# Model of Extension and Development for Export Pomelo Production

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## Abstracts

The purposes of this research were 1) to synthesize research articles regarding pomelo production 2) to synthesize the papers related to the export value chain 3) to synthesize the value chain of export pomelo production of focused groups 4) to develop the model of extension and development for export pomelo production and 5) to evaluate and finalize the model. The targeted samples were 36 research articles regarding to pomelo production, 16 papers related to export value chain, 17 persons from growers, agricultural extensionists, packers and exporters. By mixed method research, five steps of the study consist of 1) utilizing the data extraction form to synthesize contents into the farm management and use descriptive statistics to analyze the data 2) similar to objective one but synthesize contents into value chains for export 3) synthesizing contents of the interview and discussion of focused groups into value chains 4) using the results of objective 1, 2, 3 and the literature review to develop the model and 5) utilizing the evaluated results of the six specialists to finalize the model.

The research result found the model of extension and development for export pomelo production. The model consists of four parts: the development indicators, the sender, the message, the channel and the receiver. The detail of development indicators displays into social, environmental and economic aspects. The detail of the message divides into four parts responding to the value chain while sub-details of each value chain part related to farming and community management which categorizes into social, environmental and economic aspects. The sender is the providers of knowledges such as extensionists while the receiver is pomelo growers. The channel is the communication through individual, group and mass by considering the ERG theory needs. This model addresses challenges in the agriculture that requires the coordination with groups and networks enhancing value-added from different sectors and developing the skillsets of production management.

**Keywords:** Model; Model of Extension and Development; Export Pomelo Production

## Introduction

Food security is a crucial topic when we talk about world population increases recently. The world population has been expected to reach 9.8 billion by 2050 and 11.2 billion by 2100 (Roser et al, 2022 : online). This brings opportunities for agricultural businesses and food markets. Fresh fruit trades take a significant role in the world markets. Consumers trend to concern more about food safety and environment friendly. Accordingly, export regulations for agricultural commodities have been stricter. Thailand agricultural extension strategies for year 2017-2036 have been focused on sustainable agriculture, international production standards, value added products, environment friendly and competitiveness in the world markets (DOAE, 2017 : online). Thailand has been full of tropical fruits and exported around the world. The

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pomelo is aimed to this study, this fruit shares common family with grapefruits. FAO includes pomelo statistical data in the group of grapefruits. Important import markets for pomelos are in Europe and China. China is also the largest producer of pomelos (FAO, 2019 : online). However, differences in geography and varieties of fruits can provide different entity. Thai pomelos have many varieties and can grow in all Thai regions. Exporting pomelos, it must follow global quality standard and export regulations, specially according to standard requirements of import countries.

This research will emphasize on farming locations in Phichit province due to the largest growing areas and various varieties of pomelos such as Khaotangkwa, Thongdee and Thakoi. Conditions of export take account of sufficient quantities for a full container load and quality selection. This research studies pomelo production from research articles and value chain papers by using the data extraction form for content synthesis based on principles of the farm management and export value chain. The interview and discussion responding to pomelo production were approached with focused pomelo export groups, then developing the model of extension and development for export pomelo production based on principles and theories related to agricultural extension and development.

## Research Objectives

The purposes of this research were 1) to synthesize contents of research articles regarding the pomelo production 2) to synthesize contents of the papers related to the export value chain 3) to synthesize contents of the interview and discussion of the focused pomelo export groups 4) to develop the model of extension and development for export pomelo production and 5) to evaluate and finalize the model of extension and development for export pomelo production.

## Literature Reviews

The agricultural extension for export pomelo production needs to realize international market contexts and quality standards that will be explored three parts of international trades for fresh fruits, export pomelo production, and principles and theories executed the model of this research.

**1. International trades for fresh fruits**

International trades for fresh fruits defined in this study are five aspects. 1) Political and legal aspect can be benefited by free trade agreement (FTA) through zero or reduced import duty. It makes easier for companies exporting their products. With FTA partner countries, it also needs to implement quality standards based on export regulations such as requirements of health certificate and phytosanitary certificate. 2) Economic aspect can be considered by high values and volumes of pomelo importers, such as Netherlands, Russia and China (FAO, 2019 : online). FOB values of exported pomelos can be checked from statistical data of Thai customs. Economic growth and purchasing power can be also considered to assure ability of payment. 3) Social aspect includes population growth and consumer behaviours. World populations trend to increase, especially in Asia. The age over 65 years are many people in Japan, Europe and developed countries that this group usually concerns with healthy foods. Global consumers have recently emphasized on health and safety foods and environment friendly (Roser et al, 2022 : online). 4) Technology involves internet using and social media that buyers can gain information of products, quality, brands, market contents and companies to make decisions for

purchasing or consumption. Thus, this information can result in consumer relations and credibility (Hollingsworth, 2021 : online). 5) Environment can be described as environment friendly through farming standard such as good GAP practices for farming and GMP practices for packing house.

**2. Export pomelo production**

Export pomelo production performed in this research are three aspects. 1) Environment aspect is such as pomelo growing conditions of well-drained soil, pH value 5.5-6 of soil, 6x6 6x8 7x8 or 8x8 metre of a planting distance, average rainfall of 1,500-2,000 mm. and temperature 25-30 degrees Celsius etc. Phichit province, the area in this study, has highly appropriate soil quality with the largest pomelo growing area with high productivity (DOAE, 2019 : online) having peak season during August to September and low season during February to April. Most growing varieties of pomelos are Khaotangkwa, Thongdee and Thakoi. 2) Social aspect regarding to knowledges for pomelo growing includes farming activities and standard, input quality, pest and planting disease control which the management may vary according to ages of pomelo trees, stages of growing through year-round, environmental conditions and market requirements (Paradnuwat, 2013:1). 3) Economic aspect is likely to the revenue. The commercial specification is crucially for export pomelos such as (i) general characteristics including external color, internal color, shape, peel thickness, pips-seeds and (ii) climatic, packing and delivering conditions including scratching, windscar, rubbing, sunburn, mould, foreign matter, oil spotting, water spots and (iii) insects or diseases including insect damage, brown rot and green mould. The grading can be extra-class, class-I, class-II or out of grade depending on the agreement between sellers and buyers (OECD, 2010 : online).

**3. Principles and theories executed the model of this research**

Developing a conceptual model regarding to this research, reviews of literature are intensively executed based on principles and theories as follows. 1) Value chain: Porter, (1985:1) describes the value chain as moving process within business unit to enhance the business competitiveness. The activities of value chain can cause buyers willing to pay for products. By making differences on products and services, the primary activities are inbound logistics, operations, outbound logistics, marketing and sales, and service. The support activities are procurement, technology development, human resource management and firm infrastructure. FAO & OECD (2019 : online) reports that integrated farming through value chains can increasingly interlink industries over all activities in producing to the finished products. This concept intergrades products and services with other firms and develop value-added, innovation and local economy sustainably. 2) Farm management: EISA (2012 : online) provides a concept of the integrated farm management that outlined in nine elements of organization and planning, soil management, crop health and protection, pollution control, crop rotation, energy efficiency, water management, crop nutrition, and community engagement and marketing. This management process uses information combining technology with traditional practices to enhance effective uses of inputs. This process supports farms in term of economic, environmental and social impacts that can prepare for the future challenges, and access connections of producers, customers and industry. 3) Agricultural extension and sustainable development: Angkhasit (2015:1) states that the process provides education and service to target person, group and community with academic, research and technology to enhance knowledges and actions improving the lives, productivity, families and community and develop economic, social and environmental conditions. The economic development can be the productivity, value-added and wide variety products, minimum costs, maximum orders,

reduced chemical uses and food security. The social development can be the learning self-reliance, education, resources, society, customer satisfaction and food safety. The environmental development can be improving natural resources, lower waste and effective natural uses (Alemany et al, 2021 : 19-33). Grower's access information, knowledge sharing and interaction among growers can improve them management skills and agricultural R&D (FAO & OECD, 2019 : online). 4) ERG Theory: Alderfer (1972:1) summarized Maslow's five human needs into three sorts. Existence needs: E include physiological and safety needs such as foods, water, security, housing, finances and etc. Relatedness needs: R include social needs and self-esteem such as family, friendship, acceptance, respect and etc. Growth needs: G include self-actualization such as ability and purpose. 5) SMCR: Berlo's communication process has 4 elements of sender, message, channel and receiver. Sender can be a person, group, organization, farmers, extensionists and institutions that senders should have proper ways of presenting. Message can be stories, motivation, information, knowledge, practices and contents. Channel is through sight, hearing, touch, smell or taste. Communication can be face-to-face, telephone, voice recorder, internet, publications or activities. Receiver can be a person, group or organization to get messages from senders. The communication should be concerned about social, cultural, skill, attitude and knowledge contexts (Berlo, 1960:1). 6) Community development: it is the idea of educating methods for people in community to be self-reliant. The community as groups, government or networks learns together to develop ideas creating the power and sharing responsibilities to improve economic, social and cultural conditions. Leaders and people in the community can analyze problems making plan, decision, managing action plans and evaluate the results appropriately with situations of the commodity (Supupathum, 2015 : online).

## Research Conceptual Framework


**Figure 1:** The conceptual framework

According to the five objectives and literature reviews, the conceptual framework can be measured as above figure 1.

## Research Methodology

The mixed method by qualitative research leaded was used. The research related to agricultural extension and export pomelo production having 4 steps of the method as follows.

Step 1 Synthesis for the contents of research articles regarding to pomelo production: the samples of 36 journal articles relating to pomelo production were searched from ThaiJo, TRF, Google Scholar, ThaiLIS etc, then synthesized the contents by using the data extraction form based on the farm management principle. The descriptive statistics of frequency and percentage was used to analyze the data.

Step 2 Synthesis for contents of the data related to export value chain: the samples were 16 sources from report, book, website and article, then synthesized the contents by using the data extraction form based on the value chain principle. The descriptive statistics of frequency and percentage was used to analyze the data.

Step 3 Synthesis for contents of the interview and discussion of focused pomelo export groups: 6 growers taking semi-structured interview individually, 4 collaborative large-scale growers taking unstructured discussion group, 2 export pomelo packers taking unstructured interview, and 3 governmental agriculture extensionists and 2 exporters taking unstructured discussion group, then synthesizing the contents of the interview and discussion into the value chain criteria.

Step 4 Development for the model of extension and development for export pomelo production: utilizing the synthesis results of objective 1, 2 and 3 with the principles and theories from the literature reviews to develop the model of extension and development for export pomelo production.

Step 5 Evaluation for the model of extension and development for export pomelo production: the 6 specialists of horticulture, logistics and supply chain, agricultural academic and extensionist, quality assurance of export fresh fruits, pomelo farming leader, and natural sources and environment that evaluated the model by utilizing questionnaires under the criteria of propriety, feasibility, accuracy and utility. The analysis results were summarized by statistics of mean, standard deviation, min, max and using the results to develop the final model.

## Research Results

The finding results were described in 5 objectives as follows.

**1. The synthesis of the journal article contents regarding pomelo production:** the 36 research articles were selected that had 13 articles (36.11%) from ThaiJo, 10 articles (27.78%) from Thailand Research Fund (TRF), 9 articles (25%) from Google Scholar, 1 article (2.78%) from ThaiLIS and 3 articles (8.33%) from other sources. The varieties of pomelos mainly taken were Thongdee for 18 (38.30%), Thaikoi for 8 (21.28%), Khaotengkwa for 5 (17.02%) and other varieties for 16 (10.64%) articles. Nakhonpathom province was mostly selected for 11 (24.44%) research articles, Chainat 6 (13.33%), Chiangrai 4 (8.89%), Chaiyaphum 4 (8.89%), Nakhonsithammarat 3 (6.67%), Phichit 2 (4.445) and other total provinces 15 (33.33%) research articles. The contents were synthesized (Table 1) to figure the

farm management criteria of the organization and planning for 19 (19.19%), crop nutrition for 18 (18.18%), crop health and protection for 15 (15.15%), community engagement and marketing for 13 (13.13%), soil management for 12 (12.12%), pollution control for 9 (9.09%), water management for 9 (9.09%), crop rotation for 4 (4.04%) articles, and none of energy efficiency. The characteristics of sweetness was mostly aimed for 10 articles (30.30%) and other shown in below table.

| Criteria of Farm Management | Frequency | Percentage |
|---|---|---|
| Organization and planning | 19 | 19.19 |
| Crop nutrition | 18 | 18.18 |
| Crop health and protection | 15 | 15.15 |
| Community engagement and marketing | 13 | 13.13 |
| Soil management | 12 | 12.12 |
| Pollution control | 9 | 9.09 |
| Water management | 9 | 9.09 |
| Crop rotation | 4 | 4.04 |
| Energy efficiency | 0 | 0.00 |
| Total | 99 | 100.00 |

| Appearance/Charecteristics | Frequency | Percentage |
|---|---|---|
| Sweetness | 10 | 30.30 |
| Pulp/flesh color | 6 | 18.18 |
| Others (Peel thickness, firm, vitamin c, etc) | 6 | 18.18 |
| Sizing | 5 | 15.15 |
| Bitter taste | 3 | 9.09 |
| Juice content | 2 | 6.06 |
| Peel defects | 1 | 3.03 |
| Shape | 0 | 0.00 |
| Total | 33 | 100.00 |

**Table 1:** Criteria of farm management & Characteristics of pomelos

The content synthesis of the farm management criteria consisted as follows. 1) The organization and planning included a studying Thai pomelo compared to competitor's pomelos, learning consumer's satisfactions of target markets, understanding supply chain of export pomelo business, studying locations of farming and factors of quality conditions, and searching possible issues of production and development guideline. 2) The crop nutrition and rotation, and soil Management included a considering soil conditions at planting areas, managing proper tree canopy, using organic fertilizer, right time fertilizing at each growing stage, learning nutrients in soil and leaves, learning micronutrients, and managing appearance and taste of pomelos. 3) The crop health and protection, and pollution control included the pest, plant disease and weed management. 4) The water management included a checking water quality, watering the plants properly and proper irrigation according to community environment. Finally, 5) the community engagement and marketing included a cooperating with community and networks to improve production effectively, developing production based on quality of market's requirements, learning the market process of export and quality management for export, harvesting fruits based on quality requirements, learning sales channels of export markets.

**2. The synthesis of the papers related to the export value chain:** the 16 sources of export value chains were selected that included 7 reports (43.75%), 5 textbooks (31.25%), 3 websites (18.75%) and 1 article (6.25%). The contents were synthesized to classify the export value chain criteria of the marketing and sales for 10 (19.23%), operations for 8 (15.38%), firm Infrastructure for 7 (13.46%), human resource management for 6 (11.54%), inbound logistics for 5 (9.62%), outbound logistics for 4 (7.69%), service for 4 (7.69%), technology development for 4 (7.69%) and procurement for 4 (7.69%) articles. The content synthesis of the export value chain criteria involved as a following. 1) Inbound logistics related to inputs

from natural resources and other sourcing. 2) Operations included a quality management, managing value added, utilizing resources for production, handling production under global warming conditions and managing production prepared for uncertainty of supply and demand. 3) Outbound logistics included a managing product specification for industrial products and understanding quality requirements of supermarkets. 4) Marketing and sales included learning roles of stakeholders in the markets, developing agri-businesses, understanding target markets and taking social responsibilities. 5) Service included a managing information, using online communication and creating business connections. 6) Procurement included accessing inputs and gaining quality inputs. 7) Technology development included implementing technologies for the resource and quality management. 8) Human resources included learning knowledges of social, environmental and economic management. 9) Firm infrastructure included accessing business networks, and creating business values and manging funds.

**3. The synthesis of the value chain for export pomelo production of focused groups:** the data were gained (Table 2) from 6 general growers, 4 collaborative large-scale growers, 3 agricultural extensionists, 2 pomelo exporters and 2 export pomelo packers. The total pomelo planting areas of the 10 growers had grown Khaotengkwa for 100, Thongdee for 68.1, Thakoi for 32, Khaonampueng for 24, Tabtimsiam for 6 rai, and totally 230.1 rai.

| Group | Persons | Planted Varieties | Areas (Rai) |
|---|---|---|---|
| General growers | 6 | Khaotengkwa | 100.0 |
| Collaborative large-scale growers | 4 | Thongdee | 68.1 |
| Agricultural extensionists | 3 | Thakoi | 32.0 |
| Export pomelo packers | 2 | Khaonampueng | 24.0 |
| Pomelo exporters | 2 | Tabtimsiam | 6.0 |
| Total | 17 | Total | 230.1 |

**Table 2:** Groups of Interview and discussion & Varieties planted of pomelos

In term of ERG theory, the sample group of the 10 grower needs were analyzed into 3 components. 1) Existence needs for 1 grower stated to select breeds of easy planting, low farming costs, waiting for government agents and buyers visiting their farms rather than going out by themselves. 2) Relatedness needs for 6 growers indicated to have business connections specially for sales, understand quality grading and favor in benefits from grouping. Lastly, 3) growth needs described almost having large planting areas, focusing on good breeds and profit returns, having good relations to packing house agents, and ably accessing demand info. With the sample group of these 17 persons, the synthesized contents of the interview and discussion based on the value chain criteria can be classified as follows. 1) Inbound logistics included selecting proper breeds of pomelos based on markets or practicability, a considering strength and weakness of each pomelo variety, deciding distance of planting in the filed based on available planting areas, and using available resources adaptively. 2) Operations included a general management of farming, fertilizer utilizations, a preventing and controlling for pest, plant disease and weeds, and managing product quality. 3) Outbound logistics included a managing of a harvest at demands, a time space of spraying chemicals and producing to right time outputs. 4) Marketing and sales included accessing market channels, handling a commerce as opportunities, and learning contexts of markets and packing houses. 5) Service

related to a providing information of a quality and product availability. 6) Procurement related to a purchase of fertilizers. 7) Technology development related to GAP farming practices. 8) Human resource management included a worker employment and a training of the production standard. Eventually, 9) firm infrastructure included attending grower groups, handling issues of production and accessing networks.

**4. The development of the model of extension and development for export pomelo production:** the finding results of objective 1, 2 and 3 figured out the model (Figure 2) to five parts as the development indicators, sender, message, channel and receiver. The sender roles were to give the information or knowledges in the message details while the receiver roles were to have those information and knowledges. The channel process was to concern types of grower's ERG needs. Intensely, the message contents were involved with the principles and theories from the literature reviews. This model had been finalized after evaluated by the six specialists as the following description.

**The development indicators:** *D1. Social aspect* involved D1.1 Good product quality and increases of a premium grade D1.2 Supporting within groups and networks D1.3 Producing responsibly to society D1.4 Increases in business partner satisfactions D1.5 Product availability and reducing in missing sales. *D2. Environmental aspect* involved D2.1 Good quality or improvement of soil D2.2 Increases in productivity D2.3 Reducing in resource and chemical utilizations D2.4 Reducing a waste from the production and D2.5 Improving and developing for production effectiveness. At last, *D3. Economic aspect* involved D3.1 Increases in revenues from products D3.2 Reducing in production costs D3.3 Increases in accumulated funds D3.4 Adding product values and various varieties and D3.5 Reducing in loss of outputs.

**The sender:** the criteria of *inbound logistics and procurement* involved exporters, packers, governmental and private extensionists, and specialists for chemical and fertilizer utilizations. *Operations* criteria involved governmental and private extensionists, educational institutions, the office of agricultural research and development, specialists of natural resources and environment, and specialists of pomelo production with GAP practices. *Outbound logistics, marketing and sales, and service* criteria involved exporters, packers, governmental and private extensionists, buyers or collectors of export pomelos, and specialists of marketing and consumer behavior. Finally, *firm infrastructure, human resource and technology development* criteria involved governmental and private extensionists, office of agricultural research and development, educational institutions, exporters, packers and specialists of pomelo production.

**The message**: the message of *V1. Inbound logistics and procurement* included V1.1 Social aspect was the input accessibility such as (1) considering selection of pesticide and (2) knowledge of utilizations and limitations of inputs. V1.2 Environmental aspect was the natural resource inputs for production such as (1) selection of farming location considering soil and water (2) selection of pomelo breeds appropriate with environmental conditions (3) input selection based on environment friendly and (4) considering natural resources under global warming. V1.3 The economic aspect was inputs from procurement such as (1) sourcing of various pomelo varieties, (2) proper planting distance in the field and (3) purchasing power of inputs. Secondly, *V2. Operations* included V2.1 Social aspect was production management considering uncertainty such as (1) encouraging effective uses of resources with organizing and planning of works (2) study of consumer satisfaction for production plans and (3) meeting for production improvement within growers, community and supportive networks. V2.2 Environmental aspect was the management of soil, water, fertilizer, pest and farming standard

such as (1) proper environment for planting pomelos (2) fertilizer utilization (3) pest and plant disease outbreak during pomelo growing stages (4) water management (5) weed removing and pruning and (6) GAP farming standard. V2.3 Economic aspect was the management of value-added, productivity and cost saving such as (1) production improvement for productivity and quality and (2) production management considering cost saving. Thirdly, *V3. Outbound logistics, marketing and sales, and service* included V3.1 Social aspect was the study of consumer behaviors and understanding market process such as (1) consumer groups of health care and purchasing power (2) future trends of consumer behaviors (3) target markets (4) services to support markets and (5) using online communication to connect businesses. V3.2 Environmental aspect was taking responsibilities for natural resources and environment such as (1) GAP farming and (2) GMP for packing house for export pomelos. V3.3 Economic aspect was the development of products for export and value-added for consumers such as (1) seeking export market opportunity (2) implementing GAP for value-added (3) indicating commercial specifications and (4) learning sales channels. Finally, *V4. Firm infrastructure, human resource and technology development* included V4.1 Social aspect was attending grower groups, accessing networks and developing knowledges such as (1) developing value chain collaboratively with small businesses, networks and community (2) building strong groups of growers with sharing production knowledges for competitive advantages and (3) updating situations regarding to pomelo business and participating governmental support programs. V4.2 Environmental aspect was the study of farming issues with solutions and technology utilization such as (1) studying production problems based on target pomelo varieties and consulting with the specialists (2) operating pest management and (3) managing production standard and product quality based on market requirements. V4.3 Economic aspect was creating business values and farming technology such as (1) specifying quality of products as market requirements (2) utilizing social media for business communication and (3) developing technology and knowledges to increase productivity and reduce costs.

**The channel:** based on ERG needs theory, 1) the channel for all ERG needs included guidelines of pomelo production as online and offline, and a guideline of chemical utilization and methods for pomelo farming. 2) The channel as individual for the existence needs was the visiting a grower individually for non-GAP pomelo farming. 3) The channel as a group for all ERG needs included a training, meeting or seminar conducted by government support programs for production and marketing of pomelos, visiting the good practice or GAP pomelo farms, a meeting for commercial purposes within parties of growers, exporters and governmental agents. Finally, 4) the channel as a mass for all ERG needs included exhibitions for marketing of pomelos or fresh fruits, and online information for pomelo production and markets through websites or social media.

**The receiver:** the targets of the receiver in the model were growers who expected to export or already exported pomelos.

**5. The evaluation to finalize the model of extension and development for export pomelo production:** the finding results displayed the four criteria (Table 3). The propriety level was the strongly agree (4.61 S.D.=0.15 Min=4.33 Max=4.83). The feasibility level was the agree (4.49 S.D.=0.18 Min=4.17 Max=4.83). The accuracy level was the strongly agree (4.55 S.D.=0.17 Min=4.33 Max=4.83). The utility level was the strongly agree (4.64 S.D.=0.17 Min=4.33 Max=4.83).

**Four criteria evaluations of the model by the 6 specialists**

| Criteria | $\bar{X}$ | S.D. | Min | Max | Level of Agreement |
|---|---|---|---|---|---|
| Propriety | 4.61 | 0.15 | 4.33 | 4.83 | Strongly Agree |
| Feasibility | 4.49 | 0.18 | 4.17 | 4.83 | Agree |
| Accuracy | 4.55 | 0.17 | 4.33 | 4.83 | Strongly Agree |
| Utility | 4.64 | 0.17 | 4.33 | 4.83 | Strongly Agree |

Scale level: 1.01-1.50=strongly disagree, 1.51-2.50=disagree, 2.51-3.50=neutral, 3.51-4.50=agree, 4.51-5.00=strongly agree

**Table 3:** The four criteria evaluation of the model by the 6 specialists

The six evaluators had the suggestions as follows. Firstly, most farmers faced the problem of high costs that need agencies or methods to reduce costs, and the ways to educate farmers to understand the contents in the model. The recent event has showed a lack of creating a network to cooperate between growers and other sectors that limit growers to access useful information for production planning and innovation. Secondly, the connection within the model needs to link between the development indicators and the knowledge contents. After the model evaluated, the improvement of the model was developed by using SMCR communications and the community development in order to creating the networks. In addition, the contents in the message were adjusted to three aspects of social, environmental and economic in order to linked with the development indicators. The final model was in the figure 2 as the results of the objective 4 and 5. The model of extension and development for export pomelo production has five parts of the development indicators, the sender, the message, the channel and the receiver as below.

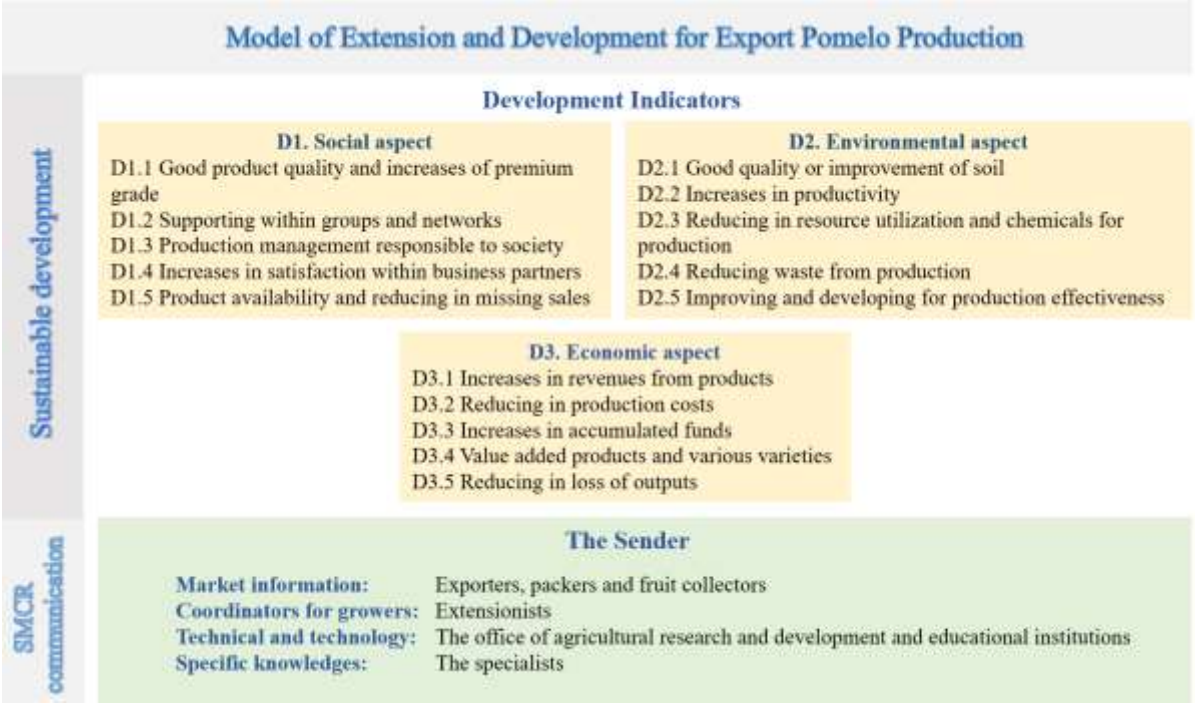


**Figure 2:** Model of extension and development for export pomelo production


**Figure 2:** Model of extension and development for export pomelo production (continue)

## Discussion

The results of this research can be mainly discussed as follows.

1. The research articles for the pomelo production: the 36 research articles were selected. Nakhonpathom province was mostly selected to study for 11 articles while Phichit province was selected only 2 articles. The variety of Thongdee were mainly taken to study for 18 articles while Khaotengkwa was taken only 5 articles. This was inconsistent with the data of DOAE (2019 : online), Phichit province had the largest pomelo areas with mainly growing Khaotengkwa variety. Thus, this is likely insufficient researches for Phichit locations with Khaotengkwa pomelos. The studied characteristics in the research was mostly the sweetness for 10 articles. Other studied characteristics were pulp color, sizing and juice content. Only 1 article studied peel defects. On the contrast for OECD (2010 : online), OECD provided the global quality standard for pomelos, the required characteristics were the external color, internal color, shape, peel thickness, pips-seeds, scratching, windscar, rubbing, sunburn, mould, foreign matter, oil spotting, water spots, insect damage, disease damage, brown rot and green mould. The contents in the 36 research articles mainly related to the activities of fertilizer utilization, and pest and plant disease control. These activities seemed insufficiently as EISA (2012 : online) provided the integrated farm management for 9 criteria. The community

engagement and marketing were the significantly important because the one of the organization and planning criteria includes the planning of market requirements before operating the production.

2. The paper contents related to export value chains: the 16 papers of the value chain were selected. The contents of marketing and sales were mainly referred for 10 papers and followed by the operations for 8 papers. The contents of marketing and sales found were the learning roles of stakeholders in the markets, developing agri-businesses, understanding target markets and taking social responsibilities. This is necessary for the grower's skills and knowledges. Training and extension were a key supporting farmer's skills that should reflect consumer's requirements. The value chain skills can develop businesses and market developments. Accordingly with FAO & OECD (2019 : online) stated that the integrated farming through value chains can increasingly interlink business sectors over all activities in producing to the finished products. This concept intergrades products and services with other firms and develop value-added, innovation and local economy sustainably.

3. The contents of interview and discussion of the focused pomelo export groups: the contents were sorted out to the value chain criteria, however, the growers, extensionists, exporters and packers knew different information such as the marketing details mainly provided by the exporters, GAP practices mainly provided by the extensionists, and product grading mainly provided by the packers. This is according to Supupathum (2015 : online), the power and sharing as a group or networks with different sectors can ease the problems by learning and responding activities together. The needs of growers under ERG theory shown in this research obviously reflected the ability to access the market information differently. The growth needs' growers had abilities to access the market information due to having good relations with the buyers. The relatedness needs' growers were likely adaptive for export market conditions. The existence needs' growers had low powers to access the markets. This can be solved by the interaction among growers that can cause a research and development in the agriculture FAO & OECD (2019 : online) together with the providing education to target person, group and community with academic, research and technology to enhance knowledges improving the productivity and community to develop economic, social and environmental conditions (Angkhasit, 2015:1).

4. The model of extension and development for export pomelo production: the model shown in the figure 2 has five parts of the development indicators, the sender, the message, the channel and the receiver. First part, the development indicators can be achieved by knowledges as follows (figure 3). The social development relates to attending networks and customer's satisfactions that achieved by knowledges of grower's needs and skills, networks and communication, and the extension and community. The environmental development relates to production resources of effective utilization, natural improvement, reducing waste and chemicals, and productivity that achieved by knowledges of the farm management and farming standards. The economic development relates to revenue increases, reducing in costs and loss of outputs, and value-added products that achieved by knowledges of the value chain, market and consumer preferences, and technology for businesses. The above development was created according to the diverse contexts of international trades for fresh fruits such as trade policies, export regulations, purchasing power, consumer behaviour, brand reviews through the internet by buyers, and farming standards. These contexts obviously impact on producer practices (FAO, 2019 : online & Roser et al, 2022 : online & Hollingsworth, 2021 : online).

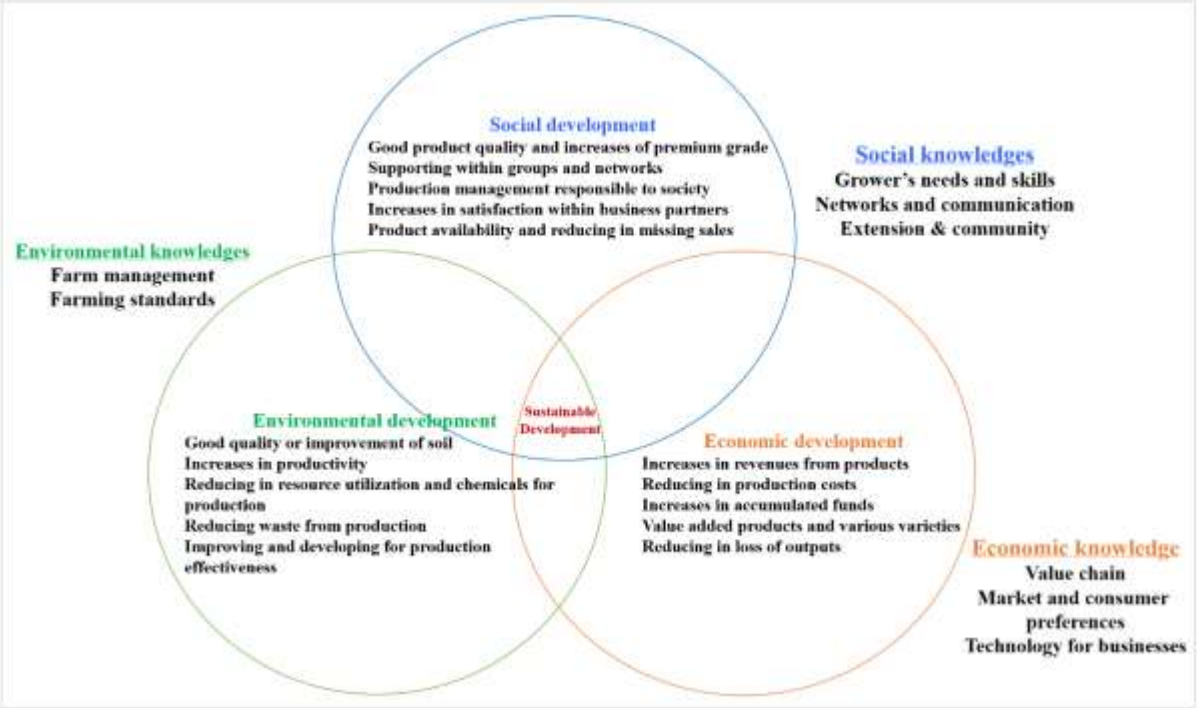


**Figure 3:** Knowledges for social, environment and economic development

Second part, the sender (figure 2) includes exporters, packers, fruit collectors, extensionists, the office of agricultural research and development, educational institutions, and specific specialists. Exporters, packers and fruit collectors can provide market information, export requirements, quality preferences, and trends of consumer behaviour. Extensionists can be representative for grower's needs and can connect with several sectors to support growers. The office of agricultural research and development, and educational institutions can provide technical production and standards, and technology development. The specific specialists of the marketing or the fertilizer and chemicals utilization or the natural resources and environment can provide specific knowledges and suggestions to growers in contexts of marketing mix, effective uses of resources and environment friendly. These knowledge providers can educate to growers as groups or community leading grower's abilities to improve productivity, lives and economic conditions (Angkhasit, 2015:1). Third part, Berlo (1960:1) refers to the message that can be information, motivation, knowledge, practices and contents. The contents and knowledge in the message (figure 2) involved the value chain of Porter's concept (1985). It is the ideas to enhance the business competitiveness. The activities of the value chain can cause buyers willing to pay for products. The activities in this model were grouped into four areas. 1) Inbound logistics and procurement consisted of inputs and resources from natural and purchasing. The social aspect concerned an ability to access and selection. The environmental aspect concerned farming locations and environment friendly. The economic aspect concerned pomelo varieties and purchasing power. 2) Operations consisted of production management, productivity and value-added. The social aspect concerned resource utilization, production uncertainty and the planning for customer and partner satisfactions. The environmental aspect concerned the proper planting, farming activities and standards, and pest and disease controls. The economic aspect concerned value-added, productivity and cost-

saving. 3) Outbound logistics, marketing and sales, and service consisted of the consumer behavior, pomelos for export, and market channels and satisfactions. The social aspect concerned target markets and services. The environmental aspect concerned GAP and GMP standards. The economic aspect concerned pomelo characteristics and sales channels. 4) Firm infrastructure, human resource and technology development consisted of networks, production solutions and creating business values. The social aspect concerned collaborations, sharing knowledges and value chains. The environmental aspect concerned production standards and the product quality. The economic aspect concerned market requirements and technology utilizations. As above, the social aspect is likely to be knowledges. The study of Paradnuwat (2013:1), knowledges for pomelo growing includes farming activities and standard, input quality, pest and planting disease controls which the management may vary according to ages of pomelo trees, stages of growing through year-round, environmental conditions and market requirements. The environment aspect is the growing conditions such as soil quality, pH value of soil, a planting distance, average rainfall and temperature. The appropriate growing areas can result in high productivity (DOAE, 2019 : online). The economic aspect relates to the revenue. The commercial specification for international standards takes account of general characteristics of pomelos, climatic, packing and delivering conditions, and defects from insects or diseases. The different grading levels will classify as extra-class, class-I, class-II or out of grade depending on the trading agreement (OECD, 2010 : online). Fourth part, Berlo's communication through the Channel (1960) can be through sight, hearing, touch, smell or taste. The communication can be face-to-face, telephone, internet, publications or activities. In addition, Alderfer (1972:1) states that the existence needs include physiological and safety needs such as foods, water, security, housing, finances and etc. The relatedness needs include social needs and self-esteem such as friendship, acceptance and respect. The growth needs include self-actualization such as abilities and purposes. Agreed with these concepts, the communication in this model was developed as follows (figure 2). By individual communication, the existence needs' growers may have large areas of pomelo farms but do not prefer to manage the GAP farming standard. By group communication, all ERG needs of growers can attend through the training, meeting and visiting good practice farms. The group meeting can be focused on a commerce between buyers and growers. Grower groups can also share production issues to consult with the specialists as necessary. By mass communication, the practices can be through internet or social media for electronic guidelines of pomelo production and chemical utilization. The activities of fresh fruit exhibitions can be beneficial for growers. Especially, the growth needs' growers can attend or visit the international food exhibition in Thailand to learn global markets. Fifth part, the receiver in this model (figure 2) was focused on the growers. It can be the growers who have planted pomelos for the export or who are interested to export. Berlo (1960:1) states that the receiver can be a person, group or organization. Export pomelos need a good practice and standard, the growers who are interested in exporting shall have similar attitudes to expect the quality improvement but growers may have different skills of production practices. As this, leaders in the community can lead the group to learn and share farming methods and activities (Supupathum, 2015 : online) because the knowledge sharing and cooperation among growers can improve skills and agricultural development (FAO & OECD, 2019 : online).

5. The evaluation for finalizing the model: the six evaluators suggested to improve issues of grower's high production costs, the ways to educate farmers to understand the model, and lacks of creating a network to cooperate between growers and other sectors that resulted in

limitations to access useful information for the production planning of growers. To solve this issues, Berlo's SMCR communication (1960) was used in the model. The senders in the model were specialized in various fields of information such as exporters available for the market information, the office of agricultural research and development available for the technical production, and educational institutions available for the technology and innovation development. The model in this research was aimed to bring the community development that can be methods to encourage ideas creating the power and sharing knowledges to analyze problems, making plans and decision among the groups (Supupathum, 2015 : online). Finally, the connection within the model contents was improved to link the development indicators with the knowledge contents by indicating three aspects of social, environmental and economic. The social development can lead to the customer satisfaction and food safety. The environmental development can result in the waste reducing and effective uses of natural resources. Finally, the economic development can improve revenues from productivity and value-added products. (Alemany et al, 2021 : 19-33).

## Suggestion

By policy levels, government agencies can implement the model of this research to plan the strategies by integrated knowledges and information from different sectors and specialists of farming, marketing, quality, operations, exporting and etc, as the creating networks and value chains in order to support the growers having the transformation in skillsets leading all sectors to achieve the sustainable agribusiness.

By operational levels, studying this research should consider situations of the using time such as updated market conditions. This research provided overviews of the value chain in the business leading growers to have ideas of production plans and pay more attentions to creating networks and connections. The extensionists for the export pomelo production should more consider the value chain in different sectors leading growers to have more opportunities.

Next studies, researchers may pay attention to one variety of pomelos and specify one country, then development indicators can be numbers or specify output characteristics for the growers such as creating commercial specifications for each market channel to manage the production accordingly.

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