

Development of rice products as healthy food from local rice in Maha Sarakham Province

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Abstract - The development of value-added health food products from indigenous rice in Maha Sarakham province focuses on analyzing the nutritional value of indigenous rice products. It also aims to develop rice products that cater to the preferences of the target consumers and create market channels for community products. The primary goal is to address and elevate the organic rice products of the Plabu Community Enterprise in Nong Saeng sub-district, Wapi Pathum district, Maha Sarakham province. This community enterprise comprises over 50 members who collectively cultivate 1,200 acres of land, producing an average of 100 kilograms of organic rice per month, with a 100% organic farming approach. Therefore, the rice produced by this community enterprise is nutritionally both valuable and safe. This research project employs a participatory and mixed-method approach. After delivering nutritional information about eight local rice varieties to the community enterprise, it resulted in the community understanding the factors and reasons behind all the changes that occurred. This led to the exploration of solutions that address various issues, including: Learning and Knowledge Management: This involves acquiring research skills and knowledge management resulting from the study of the community's dynamics and changes (Time Line Analysis). This understanding helps identify factors and causes of all changes and leads to the exploration of solutions aligned with various problems. Livelihood Generation: This includes skill development on a community basis, expanding career opportunities, and entrepreneurship. The research links and engages target groups in activities aimed at building vocational skills, such as enabling community enterprises and community members to sell their products online using modern media and packaging. This can create income and economic opportunities. Income Generation: Traditional rice markets involve middlemen and rice mills, which often result in low rice prices. This research analyzes the

potential for creating an identity for the product, such as modern packaging that reflects the community's identity. This can improve the value of the rice and generate income for the community. Quality of Life Improvement: Increasing the income of the community enterprise aims to enhance the quality of life in terms of improving the economic aspect (Economic Development) and using science and technology for analyzing nutritional values and designing packaging. Networking and Community Building: Establishing networks and connections with private individuals, community enterprises, and universities plays a crucial role in expanding the market for community enterprises. This is a significant strategy for creating a "New Economy" that generates new value chains for community enterprises. The research involves agricultural practices that focus on area analysis, efficiency improvement, and productivity enhancement, incorporating science, technology, and innovation to help achieve these goals.

Keywords: New value chains, organic rice, indigenous rice, antioxidants, community enterprise

1. Introduction

Although in the past, Thailand was the world's leading exporter of rice, in recent years, the country has lost the championship to India. In the fiscal year 2018, India exported 11.97 million metric tons of rice, while Thailand exported 10.09 million metric tons of rice (Thai Rice Exporters Association, 2019). It is estimated that in the fiscal year 2019, India's rice exports increased to 12.50 million metric tons, while Thailand is expected to export only 10.00 million metric tons of rice. This is partly due to Thailand facing challenges such as droughts caused by weak El Niño events and severe flooding in the lower northeastern region in September of the previous year. Additionally, competition in the rice market has been growing, with countries like Vietnam developing higher-quality fragrant rice but selling it at lower prices than Thailand, enabling Vietnamese fragrant rice to penetrate markets in Africa and the Middle East. Furthermore, Vietnam is also developing indigenous rice varieties to cater to the health-conscious consumer trend, which has gained momentum in the modern society focusing on health-oriented consumption. Therefore, Thailand should seriously consider rice variety development and create digital-era global marketing channels for local communities. Thailand is known for its rich rice genetic diversity, with over 100 indigenous rice varieties, many of which excel in drought and disease resistance, resulting in lower pesticide contamination compared to market-oriented rice varieties. Some of these indigenous varieties are aromatic rice varieties, such as Khao Kao, Hom Mali Daeng, Hom Nil, and Riceberry, which also contain antioxidants like anthocyanins in purple to black-colored rice or pro-vitamin A, found in yellowish-brown rice like Khao Kao. Thus, these indigenous rice varieties have potential in promoting market share by targeting health-conscious consumers. Nevertheless, it is important to note that rice is a carbohydrate source of energy, and excessive consumption may impact health. Hence, developing rice processing methods that reduce the conversion of starch into sugar in the digestive

system while retaining essential compounds like antioxidants in rice grains may benefit both farmers, consumers, and government policies related to producing safe food. ‘Low-Calorie Rice’ refers primarily to the process of cooking rice by adding oil to coat the rice grains, allowing the oil to cover the hilum, a location where the enzyme amylase acts to break down amylose in the starch granules. Moreover, rapidly cooling the rice after it becomes fully cooked turns the starch into a gel, making it resistant to digestion by amylase enzymes in the small intestine. This can help lower blood sugar levels and is suitable for type 2 diabetes patients, obese individuals, and health-conscious consumers. Additionally, some undigested starch can reach the large intestine and serve as food for beneficial gut bacteria, reducing the risk of colorectal cancer. However, the suitability of producing low-calorie rice may differ among rice varieties due to variations in physical and chemical properties, such as granule size, shape, amylose content, amylopectin content, and the presence of certain unstable antioxidants like anthocyanins, which degrade easily with heat, commonly found in purple to black rice. Therefore, laboratory experiments are necessary to determine the most suitable conditions for producing low-calorie rice with high antioxidant properties. ‘Nong Saeng Subdistrict, Wapi Pathum District, Maha Sarakham province’ predominantly consists of rice fields, covering 30,819 out of a total area of 31,636 rai (97.41%). However, the rice grown here is salt-tolerant due to saline soil and underground saltwater intrusion. The cultivated rice includes not only fragrant rice varieties like Khao Hom Mali 105 and KDML 6 but also salt-tolerant indigenous rice varieties such as Khao Kao, Khao Khum, San Pa Tong, Thap Thim Chumphae, Hom Sakon, Mali Daeng, and Riceberry. These indigenous rice varieties are promoted by the ‘Nong Saeng Subdistrict Administration Organization’ for conservation and are also part of the effort to promote organic rice production. In the fiscal year 2017, there were 307.38 rai of organic agriculture in the area, supported by the Green Net agricultural network. Additionally, the ‘Nong Saeng Community Enterprise Group for Organic Rice Production in Pla Boo Village’ is strong in organic farming and produces various products from organic rice, such as organic Hahng rice and rice soaked with medicinal herbs. However, one of the main challenges faced by local farmers is creating a unique product identity and effective marketing to reach the target audience. This often leads to rice surpluses, financial losses for members, and the instability and sustainability of community enterprises. This research project is an interdisciplinary collaboration between the Faculty of Science and the Faculty of Accounting and Management at Mahasarakham University to achieve the goals of ‘University for Regional Development’ and ‘Community Engagement’.

2. Objectives

To analyze the nutritional value of the local rice products in Nong Saeng Subdistrict.

To enhance the product’s value through the development of distinctive packaging.

To create marketing channels that connect producers and consumers.

3. The duration of the project's implementation phase

The period from May 15, 2020 (B.E 2563) to August 15, 2021 (B.E. 2564) covers approximately 1 year and 3 months.

4. Target group

“The community enterprise group for organic rice production in Pla Bu Village is located at 86 Moo 14, Nong Saeng Sub-district, Wapi Pathum District, Maha Sarakham province. It is registered as a community enterprise under the name “Community Enterprise Group for Organic Rice Production in Pla Bu Village”. Pongpisit (2009)

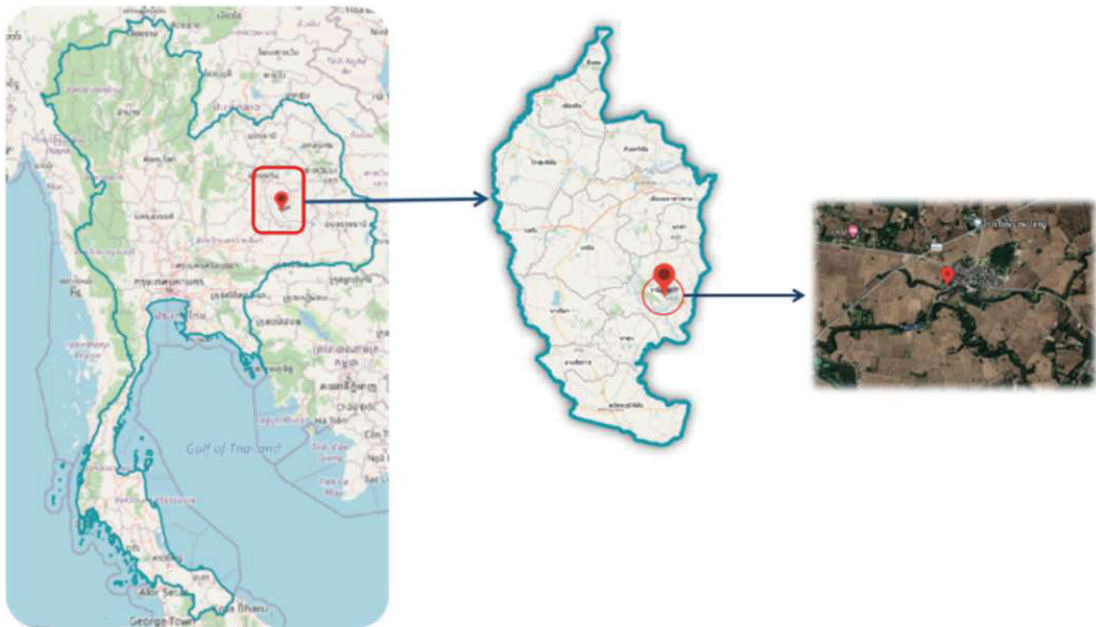


Figure 1. Map indicating the operation area.

5. The implementation of the project/activities/assessment methods

Section 2: Product Labeling for the community enterprise and Section 2: Marketing Rice Grains, in which the research team analyzed the characteristics of rice grains as shown in Figure 2, and also conducted an analysis of the marketing plan for the sale of rice grains for the community enterprise, as illustrated in Figure 3. Songprasert (2008)

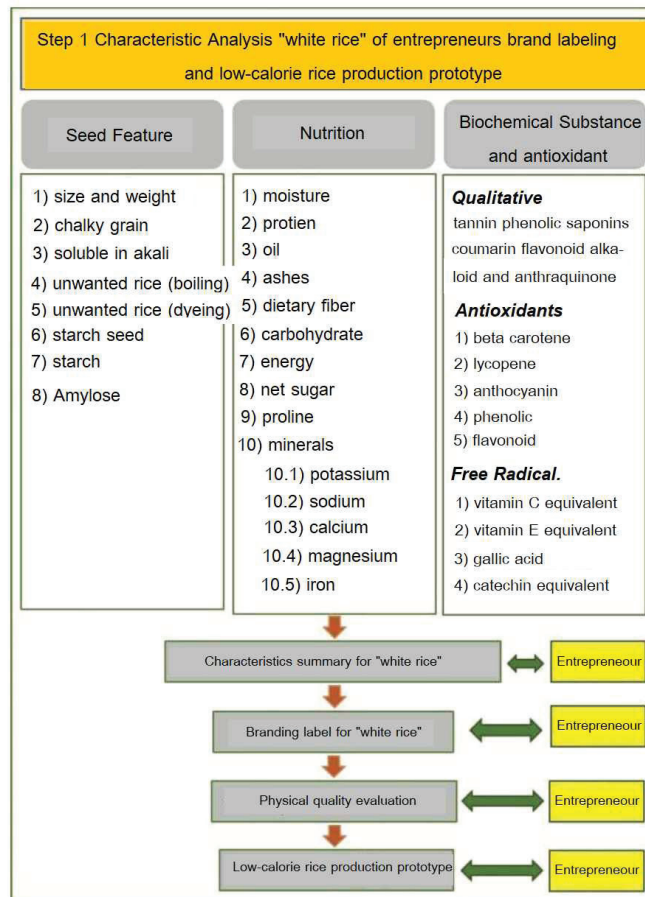


Figure 2. The analysis of the characteristics of "Rice Grains" for the community enterprise and the process of creating product labels include

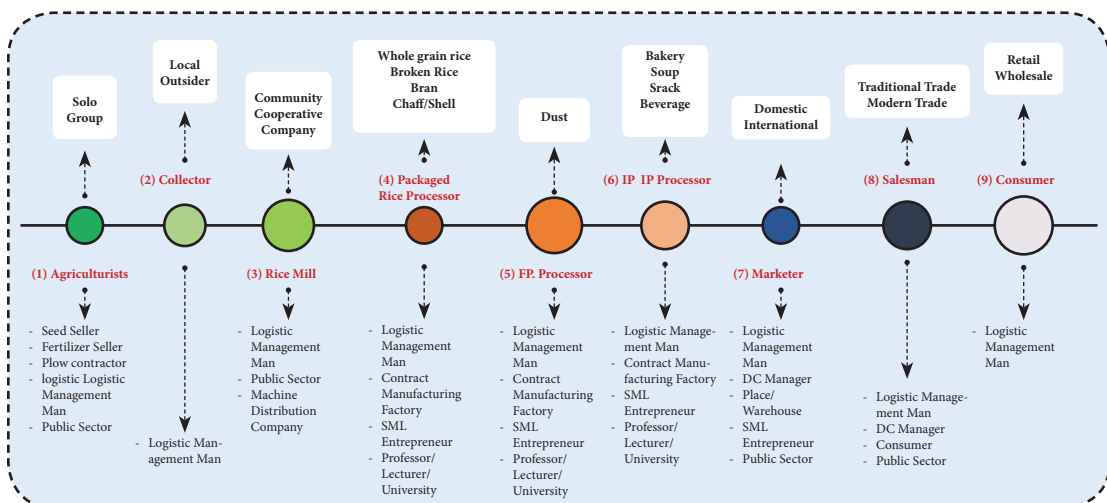


Figure 3. Rice marketing operations plan

In this study, the population and sample group consisted of a total of 46 members of the community enterprise “Community Enterprise Group for Organic Rice Production in Pla Bu Village,” located at 86 Moo 14, Nong Saeng Sub-district, Wapi Pathum District, Maha Sarakham province. The enterprise produces organic rice, and there are a total of 10 rice varieties in their production. For the research process, the research team selected and included eight rice varieties, which are: KG 69 (Tubtim Chumpae), Rice variety 105, Sticky rice, Red Hom Mali rice, Riceberry, Jasmine rice, Sticky rice from Sakon Nakhon (E-Tia), Hom Mali rice.

The researchers have developed tools for classification based on the detailed research procedures as follows:

1. The researchers conducted a Focus Group process before commencing fieldwork for knowledge exchange with the community enterprise group, “Organic Rice Production Group in Plabu Village.” The participants included farmers, community leaders, and government representatives. The aim of this activity was to gain a better understanding of the project’s background and collectively work towards regional development. This was achieved through a Focus Group discussion board.
2. A survey was conducted to assess indigenous rice varieties in the area of Tambon Nong Saeng, Wang Pong District, Maha Sarakham Province. Relevant data was collected, including the names of farmers, the number of households engaged in cultivation, the names of rice varieties, planting durations, production costs, yield per hectare, disease and pest resistance, as well as ease of cultivation and crop management.
3. The results from the survey were compiled into a scoring system for weighted evaluation. This was done to select specific rice varieties for further analysis of their physical and chemical properties in the rice grains.
4. The report summarizes the results of the examination of the physical and chemical properties of rice grains from selected rice varieties. This includes characteristics such as seed color, seed size, seed weight, fiber content, bran, protein content, starch granule size, starch granule shape, total sugar content, carbohydrate content, amylose content, amylopectin content, energy content, GABA (Gamma-amino butyric acid) content, antioxidant properties (measured using 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay, Ferric reducing antioxidant potential (FRAP) assay, and 2,2’-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) assay), flavonoid content, and flavonol content.
5. The report provides the results of the physical and chemical property assessments of rice grains, assigning weighted scores to select rice varieties with the potential for low-calorie rice production.

6. The report on testing for suitable conditions in low-calorie rice production for rice varieties that meet the criteria. The study specifies independent variables, including boiling temperature, boiling time, gelation time, and freezing temperature. Dependent variables under examination encompass total sugar content, carbohydrate content, starch content, amylose content, energy content, fiber content, anthocyanin content, beta-carotene content, phenolic compound content, and antioxidant properties (DPPH, FRAP, and ABTS). Emphasis is placed on utilizing alternative energy sources in the production process, such as solar energy and biogas energy.
7. The report on the results of the suitable conditions for creating low-calorie rice products, scored to select the most appropriate conditions for production.
8. A survey to assess consumer satisfaction with rice products that have passed the criteria, evaluated by a sample group of health-conscious consumers using the Hedonic scale sensory evaluation method.

For the tools used in product design and development, they are as follows:

1. The Focus Group process is used to establish a conceptual framework for designing product branding for rice products using the Concept Design mechanism. In this regard, the research team has applied the principles of Community Based Learning (CBL) to integrate design concepts. The analysis and development of the design will be based on four dimensions (as shown in Figure 4).



Figure 4. The framework for the project's design development

The researcher has outlined the entire design development process, which consists of 6 steps, including:

Step 1 involves the research team conducting on-site analysis. They analyze the advantages and disadvantages of the existing packaging and assess the potential for entrepreneurs to produce it themselves. The goal is to find materials that entrepreneurs can invest in to produce on their own and maintain a competitive pricing strategy to increase profitability. The research team will use brainstorming and mind mapping techniques to collaborate with entrepreneurs and generate new design directions and solutions.

Step 2 involves the consulting team developing a unique and distinctive product brand development plan. This plan aims to make the product stand out in the competitive market within the same product category.



Figure 5. The consulting team goes on-site to develop the product brand development plan

Step 3 involves the research team developing product brand prototypes, including product labels and/or packaging. The research team will present at least three product label designs, along with the concepts and graphics used for the design, for the entrepreneurs to consider.



Figure 6. The product brand prototypes

Step 4 involves conducting focus group discussions with a group of entrepreneurs and design experts. During these discussions, the research team engages in brainstorming sessions to analyze and summarize the product brand's image that aligns with the market's needs and the entrepreneurs' requirements. This step aims to gather valuable insights and ideas from participants to refine the product brand's identity and design further.

Step 5 involves conducting market testing to analyze the added value of the prototype product brand that has been newly produced.

Step 6 involves creating platforms such as websites and applications to expand communication channels that reach consumers. These platforms will showcase product stories, innovations/technologies, product details, samples, distribution channels, and payment methods to align with the trends of the modern market.

Online Marketing	Identity Building	Data Hub	Shops
 Facebook	✓		
 Line @			✓
 IG	✓		
Website		✓	
 YouTube	✓		
Application			✓
 Lazada			✓
 Shopee			✓

Figure 7. Promoting online sales and expanding communication channels to reach consumers

For the tools used in the research to create a new value chain aligned with the project's principles and objectives, focusing on community development and problem-solving, the researcher utilized the following: Focus Group Process: This involved gathering community members and conducting group discussions to understand the current market situation, target customer groups, product and packaging concepts, marketing strategies, and distribution channels. Training Sessions for Community Groups: The researchers provided training sessions to community groups, covering topics related to marketing, product development, and distribution strategies. These tools and methodologies aimed to enhance the value chain, empower local farmers, and elevate the market competitiveness of community enterprises in the Maha Sarakham province.

6. Evaluation and summary of the research project

The researchers used questionnaires to assess the research results and compile findings from the collaborative research project involving all relevant stakeholders. This was done to benefit future development efforts. Additionally, the lessons learned from working together as a research team were extracted and will be applied in future endeavors.



Figure 8. Extracting lessons from the work

6.1 Data Analysis and Statistics Used in Data Analysis

6.1.1 Rice example

In this study, there are 12 samples of rice, consisting of 8 samples from rice grown in the Nong Saeng sub-district, Wapi Pathum district, Maha Sarakham province, and 4 samples from a department store in Maha Sarakham province. The rice samples are divided into 3 categories: regular rice, colored rice, and glutinous rice. Details are provided in Table 1.

Table 1. Sample names and codes of the rice varieties used for testing

Sample	ID	Details
Jasmine rice		
Jasmine rice 105 (white)	HM-w-N	It is Hom Mali (Jasmine) rice, obtained from the community enterprise group that produces organic rice in Pla Boo Village. It was grown and harvested in the year 2020 (Thai year 2563).
Khao Dawk Mali 105 (brown)	HM-b-N	It is Hom Mali (Jasmine) Khao Hom Klong rice, obtained from the community enterprise group that produces organic rice in Pla Boo Village. It was grown and harvested in the year 2020 (Thai year 2563).

Table 1. Sample names and codes of the rice varieties used for testing (Cont.)

Sample	ID	Details
Khao Dawk Mali 105 (white- salty soil)	HM-s-N	It is Hom Mali (Jasmine) Khao Hom Mali Khad Khao rice, cultivated and harvested in the same saline soil field used for making “Tum Glua” salted fish in Setthawat Town. It was grown and harvested in the year 2020 (Thai year 2563).
Khao Dawk Mali 105 (white, from market)	HM-M	It is a brand of Hom Mali (Jasmine) Khao Hom Mali Khad Khao rice, purchased from a department store in Maha Sarakham province. It was grown and harvested in the year 2020 (Thai year 2563).
Rice		
Red Jasmine Rice	C-MR-N	It is a dark red jasmine rice received from the community enterprise group of organic rice producers in Ban Pla Bu Village. It was cultivated and harvested in the year 2020 (Thai year 2563).
Thap Thim Chumphon rice	C-RD69-N	It is a rice variety that resembles the color of a pomegranate, commonly referred to as “Tabtim Chumphae,” but its official name is “Khao Khae 69.” It was obtained from the community enterprise group of organic rice producers in Ban Pla Bu Village and was cultivated and harvested in the year 2020 (Thai year 2563).
Riceberry	C-RB-N	It is a brown rice variety obtained from the community enterprise group of organic rice producers in Ban Pla Bu Village, and it was cultivated and harvested in the year 2020 (Thai year 2563).
Riceberry (market)	C-RB-M	It is a dark brown rice variety, a specific brand, and it was purchased from a department store in Maha Sarakham province. It was cultivated and harvested in the year 2020 (Thai year 2563).
Sticky rice		
Sakhon Nakhon Jasmine rice	S-HS-N	It is sticky rice with a cloudy white color, commonly known as “Khao Niew E-Tia.” It was obtained from the community enterprise group of organic rice producers in Pla Bu Village. It was cultivated and harvested in the year 2020 (Thai year 2563).
Purple Sticky Rice	S-KO-N	Or “Khao Niew Dam” which is glutinous rice with a dark black color throughout the grains. It was obtained from the community enterprise group of organic rice producers in Pla Bu Village and was cultivated and harvested in the year 2020 (Thai year 2563).
Sticky rice Kao Hom Mali 6 (market).	S-RD6-M	It is glutinous rice with a slightly brownish white color, obtained from a department store in Maha Sarakham province. It was cultivated and harvested in the year 2020 (Thai year 2563).
Sticky red rice (market)	S-R-M	It is glutinous rice with a red color from a particular brand, purchased from a department store in Maha Sarakham province. It was cultivated and harvested in the year 2020 (Thai year 2563).

7. Summary of the results of the project/activity and key issues identified.

This research project aims to address and enhance the organic rice products of the community enterprise, the Organic Rice Production Group in Plabu Village, Nong Saeng Subdistrict, Wapi Pathum District, Maha Sarakham province, which has faced challenges in creating a distinct product identity and reaching the target market. Despite the various strengths of the organic rice, such as diverse rice varieties and higher levels of specific functional compounds compared to regular rice, as it is grown in salt-affected soil in Maha Sarakham province, the stress from salinity stimulates the accumulation of these specific functional compounds in the plant. Moreover, the soil in the salt-affected area is considered clean, with minimal plant pests. Therefore, fewer pesticides are used in agriculture. Combined with more than 50 members of the Organic Rice Production Group in Plabu Village, they cultivate 1,200 rai (approximately 480 acres) of land and have an average monthly organic rice production capacity of 100 kilograms per member. They adhere to 100% organic farming practices. Therefore, the rice produced by this community enterprise is nutritionally not only valuable but also safe. In this context, they have developed packaging that is unique and tells the story of the local area and community's way of life. They have also developed marketing channels to target specific customer groups. This helps increase the growth rate of the grassroots economy and the value of community-produced products through the creation of a new value chain.

8. Summary of the results of the operations/consolidation and recommendations

1. They have produced indigenous rice products that resonate with consumer preferences, resulting in a minimum price increase of 10%.
2. The product's value has increased due to the development and design of packaging logos.
3. The community enterprise has expanded its communication and sales channels for local rice products, thanks to online platforms and sales channels.

8.1 Partnership

The project conducted various activities in collaboration with the community, resulting in income distribution among its members. These activities empowered the members with knowledge and skills in various areas such as video production, online sales, content creation, marketing, and accounting. This exchange of knowledge and mutual assistance within the group led to increased sales and visibility for the community. As a result, the community became a model for "professional farmer" in the Maha Sarakham province, attracting the interest of both government and private sector organizations, who visited and studied the enterprise at the Ban Plabu Community Enterprise in Nong Saeng sub-district, Wapi Pathum district, Maha Sarakham province. Namhai (2010).

8.2 Mutual benefits

The project's outcomes have been utilized by the Department of Agricultural Promotion, the YSF group, and the local administration in the Nong Saeng sub-district. This includes applying knowledge in marketing, societal and technological changes, as well as creating linkages in the form of a network to establish a broader production cycle. This aims to create a “new value chain” within the production cycle.

8.3 Knowledge sharing and scholarship

Maha Sarakham University has developed and adjusted the process of conducting community-oriented academic services by creating a collaborative workspace and environment for professors, researchers, and students to work together. This fosters interdisciplinary collaboration among researchers from different fields who come together to work on projects like the “BorPorTor” project. This serves as an excellent starting point and benefits the community. The collaboration involves exchanging experiences among the research team, such as cross-disciplinary knowledge, sharing experiences, and different research projects. However, these efforts are focused on contributing to the development of projects within the same community, allowing the research team to apply their expertise to enhance research activities through the university's mechanisms.



8.4 Measurable social impact

The estimated social impacts of the project are as follows:

1) They have established production standards as a foundation for developing and supporting the elevation of production standards to the level of SMEs or the industrial level. This includes developing the community enterprise's business premises to meet these standards, selecting rice varieties that meet the standards, and standardizing packaging, among other aspects. Yantawiriyasuk (1988)

2) They have worked on developing the capabilities of the community enterprise members to lay the groundwork for development and support in elevating their

knowledge and understanding of becoming SMEs or social enterprises. This includes training on economic and social entrepreneurship, developing a mindset for professional business operation within the community, and enhancing professional skills related to agriculture, such as “professional farming”.

In terms of learning, skills in research and knowledge management have been developed through the use of Time Line Analysis tools to study the dynamics and changes within the community enterprise group. This has led to an understanding of the factors and causes of all the changes that have occurred within the group. Additionally, it has facilitated the exploration of pathways leading to solutions that align with various challenges.

In terms of marketing and innovation learning, it involves collaborative learning among the community, community enterprise groups, networks, universities, and private sectors to analyze and gain an understanding of the current and future landscape amidst various changes. Therefore, the approach of analyzing and importing critical data sets for forecasting and predicting changes is another way for the community to learn collectively.

In terms of job creation (such as developing community-based vocational skills, expanding career opportunities, and fostering entrepreneurship), the research project has connected and conducted activities related to skill development for the target groups. For example, community enterprises and community members can sell products online using modern media and packaging, which can create jobs and income for these enterprises. This linkage between the “social sphere” and the “economic sphere” of the community has been established.

Income generation (main or supplementary income) within the traditional rice market, which typically involves middlemen and rice mills that lead to low rice prices, has been analyzed in this research project. It aims to shed light on the changing landscape and opportunities to create an identity for the products. For instance, modern and identity-centric packaging has been explored as a way to add value to the products and highlight the community enterprise’s identity.

Quality of life improvement (how to enhance the quality of life) involves elevating the income of the community enterprise to generate greater revenue, thus leading to an improved quality of life in terms of “economic” aspects. Additionally, it employs science and technology to analyze nutritional value and packaging design.

Network and community building is crucial in expanding the market for community enterprises. Linking with various networks and private sectors is another important approach in creating a “new environmental economy” that fosters a new value chain for these enterprises. Collaboration with social scientists, accountants, marketers, and designers plays a pivotal role in establishing a new creative environment for product development, keeping pace with the ever-changing world.

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