Value Distribution in Food Supply Chain (FSC): *Cases of Thai Rice Chains*

Pichawadee Kittipanya-ngam (pichawadee@tbs.tu.ac.th)
Thammasat Business School, Thammasat University,
2 Prachan Rd., Pranakorn, Bangkok 10200, Thailand

Tharee Youngvanich and Mukesh Kumar (mk501@cam.ac.uk)
Institute for Manfacturing (IfM), University of Cambridge,
17 Charles Babbage road, Cambridge, CB3 0FS, United Kingdom

Abstract
This research aims to understand *how value is being distributed in food supply chains* to understand FSC resilience, within the context of food security. Farmers are leaving agricultural sector because farming has become increasingly unsustainable commercially – low profitability and high risk (Agarwal and Agrawal, 2017). To increase profit/value for farmers in the chain, the study of the distributed value within FSCs is required. However, to date, the concepts of applying costs/profits to Value Chain Analysis in food sector are yet to be explored (Medeiros et al., 2017). Hence, this research aims to develop a more comprehensive costing tool for food sector and consequently using the tool to explore how the value is being distributed across the chain.

Keyword: Food supply chain, Value distribution, Value chain

Research Background
The purpose of this research is to understand *how value is being distributed in food supply chains to understand food supply chain resilience, within the context of food security*. Farmers are leaving agricultural sector because farming has become increasingly unsustainable commercially – low profitability and high risk (Gupta, 2016; Agarwal and Agrawal, 2017). They are more or less forced to work in other sectors. If this trend continues then there might be fewer food producers that may lead to food shortages. Meanwhile, the growing human population increases the demand for food. Food security hence becomes more difficult to achieve, leading to a less resilient Food Supply Chain (FSC) system because FSC resilience is highly dependent on the resilience of primary producers' supply (Leat and Revoredo-Giha, 2013). To ensure the primary producers' resilience, the value that the primary producers can capture within FSCs is the key (Toth et al., 2016). To increase such value in the chain, the study of the value being distributed within FSCs is required. However, to date, the concepts of applying costs/profits to VCA (Value Chain Analysis) and Value Stream Mapping (VSM) in agricultural industry and FSCs are yet to be explored (Medeiros et al., 2017). This is partly because costs/profits are confidential to many processors and retailers. In addition, to collect costs/profits in farming sector requires a more

detailed and comprehensive tool because such details could be industry-specific. Hence, this research aims to develop a more comprehensive costing tool based on VSM for food sector and consequently using the tool to explore how the value is being distributed and how the value can be redistributed in FSCs in the context of food security. This research is one of the few academic works that focuses on food supply chain from perspective of farmers additionally it considers that there is a similarity between farming and engineering operations , both involving input-transformation-output model.

This research begins with the *research background* to highlight the research gap, followed by *research methodology* to explain how this research is conducted briefly. Then, *literature* on supply chain and resilience, and value chain analysis models is reviewed in order to identify the literature gaps to draw a conceptual framework (costing model). Later, data from five in-depth case studies are briefly presented, followed by *empirical studies and analysis* across cases which enrich the conceptual understandings from the literature. This paper ends with *discussion and conclusion* indicating the key research findings and limitations.

Research Methodology

This research adopted a qualitative research method through multiple case studies (Yin, 2009) to answer the research question "*how value is being distributed in food supply chains to understand food supply chain resilience, within the context of food security*". Figure 1 presents the three main stages and key activities of this research.

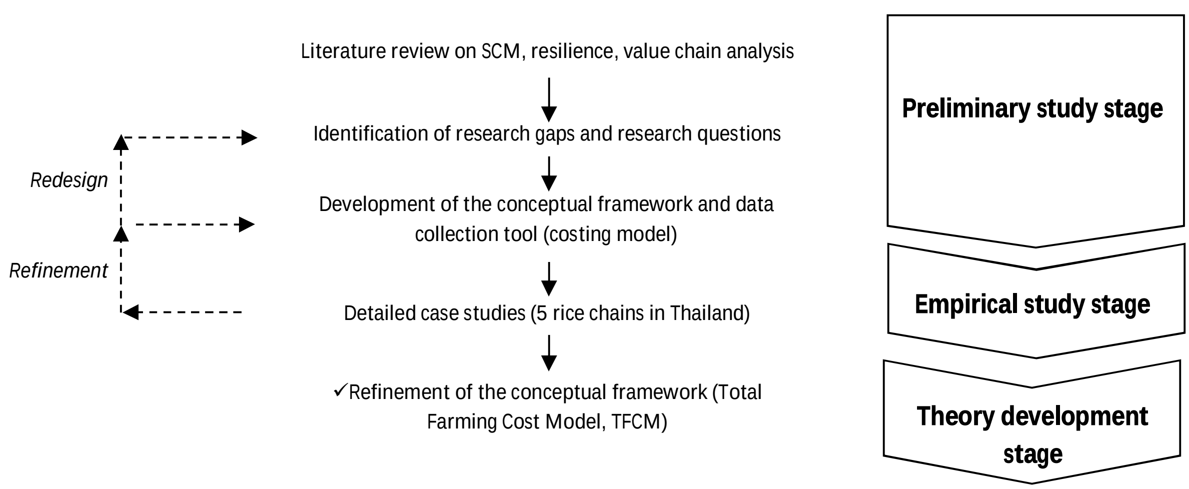

Figure 1 – three main stages and key activities of this research

This research aims to explore the value distribution of food supply chains. It is exploratory in nature. Multiple case studies (Yin, 2009) were used to collect and analyse the case data. Based on the literature in resilience, food supply chain, and value distribution, a total farming cost model (TFCM) was conceptually developed for data collections in five rice supply chains in Thailand. Rice product is selected because it contributes the most to Thai export value and volume for the past decades (National Food Institute, 2017). Rice supply chain, as the unit of analysis, includes three players in rice supply chains, which are farmers, millers, and retailers. Six cases range from different types of farmers, from stand-alone farmers to integrated farmers who also perform as millers and retailers. The cases also cover different rice products, ranging from white rice, brown rice, organic and inorganic rice, to ensure the construct, internal, and external validity of the findings. Each case is analysed individually before cross-case analysis being conducted. Case study method allows the richness of the data despite a small number of cases (Eisenhardt, 1989). Triangulation of data collection through semi-structured interviews, direct observations, and documentation increase the validity and reliability of the research (Yin, 2009). Triangulation of data collection through semi-structured interviews, direct observations, and documentation increase the validity and reliability of the research (ibid.).

Literature Review

This research aims to answer the question "*how value is being distributed in food supply chains to understand food supply chain resilience*". Hence, the literature review includes supply chain resilience in the food industry and value distribution models.

Food supply chain (FSC) & resilience

FSC's unique characteristic lies in the nature of production, nature of product and social attitude toward the end consumption (Aramyan et al., 2006). Each actor in FSC performs value adding activities (Macfadyen et al., 2012). For agricultural producers, their inputs include seeds, fertiliser/manure, water, electricity, crop protection (pesticide/herbicide), equipment and labour (Kumar et al., 2014; Deng et al, 2016). These inputs go through transformation processes and produce product for their customers (Kumar et al., 2014). The processes within and between actors in food system have been industrialised with the goal of driving economic and production efficiency up (Rotz and Fraser, 2015; Toth et al., 2016). Successfully, food systems have become more lean and cost effective (Rotz and Fraser, 2015; Stone et al., 2015). However, the trade-off is them being more vulnerable and *less resilient* to disruptions (Rotz and Fraser, 2015).

A resilient food system comprises of high diversity, low connectivity and high decision-making autonomy (Rotz and Fraser, 2015). Observation of the past 50 years has shown that industrialised food systems are becoming less resilient – less diverse, more connected, and producers hold less decision-making autonomy (ibid.).

Less diversified crop systems are adopted to support the shift to mechanisation and economies of scale however they are more prone to extreme weather, pest outbreak and price instability (Rotz and Fraser., 2015; Abson et al., 2013). Moreover, food system has become more connected, evident by the decrease in number of farms while the number of cultivated land remains the same (Rotz and Fraser, 2015). The impact of disturbance can be spread out easier. Lastly, 'Cost-price squeeze' has led producers to become less powerful in decision-making autonomy (ibid.). Farmers lost their negotiation power as production cost rises and farm debt increases. Another cause is their dependency on producers. Small and medium size producers rely on large processors and retails to bring their product to market (ibid.).

The impact of these resilience factors has reflected in the continuing decline of farmers. Farming has become increasingly infeasible commercially hence why farmers are leaving this sector (Gupta, 2016). Low level of rain falls, increased in input cost (such as fertiliser and other chemical), increased in agricultural labour wage and increased farmer's indebtedness all affect farmer income and return (ibid.). Particularly with the rise of agricultural wage, the overall cost of farming has increased significantly. Cultivation is a labour intensive activity. Labour cost attributes to approximately two fifth of the total production cost (ibid.). Receiving less profit and return leads to financially unsustainable living which forces farmers to move to other sector. The main trigger point for farmers leaving is low profitability (Gupta, 2016; Agarwal and Agrawal, 2017). Without financially sustainable life, farmers are forced to move to other industry sector.

This is an important concern because FSC resilience is highly dependent on the resilience of primary producers' supply (Leat and Revoredo-Giha, 2013) and ensuring the producers livelihood is the key to producer resilience (Toth et al., 2016).

Value distribution in supply chain

Value is created through the interrelated activities along the chain from producer to consumer (Kirimi et al, 2011). Value chain consists of a range of activities required to deliver a product or service from raw material to final consumer (Kaplinsky and Morris, 2000). Value chain analysis (VCA) allows user to understand value creation, power governance and profit distribution along the chain (M4P, 2008). Quantitatively analyzing value chain enables comparison between financial performance and value addition of each actor to be made. The key financial indicators are sale prices, operational profit, net profit and value creation (Macfadyen et al., 2012; Deng et al, 2016). Some researchers have applied quantitative VCA on FSC (fishery: El-Sayed et al., 2014; Anane-Taabeah et al., 2016; grape: Deng et al, 2016; potato: Svubure et al., 2017; rice: Isawilanon et al., 2013). These literatures revealed a mixed result on the producer's financial performance. Some findings confirmed the farmers' unprofitability situation (Anane-Taabeah et al., 2016) whereas some findings revealed the contradiction (Macfadyen et al., 2012). This contradictory raises the question of how is value actually being distributed in the current FSC – whether producers are profitable or unprofitable, financially sustainable or not.

Value stream mapping (VSM) is a technique used in lean manufacturing (Rother and Shook, 1998). The purpose of lean manufacturing is to utilise fewer resources while generating the same output (Womack et al., 1990) by mapping material and information flow to identify and eliminate waste in a system. A full VSM process consists of three phases: create the current state map, build a future state map and take the development into action (Forno et al., 2014). VSM is operational improvement tool rather than a cost modelling tool (Womack et al., 1990; Singh et al., 2011). However, this concept of process-orientated evaluation and mapping can be adopted to costing model (Gracanin et al., 2014).

A value stream costing model (VSCM) was developed based on VSM by taking into account of process, cost and activities and is formed a cost-time profile (Gracanin et al., 2014). The efficiency of Thai rice logistics and supply chain was evaluated through the use of VSM, time and cost (Thoucharee and Pitakasom, 2012). Cost and time were assigned to each activity in the scope of logistic therefore farmer's activities only include procurement, material handling and transportation. VSCM is developed by Sobczyk and Koch (2008) is a lean accounting method of measuring value stream performance over a given time. It was originated from value stream. VSCM assesses value stream process cost by assigning cost to cost pools. Firstly, cost contribution factors have to be categorised (eg. direct labour, machine depreciation, energy). Secondly, each cost category is broken down into cost pools. Cost pool can be single process, group of processes or cover the entire value stream. Lastly, cost can be assigned to each cost pool (ibid.). Three types of cost pool are: single process, group of processes and value stream cost pool (ibid.). This method allows user to estimate the total cost of value stream and the cost per each cost category or process (ibid.). To this date, the concept of applying cost to value stream is still new (Medeiros et al., 2017). There is no solid procedure to for farmer's accounting. Farmer's process breakdown and cost category literatures are very fragmented. Academic literatures on producer's activity breakdown are limited to mainly staple products namely rice, wheat and corn. In addition, theoretically, there is no literature on VSCM and food sector yet.

Therefore, this research aims to develop a costing model, based on VSCM, for this sector. In order to do so, process breakdown and cost category must be identified.

The conceptual framework

Total farming cost model (TFCM) for farmers is based on the activities break down of a rice supply chain. Farming process starts from breed selection to transportation. Some studies also mentioned accounting and procurement/sell as a part of farmer's activity (Sriwongchai and Rungmatharat, 2014; Islam, 2016). Most literatures agree on the main activities (for staple production) such as soil preparation, seedling, irrigation, fertiliser application and harvesting while there is no uniform view for other activities (e.g. testing, storage, transportation). Accordingly, the conceptual framework on TFCM, as seen in Figure 2, is developed from literatures, the process break down, in accordance to VSCM concept. It comprises process mapping and cost category. Process coding is explained in Table 1. The blank spaces are to be filled with cost pools through data collection from farmers.

Figure 2 – The conceptual framework on total farming cost model (TFCM)

Table 1 – TFCM process coding

Code	Process	Code	Process
P1	Breed selection	P11	Diseases management
P2	Soil improvement	P12	Test
P3	Soil preparation	P13	Feeding
P4	Seed preparation	P14	Harvest
P5	Seedling	P15	Processing (drying, cleaning)
P6	Irrigation	P16	Packing
P7	Fertiliser application	P17	Storage
P8	Chemical application	P18	Transportation
P9	Pest management	P19	Accounting
P10	Weed management	P20	Procurement/sell

Empirical Studies & Case Analysis

Figure 3 demonstrates the five case studies (five rice supply chains) conducted with eight farmers, three millers, and four retailers in Thailand. There are three inorganic rice famers while the rest is organic/brown rice farmers. The total 22 interviews were conducted across five rice supply chains. Some supply chain players required more than one interview.

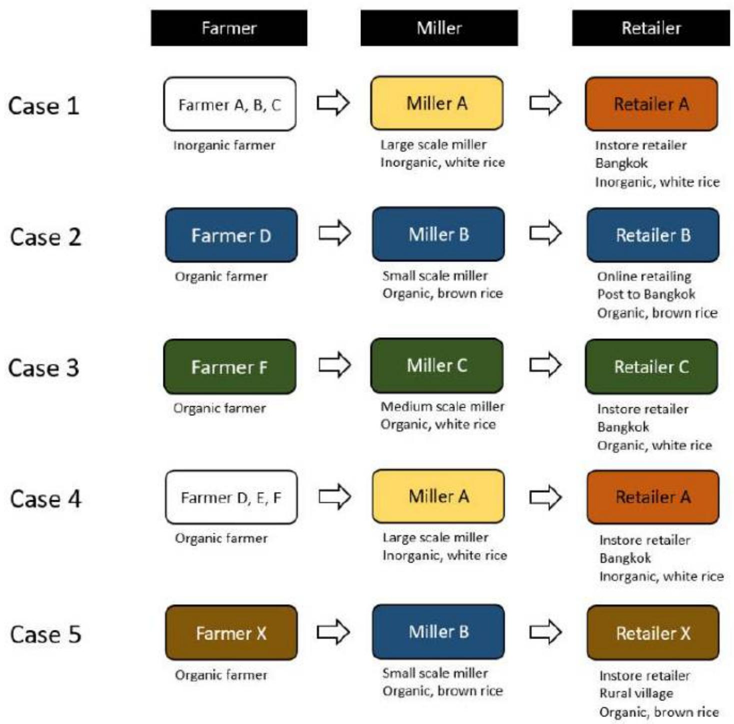

Figure 3 – Details of five in-depth case studies

According to the case studies, farmers only have a few routes to the markets. They can either sell paddies to miller directly or sell them to primary collectors or cooperatives, who will send them to millers later. Some farmers vertically integrated their rice supply chain to cover other upstream functions (e.g. milling and retailing). Value distribution is influenced by the supply chain structure. The discussion on existing value distribution is developed from cross-case analysis.

An example of the collected cost data from farmer A is shown in Figure 4. According to the case studies, farmers only perform some processes from P1 to P20. None of them performs all of the processes in one chain. Additionally, in the variable cost category, labour and input costs were captured however the other variable costs were not available. In the fixed cost category, most of the costs were not available. Hence, they were left blank in the costing model.

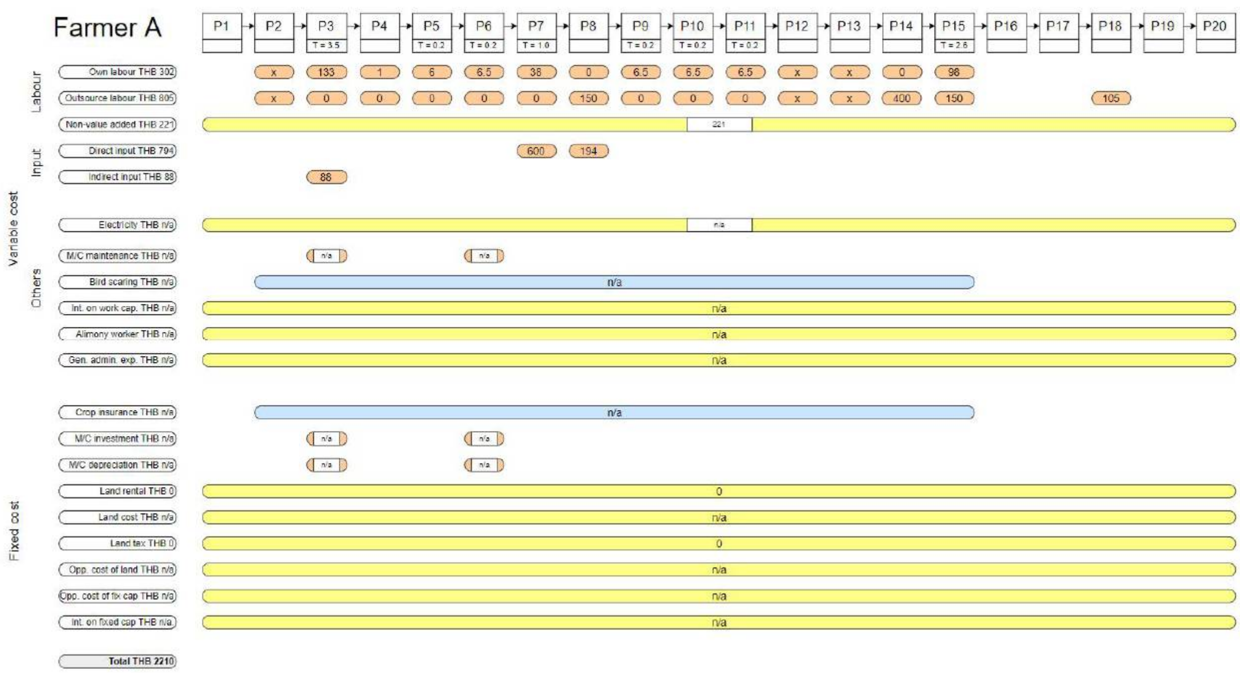

Figure 4 – An example of the collected data from Farmer A

Table 2 – A cross-case analysis of value distributed in rice supply chains

Case	Value chain details	Profit Margin (%)		
		Farmer	Miller	Retailer
Case 1	Farmer A, B, C --> Miller A --> Retailer A (inorganic milled rice supply chain)	10%	77%	13%
Case 2	Farmer D --> Miller B --> Retailer B (organic brown rice sc, vertically integrated with owned miller and online store)	0%	0%	100%
Case 3	Farmer F --> Miller C --> Retailer C (organic milled rice sc, vertically integrated with owned miller and a store in Bangkok)	0%	0%	100%
Case 4	Farmer D, E, F --> Miller A --> Retailer A (organic farmer sells to inorganic miller & rice retail store in Bangkok)	10%	77%	13%
Case 5	Farmer D, E, F --> Miller B --> Retailer X (organic farmer with outsourced miller and sells by himself to rural retailers)	0%	10%	90%

With regards to the value distribution in rice supply chains, there are two types of value distribution chain found in the case studies. One is a imbalanced value chain whereby 3 players in the chain (farmer, miller, retailer) work separately. In this type of chain (Case 1 & 4), the value is distributed unevenly. Rice farmers contribute to the highest portion of added cost (85%) but only receive 10% of the profit share. In contrast, miller adds 13% of the total added cost and obtains 77% of the total profit, highest among the three actors, as shown in Table 2. Another type is an integrated value chain whereby farmers also play the roles of miller and retailer (e.g. online store), as shown in Case 2-3 (see Table 2). In these cases, a group of farmers gather together and set up cooperatives to run as a miller and a retailer at the same time. In this type of chain, the farmers gain higher value in the chain.

Conclusion

According to the case studies, farmers still gain the least value in the supply chains whereby millers and retailers gain higher value. This has led rice farmers' income to be 54% below the poverty line. By relying on their rice income alone, they will be earning approximately 1,229 THB/person/month. This implies that farmers' lives are not financially sustainable.

In addition, according to the case studies, there are new supply chain models being observed which provide higher value for farmers. First, an integrated supply chain whereby farmers also play the roles of miller and retailer (Case 2&3). Another model can be seen in Case 5 whereby the farmer outsourced the milling activities and sells the rice on his own to gain the high value in rice chain as a retailer. However, for farmers to acquire other functions, they need initial investment on machinery, knowledge and skills. For example, in Case 2, farmers process their paddy and sell rice through online channels therefore they need a milling machine, technical skill and knowledge on e-commerce. They also hold larger risk as the value of their asset increases.

From the collected data, costs for organic and inorganic farming are similar (6.81 THB/kg and 6.83 THB/kg). This similarity was also observed by another literature (Srisompun, 2014). Hence, farmer would receive higher return (per unit product sold) in organic rice chain. Hence, it is encouraged for farmers to grow organic rice instead of inorganic rice, if they have access to organic rice markets.

To conclude, value distribution is influenced by FSC structure. In FSC, where farmers have no vertical integration, farmers will receive the lowest share of total profit. By relying on their rice income alone, they would be under poverty level. Farmers who partly or fully integrate their rice supply chain can capture more value because they are involved multiple of stages. The type of rice also effects value distribution. Organic or brown rice have higher consumer price while the production cost is estimated to be similar. This, however, can be restricted by market size and farmer's location. Lastly, millers can increase their profit margin by increasing their productivity to achieve better economies of scale.

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