinh	150	30.0	4,500	1.2	2.1
Total	**12,946**		**211,081**	**100.0**	**100.0**

Source: Provincial Departments of Agriculture and Rural Development, 2019

3.2.3 Sample size and sampling method

The minimum sample size of chili farmers is developed based on the formula by Tabachnick and Fidell (1996): $n = 50 + 8m$ (where m is the number of independent variables). The total number of independent variables in the study is 13, so the minimum sample size must be 154 observations. Meanwhile, the total number of observations of this study is 389 as presented in Table 3.

Table 3: Sample observation structure

No.	Actors	No. of observations	Sampling methods
1	Farmer	237	Conditional non-random sampling method*
		45	Discussion groups
2	Collector	30	Method of chain linkage
3	Wholesaler	21	Method of chain linkage
4	Export company	6	Method of chain linkage
5	Processing company	5	Method of chain linkage
6	Retailer	30	Method of chain linkage
7	Facilitators	10	KIP interview
8	Cooperative	5	Interview 100% chili cooperative
	Total	**389**	

(*) At least 5 years of chili production and business

3.2.4 Data collection process

- *Focus Group Discussion* **(FGD)**: 3 groups of chili farmers in 3 representative districts of 3 provinces - Dong Thap, An Giang and Tien Giang were selected to discuss chili issues by using a semi-structured questionnaire. The number of farmers participating in each group discussion was 15 farmers. The objective of the group discussion was to

collect information related to the functions and market activities of farmers in the chili value chain, to collect information on the advantages and disadvantages of chili farmers in the process of chili production and distribution.

- **Direct interview (DI)**: The direct interview method is used to collect detailed information on chili production and distribution from chain actors based on structured questionnaires.

- **Key informant panel (KIP)**: Facilitators, who are interviewed, include agricultural managers at all levels in the provinces related to chili production and distribution by using semi-structured questionnaire. The purpose of this interview is to collect information related to the general situation of chili production and distribution, the development potentials of the chili industry, the supporting policies of the State that have been applied to the chili chain actors.

- **In-depth interviews:** In-depth interviews with managers of chili cooperatives and cooperative groups in the provinces are conducted by using a structured questionnaire. Five managers in 5 cooperatives were interviewed to collect information related to the activities of cooperatives/cooperative groups in connecting farmers, cooperative services, advantages and disadvantages of cooperatives/cooperative groups.

3.2.5 Analytical methods

The analytical methods are used to obtain the objectives of the study as follows:

Objective 1: Analysis of market requirements for chili products

Qualitative and quantitative analyses from the survey of chili growers, buyers, and export companies are conducted to describe the current situation of chili distribution in MD. Information on chili product requirements of chili import markets in the world is based on the results of interviews with commercial actors of chili VC in the MD. Particularly, assessment of the market concentration to chain stages by GINI index and Lorenz graph is also done.

Assessment of the market concentration:

The GINI index (Gr) and Lorenz graph are used to assess the level of concentration of the chili market as a competitive or monopolistical market. In this study, Lorenz graph shows the relationship between the cumulative percentages of the actors (farmer or collector or wholesaler) with the cumulative percentage of the chili sold by the actors. To calculate the cumulative percentage, the output of the above actors is sorted from high to low. The GINI index is derived from the Lorenz graph, which measures the inequality in distribution between different groups of producers and traders. The GINI index is calculated using the following formula:

$$Gr = 1 - \sum_{i=1}^{n-1} \left[(P_{i+1} - P_i)(S_i + S_{i+1}) \right]$$

Objective 2: Tools to assess the current situation of chili production, processing and distribution; production efficiency analysis

(1) Descriptive statistics

Descriptive statistics is a collection of all methods of measuring, describing and presenting data such as the frequency distribution tables of criteria on area, output and productivity, such as the

standard deviation, comparative analysis, simple mean ($\sum x_i/n$) and weighted mean ($\sum(x_i*f_i)/\sum f_i$) for calculating mean of area, average yield. In addition, mean of time series

$$\bar{x} = \left[n-1\sqrt{\frac{x_{n-1}}{x_0}} - 1 \right] 100\%$$ is used to calculate the average growth rate of area, yield and

productivity of chili production.

(2) Analysis of production efficiency

The data envelope analysis (DEA) method is applied to measure production efficiency and efficiency of scale. There are two steps to conduct the DEA model:

Step 1: Estimate production efficiency

Production efficiency is estimated by three criteria: (i) TE; (ii) CE; and (iii) AE. Simultaneously, the scale efficiency (SE) is also estimated.

Step 2: Regress a number of relevant factors

There are 13 independent variables (x_i) that can explain the change in the production efficiency of chili production. Table 4 describes the independent variables as below.

Table 4: Independent variables affecting production efficiency

Variables	Marks	Elaborations
1. Gender	X_1	Gender of (Male/Female) – Dummy variable
2. Age	X_2	Age of head of chili household (years)
3. Ethnicity	X_3	Kinh or other Ethnicity – Dummy variable
4. Production experience	X_4	No. of experience years (Years)
5. Education level	X_5	Coding by No. of 1, 2, …
6. Technical training	X_6	Yes/No answer – Dummy variable
7. Number of main labors of the household	X_7	Main labor for chili production (No. of person)
8. Join Cooperative/ Cooperative Group	X_8	Yes/No answer – Dummy variable
9. Capital loan	X_9	Yes/No answer – Dummy variable
10. Local support	X_{10}	Yes/No answer – Dummy variable
11. Area	X_{11}	Area for chili production ($1.000m^2$)
12. Form of planting	X_{12}	By quality standards or by traditional cultivation – Dummy variable
13. Number of chili crops	X_{13}	No. of chili crops by year (crop)

Source: Synthesized through the literature review

Objective 3: Analysis of the chili VC in the Mekong Delta

(1) *Chain economic analysis*

Analyses of the chili revenue, costs, added value, net added value (profit) of the chain actors are calculated to present the production and business results of each chain actor as well as the allocation of added value among actors (Figure 2).
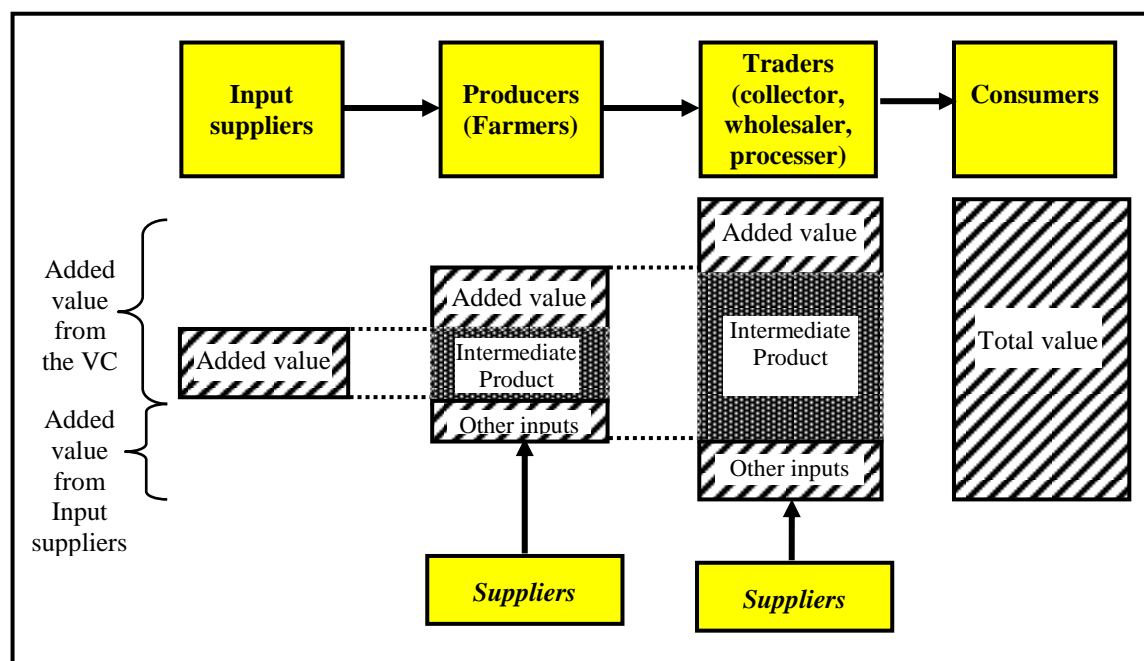

Figure 2: the allocation of added value among chain actors
Source: GTZ (2007)

(2) *Financial ratio analysis*

Financial ratios such as revenue/cost, profit/cost and profit/revenue are used to evaluate the business performance of the chili chain actors in the MD.

(3) *Analysis of chain logistics and risk*

The analysis of the VC logistics aims to describe and analyse the involvement of facilities, infrastructure and transportation in the chili VC. However, in this study, the logistic analysis is based on the results of interviews with chili chain actors and facilitators. It consists of two parts: (1) Production logistics including all of the chili producer's vehicles, machinery, equipment, infrastructure, and transportation; and (2) Logistics in the distribution stage including trucks and costs relating to the remaining actors.

Risk analysis aims to find measures to limit risks in order to improve the quality, quantity and added value of the chili chain actors. This study will examine seven types of risks as introduced by Steve, *et.al.,* (2008) (Table 5). This analysis uses a qualitative method with three levels: low, medium and high risk.

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Table 5: Types of risks in the agricultural supply chain

No.	Types of risks	Description
1	Risks due to weather, climate	Rain, temperature, wind, humidity
2	Risks due to natural disasters	Storm, flood, tsunami
3	Risks related to biology and the environment	Insects, pests, degradation of natural resources, environment
4	Risks related to the market	Changes in supply and demand affecting domestic and international prices
5	Risks related to infrastructure and logistics	Changes in costs, damages, etc. related to transportation, communication and energy issues
6	Risks related to operations and management	Weak management, control, and use of assets and resources
7	Risks related to policies and institutions	Changes in policy, currency, finance, and taxes

Source: Steve, et.al., 2008

Objective 4: Strategies and solutions to upgrade chili value chain in the Mekong Delta

As described in the above sections, to develop strategies and strategic solutions for upgrading the chili VC, it is necessary to analyse the chili market requirements, VC analysis of chili products in the MD and SWOT matrix analysis. Analytical methods of the first two contents have been presented in the objectives 1 and 2 above. The SWOT matrix analysis is shown in Table 6.

Table 6: SWOT matrix and strategic solutions

SWOT	O: Opportunities List of opportunities	T: Threats List of Threats
S: Strengths List of strengths	SO strategic solutions *Make use of strengths to take opportunities*	ST strategic solutions *Make use of strengths to overcome challenges*
W: Weaknesses List of weaknesses	WO Strategic solutions *Take opportunities to overcome weaknesses*	WT Strategic solutions *Minimize weaknesses and avoid threats*

Source: Humphrey (2005)

In this study, SWOT analysis is used to develop strategic solutions, and based on the content of these strategic solutions, appropriate upgrading strategies will be chosen. According to the value chain approach, there are four upgrading strategies: quality improvement, cost reduction, technology investment and redistribution strategy. The choice of one or combined strategies depends on the content of the strategic solutions of the SWOT matrix analysis of the whole chili value chain.

4. Research Results and Discussions

4.1 Analysis of chili market requirements

4.1.1 Market requirements of chili export

Most of the chili products in the MD are exported (accounting for 97.7%), domestic distribution is negligible (2.3%). By the survey results of commercial chain actors, the export market requirements for fresh and dried chili are as follows:

- For fresh chili: chili characteristics required by the market include: large size and not soft, glossy, bright color, green stalk, no flower stalks, and no black spots. The requirements of each export market are different regarding size and color. For example, the Korean market requires fresh chili with less than 5 cm long and bordo red color, while Malaysian and Singapore markets require fresh chili with 5-6 cm long, yellow-orange color. Chili of the MD has not met the standard in length to these markets, so chili is mainly exported to the Chinese market.

- For dried chili: The import markets require dried chili with red-orange color, dry, crispy and without impurities. The Korean market requires brown chili (the color of paste wings) but the dried chili of the MD is darker, so Korea buys fresh or frozen Vietnamese chili to dry and process it themselves.

Gaps of chili products in the Mekong Delta compared to the market requirements:

Chili of Vietnam in general and that of the MD, in particular, have not met 3 requirements of the import markets: (1) the chili has not met the standard of size and color; (2) the chili has high spiciness while different import markets requires different spiciness (due to lack of chili market researches from the Vietnamese); (3) the hili has not met the standards of clean production for large quantities to export officially to some fastidious markets, and residues of pesticides in chili are still high.

4.1.2 Situation of chili distribution of chain actors

(1) Distribution of chili by farmers: The farmers mainly sell their chili to collectors (76.1% of the whole production chain) (Figure 3).
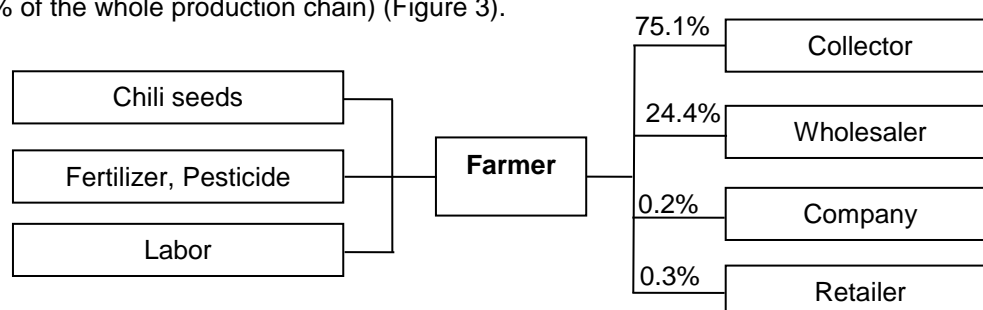

Figure 3: Distribution channels of chili farmers

Source: Survey results, 2019

(2) Distribution of chili by collectors: The majority of the collectors (90%) sell chili to the wholesalers (80% of their chili volume) (Figure 4).
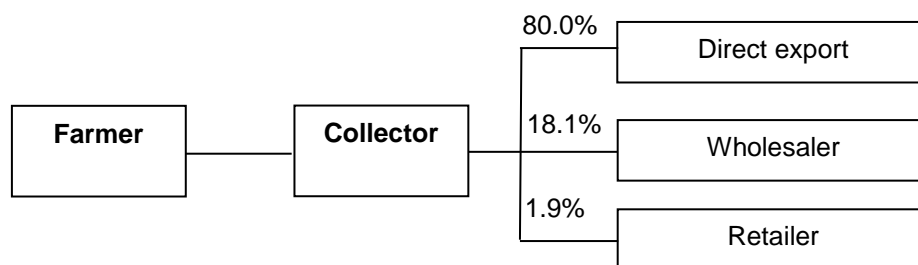

Figure 4: Distribution channels of chili collectors
Source: Survey results, 2019

(3) Distribution of chili by wholesalers: Wholesalers export 95.5% of their chili output directly as both fresh and dried chili (percentages of chili production in Figure 5 have been converted into fresh chili: average 3.5kg of fresh chili = 1kg of dried chili).
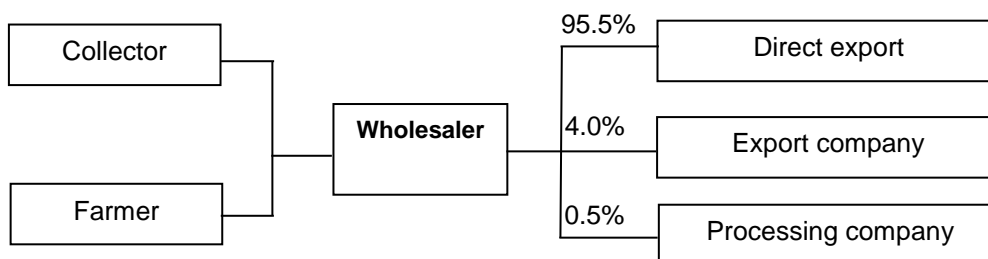

Figure 5: Distribution channels of chili wholesalers
Source: Survey results, 2019

4.1.3 Assessment of market concentration

The results of our market concentration analysis using the GINI Lorenz coefficient (Figure 6, 7, 8) show that chili farmers are dispersed and have almost no barriers in terms of financial, technical and productive experience. Therefore, the chili farmers are easy to participate or withdraw from chili cultivation (Gr = 0.45). In contrast, collectors and wholesalers (traders) are more concentrated, which means that the market for chili in the MD is relatively monopolistic. This requires traders (except small traders) to have enough capital and business experience to participate in this market (Gr = 0.64 and Gr = 0.65 respectively).

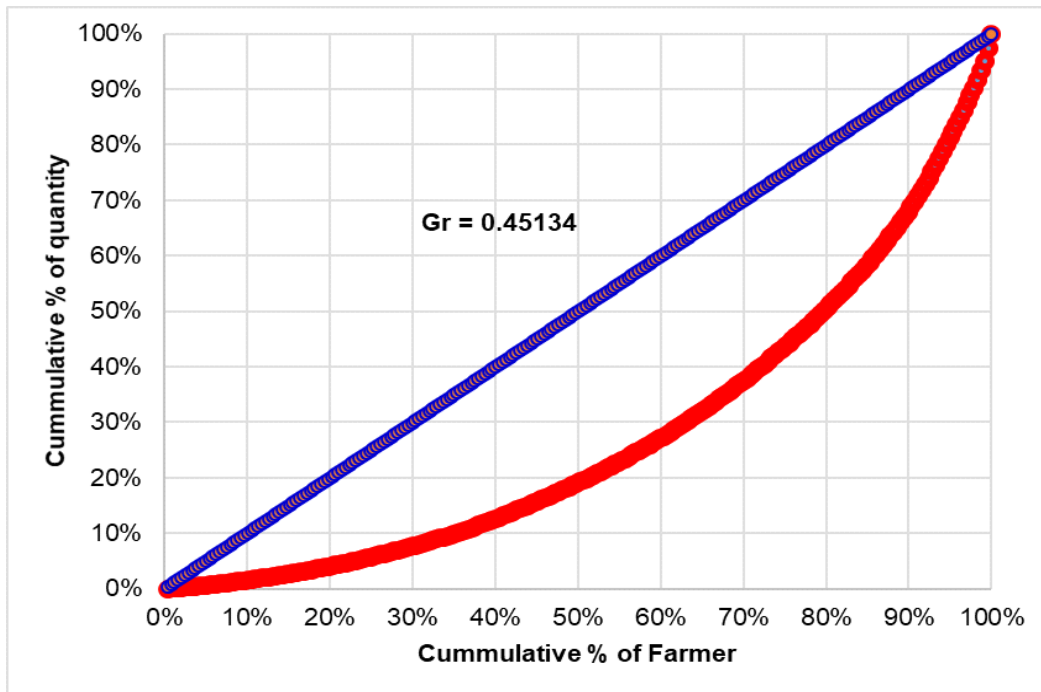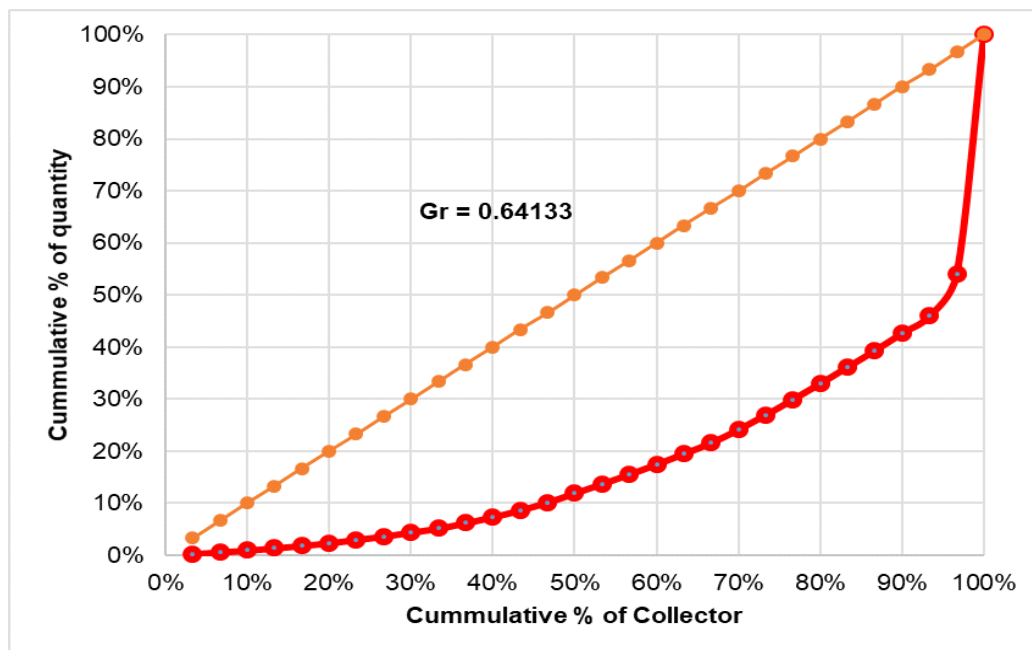Figure 6: GINI coefficient in production stage

Source: Survey results, 2019

Figure 7: GINI coefficient in collection stage
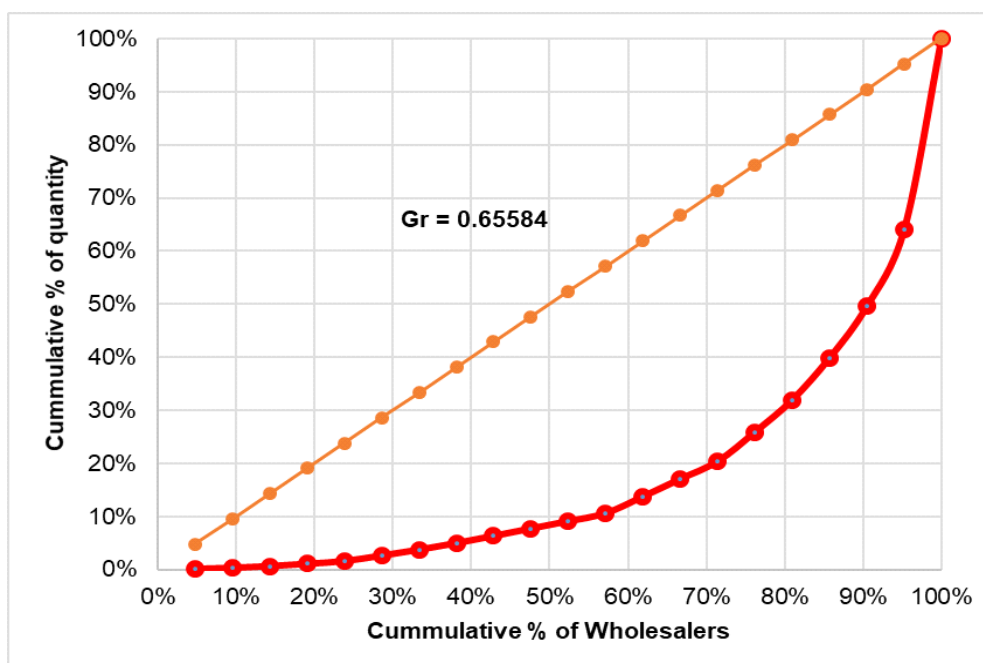
Source: Survey results, 2019

Figure 8: GINI coefficient in commercial stage

Source: Survey results, 2019

4.2 Situation of production, processing and production efficiency of chili

4.2.1 Productive situation

The average growth rate of chili production in Tien Giang and Dong Thap provinces increased 2.5% and 8.5% respectively. In contrast, the area of chili cultivation in the An Giang province decreased 3.9%, however, chili yield increased by an average of 2.6%/year in the period 2014-2019 (Table 7). Similarly, the chili yield of the Dong Thap province increased by an average of 1.6%/year. Meanwhile, chili production of the Tien Giang province decreased by an average of 3.2%/year because the farmers used too much inorganic fertilizers. Moreover, closed dikes lead to reduced soil fertility and chili yield.

Table 7: Chili area, yield and production of the three provinces in the period 2014-2019

Province	Indicator	Unit	2014	2015	2016	2017	2018	2019	Growth ratio (%)
Tien Giang	Area	Ha	3,180	3,837	3,789	4,237	4,229	4,229	5.9
	Yield/year	Ton/ha	17.8	18.2	15.9	15.1	15.1	15.1	- 3.2
	Production	Ton	56,633	69,848	60,150	63,780	63,942	63,942	2.5
An Giang	Area	Ha	3,895	4,582	5,207	4,543	3,960	2,811	- 6.3
	Yield/year	Ton/ha	14.7	14.8	14.9	15.2	15.1	16.7	2.6
	Production	Ton	57,251	67,812	77,648	68,909	59,742	47,015	- 3.9
Dong Thap	Area	Ha	3,043	3,235	3,485	4,493	4,305	4,210	6.7
	Yield/year	Ton/ha	17.0	17.1	16.5	17.2	17.7	18.4	1.6
	Production	Ton	51,731	55,372	57,436	77,243	76,114	77,672	8.5

Source: Synthesized data from the Department of Statistics, Departments of Agriculture and Rural Development of the three province in the period 2014-2019

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4.2.2 Situation of chili processing

Some large-scale processing companies not only invest in cold storage and freezers to export frozen fresh chili but they produce value-added products including chili salt, chili powder, dried chili and chili sauce. These processing companies also distribute packaged chili powder and dried chili through the supermarkets in Vietnam. Particularly, chili salt from the companies is distributed through agents nationwide or sold at their companies; chili sauce is sold to the supermarkets, local market places and fairs in the country. There are about 10 medium and large-scale chili export companies in Ho Chi Minh City (average export quantity of 600 tons/month or more). The chili materials of these companies come from wholesalers with frozen warehouses of 100m2 or more in the provinces of Dong Thap, Tien Giang, An Giang, Da Lat and Tay Ninh.

4.2.3 Analysis of chili production efficiency

The results of the DEA analysis (Table 8) show that chili farmers had low production efficiency. Specifically, TE = 0.58, CE = 0.37 and AE = 0.52 are still low.

Table 8: Production efficiency of chili farmers

Value of efficiency	TE (Technical efficiency)		AE (Allocation efficiency)		CE (cost efficiency)	
	No. of farmer	(%)	No. of farmer	(%)	No. of farmer	(%)
1.000	23	10.0	4	2.0	4	1.7
0.900 – 0.999	8	3.0	0	0.0	0	0.0
0.800 – 0.899	12	5.0	3	1.0	1	0.4
0.700 – 0.799	16	7.0	12	5.0	4	1.7
0.600 – 0.699	33	14.0	58	25.0	1	0.4
0.500 – 0.599	52	22.0	72	30.0	11	4.6
0.400 – 0.499	48	20.0	33	14.0	25	10.6
< 0.400	45	19.0	55	23.0	191	80.6
Total	237	100.0	237	100.0	237	100.0
Average	**0.58**		**0.52**		**0.37**	
Range	0.15 – 1.00		0.15 – 1.00		0.1096 – 1. 000	
Standard deviation	0.22		0.16		0.16	

Source: Survey results, 2019

Chili farmers can improve their production efficiency by combining more reasonable inputs such as reducing the amount of seeds, fertilizers, the number of sprays of drugs, gasoline for chili irrigation, etc…However, the scale efficiency of chili farmers is quite reasonable (SE = 0.86) but still 95% of the chili farmers have not reached the optimal scale efficiency (Table 9).

Table 9: Production Efficiency by scale (SE) of chili farmers

	No. of farmer	(%)	Yield (ton/year)	Yield (kg/1.000 m²)
Chili farmers with increasing production efficiency (IRS)	67	28	2.654	898
Chili farmers with constant production efficiency (CRS)	12	5	10.933	1,947
Chili farmers with reduced production efficiency (DRS)	158	67	7.351	1,252
Average SE	**0.862**			
Standard deviation	0.153			
Range	0.146 – 1.000			

Source: Survey results, 2019

4.2.4 Factors affecting chili farmers' production efficiency

The results of the Tobit regression analysis (Table 10) show that factors have a positive influence on chili farmers' production efficiency including production experience, participation in technical training courses provided by the local authorities and NGOs, chili cultivation under the model of large fields at Good Agricultural Practices (GAP) and rotational production patterns applied; and low intensity of land use in a year. In particular, the larger the scale of the chili production, the better and statistically significant at the level of 1% to all 3 efficiency coefficients TE, AE, CE. This shows that increasing the cultivation area and limiting small-scale production will help pepper growers improve their production efficiency. Therefore, the establishment of cooperative economic organizations among farmers in the form of cooperatives/cooperative groups is necessary and meaningful.

Table 10: Factors affecting chili production efficiency

Variables	Marks	TE		AE		CE	
		Coeffi.	P value	Coeffi.	P value	Coeffi.	P value
Constant		0.398	0.011	0.495	0.000	0.145	0.163
1. Gender	X_1	0.002	0.182	0.001	0.129	**0.002**	**0.055**
2. Age	X_2	0.035	0.464	-0.006	0.856	0.034	0.283
3. Ethnicity	X_3	-0.004	0.976	-0.060	0.464	-0.041	0.616
4. Production experience	X_4	**0.005**	**0.058**	0.000	0.850	**0.003**	**0.060**
5. Education level	X_5	0.003	0.624	-0.001	0.723	0.001	0.796
6. Technical training	X_6	**0.055**	**0.075**	-0.023	0.268	0.014	0.494
7. Number of main labors	X_7	0.005	0.422	0.003	0.524	0.004	0.365
8. Joining Cooperative/ Cooperative Groups	X_8	-0.011	0.753	0.016	0.500	0.006	0.803
9. Capital loan	X_9	-0.013	0.657	-0.002	0.940	-0.006	0.780
10. Local support	X_{10}	-0.012	0.682	**0.049**	**0.016**	0.029	0.153
11. Area	X_{11}	**0.009**	**0.003**	**0.013**	**0.000**	**0.015**	**0.000**
12. Form of planting	X_{12}	0.005	0.909	**0.109**	**0.001**	**0.068**	**0.033**
13. Number of chili crops	X_{13}	-0.056	0.269	**-0.079**	**0.019**	**-0.069**	**0.044**
Sig.F			0.003		0.000		0.000
Log-Likelihood			36.929		132.164		131.949

Source: Survey results, 2019

4.3 Analysis of the chili value chain in the Mekong Delta

4.3.1 Chili value chain map

Chili production in the Mekong Delta in 2015 reached 211,081 tons, of which 97.7% for export (206,226 tons) and domestic consumption 2.3% (4,855 tons). Figure 9 shows the chili distribution channels in the VC (percentage of chili products in the figure below converted to fresh chili).
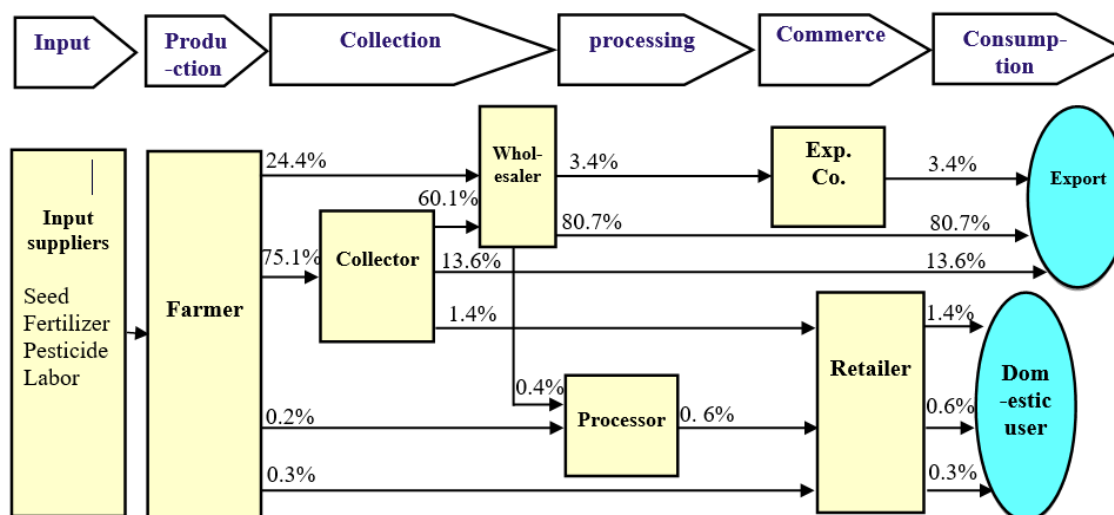

Figure 9: Chili value chain map in the Mekong Delta in 2019

Source: Synthesized by author, 2019

Chili export channels

Channel 1: Farmer → Collector → Wholesaler → Export Co. → Export

Channel 2: Farmer → Wholesaler → Export Co. → Export

Channel 3: Farmer → Collector → Wholesaler → Export

Channel 4: Farmer → Wholesaler → Export

Channel 5: Farmer → Collector → Export

The channels 3 and 4 distribute 80.7% of the total chili production of the VC, in which channel 3 is a main market channel.

4.3.2 Economic analysis of the chili value chain in the Mekong Delta

In all five export market channels, the chili farmers (production stage) create the highest net added value and profit in the value chain. The net value added of the chili farmers is from 72.4% to 84.9% of the whole chain value added (from 11,946 - 12,746 VND/kg of fresh chili) (Table 11).

Table 11: Analysis of chili value added by market channels

Indicator	Farmer	Collector	Whole-saler	Export Co.	Total
Channel 1: Farmer → Collector → Wholesaler → Export Co. → Export					
Selling price	24,492	28,696	31,857	35,420	
Input cost	7,044	24,492	28,696	31,857	
Cost of value added	5,502	2,871	2,336	3,016	
Total value added	**17,448**	**4,204**	**3,161**	**3,563**	**28,376**
% value added	*61.5*	*14.8*	*11.1*	*12.6*	*100.0*
Net value added	**11,946**	**1,333**	**825**	**555**	**14,659**
% Net value added	*81.5*	*9.1*	*5.6*	*3.8*	*100,0*
Channel 2: Farmer → Wholesaler → Export Co. → Export					
Selling price	25,092		30,130	35,420	
Input cost	7,044		25,092	30,130	
Cost of value added	5,302		2,452	3,016	
Total value added	**18,048**		**5,038**	**5,290**	**28,376**
% value added	*63.6*		*17.8*	*18.6*	*100.0*
Net value added	**12,746**		**2,586**	**2,274**	**17,606**
% Net value added	*72.4*		*14.7*	*12.9*	*100.0*
Channel 3: Farmer → Collector → Wholesaler → Export					
Selling price	24,492	28,696	31,857		
Input cost	7,044	24,492	28,696		
Cost of value added	5,302	2,871	2,336		
Total value added	**17,448**	**4,204**	**3,161**		**24,813**
% value added	*70.3*	*16.9*	*12.7*		*100.0*
Net value added	**12,146**	**1,333**	**825**		**14,304**
% Net value added	*84.9*	*9.3*	*5.8*		*100.0*
Channel 4: Farmer → Wholesaler → Export					
Selling price	25,092		30,130		
Input cost	7,044		25,092		
Cost of value added	5,502		2,452		
Total value added	**18,048**		**5,038**		**23,086**
% value added	*78.2*		*21.8*		*100.0*
Net value added	**12,546**		**2,586**		**15,132**
% Net value added	*82.9*		*17.1*		*100.0*
Channel 5: Farmer → Collector → Export					
Selling price	24,492	28,696			
Input cost	7,044	24,492			
Cost of value added	5,502	2,871			
Total value added	**17,448**	**4,204**			**21,652**
% value added	*80.6*	*19.4*			*100.0*
Net value added	**11,946**	**1,333**			**13,279**
% Net value added	*90.0*	*10.0*			*100.0*

Source: Survey results, 2019

However, the output of the chili harvested per year by each farmer household is relatively low (an average of 9.6 tons/household/year), so the profit/household/year is the lowest (118 million VND/household/year). While this profit is distributed to the collectors and the wholesalers is on average of 1,740 VND and 2,941 billion VND/year, respectively. Although the net value added per kilogram of chili to the collectors and the wholesalers is lower than the farmers, their profits

in the year are higher than that of the farmers due to their large volume sold in a year. Similarly, the exporting company generates 12.6% - 18.6% of the chain value-added and receives 3.8% - 12.9% of the entire chain profit (Table 11). However, its average chili export profit is much lower than that of the collectors and the wholesalers because the chili export volume of the companies is low (they export other agricultural products besides chili products (Table 12).

However, the output of the chili harvested per year by each farmer household is relatively low (an average of 9.6 tons/household/year), so the profit/ household/year of is the lowest 9118 million VND/ household/year). While the profit/year of each collector and wholesaler is on average of 1,740 billion VND and 2,941 billion VND, respectively.

Table 12: Economic Analysis of the entire chili value chain

Indicator	Farmer	Collector	Whole-saler	Export Co.	Total
1. Total production chain (ton)	206,226	154,876	174,261	7,012	
2. Selling proce (VND/kg)	24,732	28,696	30,993	35,420	
3. Total cost (VND/kg)	12,466	27,363	29,288	34,009	
4. Profit (VND/kg)	12,266	1,333	1,705	1,411	
5. Gross chain income (Billion VND)	5,100	4,444	5,401	248	15,194
% Gross chain income	33.6	29.3	35.5	1.6	100.0
6. Gross chain profit (Billion VND)	2,530	206	297	10	3,043
% Gross chain profit	83.1	6.8	9.8	0.3	100.0
7. Average volume/actor/year (ton)	9.6	1,305	1,725	110	
8. Average profit/actor/year (Bill. VND)	118	1,740	2,941	155	4,954

Source: Survey results, 2019

4.3.3 Chain logistics analysis

In the production stage: Activities of chili cultivation is done manually, so a lot of labor is used for chili production including family labor and hired labor. Therefore, the cost for hiring labor is a high proportion of the total costs of the farmers. As a result, when the price of chili is low, the farmers will experience losses. Transport by motorcycle (Honda) is the main way of transportation by the chili farmers. In addition, the transport infrastructure from the chili fields to the farmers' selling places is very convenient with asphalt or concrete roads.

In the distribution stage: In general, the processing facilities for manufacturing the chili value-added products are small scale and with limited capacity. Nevertheless, the chili is dried in the natural sunlight nearby the roads, so its quality is not hygienic and safe and is still low. Although large companies and wholesalers invest in cold storage to freeze chili, the volume of chili in this case is limited.

4.3.4 Risk analysis of chili value chain in the Mekong Delta

The results of our risk analysis indicate that the production and business activities of all actors in the chili value chain are facing the biggest risks: weather changes, natural disasters, pests and diseases, input material prices, output market prices and market requirements. These factors are not easy to manage well by the chain actors.

4.3.5 The bottleneck of the chili value chain in the Mekong Delta

Through the analyzed results from the above sections, the chili VC in the MD has the following bottlenecks that need to be solved:

- Firstly, As a result of the market requirements, distribution situation, market concentration, there are bottlenecks in the chili VC, as follows: (1) the chili size has not met the market requirements; (2) the chili products do not meet the requirements of clean production by GAP standards and dried chili products do not meet the requirements of food hygiene and safety due to lack of infrastructure and conditions for drying; (3) Because the distribution market of the collector and wholesaler is relatively monopolistic, they decide on the chili price so that the chili farmers have difficulty to negotiate prices; and (4) Chili in MD is mainly exported to China, so the risk is great.

- Secondly, the analytical results about the situation of production, processing, and the chili VC analysis in the MD show that this industry has bottlenecks in the chain stages, as follows: (1) The area for cultivating chili per a household is small while chili farmers need to increase the area to improve TE, AE and CE; (2) Chili farmers have not a good combination of the inputs, which leads to a waste in input materials such as seeds, fertilizers, number of times for spraying pesticides and labor, and lead to a low CE; (3) Chili farmers face many risks by changing weather conditions, increasing diseases on chili, etc. and they have no good measures to manage these risks; (4) Chili farmers have higher value added and receive the highest profit/kg than the other actors, but due to small volume of chili per household/year, the average annual profit of a chili household is still low; (5) Most of the chain actors lack capital and infrastructure for processing, preserving and storing products (drying oven, drying yard, product freezing equipment) such that the chili quality has not meet the market requirements yet.

4.4. SWOT analysis of chili value chain in the Mekong Delta

The purpose of the SWOT analysis is to identify strategic solutions to solve the bottlenecks as well as to upgrade the chili value chain in the MD. Our SWOT analysis has identified six strengths, six opportunities, eight weaknesses and three challenges, as summarised below.

Strengths (S)
- S1: Natural conditions (climate, soil,) are suitable for the growth of chili.
- S2: There is a large concentrated area of chili in some districts of the three provinces.
- S3: There is a cirtificated trademark : "Thanh Binh chili" in Dong Thap province.
- S4: The chain actors have experience in production and business.

- S5: Chili growers are increasingly interested in chili production that meets quality standards such as VietGap, GlobalGap and safe chili cultivation.
- S6: There is an abundant local labor force for chili harvesting and preliminary processing.

Weakness (W)

- W1: The chili growing area is still small and fragmented area.
- W2: The farmers' commitment is not sure/high in the production – distribution linkage of chili.
- W3: Farmers lack techniques for caring and treating diseases of chili.
- W4: The chain actors lack capital in production and business.
- W5: Processing companies lack modern machinery and equipment for preliminary processing, processing and preservation.
- W6: Chili is exported un-officially, so the output market is not stable.
- W7: Chili quality, size, color, etc. have not met the market requirements yet.
- W8: Input materials are wasted.

Opportunity (O)

- O1: The agricultural sector in general and chili production in particular receive government development policies .
- O2: The demand for chili is large in foreign markets.
- O3: Vietnam integrates deeply with the world economy, which leads to opportunities for official export of chili products.
- O4: Modern technology creates opportunities to develop value-added products from chili.
- O5: There are opportunities to attract domestic financial resources to invest in the agricultural sector.
- O6: There are opportunities to attract foreign investment (FDI) in the agricultural sector.

Threats (T)

- T1: Climate change and pest on chili are increasing.
- T2: The chili distribution depends heavily on the Chinese market, so the selling price and exported volume are not stable.
- T3: There is a lack of linkage among chili growing provinces in planning the chili area and production to meet the market needs officially.

After fair combination of SO, ST, WO and WT, there are mainly eight strategic solutions recommended as follows:

1. Producing chili in the direction of safety and GAP standards
2. Establishing or consolidating cooperatives/cooperative groups
3. Strengthening the application of technology and science in production
4. Developing business linkages
5. Building a market connection between agricultural material suppliers and chili farmers who belong to cooperatives/cooperative groups
6. Developing export markets
7. Promoting the production of value-added products from chili
8. Enhancing investment in technology

Based on the content of the eight strategic solutions above, two strategies were selected to upgrade the chili value chain in the MD, namely the quality improvement strategy and the technology investment strategy.

(1) The strategy to improve the quality of the chili products: the goal of this strategy is to improve the chili quality, which is the basis for increasing the value of the chili products and entering new markets. Six strategic solutions of this strategy include:

 1. Producing chili in the direction of safety and GAP standards

 2. Establishing or consolidating cooperatives/cooperative groups

 3. Strengthening the application of technical science in production

 4. Developing business linkages

 5. Building a market connection between material suppliers and farmers

 6. Developing export markets

(2) The technology investment strategy: the goal of this strategy is to produce chili products with economies of scale in order to reduce costs, to increase output with consistent quality, to diversify chili products as well as to create competitive chili prices in the long run. This strategy includes two main strategic solutions:

 1. Promoting the production of value-added products from chili

 2. Enhancing investment in technology

5. Conclusions and Implications

5.1 Conclusions

Chili production in the MD is mainly for export in the form of fresh, frozen and dried chili. In general, the region's chili has not met the market requirements in terms of color, size, spiciness, food hygiene and safety.

The chili production efficiency is low. Specifically, technical efficiency (TE = 0.58), cost effectiveness (CE = 0.37) and resource allocation efficiency (AE = 0.52) are still low. Although the scale efficiency is quite reasonable (SE = 0.86), 95% of the chili farmers has not achieved an optimal scale efficiency. In addition, the most important factor affecting production efficiency is the growing area; this factor has a positive impact on TE, AE and CE at the significance level of 1% - the larger growing area, the higher the production efficiency.

Although chili farmers receive the highest net value added per kilogram, the annual production output of each farmer household is low, so the whole year profit of the farmer is much lower than other actors in the chain. Most of chili product is exported with 5 market channels that account for 97.7% of the chain's chili production. The large and traditional market for chili exports in the MD is China, and due to the over-concentration in this market, there are many risks in chili distribution, chili prices are unstable and depend greatly on the traders at border gates. Moreover, chain logistics is generally weak and limited and the risks of unmanageable chain actors include changing weather, natural disasters, pests and diseases, input prices, output market prices and market requirements for chili products.

To upgrade the chili VC in the MD, our research proposes two strategies, i.e. the quality improvement strategy and the technology investment strategy with eight strategic solutions from the SWOT matrix analysis.

5.2 Managerial implications

To overcome the bottlenecks in each stage of the chili VC in order to meet the market requirements, it is necessary to implement strategies with eight strategic solutions for upgrading the chili VC in the MD. In addition, in the three stages of the chain (production, processing and distribution) there should be focus on organizing the production towards higher quality and at lower costs through local supports in developing business links; holding training courses on production technology accompanied with market and economic knowledge; investing much more in technology to produce chili products that better meet market requirements in terms of quantity, quality and competitive price.

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