EXTENSION PATTERN DEVELOPMENT OF COMMERCIAL RICE PRODUCTION IN SAVANNAKHET PROVINCE, LAO PEOPLE'S DEMOCRATIC REPUBLIC

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DOCTOR OF PHILOSOPHY IN RESOURCES MANAGEMENT AND DEVELOPMENT

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT
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ชื่อเรื่อง EXTENSION PATTERN DEVELOPMENT OF COMMERCIAL RICE PRODUCTION IN SAVANNAKHET PROVINCE, LAO PEOPLE'S DEMOCRATIC REPUBLIC

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บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์ 1) เพื่อศึกษาปัจจัยพื้นฐานส่วนบุคคล เศรษฐกิจ และสังคมของเกษตรกรที่ปลูกข้าวเชิงพาณิชย์ 2) ประเมินระดับการยอมรับในการปลูกข้าวเชิงพาณิชย์ของเกษตรกร 3) ค้นหาปัจจัยที่ส่งผลต่อการรับการปลูกข้าวเชิงพาณิชย์ของเกษตรกร และ 4) พัฒนารูปแบบการส่งเสริมการปลูกข้าวเชิงพาณิชย์ของเกษตรกร กลุ่มตัวอย่างที่ใช้ในการศึกษานี้แบ่งออกเป็นสองกลุ่ม กลุ่มที่ 1 คือ เกษตรกรที่เข้าร่วมโครงการผลิตข้าวเชิงพาณิชย์ จำนวน 177 ราย กลุ่มที่ 2 คือตัวแทนของเกษตรกรที่เข้าร่วมโครงการผลิตข้าวเชิงพาณิชย์ในแต่ละหมู่บ้าน (หมู่บ้านละ 1 คน) รวม 13 คน เจ้าหน้าที่ส่งเสริมการเกษตรระดับอำเภอ (อำเภอละ 1 คน) รวม 6 คน และระดับจังหวัด (2 คน) ดังนั้นกลุ่มตัวอย่างในกลุ่มนี้จะมีทั้งหมด 21 คน เก็บรวบรวมข้อมูลโดยใช้แบบสอบถามและการสนทนากลุ่ม วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนา เช่น ความถี่ ค่าเฉลี่ย ค่าสูงสุด ค่าต่ำสุด ส่วนเบี่ยงเบนมาตรฐาน และการถดถอยเชิงเส้นพหุ เพื่อค้นหาปัจจัยที่มีอิทธิพลต่อการปฏิบัติในการผลิตข้าวเชิงพาณิชย์ของเกษตรกร นอกจากนี้ยังใช้การสนทนากลุ่มเพื่อให้ได้ข้อมูลเพิ่มเติม

ผลการศึกษาพบว่าผู้ตอบแบบสอบถามส่วนใหญ่เป็นเพศชาย อายุเฉลี่ย 51 ปี ส่วนมากมีสถานภาพสมรสแล้ว และสำเร็จการศึกษาระดับประถมศึกษา พวกเขามีแรงงานในครัวเรือนเฉลี่ย 4 คน มากกว่าครึ่งหนึ่ง (67.0%) มีอาชีพเสริมเป็นชาวสวน และถือครองพื้นที่เกษตรกรรมโดยเฉลี่ย 1.5 เฮกตาร์ ผู้ตอบแบบสอบถามมีรายได้เฉลี่ยต่อปีอยู่ที่ 18,940 บาท ต้นทุนในการผลิตทางการเกษตรโดยเฉลี่ยครั้งละ 10,541 บาท ประมาณหนึ่งในสามของผู้ตอบแบบสอบถาม (35%) เข้าถึงสินเชื่อสำหรับกิจกรรมการผลิตทางการเกษตร ผู้ตอบแบบสอบถามมีประสบการณ์ในการทำฟาร์มเฉลี่ย 30 ปี และติดต่อกับเจ้าหน้าที่ส่งเสริมการเกษตรโดยเฉลี่ยปีละหนึ่งครั้ง เคยเข้าร่วมฝึกอบรมและทัศนศึกษาด้านการเกษตรโดยเฉลี่ยปีละครั้ง ผู้ตอบแบบสอบถามรับรู้ข้อมูลข่าวสารทางการเกษตรผ่าน 4 ช่องทาง โดยเปิดรับสื่อที่เกี่ยวข้องกับการเกษตรปีละ 9 ครั้ง มีการติดต่อกับเพื่อนบ้านด้านการผลิตทางการเกษตรปีละครั้ง เป็นสมาชิกกลุ่มเกษตรกรรม 4 กลุ่มในชุมชน และผู้ตอบแบบสอบถามส่วนใหญ่ (72.3%) มีความรู้เกี่ยวกับการผลิตข้าวเชิงพาณิชย์ในระดับปานกลาง อย่างไรก็ตามเกษตรกรมีการยอมรับการผลิตข้าวเชิงพาณิชย์ในระดับมาก เมื่อ

พิจารณาจากรายละเอียดแล้ว พบว่ามี 2 ด้านที่มีการยอมรับในระดับมากที่สุด ได้แก่ ด้านการเตรียมพื้นที่การผลิต และด้านการเพาะปลูก อย่างไรก็ดี อีกสองประเด็นพบว่าเกษตรกรให้การยอมรับในระดับมาก ได้แก่ ด้านการบำรุงรักษาผลผลิต และด้านการเก็บเกี่ยว และการจัดการหลังการเก็บเกี่ยว นอกจากนี้ยังพบว่ารายได้ของครอบครัว การเป็นสมาชิกกลุ่ม การเข้าร่วมอบรมหรือทัศนศึกษาทางด้านการเกษตร การได้รับสื่อ และความรู้/ความเข้าใจในการผลิตข้าวเชิงพาณิชย์ มีความสัมพันธ์เชิงบวกอย่างมีนัยสำคัญกับการยอมรับการผลิตข้าวเชิงพาณิชย์ ที่ระดับนัยสำคัญทางสถิติ 0.01 และ 0.05 รูปแบบการผลิตข้าวเชิงพาณิชย์ของเกษตรกรประกอบด้วย 3 องค์ประกอบหลัก ได้แก่ 1) การพัฒนาความรู้ความเข้าใจของเกษตรกรเกี่ยวกับการผลิตข้าวเชิงพาณิชย์ 2) แนวทางการเสริมสร้างทัศนคติต่อการผลิตข้าวเชิงพาณิชย์ 3) การส่งเสริมให้เกษตรกรใช้เทกโนโลยีในการผลิตข้าวเชิงพาณิชย์ และ 4) การสนับสนุนจากรัฐบาล นอกจากนี้เพื่อสนับสนุนการผลิตข้าวเชิงพาณิชย์ องค์กรที่เกี่ยวข้องควรส่งเสริมเกษตรกรสูงอายุด้วยการจัดอบรมหรือศึกษาดูงานด้านการเกษตร การสนับสนุนการพัฒนาระบบชลประทาน การเพิ่มมูลค่าการผลิตข้าวภายใต้ระบบความปลอดภัยทางอาหาร การขยายพื้นที่ปลูกข้าวเชิงพาณิชย์ การเพิ่มช่องทางการรับรู้ข้อมูลข่าวสารทางการเกษตร และการพัฒนาตลาดข้าวในประเทศและต่างประเทศ การเปลี่ยนแปลงเหล่านี้จะช่วยทำให้บรรลุนโยบายของรัฐบาลในการส่งเสริมการผลิตข้าวเชิงพาณิชย์ทั่วประเทศเพื่อความมั่นคงและความปลอดภัยทางอาหาร และการลดความยากจน

คำสำคัญ : การยอมรับ, การส่งเสริมการเกษตร, การผลิตข้าวเชิงพาณิชย์, การพัฒนารูปแบบ, สปป.ลาว

Title EXTENSION PATTERN DEVELOPMENT OF COMMERCIAL RICE PRODUCTION IN SAVANNAKHET PROVINCE, LAO PEOPLE'S DEMOCRATIC REPUBLIC

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Degree Doctor of Philosophy in Resources Management and Development

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ABSTRACT

The objectives of this study were: 1) investigate basic personal, economic and social factors of commercial rice farmers, 2) explore a level of commercial rice production adoption of the farmers 3) find factors affecting the farmers adoption of commercial rice production; and 4) develop an extension pattern of commercial rice production of the farmers. The respondents in this study divided into two group. The first group is rice farmers who participtated on commercial rice production project consisted of 177 farmers. Second group is the representatives of rice farmers who participated on commercial rice production project in each village (1 person per village) consited 13 persons, agricultural extension staff at district level (1 person per district) consited 6 person, and agricultural extension staff at province levels consisted of 2 persons. Thus, the respondents in this phase consisted of 21 persons. A set of questionnaires and focus group was used for data collection and analyzed using descriptive statistics such as frequency, mean, maximum, minimum, standard deviation and multiple linear regression was applied to find the factors influencing the practice of commercial rice production. In addition, focus group discussions was employed to obtained some more data.

The study results showed that most of the respondents were male, 51 years old, married and elementary school graduates. They had 4 household workforces, more than one-halt of them (67.0%) had supplementary occupation in gardeners, and 1.5 hectares of an agricultural area on average. The respondents had an average annual income of 18,940 baht, they claimed that the farming production cost was 10,541 baht for each time on average. About one-third of the respondents (35%) accessed credit for agricultural production activities. The respondents had 30 years of experience in farming

and they contacted agricultural extension staff once on average. They attended agricultural training and joined educational trips once a year on average. The respondents perceived agricultural information through 4 channels. Their exposure to media related to farming was 9 times a year, they contacted neighbor on agricultural production once a year, they were members of 4 agricultural groups in their community and most of the respondents (72.3%) had a moderate level of knowledge about commercial rice production. However, the farmers had a high level of the adoption of commercial rice production. Based on its detail, two aspects were found at a highest level: preparation of production area and cultivation. However, the other two aspects were found at a high level: maintenance practice and harvest and post-harvest management. In addition, it also found that family income, group membership, agricultural training or educational trip, exposure to media, and knowledge/understanding of commercial rice production had a significant positive relationship with the adoption of commercial rice production at a statistical significance level of 0.01 and 0.05. The commercial rice production pattern of farmers was comprised 4 main components: 1) developing knowledge and understanding of the farmers about commercial rice production; 2) approaches for strengthening attitudes towards commercial rice productiont; 3) encourage to use modern technology of commercial rice production; and 4) government supporting. Moreover, to support commercial rice production, the concerned organization should empowerment of elderly farmers by organize agricultural training or study visited, Irrigation development support, adding value to rice production under the food safety system, expansion of commercial planting area, increasing channels for receiving agricultural information; and develop the domestic and international rice market. These changes would help achieve the government policy to promote commercial rice production around the country for food security, food safety and poverty reduction.

Keywords : adoption, agricultural extension, commercial rice production, pattern development, Lao PDR.

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Chapter 1

Introduction

Background and Problem Statements

Rice is the staple food of the people in the Lao People's Democratic Republic (Lao PDR). The rice planted area was approximately 866,982 ha in the year 2020 and accounted for about 80% of the total cropped area in Lao PDR. Approximately 89.74% of the rice yield is produced in the rainfed ecosystems. The rice area in the dry season 2020/2021 increased by 13.6% (102,000 ha) The rainfed lowland rice area accounted for 65% of the total rice area and 69% of the product whereas the rainfed upland rice area accounted for 21% of the total rice-growing area and contributed 12% to the total rice production. Total rice production in 2020 was about 4.3 million metric tons of paddy rice (Ministry of Agriculture and Forestry 2020)

The main producers of rice in Lao PDR is smallholder farmers, the quantity of the rice sold in the market is less than 10% of total production. The average yield in the rainfed upland rice areas is 1.7 t/ha; 3.3 t/ha in the rainfed lowland rice areas and 4.3 t/ha in the irrigated area. Approximately 85% of the total rice production is from glutinous varieties although, in the upland areas, 15% of rice production is from non-glutinous varietieS.D.uring the wet season, 100% of the varieties grown by upland farmers are local varieties. Before and up to 2020, 90% of the rainfed lowland rice area was planted to local varieties. After establishing the rice-breeding unit to identify new, more suitable varieties, which combine high yield potential and good eating quality with a good adaptation to the different ecosystems of Laos, the first improved glutinous varieties were released and widely adopted by farmers in 2020. In the wet season 2020/21, the area planted to improved varieties in farmers' fields in the provinces along the Basin of the Mekong River has increased to 81% of which 36% were planted with Lao improved varieties. However, the adoption of nine improved varieties still has limitations and the National Rice Research Program

expects that after a further two seasons, farmers can be offered and will adopt several other new improved varieties (Silinthone, Lytoua et al. 2020)

The Party and Government have determined agriculture production as one of the economic structure bases on the direction that agriculture is the basis for industry and services and as the basis of the national economy. The vision of the agriculture sector is from total rice production target: produce rice for domestic sale and export to reach 1.5 million tons (paddy rice) in 2025 by promotion of cultivation of rice that has high potential in each local area such as black rice (Khao Kaam), small chicken rice (Khao Kay Noy), Lao aromatic rice and others in the potential and suitable areas in pararel with the new improved variety and quality rice that have high market demand such as TDK, Tha Sa No rice, Phon Ngam rice and other aromatic rice in plain areas. Increase proportion of regular (non-glutinous) rice cultivation to cover 30% of total production. This includes the production of rice for export in line with good agriculture practice (GAP) aiming at regional and international markets. In small and medium plains in northern provinces, rice production shall focus on export to China and other neighbouring countries by using rice seeds that have market demand (Ministry of Planning and Investment 2021)

One of the challenges for the Ministry of Agriculture and Forestry (MAF) is to improve Lao farmers' and other agricultural value chain stakeholders' ability to take advantage of commercial high-value commodity production opportunities while also improving food security and nutrition for rural communities and country. Spurred on by policy design and by benign forces of socio-economic and technological progress, Lao PDR has embarked on a path to promote the dominance of commercial, productivity, and profit-driven agriculture over the traditional, less productivity oriented, and less market-driven subsistence systems of farming and food systemS.D.uring the ensuing transition, potentially millions of hectares and hundreds of thousands of farmers are moving from subsistence to for-cash commodity production. In the process, different resource-use, commodity ownership, management strategies, and new investment schemes are being promoted, introduced, and adopted. With increased commoditization of production, entire communities are changing their livelihood strategies and ways of life and are

becoming more integrated with the expanding market economy. At the same time, Laos continues to have some of the most adverse and intransigent food insecurity and malnutrition indicators in South East Asia (Samm 2020)

Savannakhet Province is the largest in Laos, covering 21,774 km^2, bordered by the Mekong River in the west, Vietnam in the east, Khammouane in the north and Salavan in the east. The province is drained by the Banghiang river, Bangfai river, Bangnouane river, and Xechamphone river. The river system has a comparatively steep fall and is subject to flash flooding in the upper catchment and longer-term flooding in the lower catchment, where several irrigation schemes have been established. The major rice-growing areas are found along the alluvial plain adjacent to the Mekong, with secondary areas on the residual terraces in the central part of the province. The province is traversed by three national roads route 13, which runs north-south along the Mekong corridor; Route 9, which runs on an east-west trajectory from Savannakhet City to the Vietnam border; and Route1, which runs north-south along with the eastern border range. Most of the provincial roads connecting district towns with major villages are unpaved and most local roads are in poor condition and unusable during the wet season. In 2020 –2021 Savannakhet Province accounted for 23% of the country's rice production and 25% of irrigated rice production. Rainfed wet-season (WS) rice accounted for 78% of total production within the province and irrigated dry season (DS) rice for 22%. The yield of rice in Savannakhet averaged 3.4 t/ha for WS rice and 4.1 t/ha for DS rice, above the national average. Among the 15 districts of the province, by far the largest rice producers were the five districts in the Mekong corridor, which together accounted for 60% of the total rice area in the province and 86% of the irrigated area. The average WS yield in these five districts was 3.7 /ha and the average DS yield was 4.5 t/ha, somewhat higher than the provincial average, and most local roads (Silinthone, Lytoua et al. 2020)

At present, the quantity of rice exports in Laos to foreign markets is still low. The government Lao PDR has a plan to drive production for export to more than 4 hundred thousand tons by the year 2019, which this push was planned by expanding rice planting areas nationwide by an additional 1 million hectares, and the general

average was the rice production potential of Laos will be 4.2 tons per hectare. causing the whole country to be able to produce more rice 4,220,000 tons, of which 2,700,000 tons is the domestic consumption of rice, and are kept in reserve for safekeeping. Food security 400,000 tons. The industrial sector is used for processing about 500,000-600,000 tons. Therefore, it will be able to export approximately 400,000 tons (Lao Statistics Bureau, 2020). In the international market, the rice must be of quality according to the market demand. It is therefore important to produce quality rice. Because the rice market in foreign countries is very competitive in terms of high quality. The production of good quality is related to the production process. that if there is proper management practice and understanding of marketing methods farmers across the country will have income from sales of higher production (Agricultural and Forestry Office, 2020), including the farmers of Savannakhet Province are in poor condition and unusable during the wet season.

Savannakhet Province has the policy to produce 814,369 tons of rice per year for consumption to meet the demand of people with an average consumption rate of 631 kg/person/year (Somphong, Bounmy et al. 2021). Including planning to expand production capacity to be more volume in line with the country's policy to increase exports rice to be sold to foreign markets in order to generate income for farmers and the country.

The Climate-Friendly Agribusiness Value Chains Sector Project (CFAVC) is a project that will help to support the implementation of the Agriculture and Forestry Strategic Plan until 2025 and Vision to 2030 to become successfully. Encouraged the improvement of competitiveness in rice production in Khammouan, Savannakhet, and Saravan provinces with the aim of developing production according to the value chain to be diverse and meet the needs and production programs of the government. Improve agricultural infrastructure to be resilient to climate change. Provide assistance in capacity building on processing, storage, quality control of agricultural products and promote the use of biological fertilizers and organic agricultural production. Build strength for related disciplines and organizations regarding agricultural production related to climate change (Climate Smart Agriculture). Create a favorable environment for environmentally friendly agricultural

business to promote the protection of the environment and increase income for farmers and entrepreneurs in agricultural business to be sustainable. But until now have only 314 farmers (0.228%) participated in this project, which is very small proportion compare to number of the farmers in Savannakhet Province (137,222 farmers). (The Climate-Friendly Agribusiness Value Chains Sector Project 2022)

But found that the current rice production for export is the problem of rice quality does not meet the standards. That due to breed the rice used has a high variance. The seeds were of low quality, resulting in the yield not meeting the market demand, therefore, they can be sold at a low price, the farmer's academic knowledge is not enough as a result, the management is not in accordance with the good system. Quantity Low output is insufficient for domestic consumption, resulting in very little output for export. the market has no Of course, in order to support the production, the price is low. As a result, many farmers, especially the new generation, switched to occupation. other substitutes for production factors such as fertilizers, pesticides and pesticides. fuel and wages have a higher price every year as a result, farmers have high rice production costs. (Amnouay, Wiraya et al. 2020). Including the problem that the Lao rice variety has not improved the breed. No further research was required, so we had to buy rice varieties from Thailand. Lack of labor in farming as more workers turn to wage work in the city and the lack of working capital for farming causes farmers to sell their fields and turn to other occupations. and found that rice farming in Laos tends to decrease by about 10 percent. (Eric and Ponnarong 2020). To solve these problems, commercial rice production must be developed properly, systematically, and comprehensively. in accordance with the context of the area

Based on the aforementioned problems and reviews of related research papers, it was found that no studies were conducted on the development pattern of commercial rice production in Savannakhet Province. and it does not appear that there is a clear development of rice production for commercial purposes in Savannakhet Province. Therefore, the researcher is interested in studying the development pattern of rice production as commodity product in Savannakhet Province, Lao PDR. The goal is to provide a useful guideline for rice farmers, related

agencies involved in agricultural development; and other provinces of Lao PDR with similar context which will generate income for the farmers bringing income into localities and countries including being accepted in the domestic rice market that will affect the quality of life of farmers for gaining trade surplus and further development of the country.

Research Objectives

1. To investigate basic personal, economic and social factors of commercial rice farmers;
2. To explore a level of commercial rice production adoption of the farmers;
3. To determine factors affecting the farmers adoption of commercial rice production;
4. To develop an extension pattern of commercial rice production of the farmers.

Expected Outcome

1. To know the personal, economic and social factors of commercial rice farmers in Savannakhet Province, Lao PDR.
2. To know the adoption levels of commercial rice production of the farmers in Savannakhet Province, Lao PDR.
3. To know the factors affecting to farmers' adoption of commercial rice production in Savannakhet Province, Lao PDR.
4. To have an extension pattern of commercial rice production of farmers in Savannakhet Province, Lao PDR.
5. Relevant agencies can use this extension pattern to encourage the farmers to increase the number of commercial rice farmers.

Research Scope

For this research, the researcher has defined the scope of the study as follows:

Scope of Variables:

The dependent variables are adoption levels of commercial rice production and the extension pattern of commercial rice production of the farmers in Savannakhet Province, Lao PDR.

The independent variables are age, marital status, educational attainment, household labor, supplementary occupation, farming size, family income, farming cost, amount of credit, farming experience, contact with agricultural staff, participated in agricultural training/educational trip, exposure to media, contact with neighbors about agricultural production, group membership; knowledge about commercial rice production; problems and suggestion about commercial rice production of the farmers.

Scope of Population:

The population used in this study has been divided into two groups: 1) the farmers who participated in the commercial rice production promotion projects in 13 villages, 6 districts of Savannakhet Province with a total of 317 farmers. 2) agricultural extension staffs at provincial and district levels; and farmer representative with a total of 21 persons.

Scope of Content:

This study focused on adoption levels of commercial rice production of farmers in Savannakhet Province, Lao PDR. This were led to develop the extension pattern development, which has divided the adoption process into 4 stages:

- Adoption of production area preparation stage
- Adoption of cultivation stage
- Adoption of production maintenance stage

- Adoption of harvest and post-harvest management stage

Then apply the results of an analysis of main factors and problems encountered to find problem management direction for commercial rice production

Scope of Time:

This research was started at January 2022 to September 2023

Definition key term

Adoption of commercial rice production: Refers to the adoption of practical methods derived from academic knowledge. Farmer's experience and used of production equipment apply to rice production according to commercial system that is suitable for high yields and gain more income. Including 4 stages: 1) production area preparation; 2) cultivation; 3) maintenance; and 4) harvest and post-harvest management.

Agricultural Extension: is an applied behavioral science, the knowledge of which is applied to bring about desirable changes in the behavioral complex of human beings usually through various strategies and programs of change and by applying the latest scientific and technological innovations.

Extension Pattern Development: means creation and development the thumbnail that mimics the relationship of the peasant household adoption phenomenon. to understand the phenomenon of easy adoption of peasant households consisting of important characteristics is a structural relationship can predict the outcome. However, it must be able to expand the prediction results. more spacious as well as being able to lead to the creation of new ideas

Commercial rice production: it means implementation and following from the process of rice production for high yields and gain more income.

Farmers: Refers to farmers who have produced commercial rice in Savannakhet Province, Lao PDR.

Chapter 2

Literature Reviews

The purpose of this chapter was to provide theoretical support for this study. Journals and books, proceedings from research meetings, private and public agricultural production, the adoption process, and Lao government documents were used to provide a detailed representation of the relevant literature. This review of the literature was divided into the following sections:

- Principle of agricultural extension
- Adoption theory
- Factors affecting to famer adoption
- Agricultural extension situation in Lao PDR
- ASEAN rice situation
- Rice policy in Lao PDR.
- Related of research
- Literature reviews summary
- Conceptual framework
- Hypothesis

Principle of Agricultural extension

Definition of agricultural extension

There are as many definitions of agricultural extension as there are scholars, professionals and practitioners in the field of knowledge generation, its utilization and rural development. Below are some collections of various definitions of agricultural extension:

(Leagans 1961) Defined that agricultural extension is an applied science consisting of content derived from research, accumulated field experiences and relevant principles drawn from the behavioural science synthesised with useful

technology into a body of philosophy, principles, content and methods focused on the problems of out of school education for adults and youth.

Kelsey and Harne (1963) agricultural extension are an out of school system of education in which adult and young people learn by doing. It is partnership between the Government and the people, which provides service and education designed to meet the needs of the people. Its fundamental objective is the development of the people.

D. Ensminger (1961) agricultural extension is a programme and a process of helping village people to help themselves, increase their production and to raise their general standard of living.

H.W. Butt (1961) agricultural extension as the increased dissemination of useful knowledge for improving rural life.

B. Rambhai (1958) agricultural extension is a two-way channel; it brings scientific information to the village people, and also takes the problems of the village people to the scientific institution for solution. It is a continuous educational process, in which both learner and teacher contribute and receive.

O. P. Dahama (1973) agricultural extension is defined as an educational process to provide knowledge to the rural people about the improved practices in a convincing manner and help them to take decision within their specific local conditions. -

Y. C. Sanoria (1986) agricultural extension is a professional method of non-formal education aimed at inducing behavioural changes in the farmers for increasing their income through increased production and productivity by establishing firm linkages with research for solving farmer’s problems ensuring adequate and timely supply of inputs and using proven methods of communication for speeding of the process of diffusion and adoption of innovations."

Sher (2004) The agricultural extension is primarily based on the educational philosophy and is aimed at bringing about desirable changes in the knowledge, skills, attitudes and actions of the farmers. It is based on the basic principle of helping people to help themselves to achieve the better living standard through increased agricultural production and improved farm income. The crucial factor in improving

agricultural production is the effective transfer of technology from the research organizations to the farming community particularly the small farmers. It has been observed that the transfer of technology from research to farmers through extension organizations, has been one of the main obstacles in the improvement of farm productivity.

From the above definitions, it can be asserted that “Agricultural Extension” for that matter, Agricultural extension is “an out of school educational programme or activity which brings about a desirable change in behaviour (knowledge, attitude, practice and skills) of farmers to help improve their social, economic and psychological status”.

Agricultural extension is an applied behavioural science, the knowledge of which is applied to bring about desirable changes in the behavioural complex of human beings usually through various strategies and programmes of change and by applying the latest scientific and technological innovations.

Scope of Agricultural Extension

Extension appears to have unlimited scope in situations where there is need for creating awareness amongst the people and changing their behavior by informing and educating them. Kelsey and Hearne (1967) refer by Jaiswal and Rai (2019) identified nine areas of programme emphasis, which indicate the scope of agricultural extension.

1. Efficiency in agricultural production.
2. Efficiency in marketing, distribution and utilization.
3. Conservation, development and use of natural resources.
4. Management on the farm and in the home.
5. Family living.
6. Youth development.
7. Leadership development.
8. Community development and rural area development.
9. Public affairs.

The following statements will further amplify the scope of extension.

1. Extension is fundamentally a system of out-of-school education for adults and youths alike. It is a system where people are motivated through a proper approach to help themselves by applying science in their daily lives, in farming, home making and community living.

2. Extension is education for all village people.

3. Extension is bringing about desirable changes in the knowledge, attitudes and skills of people.

4. Extension is helping people to help themselves.

5. Extension is working with men and women, boys and girls, to answer their felt needs and wants.

6. Extension is teaching through "learning by doing" and "seeing is believing".

7. Extension is working in harmony with the culture of the people.

8. Extension is a two-way channel; it brings scientific information to village people and it also takes the Problems of the village people to the scientific institutes for solution.

9. Extension is working together (in groups) to expand the welfare and happiness of the people with their own families, their own villages, their own country and the world.

10. Extension is development of individuals in their day-to-day living, development of their leaders, their society and their world as a whole.

Objectives of Agricultural Extension

Hudu (2000) Having looked at the definitions of agricultural extension, it is imperative to equally look at the objectives of extension. The objectives of extension education are the expressions of the ends towards which our efforts are directed. In other words, an objective means a direction of movement. Before starting any programme, its objectives must be clearly stated, so that one knows where to go and what is to be achieved.

The fundamental objective of extension education is the development of the people. Every extension programme or activity should have clearly defined objectives.

An objective may be defined as an end towards which efforts are directed or a condition to be attained. Objectives can be conceived as statements of purpose for which an extension service is established, change in clientele's behaviour being the ultimate end.

According to Bardsley (1982), the main objective of agricultural extension is as follows:

To communicate to individual members of the community advice and assistance with respect to knowledge and methods of technical agriculture, with due consideration of the economic and social circumstances of the individual and other people collectively.

Agricultural extension in Ghana is primarily concerned with the following main objectives:

1. The dissemination of useful and practical information relating to agriculture to enable farmers' farm more efficiently to increase incomes.
2. The practical application of useful knowledge to farm and home
3. Encourage farmers to grow their own food, eat well and live well
4. Help rural, people appreciate opportunities, beauties, and privileges of rural life and the world around them
5. Promote better social, cultural recreational, intellectual and spiritual life among rural people
6. Develop citizens proud of their occupation, independent in thinking constructive in outlook, capable, efficient self-reliant and patriotic.
7. To improve all aspects of the life of the rural people within the framework of the national, economic and social policies involving the population as a whole.

Agricultural extension work is often being described as "helping people to help themselves". This express the extension worker implicitly faith in the ability of people to shape their own destiny. But faith is not enough to get people change and guide these changes into satisfying and productive channels; the extension worker must understand the dynamic of human behavior.

Basic Principles of extension

Certain basic principles underlie the conduct of agricultural extension work. These principles differ with respect to the kind of community in which extension education is carried on. Extension principles may be defined as guidelines for the conduct of extension work and these principles are the bedrock upon which extension service rests. The principles are:

1. Extension should start where the people are

2. Extension should be based on the needs and interests of the people

3. Extension should assist farmers to determine their own problems, help them to find desirable solutions and to encourage them to act.

4. It is an established fact that human beings have unsatisfied wants, this assertion is also applicable to the farmers.

5. The principle of co-operative work must be pursued to logical conclusion.

6. Extension workers should work with all members of the family.

7. The principle of the use of variety of teaching methods is another basic principle.

8. In African rural communities, participation in extension programme is voluntary and therefore programmes must meet the varying needs of individuals.

9. Extension workers should provide maximum opportunity for the people to work on programmes that have been determined by them and the extension agent working together.

10. Extension workers should take advantage of any existing local groups to involve the people in extension programmes.

11. Subject matter covered in extension must have definite purpose and must be specific so that programme would be able to achieve the purpose for which it was established.

12. The principle of constant evaluation must be followed.

13. The principle of professionalism should be followed.

14. Learning is a gradual process and therefore results must not be expected too soon.

15. Adult learning remains high throughout life.

16. A closer principle to the one just highlighted is the principle that extension is educational in function through assisting people to make their own decisions among various alternatives put before them.

17. Extension workers should promote the use and development of volunteer leaders.

18. Extension should be based on facts and knowledge.

Social principles for agricultural extension

Vanclay (2004) Summary the principles of agricultural extension as following:

Principle 1. Farming is a socio-cultural practice

Principle 2. Farmers are not all the same

Principle 3. Adoption is a socio-cultural process

Principle 4. Profit is not the main driving force of farmers

Principle 5. It is hard to be green when you are in the red

Principle 6. 'Doing the right thing' is a strong motivational factor

Principle 7. Farmers don't distinguish environmental issues from other farm management issues

Principle 8. There is a strong desire to hand the farm on to one's children

Principle 9. Sustainability means staying on the farm

Principle 10. Women are an integral part of the farm

Principle 11. Stage in the lifecycle of a farming family and family composition are significant factors

Principle 12. Non-adoption is not the cause of land degradation, rather practices actively promoted by extension in the past have significantly contributed to degradation

Principle 13. Marginal farmers are not marginal because of their management ability but rather because of their structural location

Principle 14. Farmers' attitudes are not the problem

Principle 15. Farmers construct their own knowledge

Principle 16. Effective extension requires more than the transfer of

technology, it requires an understanding of the world views of farmers

Principle 17. Farmers have legitimate reasons for non-adoption

Principle 18. Top-down extension is inappropriate

Principle 19. The 80–20 rule is a self-serving delusion

Principle 20. Science and extension do not have automatic legitimacy and credibility

Principle 21. Representation is not participation

Principle 22. Promotion of awareness through the use of dramatic images is counterproductive

Principle 23. Put degradation into perspective

Principle 24. The best method of extension is multiple methods

Principle 25. Group extension is not a panacea

Principle 26. Extension is likely to have only a small impact

Principle 27. Farmers need to feel valued

Adoption Theory

Rogers and F.Floyd (1971) stated that adoption process is the mental process of an individual begins with the initial stage of knowing or hearing about the new concept and ends with decision - making for adoption. This must go through the following stage

1. Awareness: this is the initial stage that an individual begins to know new information or concept but lack of details because he/she has never heard or seen it before. The perception may occur accidentally or the extension of private or government official. This is an important stage since it is the first stage that an individual begins to perceive new information or concept. Thus, it should be motivated which can lead to the final stage - acceptance or refusal.

2. Interest: this is the stage that an individual is interested in the new concept and he/she tries to seek for its details by asking people who know about the new concept that he/she has perceived.

3. Evaluation: this is the stage that an individual is studying details of the new concept and compare it to the existing one in order to find advantage and disadvantage. He /she may think that it should be tried or not.

4. Trial: in this stage, an individual does some trials in accordance with the new concept. This is aimed to check whether the new concept conforms to the current situations or not on the outcome will be as it is expected or not.

5. Adoption: it is the final stage that an individual must decide to adopt the new concept in the case that he / she is satisfied with the outcome of trials.

Although the 5 stages mentioned are related to one another like a chain, each stage may be ignored. Then, an individual may refuse the new concept in one of the five stages anytime in the case that any stage does not make him/her be confident. (Rogers, 1983) proposed a new concept or new theory which is the process of the decision whether to adopt the innovation (Innovation Decision Process). This can be divided into 5 stages as follow:

1. Knowledge: this is the stage where an individual knows the innovation for the first time.

2. Persuasion: an individual like or dislikes the innovation.

3. Decision: an individual must decide whether to adopt the innovation or not. In this stage, he/she may do trials on the innovation.

4. Implementation: it is the stage that an individual implements the innovation

5. Confirmation: it is the stage where an individual is seeking for Reinforcement to support his / her decision.

Rogers (1983) explained the characteristics of Innovation as follows:

1. Relative advantage means an individual who has adopted new concepts has considered and compared the new concept with the old one and finds that the new concept is better. There are many ways to measure that which one is better such as based on the economic aspect, we must find which one can give high profit. Convenience, satisfaction, honor, trust, etc., can be used as a criterion. It can be assumed that people see the importance and benefit of the new concepts and changes.

2. Compatibility: this means that the new concept has the characteristic that conforms to the value of an individual, past experience, needs, culture, tradition, skills, etc.

3. Complexity: the new concepts may be complex and is difficult to understand or apply. This may take a long time to make an individual to adopt the new concept.

4. Trialability: the new concept that has its characteristics contributed to the trial with a small limitation and without any obligation is likely to be adopted quickly. This is because an individual who does a trial feels that it is less risky.

5. Observability: the outcome of the new concept can be seen clearly and easily.

Advancement of understanding of knowledge about the sources, process, and consequences of the adoption and diffusion of technology is inherently an interdisciplinary project. And then it is a central issue in social change an important research agenda in rural sociology (Ruttan 2009)

Communication Channel Effecting the Adoption

1. Mass media: like a radiobroadcasts, television, journal, and other Printed materials have a high level of influence in the stage of awareness and interest since these media usually present up to date issues. Also, these media present various interesting issues very fast and conditionally.

2. Personnel media: this includes friends, neighbors, relatives, community leaders, and academicians. These groups of people are around target people and they have a chance to talk to the target people. This is done by two - way communications which can talk the target group have a better understanding. (Kaewthep et al., 2005)

3. Government agencies: these are government organizations such as the department of agricultural extension, the provincial's department of agriculture and forestry, and government loan sources. These agencies play role in the encouragement and support target group in the stage, of assessment, trial and implementation.

4. Private agencies This includes private organizations, companies, state, etc. They play part of the role in the campaign, advertisement and public relations on the new things. Relationship between the methods of extension and the adoption of agriculturists

The conclusion of a research on the adoption revealed the following stages as shown in the diagram below (Cusack 1983). Whatever The farmer acceptability and improved adoption of the technology will be influenced by the extent to which efforts are taken to meet these challenges. And the response on knowledge attitude and perception provides valuable inputs for further development and modification of the technology (Ajayi, 2007)

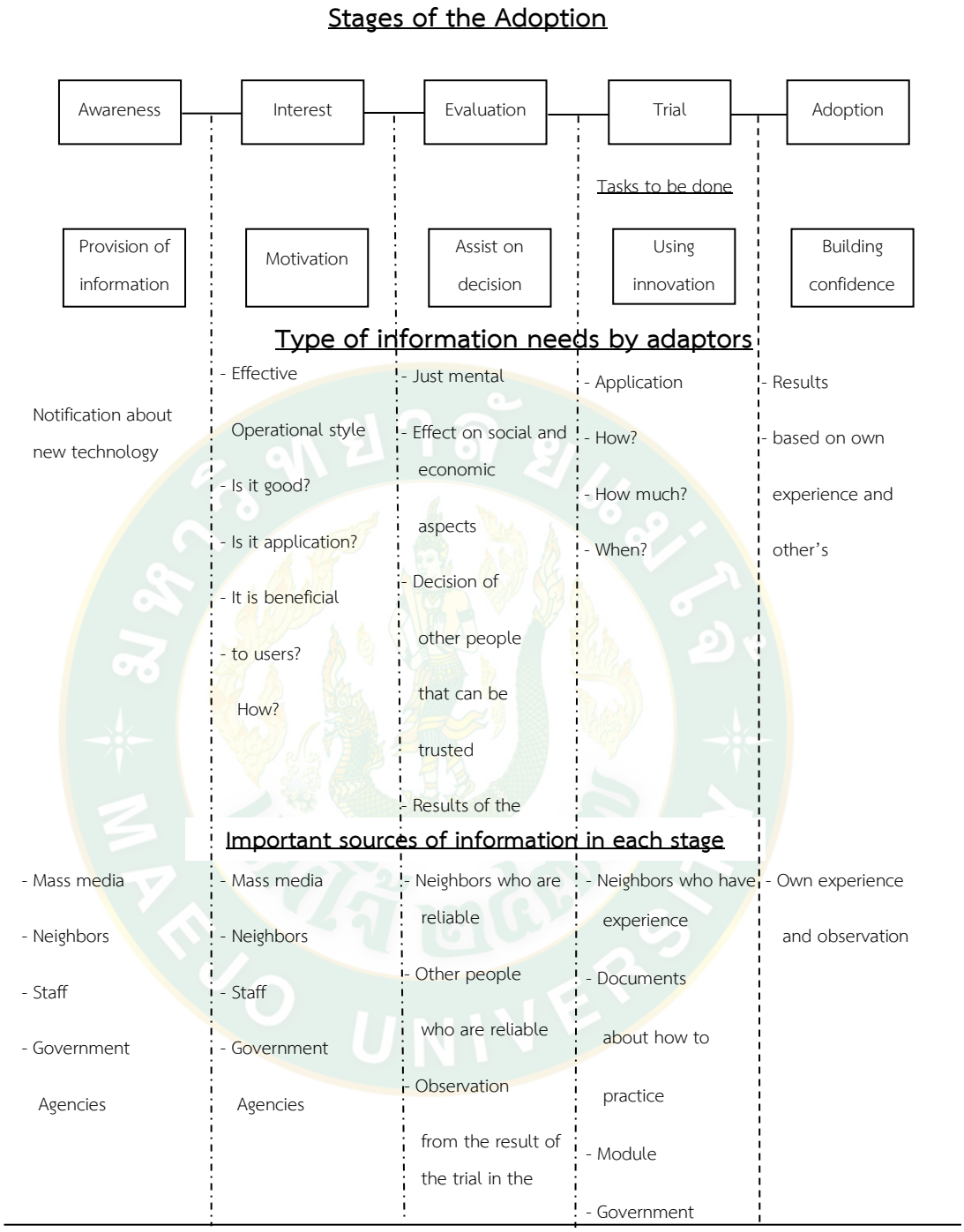

Figure 1 Sources of information needs and tasks to be done

Factors affecting to famer adoption

1. Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines.

The study was done to assess the factors influencing adoption of modern rice technology and management in Philippines which also pointed extension related variable as major on technology adoption. However, the technology adoption was found to be affected by combination of agro-climatic conditions, socio-economic and institutional factors. Other factors were farmer's formal education and household size was also significant for adoption of CS (Certified Seed) technology. Also, mixed results are obtained for the farmers who rented land adopted more as compared to those who own land. Also, farmers having labor saving assets also prefer CS technology. Non-rice income was also found to be highly significant and positively co-related. Land size also played a key role for dissipate the risk and adopt the technology in smaller area till they get assuring result for acceptance or rejection for future continuity (Mariano, Villano et al. 2012)

2. Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries.

This study has reviewed past studies on the factors influencing adoption of agricultural technology. Perception of farmers towards a new technology is a key precondition for adoption to occur. Other factors that have been shown to determine adoption of agricultural technology include human specific factors, economic factors, technological and institutional factors. From the review, the determinant of agricultural technology adoption does not always have the same effect on adoption rather the effect varies depending on the type of technology being introduced. For example, farm size as a determinant of technology adoption has been found to have mixed effect. Large farm size may have positive effect on adoption of a certain technology and it may also reveal a negative impact on adoption of another technology such as zero grazing technology. Understanding the factors that influence or hinder adoption of agricultural technology is essential in

planning and executing technology related programmes for meeting the challenges of food production in developing countries. Therefore, to enhance technology adoption by farmers, it's important for policy makers and developers of new technology to understand farmers need as well as their ability to adopt technology in order to come up with technology that will suit them (Margaret and Samuel 2015)

3. Factors Affecting Adoption of Agricultural New Technologies in Ethiopia

Melesse (2018) Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia reveals that the various factors that influence technology adoption can be grouped into the following three broad categories (1) factors related to the characteristics of producers i.e., the farmers; (2) factors related to the characteristics and relative performance of the technology and (3) program and institutional factors. The factors related to the characteristics of producers include education level, experience with the activity, age, gender, level of wealth, farm size, plot characteristics, labor availability, resource endowment, risk aversion, etc. The factors related to the characteristics and performance of the technology and practices include food and cash generation functions of the product, the perception by individuals of the characteristics, complexity and performance of the innovation, its availability and that of complementary inputs, the relative profitability of its adoption compared to substitute technologies, the period of recovery of investment, local adoption patterns of the technology, the susceptibility of the technology to environmental hazards, etc. The institutional factors include availability of credit, the availability and quality of information on the technologies, accessibility of markets for products and inputs factors, the land tenure system, and the availability of adequate infrastructure, extension support, etc. Enabling policies and programs, market linkages, access to institutional support and credit were found to play a positive role in stimulating farmer investment in and adoption of sustainable technologies.

Demographic factors

Melesse (2018) Sex differential between household heads is a very important explanatory variable in studying factors of adoption. The prevailing social set up of rural households placed a varying responsibility among male and female members.

In most parts of rural Ethiopia women are disfavored groups of the society who couldn't easily access technology information. Thus, numerous adoption studies had come up with results showing being a female headed negatively influencing technology adoption decisionS.D.ue to the prevailing socio-cultural values and norms males have freedom of mobility, participate in different meetings and trainings. Consequently, those male headed households who have more access to information to use innovation than female-headed households, which have a capacity to influence by the cultural norms and traditions. The existence of wealth difference among female headed and male headed households could be also the possible reason forwarded for the difference in adoption of agricultural new technologies. Those male headed households who do have more wealth can easily afford the price of agricultural new technologies.

Age of the household head is another variable in explaining farmers' technology adoption behavior which plays an important role through influencing farmers' information access and shaping their ability to change the available information into action. Older farmers may have experience and resource that would allow them more possibilities for trying a new technology. On the other hand, younger farmers are more likely to adopt new technology because they have had more schooling than the older generation. Different agricultural technology adoption studies revealed conflicting results on the influence of age in adoption. Some of the findings confirmed that age negatively influencing adoption behavior of farmers. On the other hand, other agricultural technology adoption studies by other researchers indicated that age positively affected adoption. But, the reviewer supports the argument if age has a negative relationship with adoption of agricultural new technologies. When we see the adoption category of farmers in adoption of agricultural new technology, younger farmers categorized under the first category and they are characterized as innovative which enables them to make decision on adoption of agricultural new technologies. In addition, the reason probably due to their exposure to access to information than older farmers.

Socio-Economic factors

Melesse (2018) Education status of the household head is the most common and important variable that is found to explain farmers' agricultural technology adoption behavior. Various studies confirmed that it has a significant positive influence on adoption of technologies. For instance, Mahadi et al. studied factors affecting adoption of improved sorghum varieties in Somali Region of Ethiopia. They have found out that more educated farmers are more likely to adopt improved sorghum varieties in the study area. This finding is in line with other results. In other studies, Shiferaw et al. household head's level of education was found to enhance awareness and decision-making, which was likely to increase the probability of adoption of SWC practices. Educated household heads may have enhanced practical awareness and understanding of an erosion problem and apply measures to control it rather than considering erosion as a curse. I strongly agree that education has positive and significant relationship with the adoption of agricultural technology. This is due to education has the power to change the knowledge, skill and attitude of farmers. It also enhances the analytical and problem-solving skills of farmers. In addition, Education enhances a locative ability of decision makers by enabling them to think critically and use information sources efficiently. Farmers with more education should be aware of more sources of information, and more efficient in evaluating and interpreting information about new agricultural technologies than those with less education. That is why I agree those farmers who have better education status have higher probability to adopt agricultural new technology than those we do not have.

Many studies conducted in different parts of Ethiopia showed that farm land, livestock holding and access to different productive assets have been affecting food security status of rural households in Ethiopia. Availability and amount of family labor plays a vital role in determining adoption and intensity of use of agricultural technologies. The existence of active work force in rural households usually encourages them to show interest in trying some agricultural technologies. Off course, the influence of labor availability on adoption depends on the characteristics of the technology to be adopted. When the new technologies in relative to the

older ones are more attractive and labor intensive, farmers with more labor would tend to adopt those technologies. Some new technologies are relatively labor saving and others are labor using. For example, when a technology is labor saving like tractors, harvesters, pesticides and the like, its impact will be negative. For those labor-using technologies, like improved varieties of seeds and fertilizer labor availability plays significant role in adoption. Plenty of adoption studies found out a positive impact of family labor on technology adoption such as Solomon et al. [13]. The reviewer argues that higher family labors increase the probability to adopt agricultural new technologies. Most of Ethiopian farmers have not used labor saving technologies like tractors, harvesters in their production system. They depend on labor-using technologies and this agricultural new technology require human resource from sowing to the final harvesting of the crop.

The impact of farm size on adoption and intensity of use agricultural technologies on the other hand, is not consistently similar in various adoption studies. Some of the studies showed a positive influence of the variable on adoption decision. For instance, studied determinants of adoption and intensity of use of improved Maize varieties in the Central Highlands of Ethiopia and found a significant positive effect. The farm size has positive relationship with adoption of agricultural new technologies this is because most of Ethiopian farmers have grown different varieties of crops in turn requires larger farm size. In addition, most of Ethiopian farmers involved in mixed farming (crop and animal production). According to different off-farm income is expected to provide farmers with liquid capital for purchasing productivity enhancing inputs such as improved seed and fertilizers. In another study conducted by Ibrahim et al. annual income of the respondent had a significant positive relationship with the adoption of recommended technologies in Bangladesh i.e., the higher the annual income of the respondents, the more they adopted recommended technologies. The influence of annual gross income was robust in our analysis and statistically significant in the adoption of teff, maize, wheat, barley and sorghum technology package.

Institutional factors

Melesse (2018) Institutional factors deal with the extent or degree to which institutions impact on technology adoption by smallholders. Institutions include all the services to agricultural development, such as finance, insurance and information dissemination. They also include facilities and mechanisms that enhance farmers' access to productive inputs and product markets. Extension service is a very crucial institutional factor that differentiates adoption status among farmers. In the existing situation much of agricultural technology delivery is undertaken by the extension system. Access to participate in training, demonstration, field day and other extensions services therefore creates the platform for acquisition of the relevant information that promotes technology adoption. Several studies have used different variable to measure farmers' access to extension services. A study conducted in four regions of Ethiopia show that farmers who had more frequent contact with extension agents were more likely to adopt wheat technology as compared to farmers who had low frequent contact. Similar study conducted by Mahdi has also found a negative influence of distance from farmers' residence to DAs office on technology adoption. Another important measure of extension is farmers' experience in extension service. Farmers' experience with agricultural extension is expected to increase their demand for yield. The introduction of new technologies creates demand for information useful in making decisions. Therefore, agricultural extension organizations supply useful information about new agricultural technologies. Access to such sources of information can be crucial in adoption of improved varieties.

Market distance of the respondents is important for the producers to get attractive market price through reduction of transportation cost. The increase in market distance make farmers to get out-dates market information and becoming out of adopting agricultural new technologies. The market pulled technology adoption. The negative relationship between distance of the residence from an all-weather road and fertilizer adoption was reported by other studieS.D.ecreasing the distance from the market decreased the transportation cost of agricultural inputs. Hence market distance and use of inorganic fertilizer had a negative relationship. Access to credit service is the source of finance for the medium and lower income households

to buy inputs for agricultural production. In Ethiopia, the credit service given in kind and cash form especially credit services delivered for agricultural production system. Different Authors conformed that farmers who have access to credit service had more probability to adopt the agricultural new technologies than otherwise.

After studying different case of adoption, continue adoption and discontinuity of adoption we came to conclude that same factors are responsible for adoption and disadoption of technology. In most of the cases the factors the most responsible factor for the adoption of the technology was found to be extension service, where extension service was a key factor for the adoption of new innovations or technology. Other factors were level of education of household head, size of the farm holding, involvement in farmer's group or co-operative, distance from market or distance from urban area, cost of input, household wealth, family size, experience, training attended and minor factors were found to be gender of respondent, transportation facility, insurance scheme, number of male or female in family, area occupied by technology, geography, fertilizer use, attitude etc. Some of the factors that were responsible for discontinuity of technology were pessimistic attitude, poor extension services, improper feedback provision, non- marketability and lack of input availability.

Agricultural Extension Situation in Lao PDR

Description of the Lao Extension Approach (Tienne 2007)

The rationale for a consolidated approach to extension

The Government's policy on agricultural and forestry extension is spelled out in the 'Strategic Vision for the Agriculture Sector', 1999. The following extracts are taken from that document:

- The demand for services will be farmer-driven

- There will be supportive institutional restructuring to enhance the capacity of MAF to supply direct services to farmers in an integrated multi-disciplinary manner. The approach will be "bottom up", wherein farmers identify problems through the existing village participatory mechanism".

- This approach emphasizes: (i) encouraging farming communities to express their problem; (ii) helping the communities to participate in finding solutions to their problems; and (iii) giving communities the opportunity to gain access to the resources to solve their problems".

The Government's commitment to reforming the extension system was reiterated in the National Growth and Poverty Eradication Strategy (NGPES, 2004). The NGPES priorities for the Agriculture and Forestry Sectors include:

- Fully decentralized "bottom-up" participatory planning

- Strengthen the overall capacity of the Provincial and District Agricultural and Forestry Offices (PAFOs and DAFOs), especially the latter

- Develop an integrated extension system to transfer agricultural production technologies to the poor people and upgrade the capacity of NAFES, particularly for upland areas

- Ensure that research (NAFRI) and extension services (NAFES) are demand driven

The NGPES also contains a gender strategy that includes:

- Affirmative action concerning staffing of provincial and district staff, including extension workers and Gender focal points in villages to promote improved agricultural practices

Finally, the NGPES strategy for environmental conservation includes the following:

- Strengthen participation, especially by the poor, in the preparation and implementation of national and local plans, policies and strategies, and Co-manage environmental services and resources with the poor through strengthening community management of environmental resources.

The Challenge for Future Extension

The future system for agricultural and forestry extension in Lao PDR should be based on the policies of the Government and take account of the lessons that have been learnt from past experience. The problems that were created by the

previous centralised and sectoral approach should not be repeated. The roles and responsibilities of MAF, which are continuous and nationwide in scope, should be combined with the positive features of successful projects that have been supported by a number of different donors. The challenge is to establish an extension system that is decentralised, participatory, pluralistic and sustainable. The system should serve the interests of all farmers: men and women, from all ethnic groups, in all areas of the country.

The Government is committed to meeting this challenge, while also being cognizant of the difficulties that are involved. The difficulties that need to be overcome include:

- Lack of detailed guidelines on the operations of the extension system.
- Limited knowledge and experience of extension staff in providing the type of service that is required.
- Insufficient financial and material resources available to the extension organisation when compared to the scale of the roles and responsibilities it must perform.
- Weak coordination among organisations and projects involved in the planning and implementation of extension activities.
- The Ministry of Agricultural and Forestry is currently undertaking a number of steps to overcome these problems, with support from a number of international donors, e.g. UN Food and Agriculture Organisation (FAO), World Bank, Asian Development Bank (ADB), Swiss, Swedish and Japanese Governments.

Principles of the Lao PDR Extension Strategy

The Lao Extension Approach is built on a set of ideas about how farmers learn to solve their problems and what is the most effective way of supporting them in this process. These principles are as follows:

Decentralisation encompasses a number of related ideas. Primarily, the decentralisation of extension means a farmer-driven service, with local ownership of the learning and problem-solving process. Secondarily, decentralisation means that the technical content of extension activities is based on local constraints and

opportunities. Thirdly, decentralisation means that Government assistance to farmers is planned from the bottom-up, with District staff responding to needs that have been identified at the village level, Provincial staff supporting the efforts of the Districts and a small team at Central level coordinating and supervising.

Pluralism is an inevitable consequence of decentralisation. Pluralism means that different types of extension activities will take place in different places, and these activities will change from year to year. There will be different participants, different methods and different content. This is the opposite of standardisation. The term pluralism also recognises that the extension system encompasses the efforts of more than one organisation. Although MAF plays a leading role in agriculture and forestry extension, other government organisations, foreign projects and the private sector can make an important contribution.

Participation is an essential ingredient of local ownership. The concept is often misunderstood because there are different types of participation. Farmers can be passive participants in extension, for example by listening to a lecture, and they can be active participants, for example by getting involved in a practical demonstration. In both of these cases it is possible that the extension activity has been planned and organised by somebody else. The new farmer–driven extension system in Lao PDR is based on the idea of interactive participation, which involves farmers and village authorities taking a prominent role in analysing their problems and deciding how to address them.

Needs-based extension occurs as a consequence of interactive participation. If farmers are involved in planning, the outcome will be extension activities that are based on local needs. Real problems are likely to be the focus of farmers' analysis, and they will be seeking practical solutions. Consequently, many extension activities will follow an 'experiential' approach, meaning that they start with an examination of actual experience. This in contrast to extension that is target-based, and which follows a didactic approach, meaning that it starts with the transfer of generalised information.

Integration is important because farmers' needs encompass many different sectors. As part of a pluralistic needs-based system, extension activities address a

wide range of issues. In any single village, there could be farmers who are interested in rice intensification, vegetable marketing, irrigation management, erosion control, livestock diseases, and bamboo production. Consequently, extension workers at the District level are being retrained so that they can respond to farmers needs in a multidisciplinary manner.

Gender-sensitivity is seen as an essential feature of an equitable and effective extension system. Men and women play different roles in agricultural production, and they face different constraints and opportunities in getting access to resources and services. These differences need to be considered in the planning and implementation of extension activities. Sometimes it will be useful to organise separate activities for women. Even when this is not considered necessary, extension workers should make special efforts to ensure that all sections of the community are benefiting from extension activities.

Group-based extension is another feature of an equitable and effective system. It would be unfair to support a few individual farmers, and it is impossible to support all members of each community at the same time. The key attribute of extension groups is that members have a shared interest in learning about certain topics and/or solving particular problems. In most cases, special groups will be formed for this purpose. It is possible, however, for activities to be carried out with the members of a pre-existing group. Over time, all interested farmers should have the opportunity to become members of a group.

Self-motivation models reinforce the farmer-driven approach. Farmers should join extension groups because they want to learn, not because they are paid in cash or kind. Financial or material incentives will not be provided as part of the official extension system because this undermines ownership. By joining a group, farmers will benefit in terms of improved knowledge and skills, and a consequent ability to solve problems and improve production.

Sustainability is another important consideration in the design of the extension system for the Lao PDR. In some other countries, the operations of national extension became dependent on funding from foreign projects. When those projects came to an end, the government could not afford to continue paying

for staff or activities. By adopting the principles described above, the Government of Laos hopes to avoid this problem. Foreign projects can support the creation and expansion of the extension system, but the system will be sustainable because it is decentralized, pluralistic, participatory and self-motivated.

Structure of the Extension System in Lao PDR

The extension system that is being developed in Laos consists of two parts: The Government Extension Service and the Village Extension System. The sub-components are shown in Figure 2.

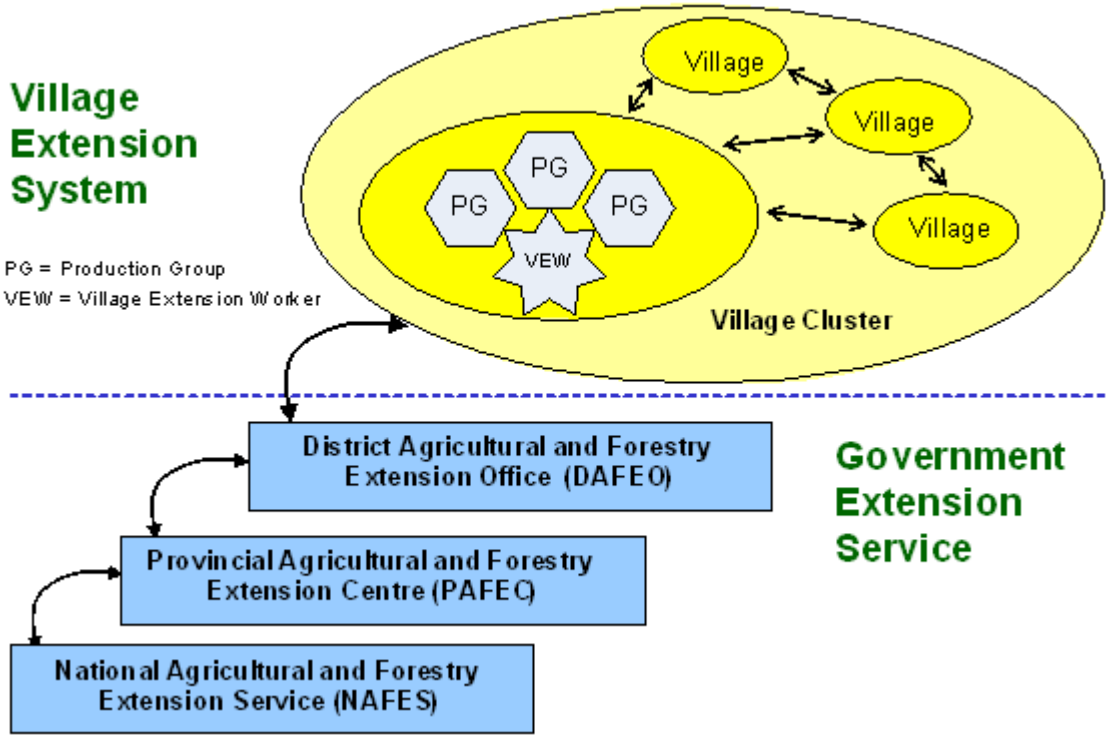

Figure 2 Structure of the Lao Extension system (Tienne 2007)

Functions of Extension Workers

The collaboration between DAFEO staff (FSEW) and the Village Extension Worker (VEW) is the main bridge between the Government Extension Service and the Village Extension System. There are important differences in the functions of these workers, as summarised in the Table 1.

Table 1 Functions of differences extension personnel in Lao

	FSEW	VEW
Status	Government employee	Community worker
Appointed by main activity	District Agricultural and Forestry Extension Office facilitating participatory planning, supporting the work of VEWS	Village Authorities; selected by the villagers facilitating learning projects by production groups, and extension to other farmers
numbers	one FSEW for 5 to 10 villages (less in pilot areas)	one or more VEW per village
Expertise	multi-disciplinary	some specialised interest and experience
Contacts	Staff from PAFEC, DAFEO staff, Village Authorities and VEWs	FSEW, Village Authorities, production groups and farmers
Payment	Fixed salary	Negotiated with community, in cash, kind or labour

Source: Tienne (2007)

In the future, the implementation of extension activities in the village will be the responsibility of farmers themselves, facilitated by the VEW and coordinated by the Village Authorities. The role of the FSEW will be to support the Village Extension System, not manage it. Currently, while the capability to implement the Village Extension System is being developed, the FSEW must take a role in initiating and guiding learning projects as a means of training VEWs.

Rice Production, Consumption, Trade and Rice Policy in Lao PDR.

Rice Production

Eric and Ponnarong (2020) report that rice is a key staple for Laos and over 60 percent of arable land is used for its cultivation. Only around 4 percent of Laos' total area is arable, which is the smallest amount of arable land of any country in Southeast Asia, due its mountainous terrain. Rice is primarily produced in the country's lowland areas with only approximately 11 percent of production taking place in highland areas. Many of the leading rice producing provinces are located along the Mekong River (e.g., Vientiane, Khammouan, Bolikhamxai, Savannakhet, Salavan, and Champasak). Average rice farms are small, averaging only around 1-2 hectares. Production can vary significantly between years but has been improving due to the adaption of higher yield varieties and increased irrigated acreage. However, almost 90 percent of rice production occurs during the wet season as only about 12 percent of the cultivated rice area is irrigated. There is no irrigated acreage in the highland area limiting the highland rice farmers' growing season to one crop per year (April-November), while some lowland rice farmers have been able to cultivate rice twice a year with irrigated farms near the Mekong River. The lowland main rice crop is usually planted in June and July and harvested from October to December. The lowland off-season crop is usually planted in December and January and harvested in April and May. Glutinous rice production makes up around 80 percent of all Lao rice production with most of the remaining production consisting of white and fragrant rice. Mechanization remains quite limited but is becoming more common in major rice producing provinces.

In 2020-2021 rice production is forecast to recover to 1.7 million metric tons assuming normal weather conditions. Laos has experienced several years of adverse weather including severe flooding in 2018 and flooding and drought in 2019. Current precipitation levels are on a normal trajectory, which could indicate rice production bouncing back to normal.

In 202020-2021 yield is forecast to be 2.89 metric tons per hectare (MT/HA). While some farmers each year use new improved seed, varieties made available

through local rice mills and the agricultural extension service, the majority of farmers use their own saved seeds. Yield is also negatively affected by lower use of inputs such as fertilizer and pesticides as well as the lower percentage of irrigated acreage. These factors not only negatively impact rice yields but also hinder rice quality. This leads to a lower milling rate than in neighboring countries such as Thailand and Vietnam. The government uses the milling rate of 60 percent, but some areas report milling rates as low as 55 percent, according to the Food and Agriculture Organization.

Rice farmers typically sell their rice directly to rice mills or middlemen. It is estimated that there are over 20,000 rice mills in Laos, but the vast majority of these are small operations with limited capacity. Several of the larger rice mills have projects to increase rice yields and rice quality in the major rice growing regions.

Rice Consumption

Eric and Ponnarong (2020) report that in 2020-2021 rice consumption is estimated to remain at 1.67 million metric tons. Rice plays an important part in the Lao diet and to Laos' food security. Laos' per capita rice consumption is among the highest in the world at around 206 kg/year, according to the World Bank. Most Lao prefer to eat glutinous rice, and almost all the glutinous rice produced in Laos is used for domestic consumption. Glutinous rice takes longer to digest than other rice varieties, which is an appreciated characteristic in a country with high rates of undernourishment. Studies suggest that per capita rice consumption is gradually declining in Laos, particularly in urban areas where the population has a higher income and a more diverse set of food options. Food use makes up the largest share of consumption in Laos. Laos does suffer from a high post-harvest loss at approximately 15 percent of the milled rice production and very little rice goes into feed, according to the Food and Agriculture Organization. In 2019-2020 rice consumption is estimated to increase slightly as Laotian migrant labor returned home from neighboring countries during the COVID-19 outbreak. Their return will offset the decreased number of tourists during the shutdown to prevent the spread of COVID-19.

Rice Trade

Post forecasts that in 2020-2021 imports should decrease to 100,000 metric tons due to increased production. In 2019-2020 imports, however, are forecast to remain high at 200,000 metric tons as domestic rice production remains unrecovered due to adverse weather conditions for the second year in a row. Trade contacts report that Lao rice production is not sufficient to meet demand, particularly for glutinous rice. Laos has been importing glutinous rice primarily from Vietnam and some from Thailand. In 2020-2021 rice exports are forecast to remain low at 80,000 metric tons due to continued reduced production. Most exports are destined for China and Thailand. Higher costs, internal regulations, and quality concerns limit Laos' rice exports.

Rice Stocks

Due to two years of poor production, private and public stocks are estimated to be well below their normal levels. Ending stocks for 2020-2021 are forecast at 150,000 metric tons, an increase of 50 percent from 2019-2020, as both the Lao government and private rice holders rebuild their stocks. Many Lao farmers store rice paddy on their own property, using it as both a source of food and a store of value. Rice millers and exporters also tend to store a 2-3-month supply of rice in stocks.

Rice Policy

As rice is critical to rural income and food security, the government regulates the value chain for rice quite closely (e.g., setting price floors for farm gate paddy rice purchases). Similarly, traders seeking to export rice must register with both the national government and the provincial government. The Lao government is currently drafting its Agricultural Development Strategy considering the new atmosphere presented by the outbreak of COVID-19. COVID-19 came after two years of troubled agricultural production in Laos due to adverse weather conditions and pest infestations, which made the Lao government rethink its current agricultural policies. The Lao government is looking to focus more on small farmers and invest in

more research and extension. The Lao government is also placing an emphasis on green and sustainable growing techniques. The government has prioritized increasing rice production and exports with the objective of increasing total paddy rice production to 5 million metric tons with 1 million metric tons of exports by 2025. The Lao government is focusing on increasing irrigated acreage and improving seed varieties to meet its goal.

Rice policy in Lao PDR.

Rice Sector Support Policies

Paavo and Nuno (2012) reports that the accomplishment of the policy objectives, consist of a number of policies in Lao PDR. These policies use different instruments and do not form one consistent rice policy but rather a number of policies and this has intricate implications for the rice sector. Moreover, the way policy instruments are related to institutional responsibilities is not straightforward as there is not an obvious coordination mechanism. We attempt to summarize the relationship between goals, objectives, policies and responsibilities.

This not intended to be comprehensive but is thought to include most of the relevant policies affecting the rice sector and the overall institutional responsibilities for them. In particular, it makes a distinction between current policies in the Lao PDR that do not require budgetary outlays and those that involve government direct expenditure (which translate into transfers from taxpayers to consumers, producers or other value chain agents). in this group also include tax concessions, as agriculture is not subject to the same level of direct taxes as other sectors of the economy. Farmers in the Lao PDR are taxed through a land tax, with agricultural land (and in particular rice land) taxed at a lower rate compared with other categories of land. However, due to the difficulties in estimating theoretical land values in order to compare rice land value with other land values, the analysis below does not focus on tax concessions. Moreover, tax does not represent a very high percentage of rice farmers' gross margins. For example, lowland rice in Vientiane province would be taxed normally at around 45,000 Kip per ha, which translates to an estimated range

of 1 to 3 percent of a farmer's gross margin (including hired labour), depending on the typology of the farmer

The policies that require budget allocations can be classified into:

1. those directly benefiting individual farmers, including:

- payments based on variable input use (seed, irrigation operations subsidies mainly electricity and subsidized credit);

- fixed capital formation (irrigation development); and

- on-farm services (extension); and

2. those benefiting agricultural producers collectively (such as research in rice seed, rice nutrient management, etc.).

Trade policy measures and national rice reserves

Overall, trade policy measures in the Lao PDR are mainly focused on managing price volatility for urban consumers in conjunction with a programme to establish a national rice reserve, which was started in 2009.

The trade policy measures impacting the rice sector include:

- Trade bans at the provincial level
- Trade bans at the central level
- Bilateral trade agreements and regional trade relations

The Lao rice reserve policy includes three components, namely:

1. the National Rice Reserve (NRR) under the responsibility of MoIC's DTD;
2. seed reserves, which is the responsibility of MAF; and
3. emergency rice distribution programmes under MLSW.

Policy Framework

There are three main policy reference documents that provide a strategic framework for the rice sector:

1. the Political Report of the 8th Party Central Committee to the 9th Party Congress in 2011;

2. the Seventh National Socio-Economic Development Plan (NSEDP) 2011–2015; and

3. the Agricultural Development Strategy (ADS) 2011–2020 with an associated Agricultural Master Plan (AMP), which provides a roadmap for the implementation of the ADS. The AMP proposes a framework of measures and interventions that various agencies would need to undertake at the national, provincial and district levels in order to achieve the 2015 goals of the ADS. The related Agricultural Investment Plan (AIP) provides the framework of financial measures associated with the AMP. As such, the AIP is a main vehicle for discussing the funding of AMP within the Government of the Lao PDR but primarily with development partners.

Rice Sector Performance

Options for Improving Rice Sector Policies

The proposed policy recommendations seek to adapt the current policy mix to meet the challenges that the rice sector faces. They include:

(1) facilitating trade,

(2) strengthening rice seed and food reserves

(3) improving the efficiency and effectiveness of public investments; and

(4) strengthening the rice seed sector.

1. Facilitate trade in paddy and rice
2. Strengthen emergency rice seed and food reserves.
3. Improve the efficiency and effectiveness of public investments
4. Take measures to strengthen the rice seed sector.

Related of Research

Rice production

Amnouay, Wiraya et al. (2020) study on rice production development model for export of Champasak province, Lao People's Democratic Republic. The findings of research were as follows: 1) The state of rice production, distribution and promotion of Champasak province was found at a moderate level. 2) The development model

consisted of knowledge in the production process developed by development of knowledge related to seeds, area preparation, planting, treatment, harvesting and postharvest management; production efficiency developed by improvement of production efficiency and seed distribution, integrate production, collaborative farming, high price rice production, production according to the conditions, cost reduction, alarm, creating a database and certification; potential of farmers developed by self-reliance, network development, creating a new generation, setting up a farmer development fund and learning center; exports developed by development of high quality rice export market, establishment of responsible department, rice product development, rice identity development, position determination in the market, Branding, reducing export barriers, reducing trade barriers and facilitating exporters; and research and development on product loss reduction, productivity, genetic utilization, prevention and elimination of pests, commercial production, value addition and establishment of a research center in the community. 3) The model assessed by experts as well as the result to be the highest level of suitability and higher level of possibility.

Abraham, Jubril O et al. (2014) study determinants of commercial production of rice in rice-producing areas of Kwara state, Nigeria. The result of the commercialization index function indicates that the household commercialization index of rice production is 62% implying that there is a gap of 38% for the farmers to attained full commercialization level. The significant factors influencing commercialization of rice production in the study area were educational level ($p<0.05$), farming experience ($p<0.01$), farm size ($p<0.01$) and use of modern technology ($p<0.05$). The study therefore recommends provision of modern inputs and education by government and development agencies as well as expansion of farm land put to cultivation of rice by farmers.

Manivong and Cramb (2020) study on from subsistence to commercial Rice

production in Laos rice farming in Laos is the least commercialised within the Lower Mekong. Moreover, Laos has suffered the most from variability in production due to the high incidence of droughts and floods. Nevertheless, as in the region as a whole, there has been a remarkable transformation of rice-based farming systems and supply chains over recent decades. These farming systems have been undergoing a transition from subsistence-based to market-oriented production. Rice production is dominated by the rainfed lowland system and is still predominantly for subsistence production of glutinous rice, with only a small proportion marketed and even less exported. However, the cultivated area and especially the yield of both rainfed and irrigated rice have been increasing, contributing to the achievement of rice self-sufficiency at the national level. Moreover, rural livelihoods have become increasingly diversified as the economy of the region develops and opportunities for off-farm and non-farm employment increase.

Asian Development Bank (2014) study on improving rice production and commercialization in Cambodia. Key findings of the report are as follows: (i) Production efficiency is constrained by the absence of domestic milling, low rates of irrigation, and uncertified farm land. (ii) Higher levels of commercialization, rice sold, and value of sales can arise from improving irrigation and domestic milling. (iii) Improvements in farm size dynamics and allocative efficiency of land, where land is reallocated from farms with lower productivity to those with higher productivity, are related to increased milling and financing. (iv) Farm size tends to increase in areas with better legal environments and decrease with greater opportunities from nonfarm activities, while farm size tends to increase in areas with better physical infrastructure. (v) Investments in irrigation are associated with increased access to extension services, enhanced input markets, availability of domestic milling and better physical infrastructure. (vi) Providing input price subsidies for nonhigh-yielding seeds and inorganic fertilizer may have positive short-run returns in production.

Nguy and Singh (2006) study on trend in rice production and export in Vietnam to learn about the reasons why rice production and export of the country is increased or decreased at specific period. With this meaning, a study on rice production trend and export in Vietnam last 40 years (from 1965 to 2004) has conducted. Compound Growth Rates (CGRs) for overall period (1965-2004), of rice area, yield and production in Vietnam were positive and significant growth at the rate of 1.34; 2.60 and 3.97 percent per annum, respectively. These were all positive and significant growth at 1 percent level of probability. The instability analysis for overall period (1965-04), showed that overall area, yield, and production were high instability as compared to each sub-period in which most high instability was found in rice production (CV= 48.13 %); followed rice yield (CV = 31.81 %) and rice area (CV = 16.28 %). The contribution in rice production was reduced by both area effect and yield effect in overall period as compared to each sub-period, and the interaction effect had increased (28.18 %). Therefore, it can be said that rice production for total period was interaction of both yield effect and area effect, which explained for one-third of contribution but more contribution was of yield effect (52.77 %), followed area effect (19.09 %). In rice export, growth rate from 1965-2004 was very high at 25.39 and 26.09 per cent per annum for export quantity, and value, respectively. These were positive and significant at 1 per cent level of probability. With the interesting findings, it can be said that for the increase in rice production in Vietnam, the most concern is to increase rice yield by the application of high yielding and quality varieties with suitable rice production technologies. Because it is difficult to increase in area due to the limitation of this factor and the area has even declined in the certain periods.

Abraham, Jubril O et al. (2014) study on determinants of commercial production of rice in rice-producing areas of Kwara state, Nigeria. The result of the commercialization index function indicates that the household commercialization

index of rice production is 62% implying that there is a gap of 38% for the farmers to attained full commercialization level. The significant factors influencing commercialization of rice production in the study area were educational level ($p<0.05$), farming experience ($p<0.01$), farm size ($p<0.01$) and use of modern technology ($p<0.05$). The study therefore recommends provision of modern inputs and education by government and development agencies as well as expansion of farm land put to cultivation of rice by farmers.

Ministry of Economy and Finance (2010) reported on policy document on promotion of paddy rice production and export of milled rice. The result relevant that though the current global milled rice market is highly protected, Cambodia is blessed with opportunity to export milled rice in the future thank to the increase in domestic paddy rice production and the potential in the world milled rice trade. So far, the performance of agriculture is outstanding especially in terms of productivity improvement and diversification, due to steadfast efforts of the Royal Government and all stakeholders including the participation of farmers. 18. In fact, high growth in agricultural sector will benefit most Cambodian people who are farmers with their living standard improved. Thus, the Royal Government is committed to promoting paddy rice production and removing all constraints to milled rice export from Cambodia. Indeed, the success of this policy will depend on actual implementation; and the task is complex and hard to achieve, yet it really requires cooperation, coordination and strong commitment especially by way of improving the leadership and management of all concerned ministries/ agencies and stakeholders. 19. The Royal Government is strongly convinced that all ministries/ agencies of the Royal Government and other stakeholders, including the private sector and development partners, and particularly Cambodian farmers across the country, will join hands in pursuing this mission to bring about development, progress, and prosperity to the Kingdom of Cambodia.

Muthayya, Sugimoto et al. (2014) study on an overview of global rice production, supply, trade, and consumption. The results show that rice is closely associated with food and nutrition security for a vast majority of populations living in the developing world. Beginning with the Green Revolution that introduced sophisticated farming technologies and new rice varieties, the world has seen record increases in rice production. However, rice remains one of the most protected food commodities in world trade. Despite the liberalization of the market structure in developing countries, global rice trade accounts for only 7% of the total production. Rice is a poor source of vitamins and minerals and further losses occur during the milling process. Populations that subsist on rice are at high risk of vitamin and mineral deficiency. Improved technologies to fortify rice have the potential to address vitamin and mineral deficiency and its associated adverse health effects in these populations. The fact that global rice production is concentrated in just 15 countries, mostly in Asia, and that the bulk of exports originates in a relatively small number of them would make it easier to implement strategies to establish facilities to fortify rice both for local consumption and export. The supply chain that runs from the farmer to the mill to the distribution warehouse may have a number of critical points where fortification of rice can be applied. With the rice industry consolidating in many countries, there may be opportunities to fortify a reasonably significant share of rice that comes from the large mills for commercial distribution or for use in large government safety net programs that target those most in need, especially women and children. Multisectoral approaches are needed for the promotion and implementation of rice fortification in countries.

Jong-Min, Eun Chong et al. (2017) study on the review of rice: production, trade, consumption, and future demand in Korea and worldwide. The result show that being a staple food for more than half of the population of the world and South Korea, rice is an important crop. For the past 20 years, global paddy rice cultivation

area and production have shown an annual growth of 0.46% and 1.61%, respectively. Global rice consumption for food and processing has increased by 1.37% and 3.68%, respectively. Due to the main reason for such increasing human population, it is expected that from 439 million tons in 2010, additional 116 million tons will be needed in 2035. Global rice imports and exports have doubled in the last 20 years. However, in spite of such increment, global rice exports in 2013 were 8.4% of the total production. It is thought that rice protection policies in the producing countries are the main reason for such small scale of rice trading. In the past 5 years, Laos recorded the largest growth rate in rice exports (51.4%), whereas China showed the largest growth rate in imports (61.0%). For global utilization of milled rice during the same period, approximately 79.4% was used as food, 7.2% as animal feeds, and 1.4% for processing. Regionally, Asia has shown a similar pattern to the global rice usage, whereas utilization for processing in America, for food in Africa, and for animal feed in Europe was relatively higher than the global rice usage. Korea's cultivation area and production since the last 5 years, are 0.5% and 0.8% of those of the world, respectively. Its annual rice export is approximately 3,000 tons, which is 0.01% of the global rice export. Korea's rice utilization is high for food and low for feed and for processing relative to global rice utilization. Therefore, a review must be conducted to increase Korea's utilization of rice for processing and for feed production.

Nay (2012) study on production and economic efficiency of farmers and millers in Myanmar rice industry. The results it was found that there is a significant variation in economic inefficiency indexes among farms in the selected area. The average inefficiency for both studied areas is about 16% means that 16 percent of total sampled farmers are trapped in economic inefficiency due to lack to access to credit, lower schooling year, poor communication with extension workers, poor socio-economic conditions, and so on. Farmers who are getting higher income from secondary crop have lower economic efficiency in rice production. Education as a

human resource indicator shows the farmers who have higher schooling year tends to decrease profit inefficiency indicating those farmers have more allocative ability in relation to perceiving and responding to changes in the market prices and market behavior. The country processes about 32 million metric tons on paddy per year. Thus, the rice milling sector is a major manufacturing sub-sector in the country. Most of the paddy is processed by hullers and medium-sized mills. The sustained growth of milling industry depends on the viability which is largely determined by the cost of production and economic and management efficiency in processing. Accordingly, this report also tries to analyze the cost and returns structure of both hullers and medium-sized mills, and discuss the related issues in Waw Township which is located in Bago division. There are 374 hullers and 9 medium-sized China made rice mills in the township. Most of the hullers are running for home consumption purposes, and medium-sized mills are operating for trading rice. The partial budget analysis reveals that huller owners have positive net profit from mill operations though they need capital to buy paddy for milling in the whole year. Required amount of money in hand to get such a sustained net profit would be about 15 million Kyats. They are milling just in the main harvesting season. For the rest of year, they just operate milling of rice farmers who store their paddy for home consumption. Thus, the quantity of paddy to be milled is very low in the rest of the year. As a result of the lack of working capital, there is a significant gap between paddy production and utilized milling capacity of hullers in the studied area. The constraint in working capital makes hullers difficulty to modernize their mills.

NANG NU NU (2017) study on Effects of agricultural policies on rice industry in Myanmar. This study has shown that the main interest of government is to monopolize in the rice marketing in both domestic and export. Furthermore, it is quite clear that government prioritized on the rice production and domestic sufficiency rather than focusing on the farmer's interest to increase their livelihood. It

was found that government intervention and monopoly take place on rice marketing throughout the period and has brought this industry to its worst state. Myanmar' s rice industry had reached the top position as number 1 rice exporter in the global market during colonial days. Nonetheless, since Socialist period, Myanmar government monopolized not only in decision making for rice marketing and but also involved in crop choice for farmers. All the rice policies that Myanmar government implemented throughout the successive regimes were mainly focused on rice production for their own political interest. Hence, it is reflective into the industry, whereby, it was use for the gain for those in power. The successive policies clearly lack of incentives for farmers to contribute in enhancing the rice production and it also had impact on rice export at the world market in terms of quality and quantity. At the same time, lacks of freedom and market mechanisms in the industry also hampered liberalizations efforts, as junta era system such as rationing system remained in place. As a consequence, the rice policies in Myanmar still needs to be improved in order to enhance the development of rice sector. But it is difficult to achieve this since Myanmar is politically driven with interest in keeping the country stable by keeping the price of the rice low in the domestic market. It is expected that it will be very difficult for Myanmar government to liberalize the rice policy and overcome these domestic challenges in future too. Historically, with regard to the rice sector Myanmar has learned a lot of lessons, however, these lessons learned from the past are not being properly put in policies. It is the author sincere hope for such study contribute in future policy making for the sector in search for the betterment of the industry as a whole. However, as of now, with the priority given to political transition happening in the country, it will take some time for such initiative to take place. And unfortunately, it can be foreseen that the rice sector would still be stagnant in years to come

SOUPHAPHONE (2012) study on an export on agriculture products in Lao PDR. This research has as a major objective to study the potential and challenges of export on agriculture products in Lao PDR and to highlight the importance role of agriculture sector that contribute to economic development in this country. How to maintain high agricultural sector growth rates and achieve good welfare and equity impacts with this growth remain important challenges for economic policy and management. Lao's productivity in the agriculture grows at a slower pace than the other sectors like mining and hydro-electricity. Unless there is a substantial improvement in the agricultural productivity, the majority of labor force would still remain in the rural sector. The problems of labor shortages and lack of technology in both urban and rural areas would hamper Lao's export competitiveness in agriculture. Exports of agricultural products are the key for the survival of the sector. Agricultural sector must be linked to processed food industry to add more value added and create linkage between rural and urban sectors. Most of process food exports firms have to continue upgrading their quality and food-safety standards. Only firms that have dynamics schemes of quality improving can survive in the new round of competition in the world markets. The role of government is crucial providing investment in infrastructure and agricultural research to make sure that farm productivity can be enhanced continuously. At the same time policies generating growth in the agricultural sector may not be enough to support agricultural export. To this end, the government needs to play more attention on great potential agriculture products like rice, coffee, maize, green tea, fruit and vegetable in term of quality and quantity in 45 order to meet demand of the market and the minimum requirement of the international standard. The government need to develop their policy and encourage the farmers participate in farming these crops as well as processing industry.

Alice, Aileen et al. (2011) study on Opportunities for expanding paddy rice production in Laos: spatial predictive modeling using Random Forest. They proposed to reduce upland rice cultivation and to expand the area under paddy rice. Were used Random Forest, a classification and decision-tree-based method, to characterize the areas currently under paddy cultivation, and to predict which areas are suitable for paddy. Topographic variables and accessibility to villages and roads were the most important predictors for the presence of paddy cultivation. There appears to be much land available that is suitable for expanding paddy areas in central and southern Laos but not in the north, where more than 40% of the rice area is on sloping land, and much less area is suitable. We conclude that expanding paddy-based rice production will be difficult in most parts of northern Laos.

Sengsourivong and Ichihashi (2019) study on effectiveness of irrigation access on sticky rice productivity: Evidence from Lao PDR. This study estimates the impact of irrigation on household sticky rice productivity in Lao People' s Democratic Republic (Lao PDR) by applying propensity score matching (PSM) and the difference-in-differences (DID) method. This paper utilizes panel data from the Lao Expenditure and Consumption Survey (LECS) from 2003 to 2013. The results show that the average sales value and total production of sticky rice for irrigated households is greater than those for non-irrigated households by around 36 to 38% per season. Moreover, irrigated households experience improved sticky rice productivity of approximately 2. 44 tons per hectare, per season, compared to non-irrigated households. In particular, compared to households with access to irrigation in one period of the surveys, households with access to irrigation in two periods of the surveys have nearly double the sticky rice productivity. Therefore, long-term access to irrigation is more effective for sticky rice productivity. However, we cannot find any evidence to support the impact of irrigation on household consumption. Some policy implications that can be derived from this research are that farmers should be

intensively promoted to make the most use of irrigation, development of irrigation system is highly needed, and to ensure effectiveness of irrigation utilization local farmer involvement in monitoring procedure of irrigation is necessary.

Onphanhdala (2009) study on Farmer Education and Rice Production in Lao PDR. The findings from this study showed that the role of farmers' education is quantitatively important in determining the agricultural performance. The estimated rates of return to schooling for both the upland and the lowland farming are relatively high by international levels. Particularly, the rates of return to primary education are very high. The principal policy implications of the results presented in this study pertain to the potential social and economic benefits of improving education, particularly in rural areas. Adult literacy campaigns equal to a completion of primary educational attainment would generate directly the improvements in well-being in the near future. Indirectly, public investment in education may also be helpful in stabilizing shifting cultivation, diversifying the agricultural sector and maintaining a sustainable use of forest products. Up to now, large amount of public investment has been spending on the expansion of irrigation facilities. However, the findings in this study showed that the effect of access to irrigation is obviously low. Thus, policy makers should focus on promoting and/ or subsidizing such as free access, soft and long-term loan to the uses of new high-yield seeds, productive assets and chemical inputs, for the marked Farmer Education and Rice Production in Lao PDR 119 differences between the upland and lowland farming system of the country.

World Bank Group (2018) study on Commercialization of Rice and Vegetables Value Chains in Lao PDR: Status and Prospects. The study finds that Lao farmers receive a relatively high farm-gate price, yet high production costs "eat" their profits (rather than low farm-gate prices, as often perceived in the country). However, the share of farm-gate prices in wholesale and retail prices in Lao PDR is the lowest

among its peers. This dampens farm supply responses. In addition, the issues holding back the rice sector in Lao PDR pertain to: (i) low productivity and quality management at the farm and immediate postfarm levels; (ii) a fragmented milling sector dominated by small operators with old technology; (iii) an overall market system that fails to provide incentives for product quality; and (iv) the lack of a significant consumer class with high purchasing power that could foster consolidation of wholesale and retail sectors and reduce their costs. In summary, the high cost of paddy production and operational inefficiencies among multiple players in the value chain are responsible for high consumer rice prices. These constraints are largely structural and require public action aimed at: (i) facilitating value chain linkages between farmers and millers; (ii) enhancing access to finance of farmers and millers; and (iii) improving the quantity and quality of public services delivery, while increasing focus on those areas critical to reduce production costs and commercialize the agriculture sector; e.g., seed, applied research, mechanization, cooperatives/ farm clusters, and good agricultural practices. While regulatory or administrative barriers were not found to currently play a major role in directly inflating the cost structure of either the rice or vegetables value chain, the report finds that cumbersome regulations limit entry, affect market structure, and reduce competition. Recent efforts by Lao authorities to encourage private sector investment in value chains, promote contract farming, and limit the use of distortive trade instruments (such as export or cross-provincial bans/roadblocks for movement of rice) seem to have generated some progress. Yet room still exists for regulatory improvements. Lowering regulatory costs for businesses, strengthening enforcement of contracts and product labelling, and removing price regulations for paddy and rice would increase private sector investment, competition, and incentives for efficiency improvements, and further reduce costs along both value chains.

Alexander, Case et al. (2017) study on commercialising smallholder agricultural production in Lao People's Democratic Republic. This article employs the Agriculture Innovation System (AIS) framework to report on empirical findings from six case studies of Lao smallholder production. It identifies the actors, organisations, and institutions involved in systemic commercialisation of subsistence farming and articulates patterns of interactions that contribute to the relative success of the transition. Of the factors identified in the case studies, the most important enablers of commercial production and adoption of innovative technologies were technical and financial assistance, access to markets, and the formation of farmer associations/ organisations.

Setboonsarng, Leung et al. (2008) study on rice contract farming in Lao PDR: Moving from subsistence to commercial agriculture. The results of the empirical analysis support the claim that contract farming is an effective tool to increase the incomes of smallholder farmers in rural areas where market failure is prevalent. The findings show that the sampled contract rice farmers cultivated higher yielding, improved rice varieties and earned higher incomes than non-contract rice farmers under similar agro-ecosystem and socioeconomic conditions. The sampled contract farmers have better access to inputs and credit and an assured market for their produce, which enables them to earn higher profits. The evidence also suggests that contract farmers are more likely to diversify production into other commercial crops or livestock, leading to increased incomes and more secure livelihoods. The contract arrangement thus appears to be effective in facilitating the transition of small farmers from subsistence to commercial production. The role of extending new technology to improve the productivity of the agricultural sector is traditionally performed by the public sector. Moving the vast number of subsistence farmers toward commercial production, however, requires enormous public sector resources that are generally unavailable in transition economies such as the Lao PDR. This study shows that

promoting contract farming arrangements to draw FDI into the rural sector has been a policy in the right direction. Through contract farming, the private sector effectively extends new production technology and facilitates access to modern inputs and remote markets offering higher prices. This translates into improved incomes and an effective transformation from subsistence to commercial production with no financial burden to the public sector. Contract farming appears to be particularly appropriate for rural areas where transport infrastructure has recently been established and in transition economies where institutions to facilitate market exchange are in an early stage of development.

Agricultural extension model development

Oladimeji (2011) study on features of agricultural extension models and policy in selected sub - Saharan Africa countries. The models are direct products of the type of policy that has been adopted, the policy dictates the models to be used in each country. A major problem of organizing agricultural extension in developing countries is the absence of a legal and policy framework for providing the service. Putting in place a legal and policy framework is one basic new and indispensable way of conducting extension in the developing countries. It will help streamline the confusion currently existing in the effort to transfer agricultural knowledge to farmers, particularly in the areas of service provision, programme development and funding. In literature, the present forms of extension policy are Provisional Extension Policies, decrees and proclamation and legislated extension policies. Factors driving extension policy are population, natural resources and environment. Increasing population will demand more resources from extension in forms of skills, training, diversification of livelihoods and pressure on natural resources. The paper recommends that SSA countries adopt the legislated extension policies option for the improvement extension service delivery and reduce the contradictions in extension models.

Worth (2006) study on Agri flection: A learning model for agricultural extension in South Africa. This paper proposes the Agri flection extension model. The model arises out of fundamental changes in thinking about extension. Incorporating elements of livelihoods approaches and learning theory, Agri flection is a learning model that shifts i) the context and locus of learning, ii) what is learned, and iii) the learning process. The model fosters a culture of continuous reflective learning that is submitted as the highest purpose of extension. The model suggests that prosperity can be realised through engaging smallholder farmers in scientific discovery, innovation and technology development based not on what they lack, but on what they have.

Surudhi, Asokhan et al. (2017) study on utilization pattern of extension tools and methods by agricultural extension agents. The findings revealed that the extension functionaries frequently used the individual contact methods viz., telephone, office calls and farm and home visits in the process of transfer of technology. Least efforts were made in sending SMS based communication. Meetings were the common and frequently adopted group contact method. Demonstrations, farmer field school, farmer interest groups, field trips and farmer training programmes were moderately adopted. Posters, leaflets and pre-season campaigns were the widely adopted mass contact methods. They possess least skill in utilizing farm magazines and presenting television and radio programmes.

Ekasari, Saleh et al. (2013) study on communication pattern and conflict in agricultural extension. The results show that (i) social process among actors in agricultural extension based on social engineering is more project-oriented (dissociative), while social process in social learning-based extension tends to be cooperation-oriented due to the same interest in achieving goal of programs, especially skill and knowledge improvement (associative), (ii) communication in social engineering-based extension is a linier pattern (top down), while communication in

social learning-based extension is using a convergent (participatory) pattern, (iii) conflict in agricultural extension based on social engineering is generally latent (hidden) and will eventually explode and impede extension, impacting group unsolidarity, while in extension based on social learning, conflict generally are on the surface (manifest), and the accommodation is one way to solve. A major implication of these findings is the stepping up of agricultural extension (based on social learning process) which becomes a push factor towards independency group in finding new innovation. The research suggests that social learning-based extension should be developed as a potential way to sustain an important role of extension in agricultural and rural development.

Pornthai (2014) study on the model development of farmer adaptation sustainable of Songkhla Basin Area. The finding of this research demonstrates that the model development of farmer adaptation sustainable of songkhla basin area. named " SELF MANAGE MODEL" which consists of 10 major significant performances; 1) self-sufficiency, 2) enterprise group, 3) learning procedure, 4) flexible adaptation, 5) marketing, 6) agricultural diversity, 7) networks, 8) added value, 8) added value, 9) government extension, and 10) environmental conservation. Additionally, this model evaluation is expertized at excellent level and certified by public hearing.

Agricultural extension

Zoogah and Nakuja (2020) study on modernizing extension services to improve rice productivity: Lessons from Ghana's planting for food and jobs program. The results showed that farmers who benefitted from the modernized extension service were more productive than the non-beneficiary farmers. Specifically, average yield of modernized

Gideon, Dennis et al. (2018) study on agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. The study found

positive economic gains from participating in the ACDEP agricultural extension programmes. Apart from the primary variable of interest (ACDEP agricultural extension programme), socio-economic, institutional and farm-specific variables were estimated to significantly affect farmers' farm income depending on the estimation technique used. Conclusions: The study has reaffirmed the critical role of extension programmes in enhancing farm productivity and household income. It is, therefore, recommended that agricultural extension service delivery should be boosted through timely recruitment, periodic training of agents and provision of adequate logistics

Patcha, Somsri et al. (2017) study on agricultural extension services to foster production sustainability for food and cultural security of glutinous rice farmers in Vietnam. This paper was found that most glutinous rice farmers were small-scale producers, with an average glutinous rice-growing area of 0.15 ha and a yield of 3,200 kg per ha. Local as well as breeding varieties of seeds were supplied. Most farming households had sufficient glutinous rice for regular food and cultural consumption. Other starchy products were also consumed as part of their traditional diets. Supporting extension services were found to be very active and comprehensive, playing a key role in fostering the sustainable production of glutinous rice and helping to ensure local food and cultural security in Vietnam

THANASACK (2012) study the role of agricultural extension services on rice production efficiency in Laos " A case study on Borlikhanh District, Borlikhamxai Province". The results of this research indicated the variables on Labour, seed and machinery were positive and significant at 5% and had effect on rice production. Agricultural extension services, educational attainment and improved rice seed variety were negative and statistically significant at 1% in the technical inefficiency model. The mean of technical efficiency was 53% Based on results, some policy implications are in order. The quality of agricultural extension services should be improved especially, dealing with how effectively to reduce the risk of outbreaks of

pest and diseases as well as the merits of adopting improved rice seed varieties. Moreover, an increase of the number of farm visits and 26% of surveyed farmers still do not have an access to extension services should be considered.

Lyndon and Bates (2015) study effects of extension services on the technical efficiency of rice farmers in Albay. The results of the study reveal that beneficiaries have higher input utilization, yield and technical efficiency than non-beneficiaries. Furthermore, the amount of seed and fertilizer significantly and positively affects the yield of rice. In addition, the number of trainings and seminars attended, number of information, education and communication (IEC) materials availed, and distance of farms to FITS center are the significant determinants of technical inefficiency. The problems encountered in rice production are the occurrences of typhoons and floods, high cost of inputs, insufficient capital, pest infestation and limited knowledge of new farming technologies. It is recommended that non-beneficiaries be encouraged to participate in FITS program and form farmers' association, irrigators' association or cooperative, as well as monitor the performance of farmer beneficiaries

Wutinun, Sineenuch et al. (2015) study on extension pattern development for GAP rice production in upper northeastern, Thailand. Meanwhile, the typical rice farmers had a major obstacle of expensive fertilizers. The conclusion indicated that the government agencies shall have a clear policy to promote ongoing publicity, and increase the budget supporting on up - to - date technology equipment and tools adequately. In addition, the government agencies should also cooperate with private sectors to improve and encourage the separation between good quality rice markets and the other normal ones; to promote the higher GAP rice pricing than the general rice.

Rovic and Vasko (2017) the results of the research show that the agricultural extension service in Bosnia and Herzegovina has gone through three stages and three

different models of extension service development: Technology Transfer Model, The Farm Management Model and The Rural Extension Model. Taking into consideration the problems and weaknesses that were identified some recommendations were made to improve the Bosnia and Herzegovina Agricultural Extension Service performance.

Feder and Anderson (2004) study on agricultural extension: Good intentions and hard realities. The result show that agricultural extension can play an important role in development. The public goods character of much extension work underpins the extensive public investment in extension services. But although public extension organizations are common in developing economies, they are often inadequately funded and their effectiveness is limited by many administrative and design deficiencies and challenges.

Zivkovic, Jelic et al. (2009) study on agricultural extension service in the function of rural development. The results show that agriculture and agricultural extension service are facing numerous problems in present times when good solutions are not easy to find. Providing of agricultural extension service is important foreign-political instrument of a state which has stimulates the development of agricultural production. Agricultural extension service must provide effective link between holdings-producers, agricultural research and other sources of information. Agricultural extension agents must be aware of psycho-social and social aspects of group action and individual counselling. Therefore, one of priorities in agricultural development of our country is rising of the level of extension operation and establishment of extension service based on modern principles.

Adoption of agricultural extension

Donkor, Enoch Owusu et al. (2016) study impact of agricultural extension service on adoption of chemical fertilizer: Implications for rice productivity and

development in Ghana. The findings show that access to extension services significantly promotes adoption of chemical fertilizer. Access to extension services and adoption of chemical fertilizer exert positive influences on rice productivity. Promoting farmer participation in irrigation schemes and row-planting technologies, facilitating easy access to education and credit facilities, sensitization of female farmers and leasing of farmlands are policy alternatives needed to facilitate adoption of chemical fertilizer and access to extension services, with the goal of enhancing rice productivity and the livelihoods of rice farmers in sub-Saharan Africa. Governments and various institutions in Africa should train more extension officers, given the significant impact they have on agricultural technology adoption and productivity. Future studies on adoption of agricultural technologies and access to extension services in developing countries should adopt empirical approaches that account for endogeneity and selectivity effect in order to arrive at the precise magnitude and extent of impacts from productive agricultural technologies and interventions.

Ranjan, Ngai Weng et al. (2013) study on development of indicators for sustainable rice farming in Bangladesh: A case study with participative multi-stakeholder involvement. The paper concludes that by employing a true participatory approach indicator development collectively decisive to extract an essential and representative set of indicators. Moreover, the study indicates the more significance of social indicators in promoting rice farming sustainability is Bangladesh. We highlight sustainability indicator development is a fairly demanding and challenging process. However, a blend with stakeholder' s knowledge and local experience enhances the questions of indicator's applicability and practicability.

Samuel A (2020) study on rice commercialization and improved agricultural technology adoption in northern Ghana: The findings indicate that commercialization does enhance the adoption of IATs and is driven by factors such as: off-farm activities, rice output, sex, household headship, farm size, credit, commercial center

location. The probability of adopting IATs was also influenced by age, experience, mass media information sources, and home-to-farm distance. Stakeholders should target the youth and step up efforts in supporting flagship programmes such as the "Planting for Food and Jobs" and Planting for Export", while supporting livelihood diversification programmes.

Shamsudeen, Abraham et al. (2018) study on adoption of rice cultivation technologies and its effect on technical efficiency in Sagnarigu District of Ghana. This result of this study found that Farm size, fertilizer, weedicides and household labour had positive and significant effect on rice output. Farmers who adopted the rice cultivation techniques were less technically inefficient than those who did not adopt. The ATT was 0.121 which implies that farmers who adopted the rice technologies increased their technical efficiency by about 12% and this was significant at 10% for the PSM with similar results obtained for the nearest neighbour matching. The ATE value of 0.102 which was also statistically significant at 10% means that farmers on the whole increased their technical efficiency by 10.2% . Moreover, the mean technical efficiency estimates for adopters and non-adopters were about 58% and 48% respectively under regression adjustment and inverse-probability weights. The existence of a technical efficiency gap of 10% between adopters and non-adopters of rice technologies emphasized the significant effect of technology adoption on farmer's technical efficiency. The study recommends that more rice farmers should be encouraged to adopt the rice production technologies in order to improve their technical efficiency levels.

Mustapha, Undiandeye et al. (2012) study on analysis of adoption of improved rice production technologies in Jeer local government area of Borno state, Nigeria. The study result revealed that majority (56.25%) of the respondents was aware of the rice production technologies in the study area. Majority of the respondents tried rice production technologies with respect to high yielding varieties

(77.50%), early maturing varieties (69.37%), use of weedicides (93.75%), broadcasting method (55.00%), manual harvesting (75.00%) and bagging (63.75%). The study revealed that unavailability of fertilizer was the major (96.25%) constraint affecting the adoption of rice production technologies by respondents. The study recommends that extension services should be strengthened with necessary inputs for improved adoption of rice production technologies by respondents.

Awotide, Karimov et al. (2016) study on agricultural technology adoption, commercialization and smallholder rice farmers' welfare in rural Nigeria. The variables that positively and significantly influenced the intensity of IRVs adoption include income from rice production, membership of a farmers' organization, and the distance to the nearest sources of seed, cost of seed, yield and level of training. Gender of household head, access to improved seed, years of formal education, and average rice yield were those variables that are positive and statistically significant in increasing the probability that a farmer would participate in the market. The result further suggests that any increase in the farmers' welfare is conditional on the probability of the farmer participating in the rice output markets. In addition, higher yield, income from rice production, gender of household head, and years of formal education are the variables that are positive and statistically significant in determining households' welfare. Therefore, it is recommended that formation of associations among the rural farmers should be encouraged. Access to seed and information about the IRVs are also essential to increase the intensity of its adoption. Programmes to improve contact with extension agents, increased access to credit, raising educational background and increasing the area devoted to cultivating IRVs are the factors to be promoted in order to increase market participation and hence improve the welfare of rural households.

Onyeneke (2017) study on determinants of adoption of improved technologies in rice production in Imo state, Nigeria. The result obtained shows that

73.33, 67.41, 78.52, 86.67 and 45.4% of the rice farmers adopted improved rice varieties, use of agrochemicals, fertilizer application, optimum seed rate, and mechanical harvesting, respectively. Farmers' socioeconomic factors such as age, income, cooperative membership, household size, level of education, farm size and number of contacts with extension agents affected adoption. These key factors need to be taken into consideration when expanded program on technology adoption is to be considered.

Factors influencing farmers adoption

Abubakar, Garba et al. (2019) study on Factors influencing adoption of rice improved production practices by farmers in adopted villages, Niger state, Nigeria. The results of a 3-point perception rating scale (Likert ratio) indicated that method-cum-result demonstration, farmers' participation in On-Farm Adaptive Research (OFAR) trials, Management Training Plot (MTP) and use of contact farmers were the very effective extension delivery methods. The results of binary logit regression model revealed farmers' training and extension contact as highly significant ($P \leq 0.01$) factors influencing adoption of the rice production practices, while the household size, land owned and years of farming experience were significant at 5% level of probability. The study therefore concluded that extension delivery methods were effective; farmers' adoption decision was influenced by range of factors, and therefore, these should be focused by research and extension organizations for policy formulation and development of extension strategies for technology delivery.

Srisompun, Athipanyakul et al. (2019) study on the adoption of mechanization, labour productivity and household income: Evidence from rice production in Thailand. The study found that the average rice planting workforce and labour productivity have an inverse relationship with planted area, while large farms have the highest ratio for machine labour to workforce. The rice yield, labour usage

and labour productivity of the farmers varied by mechanization level (ML) and farm size while different levels of Machinery Owned labour (MO) have no effect on rice yield. Therefore, there are three main suggestions: 1) performing land consolidations, since applying a production strategy with large rice paddies may increase labour productivity and the net profit of rice famers; 2) improving the quality of machinery for use in rice production in Thailand, especially the performance of the machinery to prevent losses during harvest; and 3) increasing the mechanization level to 50-75%, which could also increase labour productivity and net returns.

Waritsara and Kamon (2020) study on the farming promotion approaches of local Chaiya native rice in Chaiya district, Surathani Province, Thailand. The results found that the factors affecting the planting of Chaiya native rice; namely knowledge, production costs, production factor, market demand, government support, area conditions, values of farmers, production and the product price. As for the guidelines to promote Chaiya native rice varieties, namely supporting research and development of Chaiya native rice varieties, supporting knowledge and necessary production factors as appropriate, promoting management throughout the supply chain, promoting integration and networking, including creating heirs for farmers, creating awareness and public relations and promoting GI products.

Literature Reviews Summary

From the literature reviews of preliminary documents in terms of concepts, theories and research results related the farmers adoption of commercial rice production. It is found that there are many factors affect to decision and supporting of the farmer operation that included personal the factors such as gender, age, status, educational level, and knowledge about commercial rice production; economic factors were included household labor, supplementary occupation, farming size, family income, farming cost, amount of credit; and social factors: farming experience, contacted with agricultural staffs, participated on agricultural training/educational trip, number of perception of agricultural information, number of contacted with neighbors on agricultural production, group membership, and also government policy such as provide ongoing training to educate officers on rice quality, share exchange knowledge among provincial officers, organize study visit in rice quality certified farmer cultivation, provide training to the farmers on the importance of rice commodity standards promotion for rice; and learning support of good quality rice farming. These variables will affect whether the technology is adopted sooner or later, depending on the farmer and suitability to the local environment of the farmer's production. There are also other relevant factors such as the factor of the innovation that there is a difficulty of easy to use and at what level is the farmer's suitability for production areas.

Therefore, if knowing the factors affecting the adoption of commercial rice production of the farmers in Savannakhet Province, Lao PDR, it’s would allow the agricultural extension staff to use various information from this research to develop an extension model for commercial rice production in the future and also to enable farmers to plan rice production according to the needs of consumers that tend to increase every year.

Conceptual Framework

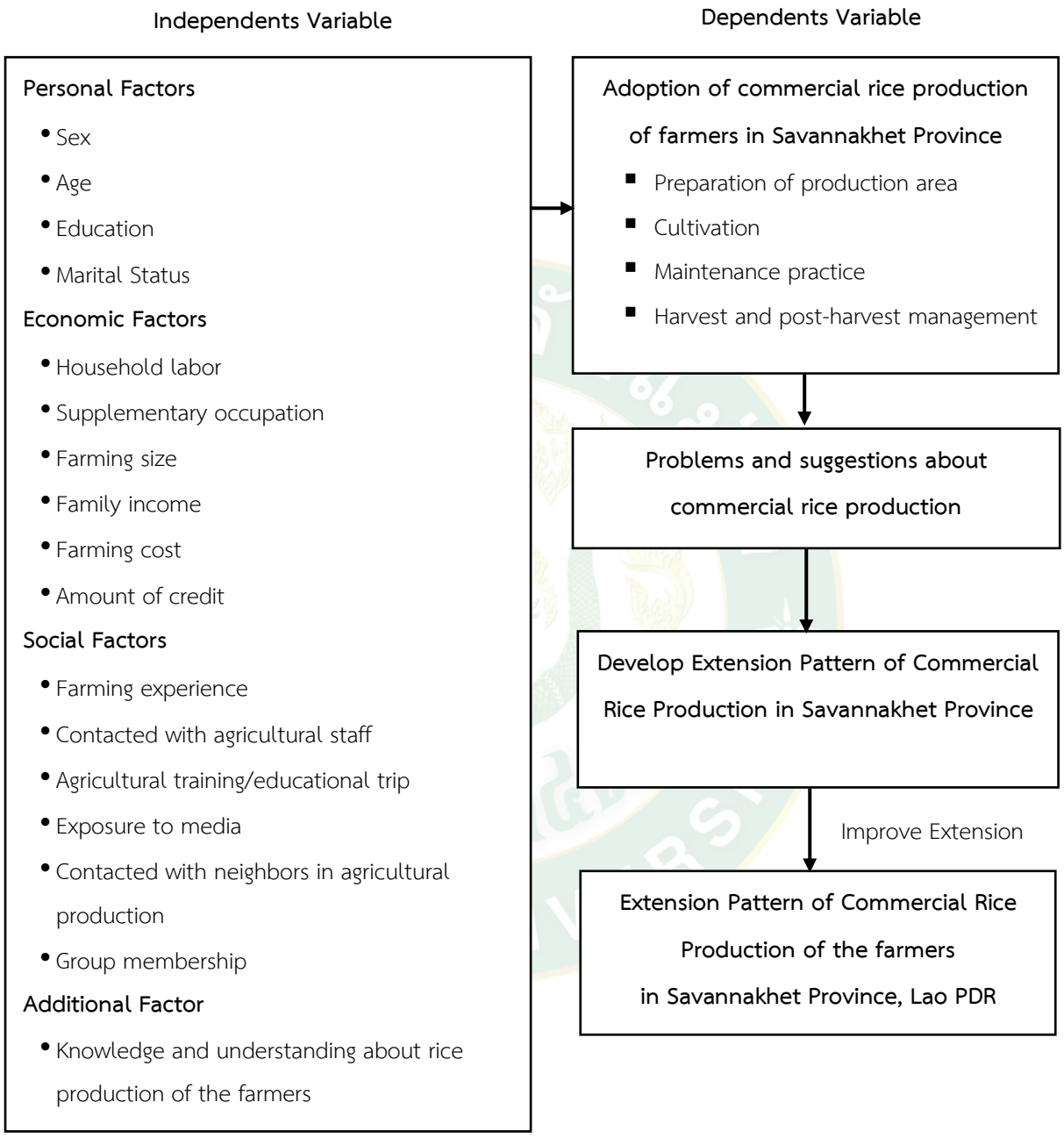

Figure 3 The Conceptual Framework of Study

Hypothesis of the research

Base on the research conceptual framework, study of theoretical concepts and related researches results. The hypothesis of this study was the adoption of commercial rice production of farmers in Savannakhet Province, Lao PDR depends on the currently of personal, economic, and social factors of the farmers are affecting the adoption of commercial rice production.

Chapter 3

Research Methodology

The extension pattern development for commercial rice production of the farmers in Savannakhet province, Lao People's Democratic Republic. In this study mixed method was used. Interview schedule and focus group was used as tool for data collection from the target group. Obtained data was used for further analysis. This chapter presents a description of:

Research location

This research was conducted in 6 districts of Savannakhet Province, Lao PDR. These districts have project to encourages farmers to produce commercial rice in Savannakhet province; and is a district where rice is grown rice for commodity that is most suitable along with the support from the government and government projects to promote the rice planting for commodity in the past.

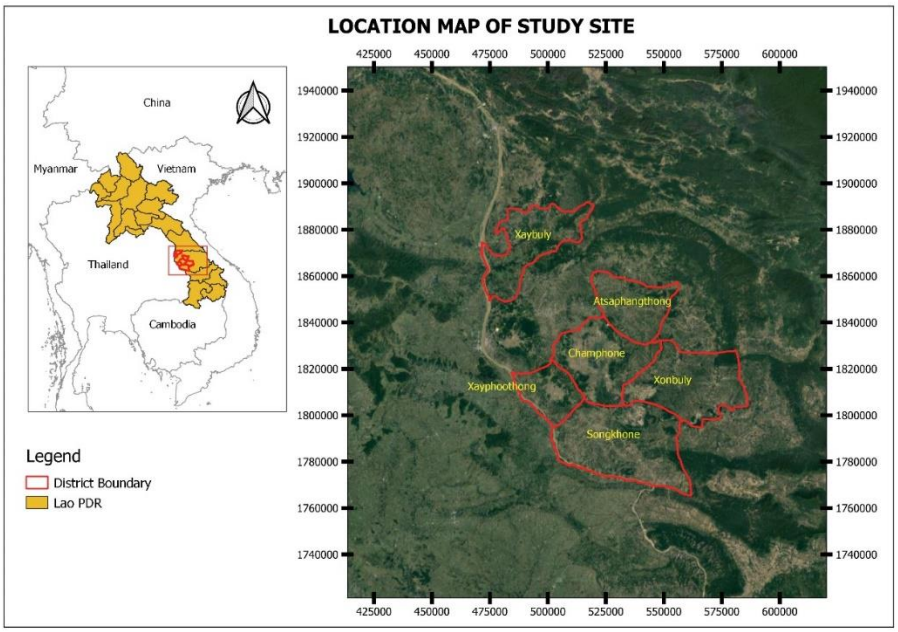

Figure 4 Show the location map of study site

Source: Department of Agricultural Land Management (2019)

Population and Sample

Phase 1: study the status of commercial rice production and study the adoption level of commercial rice production. The population of rice farmers in 13 villages, 6 districts, Savannakhet province was considering as follows:

Step 1: Calculate the sample size by using a calculation method from the formula (Taro Yamane, 1973) at a confidence level of 95% and a tolerance of 0.05 to determine the size of the sample from the farmers who participate of the commercial rice production project in 13 villages, 6 districts, Savannakhet province, a total of 317 farmers:

$$n = \frac{N}{1 + N(e^2)}$$

Where: n Sample size

N Total population

e random discrepancy at (0.05)

Then will get

$$n = \frac{317}{1 + 317(0.05^2)}$$

$$= 177 \textit{ Samples}$$

Step 2: Calculate the sample size from farmers in 13 villages. The total sample was 177 samples, randomly selected from the total number of farmers who have participated of the commercial rice production project in 13 villages, 317 farmerS.D.ue to the population in each village is not equal. Therefore, it is necessary to find the proportion of the sample size by using the formula of (Kanlaya 2005)

$$n_i = \frac{nN_i}{N}$$

Where: n Sample size

N Total population

N_i Population in each village

n_i Random sample size in each village

Table 2 Population and sample size

No.	District	Village	Population	Sample
1	Xaybouly	Hatxaisoung	27	15
2	Xaybouly	Kangpa-Phonthan	25	14
3	Xaybouly	Buengxe	27	15
4	Champhone	Phalaeng	24	13
5	Champhone	Thouad	25	14
6	Songkhone	Dongsawang	25	14
7	Songkhone	Nongdeune	25	14
8	Xonnabouly	Thakhamleum	25	14
9	Xonnabouly	Kongpathoumvanh	25	14
10	Xonnabouly	Xienghom	25	14
11	Atsaphangthong	Pongna	11	6
12	Xayphouthong	Mouangkhai	28	16
13	Xayphouthong	Khanthachan	25	14
	Total		**317**	**177**

Source: The Climate-Friendly Agribusiness Value Chains Sector Project (2022)

The number of samples in each village was anlayzed by a simple random sampling method, which brought the house numbers to draw lots. so that rice farmers have equal chances to be randomly interviewed.

Phase 2: Developing an extension pattern of commercial rice production. Focus group was used for data collection by invited representatives of rice farmers who participated on commercial rice production project, one farmer per village; agricultural extension staff who responsible for rice extension at district and province levels. A total of 21 participants were developed an extension pattern of commercial rice production.

Instrumentation for data collecting

Development procedures and instrument selection

Procedure development and / or instrument selection tools were use; questionnaires and interviews. The questionnaires and interviews were planned and scheduled. The researcher has used data forms survey for this research

One-on-one interviews are a form of survey data collection. In one-on-one interviewing in survey research, investigators conducted an interview with an individual in the sample and record responses to closed-ended questions. (Creswell 2008)

Thus, the instrument design for data collection, open-and closed-end questions for basic information, structure with rating scale was used in this study. (Likert Scale) (Barnett 1991)

The questionnaires consist of 4 parts as follows:

Part 1 Personal, economic and social factors of the farmers

Part 2 Knowledge about commercial rice production

Part 3 The levels of adoption of commercial rice production of the farmers.

Part 4 Problems and suggestions of commercial rice production of the farmers.

Focus group part

The second part of this study were analyzed of qualitative data. This was created by using focus group discussions with 21 participants. Below are concerning issues:

1. What media have an effect on the adoption of commercial rice production? Why?

2. Based on the concept of the commercial rice production, have can we adopt it to our daily live activities?

3. How can we practice the principle of self-reliance? What aspect (s) can you practice?

4. Are basic factors in agricultural livelihood (expenses) reduction, an increase of incomes, opportunity expansion) related to the concept of the commercial rice production? How?

5. The adoption of the commercial rice production must have sufficiency in various aspects, e.g. economic, social, and spiritual aspects). What is your opinion about it? What things have you been practicing?

Research instrument development

1. Research instrument development:

2. Review literatures related to the research title to study methods, theories and research summaries, in order to be used in conceptual framework.

3. Determine scope and research questions in concordant with the conceptual framework and objective of the research.

4. Present the instrument that is conducted, to the dissertation advisory committee for examination and comment, and improves the instrument as suggested from the dissertation advisory committee.

Details of research instrument

Instrument used in this research is mainly a questionnaire which consists of 3 parts as follows:

Part 1: Personal, economic, and social factors of farmer, consists of 18 items such as gender, age, education, marital status, knowledge about commercial rice production, number of members in household, number of labor in household, supplementary occupation, farming size, family income, farming cost, amount of credit, farming experience, contact with agricultural staff, participated on agricultural training or educational trip, exposure to media, contact with neighbors in agricultural production, and group membership, which is the close-ended questions with multiple choices and open-ended questions with fill-in blank.

Part 2: Questions regarding level of the adoption of the commercial rice production

Questions regarding the adoption of the commercial rice production consist of 4 aspects (46 items) such as adoption of production area preparation (6 items), adoption of cultivation (20 items), adoption of maintenance practices (10 items), adoption of harvesting and post-harvest management (10 items).

Those questions apply a multiple choice of level of the attitude of the adoption of the commercial rice production, which are 5 levels (adopted from Likert's scale), how much farmer take of the adoption of the commercial rice production as follows:

1 = No adoption
2 = Low adoption
3 = Moderate adoption
4 = High adoption
5 = Highest adoption

Research instrument testing

For the quality of research instrument, the researcher checked the instrument consist of content validity and reliability such as:

Content validity

In order to check whether the questionnaire that is conducted is able to measure as expected and cover the scope, the researcher submit it to dissertation advisory committees for their consideration to check for the content validity.

Testing the validity of the research instrument to test content validity and construct validity in the interview form. The researcher creating the test was consider whether the questions are measured according to the research purpose or not. If they are sure that the research instrument "valid" they were marked +1 in the table. If they are sure that the questions are "not valid" they were put - 1 in the table; and if they not sure whether it is "valid or not" they were put 0 in the table. When checked, take the obtained score to find the Index of Consistency (IOC). Then the

improvement can be made as the advisory committee has instructed before testing it in an actual field.

$$IOC = \frac{\sum R}{N}$$

Where: IOC is Index of consistency

$\sum R$ is sum of score from expertise

N is number of expertise

If the Index of consistency value is 0.5 or more, it is considered that the question meets the objective. which from testing questions related to knowledge questions related to attitude Including questions related to farmers' adoption of commercial rice production. Then the analysis of the consistency index was between 0.67 - 1.0, which is considered accurate in terms of content and structure and can be tested with a sample group.

Reliability

The questionnaire that is already approved by the thesis advisory committees shall test with farmer who have shared similar characteristic, but not the target population 30 samples, and find out reliability of the questionnaire by using Alpha Coefficient in pursuant of the method of Cronbach (1951) referred by Edward G. C. and Richard A. Z. (1979: 44) by using SPSS for windows. The results of the comparative analysis of all 46 acceptance questions, which received a total alpha of 0.97, were allowed to be used with real samples.

Reliability test by using the interview form obtained from expertise. It was then tested with farmers who participated on the commercial rice production. which were farmers with similar qualifications to the actual sample size, numbering 30 people. Then they were analyzed to find reliability in the questions that were tests of knowledge, attitude, and level of adoption using the method of finding the alpha coefficient according to the model of Cronbach (1970) with the calculation formula as follows:

$$\alpha = \frac{N}{N-1}\left[1 - \frac{\sum S_i^2}{S_t^2}\right]$$

Where α mean alpha coefficient

N mean number of questions

$\sum S_i^2$ mean sum of the variances for each question

S_t^2 mean total variance score

Data collection

Data sources

In this research, the researcher has collected the data from 2 major sources as follows:

1. Primary data is acquired by asking 314 farmers in 13 villages, 6 districts of Savannakhet Province by questionnaire.

2. Primary data is acquired by focus group 21 participants in Savannakhet Province by questionnaire.

3. Secondary data is acquired from academic papers including as well as websites of related organizations to use as supporting data and compare the research result.

Data collecting method

This research has stipulated farmer as a unit of analysis, totaling 314 farmers. Personal interview of farmer was primarily be conducted by the researcher while some parts were carried out by the assistant. However, the researcher has deliberately brought all questions in the questionnaire into the assistant's focus before actually collecting the data. The data collection was conducted from January to March, 2023.

Data collection Procedures

In order to obtain data of the adoption of commercial rice production of farmer to improve the communication processes necessary and possibly lacking among farming communities that would lead to increased quality of life.

This research uses the method of primary and secondary data.

Primary data: has been done by using the one-on-one interviews schedule.

1.1 Preparing a letter from the Faculty of agriculture and environment, Savannakhet University to request for a favour on the assessment to the locale of the study and data collection to the District office of Agriculture and forestry.

1.2 The obtained sample groups were appointed for the interview which has be done by the coordination of the local staff.

1.3 Doing data collection by using the interview schedule, the sample groups must be understood on the purposes of the study and the obtained data provided by the sample groups keep it confidentially particularly on personal data.

Secondary data This is done by collecting data from related documents and various Media in the following aspects:

2.1 Database on statistical value such as household farmers, districts, village which will have already prepared.

2.2 Data on locale of the study which can be collected from the District's agriculture and forestry office (DAFO). The data included agricultural careers and other concerned factors.

2.3 Information retrieval on information technology related to internet network and websites both in the Thai and foreign languages. It also included data used in the review of related literature.

Data Analysis

This research is a correlational research design to answer the objectives of this study as follows:

1. Objective 1st: For analysis the personal, economic, and social factors of the farmers in Savannakhet Province, Lao PDR was used descriptive statistics: frequency, mean, max, min, percentage, and standard deviation.

For find out the levels of knowledge about commercial rice production of the farmers were used descriptive statistics (frequency, mean, percentage) for an analysis knowledge of the respondents, which the respondent who answers "Yes" to the question is equivalent to 1 point. On the other hand, if the respondent who answers "No" to the question is equivalent to 0 point.

2. Objective 2sd.: For analysis the level of farmers adoption **-** find out levels of the adoption of the commercial rice production of the farmers by using the weight mean score will use to measure levels of the adoption of the commercial rice production by comparing with the following criteria.

Average	**Description**
1.00 - 1.49	No adoption
1.50 - 2.49	Low level of adoption
2.50 - 3.49	Moderate level of adoption
3.50 - 4.49	High level of adoption
4.50 - 5.00	Highest level of adoption

3. Objective 3rd: For analyze the relationship between elements of the personal, economic, and social factors**,** and the adoption level of the commercial rice production of the farmers, the researcher applied multiple regression analysis.

4. Objective 4th: To develop an extension pattern of commercial rice production. The content analysis is a descriptive research technique that will be used. The content of the message or document It has three main characteristics: systematic use of quantitative methods and focus on objectivity and based on the theoretical framework.

Chapter 4

Research Results

The results of the study on pattern development of commercial rice production in Savannakhet province, Lao PDR were presented into 5 parts as follows:

Part 1: Personal, economic, and social factors of the rice farmers in Savannakhet province and their knowledge about commercial rice production.

Part 2: Adoption level of commercial rice production of the rice farmers

Part 3: Factors affecting the rice farmers adoption about commercial rice production

Part 4: Problems encountered and suggestions for commercial rice production

Part 5: Commercial rice production pattern development in Savannakhet Province.

Part 1: Personal, economic, and social factors of the rice farmers in Savannakhet province and their knowledge about commercial rice production.

Personal factors of the respondents

Sex

Most of the respondents were male (70.1%), only 29.9% were female (Table 3). According to results of the study, however, most male farmers were responsible to agricultural activities such as soil preparation, fertilizer application, rice yield transportation/selling. Meanwhile, female farmers were mainly responsible to cooking and home chores.

Age

An average age of the respondents was 50.75 years, the lowest was 25 and the highest was 76 years old. However, age range of most of respondents was 31 -40 years old (35.6%), 51-60 years old (25.4%), more than 60 years old (20.3%) and below 30 years old (18.6%). In other words, they were grown responsible adults and had accumulated knowledge experience. Therefore, they had an opportunity to fully

apply their knowledge and experience in their commercial rice production. These rice farmers did not encourage their children to engage in farming because it was a hard work without wealth and prestige in the Lao society. In the case of career shifting, it was not easy due to inadequate knowledge, experience and skills.

Marital Status

It was found that almost all of the respondents were married (92.1%), only 2.3% were single and the rest were divorced and widowed. It could be assumed that those who were married usually had an idea to have a stable and happy family. Traditionally, married people in Lao were socially accepted in term of life security.

Education Attainment

More than one-half of the respondents (52.5%) were elementary school graduates. This was followed by lower secondary school (37.3%), upper secondary school (7.9%), higher vocational certificate (1.7%) and bachelor's degree (0.6%), respectively (Table 3). It was due to the fact that the Lao government encouraged it's people to at least complete compulsory education. Most people in Lao PDR rarely pursued their study in higher education because it needed a big sum of money for schooling.

Table 3 Personal factors of the respondents

(n=177)

Personal factors	N	%
Sex		
Male	124	70.1
Female	53	29.9
Age (year)		
≤30	33	18.6
31-40	63	35.6
51-60	45	25.4
>60	36	20.3
$\bar{X}$ = 50.75 Min-Max = 25 - 76 S.D. = 10.97		
Marital Status		
Married	163	92.1
Widowed/Divorced	10	5.6
Single	4	2.3
Education Attainment		
Elementary school and below	93	52.5
Lower secondary school	66	37.3
Upper secondary school	14	7.9
Higher vocational certificate	3	1.7
Bachelor's degree and above	1	0.6

Economic factors of the respondents

Number of household members

The respondents had 7.12 household members on average, the lowest was 1 and the highest was 19. However, most of them had 6-10 household members (53.1%), followed by 5 and below (31.6%), 10 - 15 household members (11.3%), only 4.0% had more than 15 household members (Table 3). It could be observed that most of the respondents had a lot of household members. This might be because

they could help do farming as household labors so it needed not to hire more labors for farming.

Number of household labors

The respondents had 4.20 household labors on average, the lowest was 1 and the highest was 9. However, most of the respondents had 3-4 household labors (37.9%) and followed by 2 household labors and below (25.4%), 5-6 household labors (20.9%), only 15.8 percent had more than 6 household labors. This implied that most of the respondents were extended families. However, most of their children were students and had not available time to help them during the rice growing and harvest season. Hence, the respondents needed to employ some more labors.

Supplementary Occupation

Most of the respondents had supplementary occupation - gardeners (67.2%). This was followed by farmers (17.5%), workers (3.9%), officers (3.4%) and sellers (7.9%), respectively. All of them needed to generate supplementary income for household expenses since the cost of living was very high.

Farming Size

The respondents had 1.5 hectares on average. The lowest was 0.5 and the highest was 6. However, more than one-half of the respondents had 1 hectare farming area and below (50.3%) and followed by 1.1 - 2.0 hectares (37.9%), 2.1 - 3 hectares (9.6%), only 2.3 percent had more than 3 hectares. This implied that most of the respondents were moderate farming land. However, the majority of land acquisitions are inherited from ancestors or from generation to generation, which resulting in a steadily decreasing agricultural area. In addition, the current increase in population causing the area to expand for living, industrial factory expansion causing agricultural production areas to be encroached.

Family income

It was found that the respondents had an average income for 18,940 baht per month, the lowest was 1,786 baht and the highest was 211,429 baht. However, most of the respondents had a family income range of 10,001 - 20,000 baht (39.5%) and followed by 10,000 baht and below (28.8%), 20,001 - 30,000 baht (17.5%), 40,001 -

50,000 baht (10.2%), only 6.2 percent had more than 50,000 baht. (Table 4). It was assumed that the incomes of the farmers differed greatly between the lowest and highest income. The income of each household depends on the farming size, management method, number and type of crops planted such as rice farm, fruit trees, vegetables and animals; and income from other trades as well, or farmers who grow a variety of vegetables and manage their produce every week have the opportunity to make a more profit.

Farming Cost

It was found that the respondents had an average farming costs for 10,541 baht per year, the lowest was 3,570 baht and the highest was 171,429 baht. However, most of the respondents had a farming cost range of 5,001 - 10,000 baht (41.2%). This was followed by 10,001 - 15,000 baht (24.3%), below 10,001 baht (22.6%), more than 20,000 baht (6.2%), only 5.6 percent had 15,001 - 20,000 baht farming cost. (Table 4). It was observed that almost all of respondents did not grow rice in a big place of land.

Amount of Credit

More than one-halt of the respondents had an amount of credit which was 5,000 baht and below. However, an average amount of credit of all of the respondents was 7,406 baht, the lowest was less than 5,000 baht and the highest was more than 20,000 baht. More than one-halt of the respondents did not want to have debts so they relied on their own savings from agricultural yield selling. In contrast, some of the respondents got a loan from a bank or the village fund.

Source of credit

Almost all of the respondents (90.4%) spent their own capital for commercial rice production 90.4 percent, few of them used the service of a bank (8.5%) and the village fund (1.1%).

Table 4 Economic factors of the respondents

(n=177)

Economic factors	N	%
Number of household members (people)		
≤5	56	31.6
6-10	94	53.1
10-15	20	11.3
>15	7	4.0
$\bar{X}$ = 7.12 Min-Max = 1-19 S.D. = 2.94		
Number of household labor (people)		
≤2	45	25.4
3 - 4	67	37.9
5 - 6	37	20.9
>6	28	15.8
$\bar{X}$ = 4.20 Min-Max = 1-9 S.D. = 2.00		
Farming size (Ha)		
≤1	89	50.3
1.1 - 2.0	67	37.9
2.1 - 3.0	17	9.6
>3	4	2.3
$\bar{X}$ = 1.50 Min-Max = 0.5 - 6 S.D. = 0.77		
Supplementary occupation		
Farmer	31	17.5
Gardener	119	67.2
Officer	6	3.4
Seller	14	7.9
Worker	7	3.9
Family income (Baht per year)		
≤10,000	51	28.8
10,001 - 20,000	70	39.5

Table 4 (Continued)

(n=177)

Economic factors	N	%
20,001 - 40,000	31	17.5
40,001 - 50,000	18	10.2
>50,000	7	4.0
$\bar{X}$ = 18,940 Min-Max = 1,786 - 211,429 S.D. = 19,847		
Farming cost (baht)		
≤5,000	40	22.6
5,001 - 10,000	73	41.2
10,001 - 15,000	43	24.3
15,001 - 20,000	10	5.6
>20,000	11	6.2
$\bar{X}$ = 10,541 Min-Max = 3,570 - 171,429 S.D. = 13,934		
Amount of credit		
≤5,000	95	53.7
5,001 - 10,000	42	23.7
10,001 - 15,000	11	6.2
15,001 - 20,000	17	9.6
>20,000	12	6.8
$\bar{X}$ = 7,406 Min-Max = 862 - 43,103 S.D. = 7,506		
Source of credit		
Their Own	160	90.4
Bank	15	8.5
Village Fund	2	1.1

Social factors of the respondents

Farming Experience

As a whole, the respondents had 30 years of experience in farming, the lowest was 1o years and the highest was 60 years. However, most of them had 21 - 30 years of experience in farming (32.8%). Only 11.9 percent had more than 40 years of experience in farming (Table 5). Almost all of the respondents accumulated experience in farming. They analyzed the production situation to determine which type of crops or animals to be domesticate for an increased income.

Agricultural extension staff contact

More than one - halt of the respondents (59.9%) had never contacted agricultural extension staff. That was 34.4 percent contacted them twice and below, only 0.6 percent did it for more than 4 times. This was due to many factors such as the target villages were located far from the office of agricultural extension and difficulty in travelling.

Agricultural training and educational trip

About one-half of the respondents (49.7%) had never attended an agricultural training or educational trip. Most of the respondents attended it twice and below (40.7%). In other words, this denoted that they had no available time due to many factors such as poor public relations, remote village, infrequent training, etc.

Exposure to media

Almost all of the respondents had exposure to media (96.0%), only 4 percent had not. Most of them perceived agricultural news or information through media for 5 times and below (41.2%). Only 11.9 percent did it for 11 - 15 times (Table 5). This implied that a number of times the respondents perceived agricultural news or information was still at a low level. It was found that they perceived news or information about productional area management, seed management, weed control and management, pests and plant diseases.

Neighbor contact about agricultural production

About three-fourths of the respondents (75.1%) did not contact their neighbors about agricultural production. Only 10.7 percent contacted their neighbor twice and only 1.8 percent did it for more than three times (Table 5). This might be

because the farmers these still lacked of knowledge and understanding about commercial rice production. Therefore, there were very few meetings or discussions about this matter. Instead, they preferred to talk with their neighbors about general daily life activities.

Group membership

Most of the respondents were only a group member (71.1%). Only 2.3 percent were members of 3 social groups. It could be said that social/occupational group membership helps the respondents or other farmers to poor their scare economic resources together to help themselves in their farming. There was a positive correlation between social group, adoption of technology crop productivity, food security and income. However, participation in social group networks on the adoption of commercial rice production.

Table 5 Social factors of the respondents

(n=177)

Social factors	N	%
Farming experience (year)		
<20	47	26.6
21-30	58	32.8
31-40	51	28.8
>40	21	11.9
$\bar{X}$ = 30 Min-Max = 10 - 60 S.D. = 10.87		
Agricultural extension staff contact (time)		
not contacted	106	59.9
contacted (time)	71	41.1
≤2	61	34.4
3-4	9	5.1
>4	1	0.6
$\bar{X}$ = 0.56 Min - Max = 1 - 5 S.D. = 0.89		

Table 5 (Continued)

(n=177)

Social factors	N	%
Agricultural training and educational trip		
not participated	88	49.7
participated	89	51.3
≤2	72	40.7
3-4	16	9.0
>4	1	0.6
$\bar{x}$ = 0.82 Min-Max = 1 - 5 S.D. = 1.05		
Exposure to media (time)		
Never	7	4.0
Received	170	96.0
≤5	63	41.2
6 - 10	42	23.7
11-15	21	11.9
>15	34	19.2
$\bar{x}$ = 9.25 Min-Max = 2 - 35 S.D. = 7.43		
Neighbors contact about agricultural production		
Never	133	75.1
Contacted	44	24.9
1	15	8.5
2	19	10.7
3	7	4.0
>3	3	1.8
$\bar{x}$ = 0.50 Min-Max = 0 - 7 S.D. = 1.06		
Group membership		
1 group	126	71.1
2 groups	34	19.2
3 groups	13	7.3
>3 groups	4	2.3

Knowledge of the farmers about commercial rice production

As a whole, it was found that the respondents had a moderate level of knowledge about commercial rice production (Score 13.74), the lowest was 3 and the highest was 19. In other words, most of the respondents (72.3%) had a moderate level of the knowledge, only 0.6 percent was found to have a low level (Table 6).

Table 6 Levels of knowledge of the farmers about commercial rice Production

Knowledge level	N	%
Low	1	0.6
Moderate	128	72.3
High	48	27.1
$\bar{x}$ = 13.74 Min-Max = 3 - 19 S.D. = 2.43		

Remarks: 15 - 21 = High, 8 - 14 = Moderate, 0 - 7 = Low

Based on its detail, it was found that the respondents who answered the questions correctly for 85 - 100 percent base on 13 question items. That was, the question item number 13 was answered correctly most (transplanting should use 3 - 5 seedlings per clump with 97.1%). This was followed by the question items number 7 and 11 (Soaking the seeds in clean water for about 24 hours and cover it with a hemp sack or damp cloth in a well-ventilated place for about 48 hours, and the paddy field use for cultivation should has water about 5-10 cm. in depth - 98.5%).

The following question items were answered correctly by the respondents of less than 60 percent: to get high yields, the water level must not be more than 50 cm. in depth (58.1%), soil suitable rice growing rice must be fertile with a pH value of 5.5 - 6.5 (56.2%); the first plow to destroy weeds should be 15 - 20 cm. in depth and soil turning should be about 1- 2 weeks (19.8%); when the rice stalks have grown for about 2 weeks, the water must be removed from the paddy field to be ready for harvest (49.8%); and good rice grain storage and dry should be on upland to prevent flood; the shed must be covered with a roof to prevent sunlight rain and dew (51.4%)

Table 7 Question items answered by the respondents

(n=177)

Question items about good practice of commercial rice production	Incorrect answer	Correct answer
	No. of persons (%)	No. of persons (%)
1. To get high yield, the water level must not be more than 50 cm. in depth	74 (41.9)	103 (58.1)
2. Soil suitable for growing rice must fertile with a pH value of 5.5 - 6.5	78 (43.8)	99 (56.2)
3. The first plow to destroy the weeds be 15-20 cm in depth and soil turning the should be about 1-2 weeks.	142 (80.2)	35 (19.8)
4. Plowing should be done again for 1-2 times for weeding	45 (25.2)	132 (74.8)
5. There were not weed seeds and insect contamination	9 (5.1)	168 (94.9)
6. Good seeds should germinate at least 80 percent.	8 (4.5)	169 (95.5)
7. Soaking the seeds in clean water for about 24 hours and covering the it with a hemp sack or damp cloth for about 48 hours	6 (3.2)	171 (96.8)
8. 50 - 80 kg of seeds per rai for seedlings.	10 (5.4)	167 (94.6)
9. Fertilizer containing nitrogen and phosphorus should be applied to seedlings first and wooden boards are used to spread the fertilizer	10 (5.8)	167 (94.2)
10. 25 - 30 days old age of seedlings is suitable for transplanting	8 (4.5)	169 (95.5)
11. The paddy field used for cultivation should have water about 5 - 10 cm. in depth.	6 (3.2)	171 (96.8)

Table 7 (Continued)

(n=177)

Question items about good practice of commercial rice production	Incorrect answer	Correct answer
	No. of persons (%)	No. of persons (%)
12. To gain high rice productivity, the distance between the clumps is 20 cm and between rows is 25 cm.	11 (6.1)	166 (93.9)
13. 3-5 seedlings per clump should be used for transplanting	5 (2.9)	172 (97.1)
14. When the rice is 3 months old, or before pregnancy, apply 15-15-15 fertilizer at the rate of 120 kg/ha	8 (4.8)	169 (95.2)
15. Pruning rice leaves will encourage good tillering. Consistent rice growing together with ears of rice can increase yields up to 12%	50 (28.4)	127 (71.6)
16. When the rice stalks have grown for about 2 weeks, the water must be removed from the rice field to be ready for harvest.	89 (50.2)	88 (49.8)
17. Flowering occurs when the rice is about 90 days old.	80 (45)	97 (55)
18. A plot survey is done every week, keeping wees away and prevention of mixed rice varieties	8 (4.5)	169 (95.5)
19. The rice must be dried for about 1-2 weeks after harvest to control moisture content of not exceeding 15% before selling.	14 (7.7)	163 (92.3)
20. The rice to be collected must be clean and free from contaminants such as straw, weeds, soil, sand, etc.	7 (4.2)	170 (95.8)

Table 7 (Continued)

(n=177)

Question items about good practice of commercial rice production	Incorrect answer	Correct answer
	No. of persons (%)	No. of persons (%)
21. Good rice storage and dry should be on clean upland to prevent flood, the shed must be completely closed and covered with a roof to prevent sunlight, rain and dew.	86 (48.6)	91 (51.4)
$\bar{x}$ = 16.75 Min - Max = 8-21	S.D. = 1.58	

Part 2: The adoption of commercial rice production of the farmers in Savannakhet, Lao PDR.

According to the results of the study, as a whole, it was found that the respondents had a high level of commercial rice adoption ($\bar{x}$ = 4.15). based on its detail, preparation of production area ($\bar{x}$ = 4.68) and cultivation ($\bar{x}$ = 4.54) were found at the highest level. However, harvest and post-harvest management ($\bar{x}$ = 3.78) and maintenance practice ($\bar{x}$ = 3.61) were found at a high level (Table 8)

Table 8 Adoption of commercial rice production level

(n=177)

Adoption of commercial rice production	$\bar{x}$	S.D.	Description
1. Preparation of production area	4.68	.47	Highest
2. Cultivation	4.54	.42	Highest
3. Maintenance practices	3.61	.54	High
4. Harvest and post-harvest management	3.78	.58	High
On average	**4.15**	**.31**	**High**

Remarks: 4.51 - 5.00 = Highest level of adoption, 3.51 - 4.50 = High level of adoption, 2.51- 3.50 = Moderate level of adoption, 1.51 - 2.50 = Low level of adoption, 1.00 - 1.50 = No adoption

1. Famers Adoption of commercial rice production based on preparation of production area

As a whole, the respondents adopted commercial rice production based on preparation of production area at a highest level ($\bar{x}$ = 4.68). based on its detail, all of the following were also found at highest level: the rice production area is flat without flood throughout the year ($\bar{x}$ = 4.60); the rice production area is cleaned before planting in every step ($\bar{x}$ = 4.67); tractor is used for the plowing ($\bar{x}$ = 4.71); plowing is done when there is water in the rice field and it is left for 2-4 weeks ($\bar{x}$ = 4.69); the rice production area is prepared based on rice field maintenance, weeding

and taking care of seedlings ($\bar{x}$ = 4.72); and the soil is plowed to the depth of 15 - 20 cm. ($\bar{x}$ = 4.61) (Table 9).

The respondents had a highest level of all aspects of the commercial rice production. This might be because the rice growing area there is plain and without flood all year round. Good practice of soil or rice field preparation is inherited from generation to generation.

2. Famers Adoption of commercial rice production based on cultivation

The showed that, as a whole, the respondents had a highest level of the adoption of commercial rice production base on cultivation ($\bar{x}$ = 4.54); based on its detail the following were found that at a highest level: last year improved seeds are used for planting rice ($\bar{x}$ = 4.77); the rice varieties are selected from seeds which growth characteristics are suitable for the planting area environment ($\bar{x}$ = 4.65); commercial rice varieties that have been planted are from the seeds that meet needs of consumers ($\bar{x}$ = 4.66); rice seeds are soaked for 8 - 12 hours and incubated to activate germination ($\bar{x}$ = 4.66); rice seeds are sown in the field prepared by manual labors ($\bar{x}$ = 4.73); water is released to make the rice field dry ($\bar{x}$ = 4.75); rice seeds that geminate well are sown evenly throughout the plot ($\bar{x}$ = 4.72); transplant is conducted when seedlings are about 25-30 days old ($\bar{x}$ = 4.66); cultivation of commercial rice by planting in rows will make it easier to eliminate diseases and insects. Also, the clumps will have an opportunity to receive nutrients and sunlight regularly ($\bar{x}$ = 4.66); commercial rice is planted by using seedlings in the paddy field ($\bar{x}$ = 4.72); commercial rice is planted during the rainy season. or in the fields where there is enough water ($\bar{x}$ = 4.72); before planting commercial rice, the seedlings are about 25-30 days old, the seedlings are been uprooted and tied together in bundles, the end of the rice leaves is cut off before transplanting ($\bar{x}$ = 4.63); there is a way to embroider by walking backward in a row in front of the board to be able to see the rows ahead already planted ($\bar{x}$ = 4.68); Rice can be transplanting by machine ($\bar{x}$ = 4.70); and for fertile soil, rice is planted rather for a part from each rice crump than those in not fertile soil to avoid inadequate sunlight receiving ($\bar{x}$ = 4.61). Only two

aspects was found at high level: Seeds are sown in the afternoon or evening to avoid strong sunlight and seed damage ($\bar{x}$ = 4.33); one day after sowing, the seeds watering is distributed throughout the plot for about 3-5 days to have much water enough ($\bar{x}$ = 4.03); when the seedlings are tall enough, water is supplied to the rice field for about 5 - 10 cm. in depth ($\bar{x}$ = 4.48). And only one aspect was found at moderate level: Rice seeds are soaked in water for 1-2 nights then the roots have sprouted, they will be sown in the plot prepared for planting seedlings ($\bar{x}$ = 2.82) (Table 9).

The results of the study showed that the respondents had highest level of the adoption of commercial rice production based on cultivation ($\bar{x}$ = 4.54), This might be due to the fact that their rice growing area is flat and not flooded, and easy to clean. In addition, the practice of rice planting areas preparation has been inherited from generation to generation. Not only this, soil preparation also included weeding which farmers could do it easily.

3. Famers Adoption of commercial rice production based on maintenance

As a whole, the famers adoption of commercial rice production- based on maintenance practices was found at a high level ($\bar{x}$ = 3.61). based on its detail, there were two aspect found at a highest level: regularly monitor the rice field at least twice a week ($\bar{x}$ = 4.66) and Manure is used in the commercial rice field ($\bar{x}$ = 4.69). Only one aspect was found at a moderate level - add fertilizers or nutrients to nourish the soil 25-30 days after planting by using fertilizer formulas 16-20-0 or 15-15-1 5 according to the amount recommended by the agricultural extension staff ($\bar{x}$ = 2.51). Only two aspects were found at a low level: some types of weeds and insect pests are prevented and eliminated by using chemicals ($\bar{x}$ = 1.79). and fertilizers are applied twice to provide enough nutrients to meet needs for rice growth ($\bar{x}$ = 2.45). In addition, the rest were found at a high level (Table 9).

In conclusion, there was a high level of the farmers adoption of commercial rice production based on maintenance (**$\bar{x}$** = 3.61). This might be because the respondents used fertilizers and soil nutrients appropriately in commercial rice production. Also, there were regulations and recommendation on use of fertilizers in

agricultural areas to improve soil fertility. Proper use of fertilizers helped produce quality and safe product. Some farmers avoided complying with the specified criteria. This might be because it was inconvenient to practice during the pre-cultivation period.

4. Famers Adoption of commercial rice production based on harvest and post-harvest management

On average, there was a high level of famers adoption of commercial rice production based on harvest and post-harvest management ($\bar{x}$ = 3.61). Based on its detail the following were found at highest level: 1) The moisture content must not exceed 15 percent before being delivered for sale. 2) Visually observe the yellow rice, both the stalks and ears, and then harvested. 3) The water is drained from the fields 7-10 days before the harvest to ensure that the rice is evenly ripe. 4) Paddy is threshed from the rice stalk by a threshing machine. 5) Explore the rice fields, If the whole rice plot is about 80% flowering, it is the flowering day, and after 28-30 days from the flowering date is the rice harvesting day with an average of 4.70; 4.67; 4.65; 4.60; and 3.56 respectively. Only one aspect was found at high level - the traditional method is used to reduce moisture like sunlight as a heat source, which is the most commonly used method by farmers ($\bar{x}$ = 3.56). Only two aspect was found at moderate level: after threshing, the rice will be dried to reduce the incidence of mold which may accelerate the deterioration of the rice grains ($\bar{x}$ = 3.19) and rice is harvested by using a combine harvester ($\bar{x}$ = 2.60). However, one more aspect was found at a low level. (Table 9).

It was observed that the respondents knew that harvest and post-harvest are not independent technique. It started with producing paddies as consistent in quality as possible when cultivating rice. The uniform quality of the paddies should not be damaged at any stage of post-harvest treatment. In particulars, responding to requests from the market side, the introduction of mechanical milling has long been advised. When utilizing milling machines, compared with manual milling, maintaining a constant paddy quality becomes much more important. It could be said that this is

the target to be achieved for increasing edible amounts of white rice and improving quality.

Table 9 Levels of Famers' Adoption of commercial rice production

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
1. Preparation of production area						**4.68**	**0.48**	**Highest**
1.1 The rice production area is flat without flood throughout the year.	116 (65)	52 (29.1)	8 (4.5)	1 (0.6)	-	4.60	0.59	Highest
1.2 The rice production area is cleaned before planting in every step	122 (68.9)	51 (28.8)	4 (2.3)	-	-	4.67	0.51	Highest
1.3 Tractor is used for the plowing	129 (72.9)	45 (25.4)	4 (2.3)	-	-	4.71	0.49	Highest
1.4 Plowing is done when there is water in the rice field and it is left for 2-4 weeks.	125 (71)	47 (26.7)	4 (2.3)	-	-	4.69	0.51	Highest
1.5 The rice production area is prepared based on rice field maintenance, weeding and taking care of seedlings	132 (130)	40 22.6)	5 (2.8)	-	-	4.72	0.5	Highest
1.6 The soil is plowed to the depth of 15 - 20 cm	130 (73.7)	40 (22.7)	3 (1.8)	3 (1.8)	-	4.68	0.61	Highest
2. Cultivation						**4.54**	**.42**	**Highest**
2.1 Last year improved seeds are used for planting rice	143 (80.8)	30 (17)	2 (1.1)	2 (1.1)	-	4.77	.54	Highest

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
2.2 The rice varieties is selected from seeds with growth characteristics suitable for the environment in the planting area. and it has high yields	124 (70.0)	49 (27.7)	4 (2.3)		-	4.65	.60	Highest
2.3 Commercial rice varieties that are used for planting are very resistan to rice diseases and insects	129 (73)	47 (26.4)	1 (0.6)	-	-	4.72	.45	Highest
2.4 Commercial rice varieties that have been planted are from the seeds that meet needs of consumers.	122 (68.4)	49 (28)	3 (1.8)	3 (1.8)	-	4.66	.53	Highest
2.5 Rice seeds are soaked for 8-12 hours and incubated to activate gemination.	122 (68.0)	51 (29.6)	3 (1.8)	1 (0.6)	-	4.66	.54	Highest
2.6 The seeds were sown in the field prepared by manual labor.	131 (74)	46 (26)	-	-	-	4.73	.44	Highest
2.7 Water is released to make the rice field dry and smooth	133 (75.1)	44 (24.9)	-	-	-	4.75	.43	Highest
2.8 Rice seeds that germinate well are sown evenly distribute throughout the plot.	129 (72.9)	47 (26.5)	1 (0.6)	-	-	4.72	.46	Highest

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
2.9 Seeds are sown in the afternoon or evening to avoid strong sunlight and seed damage	111 (62.8)	36 (20.3)	12 (6.7)	15 (8.4)	3 (1.8)	4.33	1.04	High
2.10 One day after sowing, the seeds watering is distributed throughout the plot for about 3-5 days to have much water enough.	93 (52.6)	36 (20.3)	20 (11.3)	18 (10.1)	10 (5.7)	4.03	1.25	High
2.11 When the seedlings are tall enough, water is supplied to the rice field for about 5 - 10 cm. in depth	106 (60)	60 (34)	4 (2.2)	4 (2.2)	3 (1.7)	4.48	.820	High
2.12 Transplant is conducted when seedlings are about 25-30 days old.	128 (72.3)	44 (24.9)	5 (2.8)		-	4.66	.68	Highest
2.13 Cultivation of commercial rice by planting in rows will make it easier to eliminate diseases and insects. Also, the clumps will have an opportunity to receive nutrients and sunlight regularly	126 (71.2)	45 (25.4)	6 (3.4)	-	-	4.66	.54	Highest
2.14 Commercial rice is planted by using seedlings in the paddy field.	129 (72.8)	46 (26)	2 (1.2)	-	-	4.72	.45	Highest

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
2.15 Commercial rice is planted during the rainy season. or in the fields where there is enough water.	128 (72.2)	46 (26)	3 (1.8)	-	-	4.72	.45	Highest
2.16 Rice seeds are soaked in water for 1-2 nights then the roots have sprouted, they will be sown in the plot prepared for planting seedlings.	46 (26)	43 (24.3)	7 (4)	-	81 (45.7)	2.82	1.76	Moderate
2.17 Before planting commercial rice, the seedlings were about 25-30 days old, the seedlings are been uprooted and tied together in bundles. The end of the rice leaves is cut off before transplanting	125 (70.7)	41 (23.1)	7 (4)	-	4 (2.2)	4.63	.68	Highest
2.18 There is a way to embroider by walking backward in a row in front of the board to be able to see the rows ahead already planted.	124 (70.1)	48 (27.1)	5 (2.8)	-	-	4.68	.51	Highest
2.19 Rice can be transplanting by machine	129 (72.8)	44 (24.8)	4 (2.4)	-	-	4.70	.50	Highest
2.20 For fertile soil, rice is planted rather for a part from each rice crump than those in not fertile soil to avoid inadequate sunlight receiving.	120 (67.7)	50 (28.2)	4 (2.3)	3 (1.8)	-	4.61	.63	Highest

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
3. Maintenance practices						**3.61**	**.540**	**High**
3.1 Fertilizers are applied to the soil before planting, using 16-20-0 or 15-15-15 formulas as recommended by the agricultural extension staff.	108 (61)	48 (27.1)	11 (6.2)	10 (5.7)		4.41	.88	High
3.2 The dead rice plants were planted in the first month	124 (70)	12 (6.8)	21 (11.8)	16 (9)	4 (2.4)	4.36	1.08	High
3.3 Add fertilizers or nutrients to nourish the soil 3 0 days after planting by using fertilizer formulas 16-20-0 or 15-15-15 according to the amount recommended by the agricultural extension staff.	29 (16.4)	37 (20.9)	17 (9.6)	9 (5.1)	85 (48)	2.51	1.61	Moderate
3.4 Some types of weeds and insect pests are prevented and eliminated by using chemicals.	18 (10.2)	1 (.6)	15 (8.5)	36 (20.3)	107 (60.4)	1.79	1.25	Low
3.5 Fertilizers are applied twice to provide enough nutrients to meet needs for rice growth	24 (13.5)	43 (24.3)	13 (7.3)	5 (2.8)	92 (52)	2.45	1.61	Low
3.6 The area is leveled and the water level is controlled, which can reduce a number of weed.	108 (61.0)	46 (26.0)	16 (9.0)	4 (2.3)	3 (1.7)	4.42	.87	High

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
3.7 Regularly monitor the rice field at leat twice a week	215 (67.8)	91 (29.3)	7 (2.9)	-	-	4.66	.51	Highest
3.8 Manure is used in the commercial rice field.	133 (75.1)	44 (24.9)	-	-	-	4.69	.66	Highest
3.9 Fertilization is divided into three times: seedling period; pre-mature period; and during the flowering period	32 (18.0)	46 (26.0)	12 (6.8)	2 (1.2)	85 (48.0)	2.64	1.67	Moderate
3.10 Chemical fertilizers and organic fertilizers are used for commercial rice production	112 (63.2)	12 (6.8)	28 (15.8)	23 (13.0)	2 (1.2)	4.17	1.18	High
4. Harvest and post-harvest management						**3.78**	**0.58**	**High**
4.1 Explore the rice fields, If the whole rice plot is about 80% flowering, it is the flowering day, and after 28-30 days from the flowering date is the rice harvesting day.	128 (72.3)	39 (22)	4 (2.3)	6 (3.4)	-	4.62	0.7	Highest
4.2 The water is drained from the fields 7 -1 0 days before the harvest to ensure that the rice is evenly ripe.	127 (72.7)	42 (23.7)	4 (2.3)	4 (2.3)	-	4.66	0.62	Highest
4.3 Visually observe the yellow rice, both the stalks and ears, and then harvest.	133 (75.1)	37 (20.9)	3 (1.7)	-	4 (2.3)	4.67	0.7	Highest

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
4.4 Rice is harvested by using a combine harvester	30 (17)	50 (28.2)	5 (2.8)	5 (2.8)	87 (49.2)	2.60	1.68	Moderate
4.5 After harvesting, the rice is dried for 2-3 days after harvesting so that the rice grains dry well.	127 (71.7)	41 (23.1)	4 (2.3)	4 (2.3)	1 (0.6)	4.60	0.79	Highest
4.6 Paddy is threshed from the rice stalk by a threshing machine.	129 (72.6)	41 (23.2)	1 (0.6)	6 (3.4)	-	4.65	0.68	Highest
4.7 After threshing, the rice will be dried to reduce the incidence of mold which may accelerate the deterioration of the rice grains.	23 (13)	67 (37.9)	34 (19.2)	25 (14.1)	28 (15.8)	3.19	1.28	Moderate
4.8 The traditional method is used to reduce moisture like sunlight as a heat source, which is the most commonly used method by farmers.	83 (46.9)	39 (22)	2 (1.2)	3 (1.7)	50 (28.2)	3.56	1.71	High
4.9 Ovens, dryers, etc. are used to reduce the moisture in the rice grains.	18 (10.1)	4 (2.3)	4 (2.3)	4 (2.3)	147 (83)	1.53	1.27	Low

Table 9 (Continued)

(n=177)

Details	Levels of Famers' Adoption					$\bar{x}$	S.D.	Description
	Highest	High	Moderate	Low	No adoption			
4.10 The moisture content must not exceed 15 percent before being delivered for sale.	133 (75.1)	44 (24.9)	-	-	-	4.70	0.66	Highest
On average						**4.15**	**.31**	**High**

Remarks: 4.51 - 5.00 = Highest level of adoption, 3.51 - 4.50 = High level of adoption, 2.51- 3.50 = Moderate level of adoption, 1.51 - 2.50 = Low level of adoption, 1.00 - 1.50 = No adoption

Part 3: Factors Affecting the Farmers Adoption of Commercial Rice Production in Savannakhet Province, Lao PDR.

Multiple linear regression was applied to find factors influencing the practice of commercial rice production in the study area. A multiple linear regression model measured the relationship between independent and dependent variables. The measured form of the equation was specified as in Equation 1:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_{16} x_{16} \quad (1)$$

Y is the dependent variable (Commercial rice production). X_1, X_2, X_3,...X_{16} were independent variables (age, marital status, educational attainment, household labor, supplementary occupation, farming size, family income, farming costs, amount of credit, farming experience, contact with agricultural staff, agricultural training/ educational trip, exposure to media, contact with neighbors about agricultural production, group membership; and knowledge about commercial rice production). β_0, β_1, β_2...β_{16} were unknown parameters (constant to be estimated from the data).

Table 10 The designation of symbols and abbreviations of variables used in the study of factors affecting commercial rice production.

Variables/coding	details	measurement
Dependent variable		
Adoption	Adoption of commercial rice production	Average from 4 aspects: 1. Preparation of Production Area 2. Cultivation 3. Maintenance 4. Harvest and Post-harvest management
Independent variables		
AGE	Age	Number (Year)
STA	Marital Status	Married =1, other = 0
EDU	Educational attainment	Primary or lower = 1, other = 0

Table 10 (Continued)

Variables/coding	details	measurement
LAB	Household labor	Number (People)
OCCU	Supplementary occupation	Gardener =1, other =0
LAND	Farming size	Number (Hectare)
INC	Family Income	Number (baht)
COST	Farming costs	Number (baht)
CRE	Amount of credits	Number (baht)
EXP	Farming experience	Number (Year)
CONT	Contact with agricultural staff	Number (Time)
TRAIN	Agricultural training/ educational trip	Number (Time)
MED	Exposure to media	Number (Time)
FRI	Contacts with neighbors on agricultural production	Number (Time)
GRO	Group membership	Number (Group)
KNOW	Knowledge about commercial rice production	Score (0 - 21)

Correlation analysis of independent variables and dependent variables; independent and independent variables and additive variables

These are a positive statistically significant relationship between the dependent variable (commercial rice production adoption) and independent variables i.e. age, supplementary occupation, farming size, farming costs, amount of credit, contact with agricultural staff, contact with neighbors about agricultural production; and group membership.

The correlation analysis between independent variables aimed to investigate the relationship between independent variables. This would cause problems with independent variables having a relationship with each other. (Multicollinearity) violates the precondition in regression analysis that every pair of independent variables must not have a correlation coefficient greater than 0.70 (Eric Alan Hanushek and John Edgar Jackson, 1977). A correlation coefficient greater than 0.70 (Table 11), could be applied to the multiple regression equations to analyze factors affecting the commercial rice production of the farmers in Savannakhet province, Lao People's Democratic Republic.

Table 11 The correlation coefficient metric between the independent variable and the adoption level of commercial rice production

Variable	ADOPT	AGE	STA	EDU	LAB	OCU	LAND	INC	COST	CRE	EXP	CONT	TRAIN	MED	FRI	GRO	KNOW
1. AGE	.189 **																
2. STA	.049	-.001															
3. EDU	-.089	-.005	.157 **														
4. LAB	-.025	.083	.036	.040													
5. OCU	.222 **	.009	-.162 **	-.048	.019												
6. LAND	.117 *	.133 *	.008	-.118 *	.206 **	.149 **											
7. INC	-.022	-.048	.056	-.080	-.105	.081	-.012										
8. COST	.201 **	-.045	.072	-.055	-.100	.011	-.011	.197 **									
9. CRE	.314 **	.258 **	-.068	.018	-.083	.163 **	.242 **	.013	.049								
10. EXP	.085	-.027	.079	-.122 *	-.035	.016	.090	.016	.031	-.133 *							
11. CONT	.170 **	.012	.437 **	.029	.119 *	.082	.089	.004	.035	-.071	.040						
12. TRAIN	.077	-.023	-.075	-.058	.030	-.052	.019	.066	.160 **	.095	-.063	-.115 *					
13. MED	.078	.343 **	.073	-.019	-.020	.057	.384 **	.081	-.016	.154 **	-.013	.090	.060				
14. FRI	.161 **	-.151 **	.015	.010	-.070	.101	-.025	-.015	.177 **	.100	-.046	.081	-.328 **	-.221 **			
15. GRO	.181 **	-.084	-.034	-.126 *	.071	.002	.060	.114 *	.262 **	-.006	.060	.051	.013	-.181 **	.232 **		
16. KNOW	.035	.020	.096	-.031	-.060	-.017	-.195 **	-.157 **	-.098	-.106	-.025	.049	-.035	.030	-.013	-.245 **	
ADOPT	.397 **	-.148 **	.106	.126 *	.012	.057	-.259 **	-.160 **	.226 **	-.075	-.094	.069	.175 **	-.085	.084	-.097	.252 **

Factors Affecting the Farmers Adoption of Commercial Rice Production

Multiple linear regression was applied to find the factors influencing the practice of commercial rice production in the study area. A multiple linear regression model measured the relationship between independent and dependent variables. The measured form of the equation was specified as in Equation 1:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_{16} x_{16} \quad (1)$$

Y is the dependent variable (Commercial rice production). X_1, X_2, X_3,...X_{16} were independent variables (age, marital status, educational attainment, household labor, supplementary occupation, farming size, family income, farming cost, amount of credit, farming experience, contact with agricultural staff, participated in agricultural training/educational trip, exposure to media, contact with neighbors about agricultural production, group membership; and knowledge about commercial rice production). β_0, β_1, β_2...β_{16} were unknown parameters (constant to be estimated from the data).

The analysis of the multiple linear regression shown in table 12 found that family income, group membership, participated in agricultural training or educational trip, exposure to media, and knowledge and understanding of commercial rice production had significant positive relationships with the adoption of commercial rice production with a statistical significance level at 0.01 and 0.05, the findings could be presented as follows:

Commercial rice production (Y) = 2.788 + 8.338(Family income) + 0.035 (participated on agricultural training or educational trip) + 0.085(Exposure to media) + 0.008(Group membership) + 0.022(knowledge of commercial rice production) (2).

Table 12 Factors affecting the farmers adoption of commercial rice production

Factors	Adoption of commercial rice production		
	B	t	Sig.
1. Age	0.004	0.964	0.336
2. Marital status	0.041	0.469	0.640
3. Educational attainment	-0.050	-0.429	0.669
4. Household labor	0.001	0.042	0.967
5. Supplementary occupation	-0.030	-0.843	0.400
6. Farming size	-0.007	-0.294	0.769
7. Family Income	8.338	2.186	0.046*
8. Farming costs	0.005	0.070	0.944
9. Amount of credit	0.003	0.092	0.645
10. Farming experience	-2.194	-0.657	0.512
11. Contact with agricultural staff	0.026	1.447	0.150
12. Agricultural training/educational trip	0.035	2.998	0.003*
13. Exposure to media	0.085	2.206	0.029*
14. Contacts with neighbors in agricultural production	0.033	0.806	0.421
15. Group membership	0.008	2.842	0.005*
16. Knowledge about commercial rice production	0.022	2.198	0.046*
Constant	2.778	9.637	0.000**
R^2 = 0.242 (24.2%) F = 3.191	Sig. F < 0.000**		

Remarks: * < 0.05 and ** < 0.01

Part 4: Problems and suggestions about commercial rice production in Savannakhet province

Problems of commercial rice production

Based on results of the study, most of the respondents had the problem in infertile soil most (93.79%). This was followed by low productivity per hectare (91.53%); high production costs (85.88%); lack of credit (85.88%); labor shortage (85.88%); not enough water for rice production (85.88%); many diseases and insect infestations, knowledge and experience about commercial rice production are at a low level (84.75%); lack of modern technology (84.18%); no monitoring from relevant agencies (84.18%); natural calamities (83.62%); lack of marketing information (83.05%); low profitable (80.23%); unstable price of rice production (76.84%); lack of knowledge about rice production management (75.71%); and difficult maintenance (75.14%) (Table 13).

Results of the study showed that most of respondents faced the infertile soil problem most. Hence, this implied that they still lacked of knowledge and understanding about soil improvement and management. Although the commercial rice production had requirements to follow, but the respondents seemed not to understand in many issues, resulting in poor quality output. In the case of the rice yield per hectare was low due to many factors such as infertile soil and lack of funding source to purchase production inputs. In addition, low profitable from rice production, it caused the respondents to sell their rice at low price and production costs is so high.

Table 13 Farmers' problems about commercial rice production

(n=177)

Issues	A problem		Not a problem	
	No. of persons	%	No. of persons	%
1. Infertile soil	166	93.79	11	6.21
2. Low productivity per hectare	162	91.53	15	8.47
3. High production costs	153	86.44	24	13.56
4. Lack of credit	152	85.88	25	14.12
5. Labor shortage	152	85.88	25	14.12
6. Not enough water for rice production	152	85.88	25	14.12
7. Many diseases and insect infestations.	152	85.88	25	14.12
8. Knowledge and experience about commercial rice production are at low level	150	84.75	27	15.25
9. Lack of modern technology	149	84.18	28	15.82
10. No monitoring from relevant agencies	149	84.18	28	15.82
11. Natural calamities	148	83.62	29	16.38
12. Lack of marketing information	147	83.05	30	16.95
13. Low profitable	142	80.23	35	19.77
14. Unstable price of rice production	136	76.84	41	23.16
15. Lack of knowledge about rice production management	134	75.71	43	24.29
16. Difficult maintenance	133	75.14	44	24.86

Farmers' Suggestions about commercial rice production

The following are suggestions of the farmers:

1. Regular home/field visit of agricultural extension staff to give advices or solve problems about commercial rice production.

2. The government should provide credits or loan sources with a low interest rates for commercial rice production.

3. Concerned agencies should provide low cost inputs and supply sources for convenience of commercial rice farmers.

4. Enough water sources for farming throughout the year such as irrigation system

5. Concerned agencies should prepare readiness for farmers to cope with natural calamities such as drought and flood.

6. Concerned agencies should give advice how to properly prevent diseases and pests from damaging rice production.

7. Government agencies should form production groups in the community to strengthen negotiation power.

8. The government should encourage people to perceive the importance of local or domestic rice consumption.

Part 5: Pattern development of commercial rice production in Savannakhet Province, Lao PDR.

This was divided into 3 steps as follows.

S t e p 1: Applying results of an analysis of main factors and problems encountered to find problem management direction for commercial rice production

According to a focus group discussion to find guideline for commercial rice production, it was found that there were 16 farmers approaches to manage problems in the production as follows: 1) Encourage soil fertility management to have sufficient nutrients for commercial rice cultivation. Land should be appropriately allocated to farmers for production; 2) encourage the farmers to form of agricultural production groups for increased access to inputs by supporting them to have access to quality seeds or materials at affordable prices; 3) encourage farmers to cooperate with the government to form agricultural production groups in the community to strengthen negotiation power. Encourage the use of existing local resources such as manure to save costs; 4) finding sources of credits with low interest rates for commercial rice production; 5) encourage youths to return to the agricultural sector by supporting

access to modern technology and farm machinery, as well as production techniques; 6) irrigation development, supplementary irrigation of rainfed lowland rice, reducing water use for land preparation, changing the crop planting date and making more effective use of rainfall, changing rice planting practices; 7) extension of knowledge about prevention of diseases and insect pests in both commercial rice production and general rice production systems; 8) organize training or study visits related to commercial rice production; 9) encouraging young people to return to the agricultural sector by supporting access to modern technology and farm machinery suitable for the planting area. And support credit sources to buy modern technology with low interest rates; 10) capacity building in monitoring and assessment project activities with the development of the project monitoring information system to the extension staff, and support budgets for project monitoring; 11) restoring forests, grasslands and natural wetlands, reconnecting rivers to floodplains, creating buffers of vegetation along water courses, essentially involve the management of vegetation, soils and/or wetlands, including rivers and stream; 12) extension of knowledge of marketing and selling, increasing channels for receiving agricultural information, organize seminars among related agencies on rice market, and provide ongoing publicity; 13) adding value to rice production under the food safety system, encourage integrated cropping or crop rotation in conjunction with the cultivation of commercial rice; 14) selling price guarantee measures; 15) extension of knowledge about quality rice production process, transfer knowledge on rice harvesting and post-harvesting management; and 16) organize training to educate farmers in rice production, from land preparation stage until post-harvest management (Table 14).

Table 14 Guidelines for developing the commercial rice production in Savannakhet province

Problems encountered	Guidelines for developing the commercial rice production in Savannakhet province
Production Factors	
Soil lack of fertility	Encourage soil fertility management to have sufficient nutrients for commercial rice cultivation. Land should be appropriately allocated to farmers for production.
Lack of credit	Finding sources of credits with low interest rates for commercial rice production.
Labor shortage	Encourage youths to return to the agricultural sector by supporting access to modern technology and farm machinery, as well as production techniques.
Not enough water for rice production	Irrigation development, supplementary irrigation of rainfed lowland rice, reducing water use for land preparation, changing the crop planting date and making more effective use of rainfall, changing rice planting practices.
Cost and Return Factors	
High production cost	Encourage farmers to cooperate with the government to form agricultural production groups in the community to strengthen negotiation power. Encourage the use of existing local resources such as manure to save costs.
Low productivity per hectare	Encourage the farmers to form of agricultural production groups for increased access to inputs by supporting them to have access to quality seeds or materials at affordable prices.
Low profitable	Adding value to rice production under the food safety system, encourage integrated cropping or crop rotation in conjunction with the cultivation of commercial rice.
Affecting Factors	
Many diseases and pests.	Extension of knowledge about prevention of diseases and insect pests in both commercial rice production and general rice production systems.

Table 14 (Continued)

Problems encountered	Guidelines for developing the commercial rice production in Savannakhet province
Knowledge and experience in commercial rice production are low	Organize training or study visits related to commercial rice production
Lack of modern technology	Encouraging young people to return to the agricultural sector by supporting access to modern technology and farm machinery suitable for the planting area. And support credit sources to buy modern technology with low interest rates.
Natural calamities	Restoring forests, grasslands and natural wetlands, reconnecting rivers to floodplains, creating buffers of vegetation along water courses, essentially involve the management of vegetation, soils and/or wetlands, including rivers and stream.
	Supporting Factors
Monitoring from concerned agencies	Capacity building in monitoring and assessment project activities with the development of the project monitoring information system to the extension staff, and support budgets for project monitoring.
Lack of marketing information	Extension of knowledge of marketing and selling, increasing channels for receiving agricultural information, organize seminars among related agencies on rice market, and provide ongoing publicity
The price of commercial rice production is not stable.	Selling price guarantee measures,
Lack of knowledge in rice production management	Extension of knowledge about quality rice production process, transfer knowledge on rice harvesting and post-harvesting management
Difficult maintenance	Organize training to educate farmers in rice production, from land preparation stage until post-harvest management.

Step 2: Developing an extension pattern for commercial rice production in Savannakhet province.

According to related literature and other documentary review in order to define the theorical framework in this study, the researcher analyzed and synthesized them to create a connection idea for developing a research model. Actually, the researcher employed related concept and theories of the following authors (Kendler 1963), (Lien and Jiang 2017), and (Wan and d Ding 2019)

In addition, the researcher has applied the model concept and commercial rice model of (Phonekeo 2022) and Keeves (1988) as a textual format. It was a type using a language as a mean for communication or explaining the phenomena to see the conceptual structure, elements and its relationships. From the foregoing, this was why the researcher had taken this concept as a basis for developing a model for commercial rice production of the farmers in Savannakhet province. Details were as follows: (Figure 7)

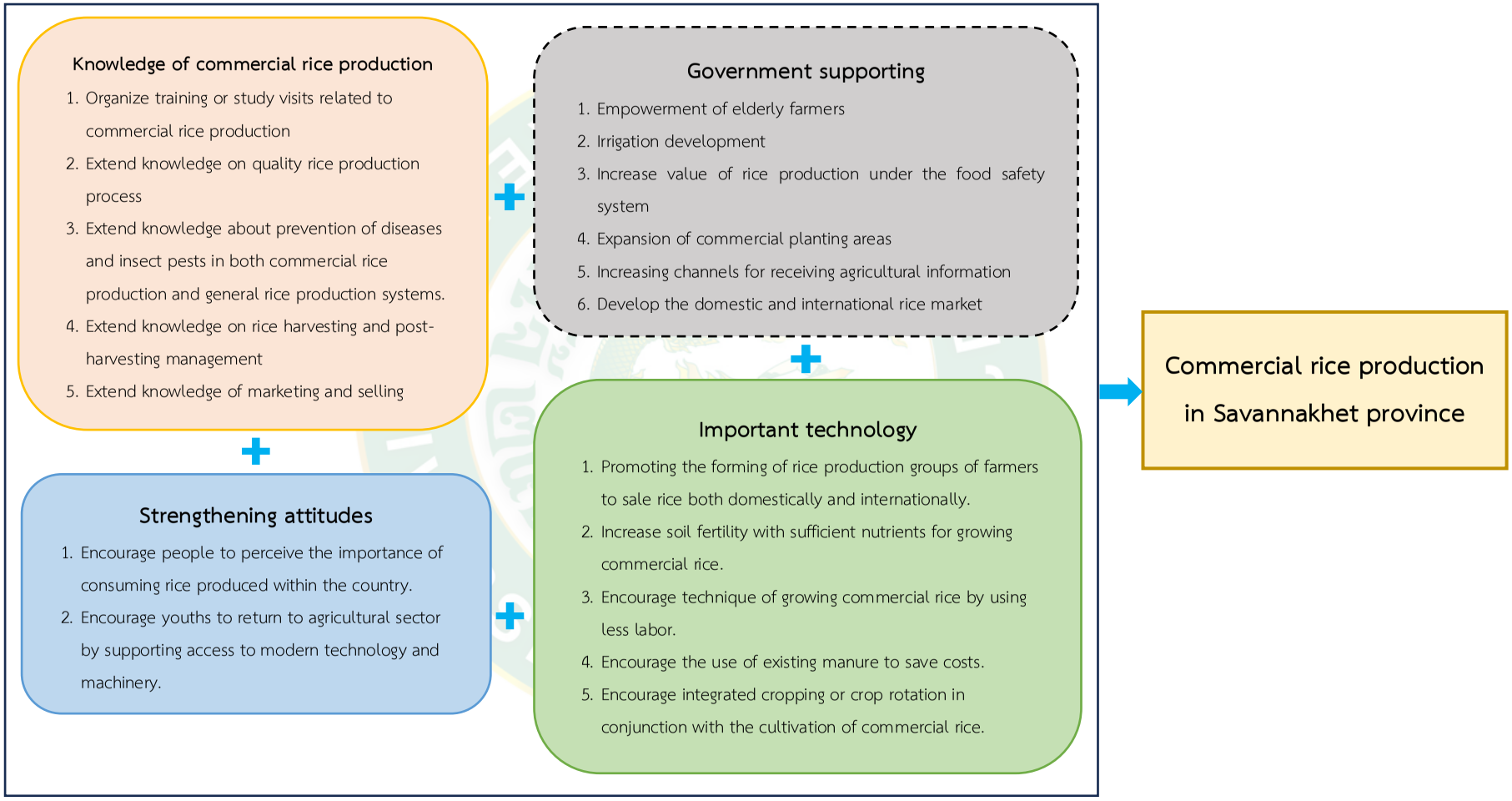

Figure 5 Extension model for commercial rice production in Savannakhet province.

The Extension Pattern Development of Commercial Rice Production in Savannakhet province, Lao PDR.

It was found that the commercial rice production pattern of farmers in Savannakhet province consisted of 4 main components: Component 1: Development of knowledge of commercial rice production; component 2: strengthening attitudes towards commercial rice production; and component 3: the production of commercial rice.

Component 1: Development of knowledge of commercial rice production, consisting of 5 development approaches namely:

1. Organizing training or study visits related to commercial rice production;
2. Extension of knowledge about quality rice production process;
3. Extension of knowledge about prevention of diseases and insect pests in both commercial rice production and general rice production systems;
4. Extension of knowledge about rice harvesting and post-harvesting management; and
5. Extension of knowledge of marketing and selling.

Component 2: strengthening attitudes towards commercial rice production , consisting of 2 approaches for enhancing, namely:

1. Encouraging people to perceive the importance of consuming rice produced within the country; and
2. Encouraging youths to return to the agricultural sector by supporting access to modern technology and farm machinery.

Component 3 : encourage to use modern technology of commercial rice production, consisting of 5 equipment and tools to support rice production, namely:

1. Promoting the creation of rice production groups of farmers to sale rice both domestically and internationally;
2. Increasing soil fertility with sufficient nutrients for growing commercial rice;
3. Encouraging technique of growing commercial rice by using less labors;
4. Encouraging the use of existing manure to save costs; and

5. Encouraging integrated cropping or crop rotation in conjunction with the cultivation of commercial rice.

Component 4: government supporting, there were 6 support factors mentioned above that could support the commercial rice production, namely:

1. Empowerment of elderly farmers;
2. Irrigation development;
3. Adding value to rice production under the food safety system;
4. Expansion of commercial planting areas;
5. Increasing channels for receiving agricultural information; and
6. Develop the domestic and international rice markets.

Step 3: Result of evaluation of the extension pattern development of commercial rice production in Savannakhet province, Lao PDR.

This step involved, the evaluation of the the extension pattern development of commercial rice production in Savannakhet province, Lao People's Democratic Republic. The researcher created an opinion evaluation form about suitability. feasibility, consistency, and usefulness of the pattern. The objective was to perceive the strengths and points that needed to be improved about the extension pattern of commercial rice production. The were collected from 5 experts, using the method of weighting the score into 5 levels, which the assessment results in all aspects were greater than 3.50, allowing the aforementioned model to be used in practice. Detail of the assessment were as follows: (Table 15).

Table 15 Results of the evaluation of the extension pattern development of commercial rice production in Savannakhet province, Lao People's Democratic Republic.

(n=5)

Items	Suitability			Possibility of implementation			Context Consistency			Practical Use		
	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description
1. Pattern develop principles	3.6	.55	high	3.8	.44	high	3.6	.54	high	3.8	.44	high
2. Pattern associations	4.20	.83	high	3.80	.44	high	3.80	.44	high	4.20	.44	high
3. Elements of the 3-element model												
Knowledge	4.00	.70	high	3.60	.54	high	3.40	.54	high	4.20	.83	high
Techniques for sustainable commercial rice production	3.80	.44	high	3.80	.83	high	4.00	.70	high	3.60	.54	high
Commercial rice production marketing	3.80	.44	high	4.00	.70	high	3.80	.44	high	3.60	.54	high
4. Drive Conditions of the 5 Conditional Model												
Government agency	3.80	.83	high	3.80	.44	high	4.00	.00	high	3.80	.44	high
Member/Leader	3.60	.54	high	3.60	.54	high	3.60	.54	high	3.80	.44	high
Farmer	3.80	.83	high	3.60	.54	high	4.00	.00	high	3.60	.89	high

Table 15 (Continued)

(n=5)

Items	Suitability			Possibility of implementation			Context Consistency			Practical Use		
	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description	$\bar{x}$	S.D.	Description
5. Explaining the pattern	3.80	.44	high	3.60	.54	high	3.00	.00	high	3.60	.54	high
6. Model overview	3.60	.54	high	4.00	.70	high	4.00	.00	high	3.40	.54	high

According to table 18: evaluation of the extension pattern development of commercial rice production in Savannakhet by 5 specialists, it was found that the specialists agree to the pattern development principles at a high level in terms of suitability, with an average of 3.60 and a standard deviation of 0.55.The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.45. Contextual consistency aspect, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55. The practical aspect of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44.

The pattern associations in terms of suitability, the expert group strongly agreed with an average of 4.20 and a standard deviation of 0.83. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44. Contextual consistency aspect, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44. The practical aspect of the model, expert groups strongly agree with an average of 4.20 and a standard deviation of 0.44.

There are 3 elements of the extension pattern development in commercial rice production, include

1. Elements of knowledge on commercial rice production in terms of suitability, the expert group strongly agreed with an average of 4.00 and a standard deviation of 0.7. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.54. Contextual consistency aspect, expert groups strongly agree with an average of 3.40 and a standard deviation of 0.54. The practical aspect of the model, expert groups strongly agree with an average of 4.20 and a standard deviation of 0.83.

2. Elements of techniques for sustainable commercial rice production in terms of suitability, the expert group strongly agreed with an average of 3.80 and a standard deviation of 0.44. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.83. Contextual consistency aspect, expert groups strongly agree with an average

of 4.00 and a standard deviation of 0.44. The practical aspect of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55.

3. Elements of commercial rice production marketing in terms of suitability, the expert group strongly agreed with an average of 3.80 and a standard deviation of 0.44. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 4.00 and a standard deviation of 0.70. Contextual consistency aspect, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44. The practical aspect of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.54.

There are 3 moving conditions for the farmer's rice production model:

1. Element of government agency: in terms of suitability, the expert group strongly agreed with an average of 3.80 and a standard deviation of 0.83. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44. Contextual consistency aspect, expert groups strongly agree with an average of 4.00 and a standard deviation of 0.00. The practical aspect of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44.

2. Element of Members/Leaders: in terms of suitability, the expert group strongly agreed with an average of 3.60 and a standard deviation of 0.54. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.54. Contextual consistency aspect, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55. The practical aspect of the model, expert groups strongly agree with an average of 3.80 and a standard deviation of 0.44.

3. Element of farmer: in terms of suitability, the expert group strongly agreed with an average of 3.80 and a standard deviation of 0.83. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55. Contextual consistency aspect, expert groups strongly agree with an average of 4.00 and a standard deviation of 0.00. The practical aspect of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.89.

For the pattern description in terms of suitability, the expert group strongly agreed with an average of 3.80 and a standard deviation of 0.44. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55. Contextual consistency aspect, expert groups strongly agree with an average of 3.00 and a standard deviation of 0.00. The practical aspect of the model, expert groups strongly agree with an average of 3.60 and a standard deviation of 0.55.

The overview of the pattern: in terms of suitability, the expert group strongly agreed with an average of 3.60 and a standard deviation of 0.44. The feasibility aspect of the implementation of the model, expert groups strongly agree with an average of 4.00 and a standard deviation of 0.71. Contextual consistency aspect, expert groups strongly agree with an average of 4.00 and a standard deviation of 0.00. The practical aspect of the model, expert groups strongly agree with an average of 3.40 and a standard deviation of 0.55.

It could be concluded that the assessment by the specialist group attached to high level of agreement in all aspects which an average mean range of 3.60 - 4.20 and the standard deviation range of 0.44 - 0.83, which were less than 1.00. Hence, this implied that the developed model could be used in practice.

Chapter 5

Conclusion, Discussion and Recommendation

This study was conducted to: 1) investigate basic personal, economic and social factors of commercial rice farmers, 2) explore a level of commercial rice production adoption of the farmers 3) find factors affecting the farmers adoption of commercial rice production; and 4) develop an extension pattern of commercial rice production of the farmers. The respondents in this study consisted of 177 rice farmers gained by the computation of Yamane's formula (Yamane, 1973). This was at a confidence level of 95% and with a margin of error of 0.05. A set of questionnaires was used for data collection and analyzed using descriptive statistics and multiple linear regression was applied to find the factors influencing the practice of commercial rice production. In addition, focus group discussions was employed to obtained some more data.

Conclusion

Personal, economic, and social factors of the respondents

According to results of the study, most of the respondents were male, 51 years old, married and elementary school graduates. They had 4 household workforces, more than one-halt of them (67.0%) had supplementary occupation in gardeners, and 1.5 hectares of an agricultural area on average. The respondents had an average annual income of 18,940 baht, they claimed that the farming production cost was 10,541 baht for each time on average. About one-third of the respondents (35%) accessed credit for agricultural production activities. The respondents had 30 years of experience in farming and they contacted agricultural extension staff once on average. They attended agricultural training and joined educational trips once a year on average. The respondents perceived agricultural information through 4 channels. Their exposure to media related to farming was 9 times a year, they

contracted neighbor on agricultural production once a year, and they were members of 4 agricultural groups in their community.

Knowledge of the farmers about commercial rice production

Results of the study revealed that most of the respondents (72.3%) had a moderate level of knowledge about commercial rice production. In addition, 27.1% and 0.6 percent of the respondents had a high and low level of knowledge, respectively.

Farmers Adoption of Commercial Rice Production

As a whole, the respondents had a high level of the adoption of commercial rice production ($\bar{x}$ = 4.15). based on its detail, two aspects were found at a highest level: preparation of production area ($\bar{x}$ = 4.68) and cultivation ($\bar{x}$ = 4.54). However, the other two aspects were found at a high level: maintenance practice ($\bar{x}$ = 3.61) and harvest and post-harvest management ($\bar{x}$ = 3.78).

Factors Affecting the Farmers Adoption of Commercial Rice Production

According to the multiple linear regression, it was found that the following had a positive significant relationship with the adoption of commercial rice production at 0.01 and 0.05: family income, group membership, agricultural training or educational trip, exposure to media, and knowledge/understanding of commercial rice production

Problems Encountered and Suggestions of the Farmers about Commercial Rice Production in Savannakhet Province.

It was found that most of the respondents (93.79%) faced infertile soil problem most This was followed by low productivity per hectare (91.53%); high production costs (85.88%); lack of credit (85.88%); labor shortage (85.88%); not enough water for rice production (85.88%); many diseases and insect infestations, knowledge and experience about commercial rice production are at a low level (84.75%); lack of modern technology (84.18%); no monitoring from relevant agencies

(84.18%); natural calamities (83.62%); lack of marketing information (83.05%); low profitable (80.23%); unstable price of rice production (76.84%); lack of knowledge about rice production management (75.71%); and difficult maintenance (75.14%).

The following are suggestions of the farmers that should be done: 1) Regular home/field visit of agricultural extension staff to give advices or solve problems about commercial rice production; 2) the government should provide credits or loan sources with a low interest rates for commercial rice production; 3) concerned agencies should provide low cost inputs and supply sources for convenience of commercial rice farmers; 4) enough water sources for farming throughout the year such as irrigation system; 5) concerned agencies should prepare readiness for farmers to cope with natural calamities such as drought and flood; 6) concerned agencies should give advice how to properly prevent diseases and pests from damaging rice production; 7) government agencies should form production groups in the community to strengthen negotiation power; and 8) the government should encourage people to perceive the importance of local or domestic rice consumption.

Extension Pattern Development of Commercial Rice Production in Savannakhet Province, Lao PDR.

This comprised 4 main components: 1) Developing knowledge and understanding of the farmers about commercial rice production with 5 approaches - training/educational trip, quality rice production process, diseases, insects, and pest prevention/control, harvest/post-harvest management and marketing strategies; 2): approaches for strengthening attitudes towards commercial rice production i.e. perception the importance of local rice consumption and young people were encouraged to be engaged in modern agricultural careers; 3) encourage to use modern technology of commercial rice production - rice farmer group forming, increase in soil fertility; using modern techniques and innovation for rice cultivation, effective use of existing local resources to reduce production cost such as fertilizer and feed; and introduction of crop rotation and mulch; and 4) government supporting factors that could support the commercial rice production included: empowerment of elderly farmers; Irrigation development; adding value to rice

production under the food safety system; expansion of commercial planting areas; increasing channels for receiving agricultural information; and develop the domestic and international rice markets.

Discussion

It can be said that the rice production in this study area is oriented towards commercialization. Also, family income, group membership, agricultural training or educational trip, exposure to media; and knowledge and understanding about commercial rice production are the significant factors determining the level of adoption of commercial rice production in the study area. Therefore, based on the findings of this study, all tiers of government including the non-governmental organization should endeavor towards training farmers on how to produce rice on commercial basis. Besides, farmers should be encouraged to expand the farm size under cultivation. In this regard, measures such as land reform that will enhance more access to farm land should be enforced. In addition, agricultural development agencies should provide the farmers with improved agricultural technologies. This should include provision of agricultural information, improved seeds, fertilizers and tractor at subsidized rate. All these measures will improve market-oriented production of rice in Lao PDR and reduce Lao's dependency on rice importation.

According to results of the study, the farmers adopted commercial rice production at high level. The farmers know that when they participated in the commercial rice production project, they will earn high yield and high income. Therefore, the government should set a clear policy to increase the capacity to promote the production of good quality rice. and continue to develop the market system to increase competitiveness. The farmers can sell their rice at a satisfactory price and are able to create a stable farming career with honor and dignity. This can improve livelihoods of the farmers. As a result, farmers who do not participate in the commercial rice production project will turn to participate in the project more in the future. This result confirms to a study of Asian Development Bank (2014) on Improving rice production and commercialization in Cambodia. The findings showed

a higher level of commercialization, rice sold, and value of sales can arise from improving irrigation and domestic milling. Likewise, Shamsudeen et al., (2018) conducted a study on adoption of rice cultivation technologies and its effect on technical efficiency in Sagnarigu district of Ghana. Result of the study showed that farmers who adopted the rice cultivation techniques had less technically inefficient than those who did not.

The factors affecting farmer's adoption of commercial rice production comprised five factors i, e, family income, group membership, agricultural training or educational trip, exposure to media; and knowledge/understanding of commercial rice production. Therefore, concerned agencies should take all of these 5 factors into consideration to develop and motivate the farmers an opportunity to grow rice for commercial in the future.

Family income is also significant and positively related to households' commercialization index. This suggests that farmers who have more farm incomes produce more rice than those who do not. Incomes provide farmers with opportunities to be acquianted with input sources and market outlets and also enhances farmers' ability to manage production and market risks. This is in line with Onyeneke. (2017) who found incomes of farmers had a positive and significant effect on the likelihood (adopting improved rice varieties, planting depth, use of agrochemicals, use of fertilizer, mechanized harvesting, improved nursery, and modern rice milling). Meanwhile, (Phoukeo, Rapee et al. 2023) confirmed that incomes had significant relationships with the practice of commercial rice production.

Group membership significantly increases the probability of uptake of planting and fertilizer. Generally, more farmers are involved in farmer organizations' meetings and activities, the more they will access new information about improved rice production and the more she/he will easily develop positive attitude towards the adoption of production rice for commercial. This result related with a study of Danso Abbeam et al. (2018) which found that group membership such as FBO enhances farmer-to-farmer extension services where knowledge and ideas on farm business and other off-farm activities are transferred from one farmer to the other. Thus, farmers who are members of FBOs are likely to get sufficient awareness and

knowledge on farm technologies and, hence, are sensitized to join extension programme for more information on their farm business.

Attending an agricultural training or educational trip was positive and significant on the likelihood of the adoption commercial. rice production. The results also indicate positive and significant (P≤0.05) relationship between the number of training attended and farmers' adoption decision of rice production. That is, training has a positively significant influence on the farmers' adoption of the recommended practices in the study area. Similar findings was remarked by Abubakar (2016) that training participation in agricultural programs including on-farm adaptive research (OFAR) trials, management training plot (MTP) demonstration techniques organized by the national cereals research institute (NCRI) in Nigeria positively and significantly influence farmers' adoption level of lowland rice production technologies.

Exposure to media had a positive effect across commercial rice production indicating that extension contact increases the likelihood of adopting commercial rice production. Extension services serve as important source of information on agricultural production. Farmers who have significant extension contacts have better chances to be aware of various management practices that they can use to increase rice production. Likewise, P. Sattaka et al (2017) found that agricultural extension services influenced glutinous rice production, especially for local food security; and also consistent with Awuni, Azumah, and Donkoh (2018) who also found mass media extension mechanisms to positively and significantly influence the adoption of multiple technologies by rice farmers in northern Ghana.

The coefficient of knowledge and understanding was found to be positive and significant (P≤0.05) in influencing the decision to adopt commercial rice production. The positive influence is expected because more understanding farmers may have good advantage of acquiring better skills and access to innovative information about improved rice production practices. The finding also implies that knowledge and experiences gained over time from working in an uncertainty production environment may help in evaluating the technologies thereby influencing their adoption decision. Similarly, Jukkaphong et al, (2016) found that knowledge and understanding is a factor affecting farmer's readiness and needs for cultivating

extension of organic animal feed plants for organic feed factory in upper northern, Thailand. Besides, Waritsara and Kamon (2020) found that knowledge is a factor affecting the planting of Chaiya native rice.

Recommendation

The following were recommended to concerned government agencies, municipality agrarian reform office and others:

1. Since the farmers have adopted the commercial rice production at a high level, concerned government agencies should keep organizing skill enhancement trainings. This helps develop potential of the farmers in commercial rice production.

2. The improvement of commercial rice production practice and results of this study can help achieve the government policy - shifting from subsistence farming to commercial farming using modern technology and appreciate rice production techniques. This will result in the production of quality and safe rice product for Lao people.

3. Ministry of agriculture and forestry need to conduct additional research to improve suitable quality rice varieties that are tolerant of drought, floods, diseases, and pests, and that are high yielding.

4. Concerned government organizations, especially provincial agriculture and forestry office (PAFO), and district agricultural and forestry office (DAFO), should have strict rules for the management and control of chemical applications; they should identify and continuously check with distributors or chemical shops which type of chemicals should be permitted to be used in the area. At the same time, they need to encourage farmers to practice the transplanting technique, to help reduce chemical applications, as it would benefit producers, consumers, environment and biodiversity in the rice field.

5. Organized rice production groups in each village. Each group should adopt a practical and concrete model, not an abstract model, in terms of regulations, agricultural information dissemination, credit and input support, production techniques, price guarantee, water use management, irrigation management and

development, and other practices. This would enable farmers to receive similar information about commercial rice production and employ the same commercial rice production techniques based on group requirements and regulations. The outcome should ensure that the average rice yield among group members does not differ widely.

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Appendix

Appendix (A)

Questionnaire

Questionnaire

Topic: Pattern Development of Commercial Rice Production in Savannakhet Province, Lao People's Democratic Republic

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Explanation: The purpose of this questionnaire was to study the pattern development of commercial rice production in Savannakhet province, Lao PDR. which is part of doctoral studies in resource management and development program, Maejo University, your answers to this questionnaire will be used for research purposes only. We would like to ask for your cooperation in answering all questions truthfully and with your own opinions. This questionnaire is divided into 4 parts as follows:

Part 1: Basic personal, economic and social factors of the farmers

Part 2: Information about farmers' knowledge and understanding about commercial rice production

Part 3: The adoption level of commercial rice production of the farmers

Part 4 : Farmers problems and suggestions about commercial rice production in Savannakhet Province, Lao People's Democratic Republic

Part 1: Basic personal, economic and social factors of the farmers

1. Sex ☐ Male ☐ Female

2. Age.....years

3. Maritage Status ☐ Married ☐ single ☐ widow ☐ divorce

4. Education attainment

☐ Primary school and below ☐ Lower-secondary school

☐ Upper-secondary school ☐ diploma and high diploma

☐ Bachelor or above

5. Ethnic

☐ Lao ☐ Phou Thai ☐ Mang Kong

☐ Tree ☐ Ta Oi ☐Other (Specifies.....)

6. Religion

☐ Buddhist ☐ ghost

☐ Cristian ☐ Catholic ☐ Other (Specifies.....)

1. Number of members in household .....person *(including you)*

2. Number of Labor for agricultural production

● labor in household.....person

● hire labor (outside).....person

3. Land holding .....ha

4.1 Total rice area.....ha

4.2 area for commercial rice production.....ha

4.3 other agricultural land .....ha

4.4 residential area .....ha

4. Total income .....kip/month

● income from farm activities..... kip/year

● income from out farm ..... kip/year

5. Farming costs .....kip/year

6. Credit sources

☐ your own ☐ cooperative ☐ Agricultural promotion Bank

☐ Policy bank ☐ capitalist ☐relative

☐ village saving fund ☐ Other (Specifies.....)

7. Amount of Credit

☐ No have

☐ have if have, how much.....kip

Social Characteristics

1. Farming experiences.....years

2. Do you have social responsibilities?

☐ No have, why.....

☐ have (*Please specifies.....)*

3. Have you ever to receive some information about commercial rice production?

☐ No

☐ Yes, if yes how many time...../month

In case you ever received, which channel? (answer more than one)

☐ Radio ...../year

☐ TV ...../year

☐ Poster ...../year

☐ Neighbors ...../year

☐ Officers ...../year

☐ Other (Specifies.....) ...../year

4. Are you currently joining a group of villages or district?

Example: village fund; organic production group; agricultural cooperative; agricultural processing group; volunteer group and so on...)

☐ Don't join, why.....

☐ Join.....group *(Please specified)*

1. _____
2. _____
3. _____
4. _____
5. _____

5. In the last 12 months ago, have you contacted an agricultural extension officer in terms of commercial rice production?

☐ Don't contacted, why.....

☐ Contacted..... time

Please specify the matter of contact with the agricultural extension officer. *(you can answer more than one)*

○ commercial rice production	○ organic agriculture
○ area preparation	○ making soil and fertilizer
○ Plant Seeding or Animal Breeding	○ Disease protection
○ Harvesting	○ Processing
○ Selling or marketing	○ Other.....

6. In the last 12 months ago, have you participated or study visited on agricultural?

☐ No, Why.....

☐ Yes, ... time

Please specify the name of activities

1. _____
2. _____
3. _____
4. _____
5. _____

Part 2. Knowledge and understanding on commercial rice production

Direction: Please mark √ in the table that you think correct and mark X that you think incorrect

No.	Items	Your answer	
		Correct	incorrect
1	To get high yield, the water level must not be more than 50 cm. in depth		
2	Soil suitable for growing rice must fertile with a pH value of 5.5 - 6.5		
3	The first plow to destroy the weeds be 15-20 cm in depth and soil turning the should be about 1-2 weeks.		
4	Plowing should be done again for 1-2 times for weeding		
5	There were not weed seeds and insect contamination		
6	Good seeds should germinate at least 80 percent.		
7	Soaking the seeds in clean water for about 24 hours and covering the it with a hemp sack or damp cloth for about 48 hours		
8	50 - 80 kg of seeds per rai for seedlings.		
9	Fertilizer containing nitrogen and phosphorus should be applied to seedlings first and wooden boards are used to spread the fertilizer		
10	25 - 30 days old age of seedlings is suitable for transplanting		

No.	Items	Your answer	
		Correct	incorrect
11	The paddy field used for cultivation should have water about 5 - 10 cm. in depth.		
12	To gain high rice productivity, the distance between the clumps is 20 cm and between rows is 25 cm.		
13	3-5 seedlings per clump should be used for transplanting		
14	When the rice is 3 months old, or before pregnancy, apply 15-15-15 fertilizer at the rate of 20 kg/rai		
15	Pruning rice leaves will encourage good tillering. Consistent rice growing together with ears of rice can increase yields up to 12%		
16	When the rice stalks have grown for about 2 weeks, the water must be removed from the rice field to be ready for harvest.		
17	Flowering occurs when the rice is about 90 days old.		
18	A plot survey is done every week, keeping wees away and prevention of mixed rice varieties		
19	The rice must be dried for about 1-2 weeks after harvest to control moisture content of not exceeding 14-15% before selling.		
20	The rice to be collected must be clean and free from contaminants such as straw, weeds, soil, sand, etc.		
21	Good rice storage and dry should be on clean upland to prevent flood, the shed must be completely closed and covered with a roof to prevent sunlight, rain and dew.		

Part 3. The adoption level of rice production of commercial rice production

Explanation: Please consider and put a mark ✓in the space according to the opinion level of

by assigning

1 Means No adoption
2 means Low-adoption
3 Mean Moderate adoption
4 means High adoption
5 Means Highest adoption

No.	Question	Adoption level				
		5	4	3	2	1
I	**Preparation of production area**					
1	The rice production area is flat without flood throughout the year.					
2	The rice production area is cleaned before planting in every step					
3	Tractor is used for the plowing					
4	Plowing is done when there is water in the rice field and it is left for 2-4 weeks.					
5	The rice production area is prepared based on rice field maintenance, weeding and taking care of seedlings					
6	The soil is plowed to the depth of 15 - 20 cm					
II	**Cultivation**					
1	Last year improved seeds are used for planting rice					
2	The rice varieties is selected from seeds with growth characteristics suitable for the environment in the planting area. and it has high yields					
3	Commercial rice varieties that are used for planting are very resistan to rice diseases and insects					
4	Commercial rice varieties that have been planted are from the seeds that meet needs of consumers.					

No.	Question	Adoption level				
		5	4	3	2	1
5	Rice seeds are soaked for 8-12 hours and incubated to activate gemination.					
6	The seeds were sown in the field prepared by manual labor.					
7	Water is released to make the rice field dry and smooth					
8	Rice seeds that germinate well are sown evenly distribute throughout the plot.					
9	Seeds are sown in the afternoon or evening to avoid strong sunlight and seed damage					
10	One day after sowing, the seeds watering is distributed throughout the plot for about 3-5 days to have much water enough.					
11	When the seedlings are tall enough, water is supplied to the rice field for about 5 - 10 cm. in depth					
12	Transplant is conducted when seedlings are about 25-30 days old.					
13	Cultivation of commercial rice by planting in rows will make it easier to eliminate diseases and insects. Also, the clumps will have an opportunity to receive nutrients and sunlight regularly					
14	Commercial rice is planted by using seedlings in the paddy field.					
15	Commercial rice is planted during the rainy season. or in the fields where there is enough water.					
16	Rice seeds are soaked in water for 1-2 nights then the roots have sprouted, they will be sown in the plot prepared for planting seedlings.					

No.	Question	Adoption level				
		5	4	3	2	1
17	Before planting commercial rice, the seedlings were about 25-30 days old, the seedlings are been uprooted and tied together in bundles. The end of the rice leaves is cut off before transplanting					
18	There is a way to embroider by walking backward in a row in front of the board to be able to see the rows ahead already planted.					
19	Rice can be transplanting by machine					
20	For fertile soil, rice is planted rather for a part from each rice crump than those in not fertile soil to avoid inadequate sunlight receiving.					
III	**Maintenance practices**					
1	Fertilizers are applied to the soil before planting, using 16-20-0 or 15-15-15 formulas as recommended by the agricultural extension staff.					
2	The dead rice plants were planted in the first month					
3	Add fertilizers or nutrients to nourish the soil 25-30 days after planting by using fertilizer formulas 16-20-0 or 15-15-15 according to the amount recommended by the agricultural extension staff.					
4	Some types of weeds and insect pests are prevented and eliminated by using chemicals.					
5	Fertilizers are applied twice to provide enough nutrients to meet needs for rice growth					
6	The area is leveled and the water level is controlled, which can reduce a number of weed.					
7	Regularly monitor the rice field at leat twice a week					
8	Manure is used in the commercial rice field.					

No.	Question	Adoption level				
		5	4	3	2	1
9	Fertilization is divided into three times: seedling period; pre-mature period; and during the flowering period					
10	Chemical fertilizers and organic fertilizers are used for commercial rice production					
IV	**Harvest and post-harvest management**					
1	Explore the rice fields, If the whole rice plot is about 80% flowering, it is the flowering day, and after 28-30 days from the flowering date is the rice harvesting day.					
2	The water is drained from the fields 7-10 days before the harvest to ensure that the rice is evenly ripe.					
3	Visually observe the yellow rice, both the stalks and ears, and then harvest.					
4	Rice is harvested by using a combine harvester					
5	After harvesting, the rice is dried for 2-3 days after harvesting so that the rice grains dry well.					
6	Paddy is threshed from the rice stalk by a threshing machine.					
7	After threshing, the rice will be dried to reduce the incidence of mold which may accelerate the deterioration of the rice grains.					
8	The traditional method is used to reduce moisture like sunlight as a heat source, which is the most commonly used method by farmers.					
9	Ovens, dryers, etc. are used to reduce the moisture in the rice grains.					
10	The moisture content must not exceed 15 percent before being delivered for sale.					

Chapter 4. Farmers problems and suggestions for growing ccommercial rice

4.1 Problems about commercial rice production

Explanation: Please consider and put a mark ✓in the row according to your concern problem (Multiple answers can be selected).

No.	Issues	A problem	Not a problem
1	Infertile soil		
2	Low productivity per hectare		
3	High production costs		
4	Lack of credit		
5	Labor shortage		
6	Not enough water for rice production		
7	Many diseases and insect infestations.		
8	Knowledge and experience about commercial rice production are at low level		
9	Lack of modern technology		
10	No monitoring from relevant agencies		
11	Natural calamities		
12	Lack of marketing information		
13	Low profitable		
14	Unstable price of rice production		
15	Lack of knowledge about rice production management		
16	Difficult maintenance		
17	Other (please specified)		
18	Other (please specified)		
19	Other (please specified)		
20	Other (please specified)		

4.2. Suggestions about commercial rice production

☐ Preparation of production area

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.....

.....

☐ Commercial rice cultivation

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.....

☐Maintenance practice

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☐Harvesting and post-harvest management

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.....

.....

☐ Rice marketing

.....

.....

.....

☐ Other recommend to improve commercial rice production

.....

.....

.....

Thank you very much for your cooperation in answering the questionnaire

Appendix (B)

Results of instrument test and data analysis

List of experts for Index of consistency test

No.	Name and Surname	Position
1	Assist. Prof. Dr. Weena Nilawonk	Supervisor
2	Dr. Somphong Chanthavong	Acting-Dean, Faculty of agriculture and environment
3	Mrs. Phonesavanh Sisavat	Deputy-head of agriculture division, Savannakhet provincial of agriculture and forestry office.
4	Mr. Duangta Sensaypanya	Head of Xaybouly district of agriculture and forestry office.
5	Mr. Khamniem Phongthady	Deputy-head of rural development and cooperative division, Savannakhet provincial of agriculture and forestry office.

Reliability Test

Reliability Statistics

Cronbach's Alpha	N of Items
.976	46

Item-Total Statistics

Question	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
a1	181.9667	758.792	0.276	0.976
a2	182.1667	748.213	0.655	0.975
a3	182.1667	751.868	0.472	0.976
a4	182.1333	747.706	0.597	0.975
a5	182.3667	746.792	0.55	0.975
a6	182.2667	746.133	0.512	0.976
b1	182.4	737.076	0.726	0.975
b2	182.4333	755.357	0.297	0.976
b3	182.1667	751.592	0.514	0.976
b4	182.1667	740.282	0.717	0.975
b5	182.1	744.438	0.588	0.975
b6	182.2333	740.875	0.635	0.975
b7	182.0667	755.168	0.382	0.976
b8	182.3333	740.851	0.663	0.975
b9	182	740.69	0.635	0.975
b10	182.3667	746.999	0.618	0.975
b11	181.9	730.024	0.798	0.975
b12	181.9667	731.206	0.732	0.975
b13	182.2667	740.34	0.666	0.975
b14	182.1333	733.913	0.766	0.975
b15	181.9667	739.757	0.677	0.975

Question	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
b16	182.0333	728.654	0.869	0.975
b17	182.1333	740.326	0.631	0.975
b18	182.2333	728.254	0.834	0.975
b19	182.1	722.99	0.905	0.974
b20	182.1333	726.74	0.846	0.975
c1	181.9	740.714	0.71	0.975
c2	181.8333	752.833	0.413	0.976
c3	182.1667	754.213	0.389	0.976
c4	182.1333	743.154	0.571	0.975
c5	182.1333	750.326	0.467	0.976
c6	182.0667	751.651	0.44	0.976
c7	182.2	734.372	0.696	0.975
c8	182.2	729.062	0.771	0.975
c9	182.0667	726.547	0.89	0.974
c10	181.9667	719.757	0.863	0.974
d1	182.1667	730.006	0.739	0.975
d2	182.0333	727.275	0.828	0.975
d3	181.9667	730.447	0.807	0.975
d4	182	727.034	0.854	0.975
d5	182.1667	725.247	0.859	0.975
d6	182.0667	730.892	0.836	0.975
d7	182.0667	736.892	0.742	0.975
d8	182.0333	738.309	0.734	0.975
d9	182.0333	738.585	0.77	0.975
d10	182.1	725.886	0.848	0.975

Appendix (C)

Figures of data collection

Figures of data collection

CURRICULUM VITAE

NAME Inta Chanthavong

DATE OF BIRTH 11 February 1986

EDUCATION

2021 - 2023 Study PhD in Resources Management and Development at Maejo University, Thailand.

2017 - 2019 Study Master in Resources Development and Agricultural Extension at Maejo University, Thailand.

2004 - 2009 Study Bechelor in Rural Economic and Food Processing at National University of Laos.

WORK EXPERIENCE

2021 - Now Head of Academic Division Affair, Faculty of Agriculture and Environment, Savannakhet University.

2020 - 2021 Head of Administration and General Division, Faculty of Agriculture and Environment, Savannakhet University.

2019 - 2020 Assistant Dean Faculty of Agriculture and Environment, Savannakhet University.

2013 - 2017 Head of Academic Division Affair, Faculty of Agriculture and Environment, Savannakhet University.

2010 - 2013 Assistant Lecturer, Faculty of Agriculture and Environment, Savannakhet University.