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OPEN ACCESS

International Food and Agribusiness Management Review
Volume 24, Issue 6, 2021; DOI: 10.22434/IFAMR2020.0135

Received: 23 August 2020 / Accepted: 3 November 2020

Special Issue: IFAMA 2020 symposium

Linking smallholder producers to high-value markets through vegetable producer cooperatives in Cambodia

RESEARCH ARTICLE

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Abstract

Modern retail markets have grown in Cambodia, but vegetable growers are unlikely to gain benefits from these high value markets (HVMs). Producer cooperatives (PCs) could play a critical role in linking smallholder farmers to HVMs. The purpose of this paper is: (1) to examine the role of PCs in linking vegetable producers to HVMs; and (2) analyse the factors affecting successful participation in HVMs. This study applied a mixed methods approach to PCs selling the members' vegetables to HVMs (PC-HVMs), and PCs selling members' vegetables to traditional markets (TMs) only (PC-TMs). Both groups of PCs provided services to their members (e.g. input, financial, extension services). However, the content and quality of these services were different. PC-TMs emphasised only on support linked to production, while PC-HVMs focused on both production and marketing support. This study indicated that vegetable farming experience, total vegetable produce, and average vegetable prices had a statistically significant influence on producers' participation in HVMs. However, vegetable farm size showed a negatively significant effect on participation in HVMs. As one of the very few empirical studies on PCs in Cambodia the research provides valuable context for further studies. It has developed and tested a framework for analysing the factors affecting successful participation in HVMs and provides an explanation of why some PCs can successfully participate in HVMs.

Keywords: producer cooperatives, smallholder farmers, vegetables, high-value markets, Cambodia
JEL code: Q13

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1. Introduction

The recent development of high-value markets (HVMs) in developing countries has implications for immediate suppliers and the whole agri-food marketing system (Reardon and Minten, 2011). This new trend has provided both opportunities and challenges for smallholder farmers (Markelova *et al.*, 2009; Maspaitella *et al.*, 2018). The emergence of HVMs has provided a valuable opening for farmers, but smallholder farmers in developing countries have often been left out of this opportunity (Poulton *et al.*, 2006).

The number of modern retail markets in Cambodia, mainly in urban areas, has been constantly growing since 2013 (McCarthy *et al.*, 2016). However, smallholder growers in the country are unlikely to gain benefits from this HVM transformation. They often have limited market access, low market competitiveness, and are excluded from HVM chains (Bienbe *et al*., 2004; Eric *et al.*, 2019). They face challenges in high input prices but receive a low output market price (Eric *et al.*, 2019; Schmerler, 2006).

It is believed that individual farmers may be unable to address these issues effectively unless smallholder farmers organize institutions such as producer organisations (POs), including cooperatives (Narrod *et al.*, 2009). MAFF (2017) suggested that producer cooperatives (PCs) played critical roles in assisting farmers in expanding their economic scale, increasing access to extension services, and strengthening market competition. Nonetheless, Theng *et al.* (2014) argue that only a very few PCs in Cambodia achieved their business goals. Many studies indicate that PCs are successful in integrating smallholder producers in HVMs (Hellin *et al.*, 2009; Shiferaw *et al.*, 2011). However, other studies show that PCs do not achieve their goals of linking their members to high-value markets (Markelova *et al.*, 2009; Poulton *et al.*, 2010).

Previous studies conducted in developing countries found membership of PCs enhances HVM participation (Mukarumbwa *et al.*, 2018; Zivenge and Karavina, 2012). However, there is very limited research on linking smallholder producers to high-value markets through PCs in Cambodia. Previous studies in the country focused on the impact of smallholder PCs on market participation (Phon, 2016) and farmers' revenues (Hun *et al.*, 2018). Therefore, the purpose of this research is: (1) to examine the role of producer cooperatives (PCs) in linking vegetable producers to HVMs; and (2) analyse the factors affecting successful participation in HVMs.

After this introduction, the rest of the paper is structured as follows. Section 2 provides a literature review of producer cooperatives and their role in the process of the transformation of agri-food value chains towards HVMs. Section 3 explains the methodology used in this study while results and discussion are presented in Section 4. The last section provides some conclusions.

2. Literature review

Cooperatives have been widely recognised as important organisations, which promote social and economic development in both developed and developing countries. Reardon *et al.* (2004) and Narrod *et al.* (2009) argue that increasing interest in organising producer organisations, such as PCs, is driven by transformation of agri-food markets and government public policies. With imperfect market conditions, smallholder producers in developing countries face a wide range of challenges, such as access to input and output markets and high transactional costs. This motivates them to establish PCs to tackle these issues by acting collectively (Bernard and Spielman, 2009; Markelova *et al.*, 2009). Another driver that encourages producers to form PCs is services and products provided by PCs, which are necessary for upgrading products and markets (Abate, 2018; Nigel and Jason, 2014). Smallholder producers also form PCs in order to open up new markets, increase market price, and sustain market position. Through PCs, producers could use collective action to negotiate with purchasers (Markelova *et al.*, 2009; Valentinov, 2007). Producers use collective action through their cooperatives when they face challenges in accessing extension services and capital for improving production systems (Reardon *et al.*, 2009; Wiggins *et al.*, 2010). Bernard *et al.* (2008), and Francesconi and Heerink (2010) claim that producers organise PCs in order to access markets and increase bargaining power.

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Wide recognition of critical roles of POs, particularly in the form of producer cooperatives (PCs), has been paid great attention among governments, NGOs, and private sectors. Stockbridge *et al.* (2003) argue that POs, such as PCs, play important roles in providing a series of services, such as marketing services, facilitation of production services, financial support, technological support, education services, welfare services, policy advocacy, and management. Marketing services provided by the PCs include input supply, output marketing and processing, and market information (Stockbridge *et al.*, 2003). PCs assist smallholder producers in accessing loans and play a role as community banks for members, who want to deposit savings (Stockbridge *et al.*, 2003). Bernard *et al.* (2008) and Valentinov (2007) assert PCs help producers to get important services, such as training, credit, input support, marketing, and internal quality control. Regarding transactional costs and market access, PCs assist producers in reducing marketing costs and strengthening market power with downstream traders (Bernard and Taffesse, 2012; Valentinov, 2007).

PCs facilitate producers to access agricultural inputs and market outputs by using collective action principles for procurement (Ménard, 2007; Williamson, 2000). It is one of the transactional governance structures of the PCs in the agricultural context. In many developing countries, PCs assist their members in governing market transactions both at the upstream and downstream levels (Abate, 2018). At the upstream level, PCs coordinate market transactions between agricultural input suppliers and credit institutes and producers. With the downstream side, PCs facilitate formal communication between producers and purchasers related to standard requirements, grading, and contract (Abate, 2018; Ménard, 2007). Widely known functions of PCs are to improve agriculture production and markets, increase market competition, and include smallholder producers in modern markets (Chaddad and Cook, 2004; Meinzen-Dick, 2009). Bernard *et al.* (2008) acknowledge that the expected roles of PCs are to promote smallholder producer's market participation. They help producers to enhance bargaining positions by leveraging collective action. Thus, smallholder producers could create new market opportunities and existing domestic markets by innovating value chain systems that are best suited for them (Weatherspoon and Reardon, 2003).

Previous studies conducted in developing countries found membership in PCs enhances HVM participation (Mukarumbwa *et al.*, 2018; Zivenge and Karavina, 2012). However, there are also examples of PCs dissolved after disappointing experiences, especially with commodity products like grain and other staples (Barrett, 2008; Markelova *et al.*, 2009; Poulton *et al.*, 2010). Macharia *et al.* (2018) claim that smallholder vegetable producers' decisions to participate in HVMs are influenced by their demographics, farm characteristics, and institutional environment support.

2.1 Producers' demographics

Producers' demographics influence the decision to choose a particular market. Previous empirical studies have identified a number of producers' demographics affecting their participation in markets, such as age, education, and farm experience (Fischer and Qaim, 2012; Hernández *et al.*, 2007; Ismail *et al.*, 2013; Matsane and Oyekale, 2014). Many studies indicate that younger producers are more likely to participate in the HVMs than their older counterparts (Bellemare and Barrett, 2006; Hernández *et al.*, 2007). Younger producers appear to have a high level of adaptation with modern techniques and good negotiation skills with purchasers. On the contrary, the studies of Rao and Qaim (2011) and Chagwiza *et al.* (2016) assert that when producers get older, the possibility of participation in a particular market is higher. Older producers have greater experience in product marketing and production than younger producers.

In terms of educational level, higher educated producers have adequate capacity to adapt to modern practices and new market requirements (Qaim and Rao, 2012). They have better understanding and knowledge of marketing and business which are the key factors for organising the product value chain, contracts, and negotiations (Ismail *et al.*, 2013). However, some studies found there was no relationship between educational level and producers' decisions to participate in markets (Blandon *et al.*, 2009; Matsane and Oyekale, 2014; Zivenge and Karavina, 2012).

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Furthermore, producers with extensive experience were better in upgrading product quality (Markelova *et al.*, 2009) and building good networks with other chain actors (Vakis *et al.*, 2003). Compared to less experienced producers, experienced producers were more likely to participate in markets. Nonetheless, the study of Sahara *et al.* (2015) indicates that long-experienced producers had low willingness to take the risk of shifting from traditional farm practices to modern farm practices.

2.2 Farm characteristics

Previous studies show that both farm characteristics and asset endowments significantly affect producers' decisions to participate in formal markets (Ataul and Elias, 2015; Dlamini-Mazibuko *et al.*, 2019; Matsane and Oyekale, 2014; Reardon *et al.*, 2009). The empirical results of Matsane and Oyekale (2014) and Dlamini-Mazibuko *et al.* (2019) indicate that farm size positively influenced producers' participation in supermarkets. With a large farm size, they had adequate capacity to produce consistent vegetable quality and volume that met supermarkets' requirements (Matsane and Oyekale, 2014). However, Fischer and Qaim (2012), Blandon *et al.* (2009), and Hernández *et al.* (2007) indicate that vegetable farm size had no correlation with producers' decisions to participate in supermarkets.

The total quantity of produce is another factor of farm characteristics, which affects the possibility of producers' participation in markets. Producers with large quantities of produce were more likely to participate in markets as they had surplus products for supplying to markets (Mukarumbwa *et al.*, 2018; Omiti *et al.*, 2009). Birachi *et al.* (2011) explain that smallholder producers producing larger farm outputs were more likely to supply a larger proportion of products to markets.

With respect to communication assets, such as mobile phones, some empirical studies have indicated a positive correlation with producers' participation in markets (Dlamini-Mazibuko *et al.*, 2019; Martey *et al.*, 2012; Zivenge and Karavina, 2012). Producers' decisions to participate in a particular marketing channel could be attributed to the level of information they received. These communication assets enabled producers to make contact with purchasers and the other chain actors to update market information (Dlamini-Mazibuko *et al.*, 2019). However, in some cases, producers' decisions to participate in markets were not related to mobile phone ownership (Byron *et al.*, 2014; Slamet *et al.*, 2017).

2.3 Marketing aspects

With regard to the marketing aspects, produce price is the dynamic factor influencing producers to make a decision about a marketing channel (Mukarumbwa *et al.*, 2018). In Zimbabwe, instead of selling vegetables at local markets with a low price, producers travelled a long distance to an urban area in order to sell vegetables at a high price (Mukarumbwa *et al.*, 2018). This is similar to what Reardon *et al.* (2009) referred to as an incentive for producers participating in HVMs. Nonetheless, Mukwevho and Anim (2014) in South Africa, and Maspaitella *et al.* (2018) in Indonesia, identify that output prices did not affect smallholder producers' decisions to participate in markets.

2.4 Institutional factors

In developing countries, smallholder producers experience various challenges to access markets. These producers have limited assets and are often impeded from accessing a wide range of necessary services such as financial support, extension services, and market support (Barrett, 2008; Reardon *et al.*, 2009). These services contributed to the promotion of production and the opening up of existing and new market opportunities for producers. Financial constraints of smallholder producers impede them from upgrading agricultural production and accessing HVMs. Numerous studies have indicated a positive correlation between producers' market participation and access to financial support (Alene *et al.*, 2008; Benard *et al.*, 2015; Taye *et al.*, 2018). Rao and Qaim (2011) and Macharia *et al.* (2018) explain that access to financial support

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enables producers to increase their production by accessing and improving agricultural inputs. However, it did not indicate any significant influence on the probability of producers' participation in a particular market.

The enhancement of smallholder producers' capacity to access markets is attributed to the provision of various extension services. Alene *et al.* (2008) and Byron *et al.* (2014) assert that access to extension services had a positive effect on producers' decisions to participate in markets. Through interaction with extension workers, producers upgrade productivity, technologies, and marketable surplus that meet a market's requirement (Byron *et al.*, 2014). However, other studies of Ismail *et al.* (2013) and Dlamini-Mazibuko *et al.* (2019) indicate a negative association between extension service access and market participation. This means producers accessing extension services were less likely to participate in formal markets. The quality and methods of extension service could be the possible reason behind these negative results (Dlamini-Mazibuko *et al.*, 2019; Ismail *et al.*, 2013).

Previous studies highlight the importance of market support for accessing HVMs. Markelova *et al.* (2009) and Valentinov (2007) explain that the improvement of the smallholder producers' market access involves a wide range of market supports provided by the PCs. To be successful in promoting producers' market participation, the market supports provided by PCs should focus on the producers and market facilitation (Martinez, 2002; Orsi *et al.*, 2017). Moreover, many empirical studies show a significant association with market information access and HVM participation (Mukarumbwa *et al.*, 2018; Nandi *et al.*, 2017; Omiti *et al.*, 2009). Having access to market information, producers can figure out a price, a quality, a demand, and a standard requirement of supermarkets (Nandi *et al.*, 2017). Nevertheless, studies by Ataul and Elias (2015), Aku *et al.* (2018), and Macharia *et al.* (2018) assert that there was no relationship between market information and producers' participation in formal markets.

To sum up, farmer decisions to participate in the high-value markets through producer cooperatives are influenced by four key factors, including producer's demographics, farm characteristics, marketing aspects, and institutional support (Figure 1). In line with this literature, the framework used in this research explored these four factors as independent variables in analysing the factors affecting successful participation in high-value vegetable markets (HVMs) in Cambodia. The theoretical framework is shown in Figure 1.

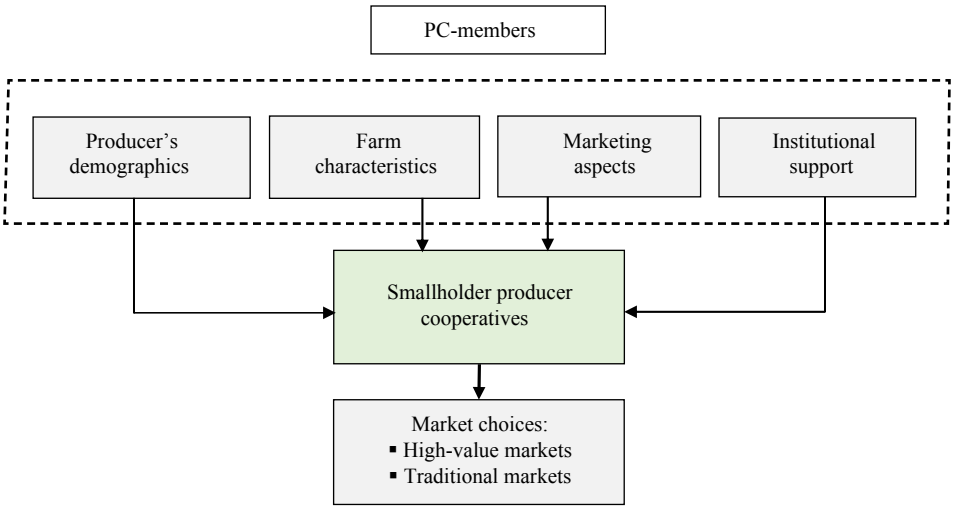

Figure 1. The theoretical framework of research.

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3. Research methods

3.1 Data and methods

The study employed a mixed method research approach to achieve the research aim. The qualitative research approach was used to examine the role of producer cooperatives (PCs) in linking vegetable producers to HVMs. While the quantitative approach analysed the factors affecting successful participation in HVMs. The data was collected using a face-to-face interview with PC managers and farmer-members. Three provinces were selected in the Great Lake Tonle Sap region of Cambodia, namely Kampong Chhnang, Pursat, and Battambang (Figure 2). The selection of these provinces was based on three specific conditions, including size of vegetable cultivation areas and total volume of production, accessibility to high-value markets, and potential for developing vegetable cooperatives. The selected region was the second largest in terms of vegetable cultivated areas and production in Cambodia (National Institute of Statistics, 2015). The geographical location is suitable for producing and selling vegetables to HVMs in the main city and provincial towns. These provinces have potential for developing vegetable cooperatives that could link smallholder producers to the growth of HVMs.

The study applied a purposive sampling technique for both qualitative and quantitative approaches. With this sampling technique, researchers could determine and select individuals or groups which fit with the research interest (Creswell and Plano Clark, 2011). It is the most effective technique for research with limited information (Patton, 2002) and budget and time constraint (Ilker *et al.*, 2016). Five producer cooperatives, namely Tasey Samaki Agricultural Cooperative (TSAC), Svay Meanchey Sattrey Samaki Agricultural Cooperative (SMAC), Ang Kamping Pouy Agricultural Cooperative (AKPAC), Peam MeanChey Agricultural Cooperative (PMCAC), and Phalet Phal Savatepheap Agricultural Cooperative (PSAC), were selected for this research. The following criteria were used for selecting PCs and producers. Two types of producer cooperatives (PCs) were selected for this study. PCs that collected vegetables from members and supply

Figure 2. Map of selected study region.

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HVMs (PC-HVMs), and PCs that collected from members and supply TMs (PC-TMs). Vegetable producers were members of the five selected PCs (two of them were PC-HVM and three were PC-TM), who had a main income from vegetable farming and grew cucumber, wax gourd, and long yard bean. This research selected three types of vegetables due to their high demand in Cambodian markets (Chhean *et al.*, 2004; Nuppun, 2016). This study included 5 PCs with total sample sizes of 122, 115 vegetable producers and 7 cooperative managers. The total samples for quantitative data was 115, which consist of 71 producers from PC-HVMs and 44 producers from PC-TMs, and qualitative data was 7 samples (Supplementary Table S1).

The qualitative data from this study was analysed by applying the Qualitative Data Analysis (QDA) technique. With this technique, the researcher categorised data into sub-categories by using tables. This study also used descriptive statistics to study the characteristics of smallholder producers selected for the research. Furthermore, this study also applied the Logistic Regression Model to analyse factors affecting smallholder producers' decision to participate in HVMs. Greene (2012) points out that the Logistic Model is simply to compute and interpret compared to other regression models.

3.2 Empirical model specification, variable description, and expected signs

The probability of a smallholder producer's decision was assumed to be a binary choice, so the logistic regression model was applied for empirical analysis. The binary logit regression is applied to predict the probability of the observation by classifying the dependent variable into one or two categories in accordance with a number of independent variables (King, 2008). The PCs-HVMs and PC-TMs were the dependent variables for assessing the market choices of smallholder vegetable producers (Table 1). This study assumed that farmer demographics, farm characteristics, marketing aspects, and institutional support were independent variables. Therefore, the empirical model for analysing the logistic regression in the research could be presented as the following equation:

$$\begin{aligned}\Pr(PM=1/X) = {} & \beta_0 + \beta_1 Age + \beta_2 Edu. + \beta_3 Exper. + \beta_4 FarSize + \beta_5 ToVeget + \beta_7 MobilePhone \\ & + \beta_8 SellPrice + \beta_9 MarkSupport + \beta_{10} AgriInput + \beta_{11} FinSupport + \beta_{12} ExtService + \mu\end{aligned}$$

The farmers' demographic variables consisted of age, education level, and vegetable farming experience. Farm characteristic variables included vegetable farm size, total volume of vegetables, and mobile phone ownership. The marketing aspects cover the prices of vegetables and market support. Institutional factors consist of agricultural input support, financial support, and extension services (Table 1).

Age of the respondents was measured in the number of years as a continuous variable. It was expected that young vegetable producers were more likely to adopt new modern techniques and take less risk compared to older producers. Education of vegetable producers was a continuous variable that was measured in the number of years attending formal education (Ouma *et al.*, 2010; Sahara *et al.*, 2015). Vegetable farming experience was expected to have a positive effect on vegetable producers' participation in the HVMs. Producers with extensive experience had greater knowledge and skills for upgrading product quality that would meet HVM requirements (Chagwiza *et al.*, 2016; Fischer and Qaim, 2012).

Vegetable farm size was a category of a continuous variable that was calculated in hectares of producers' vegetable growing areas. Producers with large areas of farmland could produce large volume and consistently supply to HVMs (Ataul and Elias, 2015; Zivenge and Karavina, 2012). Volume of vegetable was measured in tons per year of total vegetable production through continuous variables. A unit increase in the quantity of vegetable production led to an increase in the probability of selling to urban markets (Mukarumbwa *et al.*, 2018). Mobile phone ownership was set as a dummy variable where value one (1) represented mobile phone access, while zero (0) indicated otherwise. Producers owning a mobile phone could communicate with other vegetable chain actors, so it provided opportunities for them to access markets (Dlamini-Mazibuko *et al.*, 2019).

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Table 1. The description of the variables in the binary logistic regression model.

Variables	Type of variable	Measurement	Expected signs
Dependent variables:			
Market participation	categorical	1 = PC-HVM[1], 0 = PC-TM[1]	
Independent variables:			
Farmer demographics:			
Age	continuous	number of years	–
Education	continuous	number of years	+
Vegetable farm experience	continuous	number of years	+
Farm characteristics:			
Vegetable farm size	continuous	hectares	+
Total vegetable volume	continuous	tons/year	+
Mobile phone	dummy	1 = yes, 0 = otherwise	+
Marketing aspects:			
Average vegetable price	continuous	USD/kg	+
Market support	dummy	1 = yes, 0 = otherwise	+
Institutional factors:			
Agricultural input support	dummy	1 = yes, 0 = otherwise	+
Financial support	dummy	1 = yes, 0 = otherwise	+
Extension services	dummy	1 = yes, 0 = otherwise	+

[1] PC-HVM = producer cooperatives selling members vegetables to high value markets; PC-TM = producer cooperatives selling members vegetables to traditional markets only.

Average selling price was expected to have a positive influence on the HVM participation of vegetable producers. Price was the main determinant that encouraged producers to participate in market channels (Balint and Wobst, 2006; Martey *et al.*, 2012; Zivenge and Karavina, 2012). Market support was set as a dummy variable with value one (1) indicating access to marketing support and zero (0) referred to otherwise. Accessing market support enabled producers to make a better decision about market choices (Nandi *et al.*, 2017; Omiti *et al.*, 2009).

Agricultural input support was measured as a dummy variable that used value one (1) for accessing agricultural inputs and zero (0) for otherwise. Agricultural input access was hypothesized to have a positive effect on HVM participation of vegetable producers. Financial support is an important determinant that contributes to HVM access of producers. Producers accessing financial support could enhance production capacity and techniques (Rao and Qaim, 2011). Extension services were expected to be positively correlated with the producers' participation in HVMs (Byron *et al.*, 2014; Ismail *et al.*, 2013).

4. Results and discussion

4.1 Producer cooperatives

The five selected producer cooperatives (PCs) were established between June 2011 and 2018 with strong support from NGOs and various governmental projects. Ragasa and Golan (2014) discussed that PCs that have a great collaboration with external organizations were more likely to provide better agricultural support services to their members. While according to Moustier *et al.* (2010) and Reardon and Berdegué (2002), some PCs could not scale-up their business operation due to high dependency on development projects. The five PCs in this study were providing some input, financial, extension and marketing services to the members and one of them pure water supply. Bijman (2007), Orsi *et al.* (2017), and Trebbin (2014) suggested that PCs facilitated agricultural input access between input suppliers and smallholder producers.

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Members of the three PC-TMs received good agricultural input support, such as agricultural inputs (seeds, fertilizers), irrigation equipment (dripping tubes), and production equipment (nets and row cover plastics) from their PC. All PC-TMs provided loan and saving services for their members. The market support of the PCs-TM was limited and only relating to price information and the extension services focused only on vegetable production (Table 2).

In comparison, the two PC-HVMs provided quality input (e.g. seeds), financial, extension and market services (Table 2). They provided relevant extension and training services, both production- and market-oriented. PC-HVMs, besides sharing price and market information, also equipped their members with entrepreneurship and marketing knowledge (e.g. contracting). In terms of quality requirements, PC-HVMs bought vegetables from their members based on some critical criteria, such as colour, size, appearance, variety, and level of fertilizer and pesticide residue. The standard grade and quality of these vegetables were set based on the agreement between PCs, as their producer representatives, and supermarkets.

PC-HVMs' reported that they organised sub-groups of producers and the cropping calendar with their members in order to be able to ensure a stable supply of vegetables with consistent quality. In addition, these two PCs organised a formal contract with the supermarkets negotiating types of vegetables, prices and quality. They were intermediaries building networks (Yang *et al.*, 2014) and organising vertical contracts (Hellin *et al.*, 2009; Martinez, 2002) between producers and markets. The two PC-HVMs also reported challenges such as inconsistent volume and quality of vegetable supplied, limited post-harvest service facilities, lack of capital for investment, and inconsistent vegetable demand.

4.2 Factors affecting successful participation in HVMs

The result in Table 3 reveals that the Wald chi-square value was 42.2 with the *P*-value of 1%, so there was a highly statistical significance between dependent variables and independent variables. The value of Pseudo R2 was 0.49, so it showed that the Logistic Regression Model used in the study was moderately fit with a dataset at 49%. The value correct prediction was 84%, so the level of accurate prediction from predicted variables was high with 84%.

The majority of the farmers-participants were between 20-60 years old with average age of 45 years (Supplementary Table S2). Over 60% of them had completed primary school and a household size of 4-6 people (Supplementary Table S3 and S4). Half of the survey participants had less than 10 years vegetable growing experience (Supplementary Table S5). The majority of the respondents had a total farm size over 1 ha, with an average farm size for the members of the PC-HVMs of 1.03 ha and the PC-TM of 1.97 ha

Table 2. Upstream supports from producer cooperatives and downstream facilitation between producer cooperatives and high value markets.[1]

Producer cooperatives services to members	**PC-HVMs[2]**		**PC-TMs[2]**		
	TSAC[3]	**SMAC[3]**	**AKPAC[3]**	**PMCAC[3]**	**PSAC[3]**
Agricultural input support	****	****	****	****	****
Financial support	****	****	****	*****	****
Extension services	****	****	**	**	**
Market support	****	****	**	***	**

[1] *, **, ***, ****, ***** refers very poor, poor, fair, good, and very good.

[2] PC-HVM = producer cooperatives selling members vegetables to high value markets; PC-TM = producer cooperatives selling members vegetables to traditional markets only.

[3] TSAC = Tasey Samaki Agricultural Cooperative; SMAC = Svay Meanchey Sattrey Samaki Agricultural Cooperative; AKPAC = Ang Kamping Pouy Agricultural Cooperative; PMCAC = Peam MeanChey Agricultural Cooperative; PSAC = Phalet Phal Savatepheap Agricultural Cooperative.

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Table 3. Binary logistic and marginal effects results.[1]

Variables	Binary logistic			Marginal effects		
	Coef.	Std. Err	*P*-value[2]	dy/dx	Std. Err	*P*-value[2]
Farmers' demographics						
Age	0.013	0.033	0.701	0.003	0.007	0.700
Education	0.129	0.113	0.256	0.027	0.024	0.248
Vegetable farm experience	0.074	0.044	0.093*	0.016	0.009	0.086*
Farm characteristics						
Vegetable farm size	-4.535	1.387	0.001***	-0.960	0.332	0.004***
Volume of vegetables	0.279	0.119	0.019**	0.059	0.025	0.017**
Mobile phone	-0.246	1.055	0.815	-0.052	0.224	0.816
Marketing aspects						
Average selling price	4.798	2.771	0.083*	1.015	0.581	0.080*
Market support	0.973	1.191	0.414	0.206	0.254	0.417
Institutional factors						
Agricultural input support	-0.507	0.901	0.573	-0.107	0.191	0.573
Financial support	-1.440	1.478	0.330	-0.305	0.311	0.327
Extension services	0.534	1.375	0.698	0.113	0.290	0.697
Constant	-2.162	3.277	0.509			

[1] Wald Chi-square = 42.2; *P*-value = 0.000; Pseudo R2 = 0.49; correct prediction = 84%.

[2] *, **, and *** referred to 10, 5 and 1% statistical significance level, respectively.

(Supplementary Table S6). The share of the vegetable farmland was significantly smaller with an average size for the PC-HVMs of 0.26 ha and the PC-TM of 0.72 (Supplementary Table S7). Over 90% of them had a motorbike as a main mean of transportation and a mobile phone as a mean of communication (Supplementary Table S8 and S9).

The results of the logistic regression revealed that vegetable farm experience of producers had a significant influence on their decision to participate in HVMs, as presented in Table 3. Macharia *et al.* (2018) and Vakis *et al.* (2003) argue that producers with extensive experience could adopt and improve their vegetable production and build networks with traders. This is an important factor for improving product quality to meet the markets' requirements. This study shows that experienced vegetable producers were willing to adopt new production practices provided by NGOs and government agencies. However, Sahara *et al.* (2015) argue that more experienced producers were reluctant to sell to supermarkets.

This study indicates that vegetable farm size had a negatively significant influence on HVM participation. Vegetable producers with a large vegetable farm area appeared not to participate in HVMs due to difficulties in maintaining consistent vegetable quality required by the HVM, while the farmers with smaller farms were capable of supplying a more consistent, high volume to the HVM. This result is inconsistent with previous studies of Zivenge and Karavina (2012) and Matsane and Oyekale (2014), in which the producers with more farmland were more likely to participate in supermarkets since they had the capacity to grow vegetables to supply these markets all year-round. However, producers with larger farms were less likely to participate in coffee cooperative markets compared to small-scale producers in Costa Rica (Meike and Manfred, 2007).

The volume of vegetables significantly affected producers' participation in HVM. This finding is consistent with previous studies conducted in other developing countries, such as Omiti *et al.* (2009) and Mukarumbwa *et al.* (2018). The prices of vegetables had a significant influence on producers' decision-making in participating in HVMs with a positive sign. It shows that the motivation to participate in HVMs was triggered by an increase in prices of vegetables provided by supermarkets. The results were consistent with studies of Zivenge and

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Karavina (2012) and Blandon *et al.* (2009) conducted in developing countries. The study indicated that prices of produces are the key determinants, which encourage producers to sell their producer to supermarkets.

Age and education of vegetable producers had no significant effects on producers' participation in HVMs. The reason may be that producers from both groups of PCs were of very similar age and educational level. The previous studies show that age and education of producers did not influence their decision to participate in HVMs (Blandon *et al.*, 2009; Macharia *et al.*, 2018; Zivenge and Karavina, 2012). However, Bellemare and Barrett (2006) and Rao *et al.* (2012) argued that the age and education of producers significantly affect their market choices.

Ownership of mobile phones indicated a non-significant effect on the choice of HVM participation. This finding was inconsistent with the empirical results from various studies by Zivenge and Karavina (2012), Martey *et al.* (2012), and Dlamini-Mazibuko *et al.* (2019). These studies acknowledged that mobile phone ownership was one of the most important factors that significantly influenced their participation in markets.

Accessing market support had no significant effect on smallholder vegetable producers participating in the HVMs. This may be because selected producers were members of PCs, so they could access market support via their PCs. This result concurred with the study of Macharia *et al.* (2018), which indicate no relationship between producers' market participation and market support. In contrast, some studies show a significant effect of market support on producers' participation in markets (Nandi *et al.*, 2017; Omiti *et al.*, 2009).

There was no significant influence of institutional support on producers' participation in the HVM. The findings were consistent with results from previous studies on financial support (Dlamini-Mazibuko *et al.*, 2019; Macharia *et al.*, 2018) and the study of Mukwevho and Anim (2014), which showed that access to extension services did not significantly affect market choices. On the contrary, Taye *et al.* (2018) argue that producers' market choices were associated with financial support.

5. Conclusions and recommendations

The literature has shown that PCs played an important role in providing services to their members in order to help smallholder members/farmers access HVMs. Based on the analysis of PCs in Cambodia, this study found that the PCs received significant support from NGOs and governmental projects that help them provide various services to their members. The main difference was that PC-TMs appeared to place emphasis on vegetable production, while PC-HVMs gave priority to both vegetable production and business and marketing facilitation and quality requirements.

This study indicated that vegetable farming experience, total vegetables produced, and average vegetable prices statistically significantly influenced producers to participate in HVMs. However, vegetable farm size had a negatively significant effect on producer groups' participation in HVMs.

This study contributes to research in the following way: First, this is one of the very few empirical studies on PCs in Cambodia and provides valuable context for further studies. Second, we have developed and tested a framework in analysing the factors affecting successful participation in high value vegetable markets (HVMs) using quantitative approach. Third, this study provides explanation of why some PCs can successfully participate in HVMs using qualitative approach.

Based on the results of this study, several policy recommendations for policy makers, development partners, producer cooperatives, and vegetable producer groups, are proposed. Production policies should assist smallholder producers in upgrading vegetable production quality with low production cost through improving vegetable production techniques. Enabling market policies should be put in place to support smallholder producers and their cooperatives. Public-private partnership policies should be promoted in order to build strong networks between the PCs and HVM private companies. Managers of the PCs should build not only

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leadership and management skills but also strong business and marketing skills, including effective business and marketing/branding strategies that respond to a highly competitive environment of vegetable markets.

There are several limitations of this research. First, this study did not include all the vegetable value chain players (wholesalers, middlemen, retailers, input suppliers, and government and NGO agencies) it is important that further study should be encouraged. Second, this research did not examine the members transaction costs and revenues. Therefore, future research may regard these two factors as new objectives for understanding more about the effectiveness of participating in HVMs. Third, the region, number of PCs and farmers/members were limited, so future research may consider a larger sample of regions (including the Lower Mekong region where the majority of producers are growing leaf-vegetables), PCs and members.

Supplementary material

Supplementary material can be found online at https://doi.org/10.22434/IFAMR2020.0135

Table S1. Total samples of the research.
Table S2. Age distribution of respondents.
Table S3. Educational level of respondents.
Table S4. Household size of respondents.
Table S5. Vegetable farming experiences of respondents.
Table S6. Average total farm size of respondents.
Table S7. Average vegetable farm size of respondents.
Table S8. The transportation assets of respondents.
Table S9. The communication assets of respondents.

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