



THESIS APPROVAL
GRADUATE SCHOOL, KASETSART UNIVERSITY

Doctor of Philosophy (Tropical Agriculture)

DEGREE

Topical Agriculture

FIELD

Interdisciplinary Graduate Program

PROGRAM

TITLE: Factors Affecting Farmers' Adoption of the System of Rice
Intensification
(SRI) in Tram Kak District, Takeo Province, Cambodia

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THESIS

FACTORS AFFECTING FARMERS' ADOPTION OF THE SYSTEM OF RICE
INTENSIFICATION (SRI) IN TRAM KAK DISTRICT, TAKEO PROVINCE,
CAMBODIA

MINEA MAO

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy (Tropical Agriculture)
Graduate School, Kasetsart University

2009

Minea Mao 2009: Factors Affecting Farmers' Adoption of the System of Rice Intensification (SRI) in Tram Kak District, Takeo Province, Cambodia. Doctor of Philosophy (Tropical Agriculture), Major Field: Tropical Agriculture, Interdisciplinary Graduate Program. Thesis Advisor: Associate Professor Pichai Tongdeelert, Ph.D. 164 pages.

This research study were to; a) define socio-economic characteristics, b) specify the farmer adoption of SRI, c) identify the main factors affecting to leading farmer and general farmer's adoption, d) find out the farmers' major problems, suggestions, and e) propose the model of extension in SRI adoption under Cambodia conditions. Data were collected by using focus group (qualitative research) and interview schedule (quantitative research) from 372 samples which were analyzed and presented through frequency, percentage, and arithmetic mean. Chi-square test was employed to test hypotheses at the .05 level.

The research results revealed that leading farmers had followed the steps of SRI after attending the training course which it organized by local NGO, CEDAC. They utilized the trained knowledge especially in fertilizers usage, and the advantages and disadvantages of chemical and organic fertilizers. In addition, leading farmers' perception on the SRI principles and practices was at very high level, and they disseminated knowledge, practices, and experiences to family members and other farmers both in and outside district by face-to-face, informal meeting, and group discussion methods. The rice paddy yield increased from the former average 2 tons (t) per hectare (ha) to 2.8 t/ha when farmers changed to SRI implementation.

The research findings 71.8 percents of farmer households headed by male with the average age 45 years and 37.1 percents were able to read, and 28 percents obtained secondary school. 98.1 percents were farmers with the average experience in paddy cultivation were 28.16 years. The average of land holding size was 1.14 ha with the average of family member and farm labor was 5.58 persons and 3.63 persons, respectively. 78.5 percents of farmer hired labor less than 10 days. The average of family income (on and off-farm) was 3,598,210 riels with 60.2 percents were engaged in off farm employment, 93.3 percents participated in association.

Hypotheses testing revealed that education level, type of occupation, land holding size, family income, off-farm employment, association membership, rice production, and SRI yield were significantly related to the SRI adoption. Moreover, farmer community school, farmer group discussion, farmer regular meeting, farmer workshop and congress, extension agent visited farmer's field, farmer-to-farmer, exchange visit, television, radio, prints were significantly related to adoption of SRI. The problems found were irrigation and drainage problems, natural disasters, lack of technique in pests control, low soil fertility, labor shortage, rodents, insects and diseases problem. Farmers were looking forward for help to ease their problems from either government or NGOs.

Student's signature

Thesis Advisor's signature

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ACKNOWLEDGEMENTS

The author would like to express his sincere gratitude and profound appreciation to his thesis advisor, Associate Professor Pichai Tongdeelert, Ph.D., who played a very importance role in this research study with invaluable guidance and enthusiastic attention of author's work. The author also greatly appreciates his conceivable advice, patient as well as encouragement whenever facing with any obstacles throughout the thesis preparation.

The author also extends his sincere appreciation and heartfelt thanks to his thesis co-advisor, Associate Professor Praderm Chumjai, Ph.D., for his critical review, constant encouragement, advice as well as kindness in reviewing the manuscript. Furthermore, his sincere gratitude thanks to Assoc. Prof. Savitree Ransipaht, Ph.D., chairperson of defensive examination, and Assoc. Prof. Kamolrat Intaratat, Ph.D., external examiner, for their good comments, advices, as well as invaluable guidance.

With deeply express his heartily thanks to Thailand International Development Cooperation Agency (TICA) for providing him the scholarship upon an opportunity to pursue degree of Doctor of Philosophy in Agricultural Extension, Tropical Agriculture. Moreover, a special appreciation and sincere thanks for the Royal Government of Cambodia (RGC), especially, Ministry of Agriculture, Forestry and Fisheries for arrangements and supports him to be able to continued further education.

The author acknowledges the enormous thanks for Miss, Pattamaporn Tidta, graduate student in Agricultural Extension, for sharing her experiences and knowledge in relevant matters. He is also thankful to his assistants, Mr. Yong Kady and Mrs. Bout Sakoeun, for their valuable time to gather information and data from respondents. Moreover, thanks to Mr. Yi Kimthan, program office, and Ms. Mok Chenda, project officer of CEDAC in Tram Kak District, Takeo Province, for their sharing information, providing documents. In addition, he is thanks to all respondents in study area for their kindness cooperation, sharing, and providing information during field survey.

The author would like to express gratitude to his uncle, Mr. Tho Sochantha and family, and his older brother, Mr. Liv Leang Hy and family, for their guidance, encouragement, and moral supported. He is also thanks to his best friends, Mr. Chea Vireak, Mr. Bun Khla, Mr. Kol Lyna, and Mr. Oum Kanitha and Mrs. Hou Sopor, for their encouragement and helpful in many ways throughout his study in Thailand.

Last but not least, author would like to express his profound gratitude from deepest heart to his parent, Mr. Mao Rith, and Mrs. Tho Vichenda, for their irreplaceable love, understanding, and merciful support for his highest education. Furthermore, he would like to express his sincere thanks and gratitude to his younger sister, Miss. Mao Sok Ny, and youngest brother, Mr. Mao Rasmei, for their help and encourage throughout his study period.

Minea MAO
March, 2009

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LIST OF ABBREVIATIONS

ASDP	= Agriculture Sector Development Program
AusAID	= Australian Agency for International Development
CDA	= Community Development Association
CEDAC	= Centre d'Etude et de Développement Agricole Cambodgien/ Center for Studies and Development of Cambodian Agriculture
CIIFAD	= Cornell International Institute for Food, Agriculture and Development
DAALI	= Department of Agronomy and Agricultural Land Improvement
DAE	= Department of Agricultural Extension
EPP	= Extension Program Package
FAO	= Food and Agriculture Organization of the United Nations
FC	= Farmer Congress
FCS	= Farmer Community School
FGD	= Farmer Group Discussion
FRM	= Farmer Regular Meeting (monthly meeting)
FW	= Farmer Workshop
GTZ	= German Technical Cooperation
GDP	= Gross Domestic Product
ha	= hectare (100m * 100 m = 10,000 m ²)
HRD	= Human Resources Development
HYV	= High Yield Variety
ILEIA	= Newsletter for Low External Input and Sustainable Agriculture
IO	= International Organization
IPM	= Integrated Pest Management
JICA	= Japanese International Development and Cooperation Agency
K	= Potassium
km	= kilometer
kg	= kilogram
LDCs	= Less Developed Countries
MAFF	= Ministry of Agriculture Forestry and Fisheries
MCC	= Mennonite Central Committee

LIST OF ABBREVIATIONS (CONTINUED)

N	= Nitrogen
NGO	= Non Government Organization
OAE	= Office of Agricultural Extension
OFAT	= On-Farm Adoptive Trial
P	= Phosphorus
PACT	= Private Agency Collaborating Together
PDA	= Provincial Department of Agriculture
POAE	= Provincial Office of Agricultural Extension
PRASAC	= Support Program for the Agricultural Sector in Cambodia
RGC	= Royal Government of Cambodia
SMS	= Subject Matter Specialist
SPSS	= Statistical Package for the Social Science
SRI	= System of Rice Intensification
t	= tones
T&V	= Training and Visit
VSF	= Veterinaires Sans Frontieres
WFP	= World Food Program

CHAPTER I

INTRODUCTION

Cambodia comprises a relatively small and compact territory on the Indochina Peninsula and covers an area of 181,035 km² (69,898 square miles). It is bordered by Thailand on the west, by Laos on the north, by Gulf of Thailand on the south, and by Vietnam on the east.

The agriculture sector is a key priority in the Royal Government of Cambodia's (RGC) growth strategy. It is the largest sector of the Cambodian economy, accounting for 45-50% of real gross domestic product (GDP). This Agriculture sector represents a priority area in national development policy. Several strategies have been formulated to improve food security, stimulate economical growth, increase rural incomes, and develop agricultural export industries (RGC 1994, FAO 1994). Moreover, the agricultural production remains as a critical and important component in the strategic development of the RGC. This agriculture sector in the strategic development leads to the well being of nation economic for improving the people living condition and by reducing people poverty reduction. The Ministry of Agriculture, Forestry and Fisheries (MAFF) has been trying to implement the policy and the rectangular strategy of the RGC. This implementation is launched for the employment creation, and efficiency with the core strategy of good governance. The rectangular strategy is consisted of four main areas: (i) enhancement of agriculture sector; (ii) rehabilitation and reconstruction of physical infrastructure; (iii) employment and private sector development; (iv) capacity building and human resource development (MAFF, 2006).

Three out of four largest sub sectors of Cambodia's economy in the early 1990s are within the agricultural sector. Rice is the largest single subsector which contributes to an average of 17% of national GDP. Livestock is the third largest subsector which contributes to 13% of GDP. Other crops and rubber production make the fourth largest subsectoral contribution which is 10% of GDP (Nesbitt, 1997). Rice is the main staple food. The rice farming provides income and employment

opportunity from around 65% of Cambodia's population¹ (Anthofer, 2004). Nesbitt (1997) defined that the English phrase "to eat" is *pisa bei* in Khmer, which literally means "eat rice".

Cambodia has two rice crops each year, a monsoon-season crop (long-cycle) and a dry-season crop. The major monsoon crop is planted during late May to July, when the first rain of the monsoon season begins and helps to inundated and soften the land. Rice shoots are transplanted from late June through September. The main harvest period is usually six months later, in December. The dry-season crop is smaller plant size than wet season crop, and it takes less time to grow (three months from planting to harvest). It is planted in November in areas that have already trapped or retained some of the monsoon rains, and it is harvested in January or February.

The improvement of rice productivity is one of the main objectives of every agriculture and rural development program in Cambodia. During the last decades, the RGC, NGOs and IOs have implemented agricultural productivity improvement programs with different approaches and strategies to increase rice yields of small farmers. The programs are expected to improve food security, increase rural incomes, and reduce the vulnerability of rural households. Fertilizer split applications the introduction of improved high-yielding varieties and the integrated pest management (IPM) are promoted on a large scale. However, the environmental sustainability and the economic viability of the high input approach for poor farmers are still in question especially the rice production on a national scale has not yet been able to increase yields beyond 2 tons per hectare (Anthofer, 2004).

The System of Rice Intensification (SRI) is a methodology to increase the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. These practices contribute to healthier soil and plants because they enhance more root growth and increase the soil microbial diversity. The methodology comprise with a set of rice management originally developed in the highlands of Madagascar. Introduced to Southeast Asia countries such as Thailand, the Philippines, Laos and Sri Lanka, SRI has shown to have the potential for small farmers to

¹ About 85% of Cambodia's 12 million people live in rural areas, and about two-thirds of this rural population depend mainly on rice farming.

significantly increase their rice yields even without external inputs such as fertilizers. Although some of the practices and principles of SRI are already known to Cambodian farmers. However, the farmers have no experience in growing rice by systematically combining or integrating the crop cultivation components promoted by SRI.

Statement of the Problems

Takeo Province located in Southwest of Cambodia. Its total land area is 3,562.70 km², which consisting of 81,270-hectare (ha) human settlements and infrastructures areas, 244,000-ha agricultural areas (170,000-ha for wet-season rice, 70,000-ha for dry-season rice, and 4,000-ha for other crops), 17,000-ha forest areas, and 14,000-ha water bodies and nonuse areas (Takeo. 2006).

Takeo Province has 10 districts. Tram Kak is one of the district, which has high potential for growing rice and more population than other districts. Rice production is a main household income for farmer in Tram Kak. They grow rice from year to year, but the national average yield of rice is estimated to be only 1.65 to 2 tons per hectare in the wet season (MAFF 1995-2003, and FAO/WFP 1999). This low productivity is suspected to be the result of many factors. Those factors includes the absence of supplementary irrigation, lack of rice field management and cultivation technology, improper land preparation, poorly weed and pest management, improper chemical fertilizer usage, soil fertility reduction, bad post-harvest management, and the non-availability of healthy seeds. It can be noted that numbers of socio-economic factors have aggravated the rural livelihood situation. Some of those factors are unclear such as land property rights, labor shortages of widow-headed households, poor access to market, etc.

In order to overcome those stated problems, a study needs to be conduct to answer the following questions:

- What are the socio-economic factors of the difference household farmers in Tram Kak District?

- What are the important roles of agricultural extension to enhance farmer preference on SRI?
- Is there a relationship between selected demographic variables and adoption of SRI?
- Is there a relationship between training and adoption of SRI?
- Is there a relationship between extension services and adoption of SRI?
- Is there a relationship between mass media exposure and the adoption of SRI?
- Is SRI appropriated for farmers cultivation in Tram Kak District?
- Why farmers do not adopt the SRI?
- Why farmers adopt some part of SRI principles only?
- What are the problems of farmers in the adoption of SRI?
- What are farmers suggestions and recommendations to overcome the problems?

Objectives of the Study

In general, this study aim to identify the factors affecting farmers' adoption of the system of rice intensification in Tram Kak District, Takeo Province, Cambodia. The study would improve and/or modify the SRI practice and provide recommendations for the advancement of methodologies and skills in the agriculture field especially the rice production. The main objectives of this study are:

1. To define the socio-economic characteristics of farmer's household in Tram Kak District;
2. To identify the main factors affecting to leading farmer, who had successfully adopted of SRI, and factors affecting to general farmer's adoption of SRI in Tram Kak District;
3. To specify the adoption of farmers on SRI in Tram Kak District;
4. To determine the relationship between independent variables (socio-economic characteristics, training, extension services, and media exposure) and adoption of SRI in Tram Kak District;
5. To collect the farmers' major problems, their suggestions, and obtain possible recommendation for the improvement of SRI adoption; and
6. To design a propose model that will be offered in extension agency for improvement the SRI adoption under Cambodia conditions that is viable, applicable, and effective tool in the food security and/or safety program.

Expected Outcomes

After conducting this research study, the results can use as guideline for improving the extension service on SRI adoption in Cambodia. Also the researchers and extension workers can extent the knowledge in this study to their own researches. Moreover, the extension agents can further use the model on SRI adoption from this study by applying to other districts in the nation wide.

In addition, the results of this research study will be beneficial to extension agents by adapting this concept to their extension strategies in order to enhance farmer income and improve the yield of rice production in Cambodia base on SRI.

Limitation of the Study

This study will focus on farmers who adopted the SRI, and living in Tram Kak District, Takeo Province, Cambodia, only. The research was conducted during the period of August-November, 2007.

Definition of Terms

Demographic Characteristics: refers to social and economic factors of rice farmer such as: age, sex, education level, type of occupation, occupational experience, land holding size, family labour, family income, off-farm employment, farmer's association membership.

Factor: refers to variables that affected to farmers' adoption of SRI package in Tram Kak District.

Extension: refers to the conscious use of communication of information to help people form sound opinion and make good decision. Extension has been described as a system of out-of-school education for rural people.

Leading farmer: refers to farmers living in Tram kak district, who was first adopted the SRI package.

Adoption: refers to farmer's acceptance, implementation, and transferring the SRI package.

Training: refers to the period when an individual recognition about the innovation's existence and workability occurs.

Farmer community school: refers to informal education. It is meant to operate off-campus (school without wall) and uses farms, fields, under tree shade, pagoda, farmer's house and other places as classroom.

Farmer group discussion: refers to the group of all interested farmers gathering for the purpose of training and regular group consultation.

Farmer regular meeting (monthly meeting): refers to the group of training regularly organized every month as series training. They set up a simple regulation, thus most of farmers come to participate on time and regularly. The focus is on the introduction basic principles of SRI, soil fertility management, water management, ecological pest management, home garden, multi-purpose farm, etc.

Farmer workshop: refers to the way to accumulate the experiences of SRI development and dissemination, and review the progress of SRI. It is organized within the participation of 60-70 farmers and other stakeholders.

Farmer-to-farmer: refers to the farmers sharing or dissemination their knowledge/experience on SRI to other farmers living in or out of the village.

Field day: refers to the last meeting, the farmers organize at the harvest time in order to build up their confidence on the SRI practice. This meeting allows farmers to compare the yield of conventional rice production system with the SRI. Also the farmers have more opportunities to share their experiences each other in this meeting.

Exchange visit: refers to the way of extension, farmers have opportunity to expose and accumulate the concrete experiences through the learning-by-seeing method and talking to other farmers in a more informal way. Exchange visit can be organized such as NGOs/IOs exchange visit, inter-country, inter-provincial, inter-village, and hosting exchange visit.

Acceptance: refers to farmers in Tram Kak District who agree and follow the SRI principles.

Implementation: refers to farmers in Tram Kak District that produce rice by practicing the SRI principles.

Transferring: refers to the dissemination of farmer's experiences on SRI to the family member, neighbor house, and other farmers.

Product: refers to the rice yield of farmers harvesting in Tram Kak District.

Environmental aspects: refers to the non-chemical methods in soil fertility improvement due to applications of compost and green manure, and crop management to reduce the chemical load in the environment which is benefiting people's health and increasing the population of fish, frogs, crabs, birds, etc.

Income: refers to the total income (on and off farm) in the cultivation season of farmers in Tram Kak District.

Media Exposure: refers to the usage of mass media in agricultural extension for disseminating information to farmers in Tram Kak District. It consists of television, radio, and prints.

System of Rice Intensification (SRI): refers to the methodology to increase the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. It comprises a set of rice management practices originally developed in the highlands of Madagascar.

CHAPTER II

LITERATURE REVIEW

This chapter consists of the reviews of literature in the related fields as follows:

1. Adoption and diffusion of innovations
 - Adoption process
 - Adoption rate
 - Adopter category

2. Communication
 - Principle of communication
 - Component of communication
 - Type of communication

3. Media exposure
 - Printed media
 - Audio-visual media
 - Static media

4. Agricultural extension
 - Definition
 - Objective
 - The role of agricultural extension
 - The extension-teaching methods
 - Agricultural extension system in Asian countries
 - Agricultural extension system in Cambodia
 - Situation
 - Strategy
 - National policy

5. The System of Rice Intensification (SRI)

- What is SRI?
- History
- Principle
- The situation of SRI in Cambodia

6. Related research

7. The design of the study

8. Conceptual framework

9. Statement of hypotheses

Adoption and Diffusion of Innovations

Adoption is the process that a particular farmer expose to, considers, and finally rejects or practices a particular innovation (Mosher, 1978).

Diffusion is the total process that an innovation spreads out among farmers until a large number of farmers have adopted it (Mosher,1978). Similarly, Rogers (2003) defined that diffusion is the process that an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication concerned with the spread of messages that are perceived as new ideas. Diffusion is the process by which (1) an *innovation*, (2) in *communicated* through certain *channels*, (3) over *time*, and (4) among the members of a *social system*. These elements are identifiable in every diffusion research study and in every diffusion campaign program.

An time dimension is involved in diffusion in (1) an innovation-diffusion process, (2) innovativeness, and (3) an innovation's rate of the adoption. The innovation-decision process is a process that an individual (or other decision-making unit) passes the first knowledge of an innovation, forms an attitude toward the innovation, decides to adopt or reject, implements new ideas, and finally confirms its decision. There are five main steps in the innovation-decision process: (1) *knowledge*, (2) *persuasion*, (3) *decision*, (4) *implementation*, and (5) *confirmation*.

Rogers (2003) defined that innovations is an idea, practice, or object that is newly perceived by an individual or other unit of adoption. It matters little, so fare as human behavior is concerned, whether or not an idea is “ objectively” new as measured by the lapse of time since its first use or discovery. There are five attributes of innovations: (1) *relative advantage*, (2) *compatibility*, (3) *complexity*, (4) *trialability*, and (5) *observability*.

Adoption Process

Adoption is a process explaining the decisive condition of an individual mind. The degree of adoption of each individual is related to his social status based on his income, education, and occupation, the so-called “status dimension”. All individuals in a social system do not adopt an innovation at the same time. They adopt an innovation in an ordered time sequence with the “time dimension” involved in the adoption process. Mosher (1978) indicated that the process of the adoption of innovations composed of five successive steps: (1) awareness, (2) interest, (3) evaluation, (4) first trial, and (5) either repeated use or rejection.

1. Awareness: the first step towards adoption of an innovation, obviously, is to be aware that it exists.

2. Interest: the second step is to become personally interested. The critical difference between awareness and interest is the point that a person starts to believe in the possibility of particular innovation. It is common that even village farmers can see a new variety growing or new implements being used by other farmers quite close to them, they might not be interested in those innovations.

3. Evaluation: Once a farmer is interested in an innovation, he can begin the process of evaluation by deciding whether or not he wishes to try it. Evaluation is partly a matter of getting more information about the new practice. It is also partly a matter of making a mental trial of the innovation.

4. First trial: the fourth step is an actual trial of the innovation on the farm. In order to take this step, the farmer must collect the required inputs, learn every mandatory new skills, commit some land, labor, and money to the trial, and see the results of his trial.

5. Either repeated use or rejection: A farmer needs to try an innovation for general times in order to be claimed that he has “adopted” it. Pre-adoption state the

farmer can be only claimed for being increasingly interested and experimenting, both in imagination and in fact. Only the evident of several repetition of use indicates that adoption has taken place. A lot of cases, after trying an innovation once, or perhaps twice, farmers reject it and never try it again. Frequently this rejection of farmers comes from a sound decision. It may not be the extension service fault; it may simply be that the innovation has no distinguished impact on improvement of particular farms.

Adoption rate

The rate of adoption is the relative speed of a social system member adopt an innovation. The rate of adoption is generally the measurement of the number of individuals who adopt a new idea in a function of time, such as a year. The perceived attributes of an innovation are an important explanation of the rate of adoption of an innovation. The rate is measured from the use of an innovation or a system rather than an individual as a unit of analysis (Rogers, 2003).

Rogers (1995) indicated that most of variance in the rate of adoption of innovations, from 49 to 87 percent, is explained by five attributes: relative advantage, compatibility, complexity, trialability, and observability. In addition to the perceived attributes of an innovation, there are other variables that affect its rate of adoption such as (1) the type of innovation-decision, (2) the nature of communication channels diffusing the innovation at various stages in the innovation-decision process, (3) the nature of the social system, and (4) the extent of change agents' efforts in diffusing the innovation.

Innovations requiring an individual-optional innovation-decision are generally adopted more rapidly than an innovation that is adopted by an organization. The more persons being involves in making an innovation-decision, the slower the rate of adoption (Rogers, 2003).

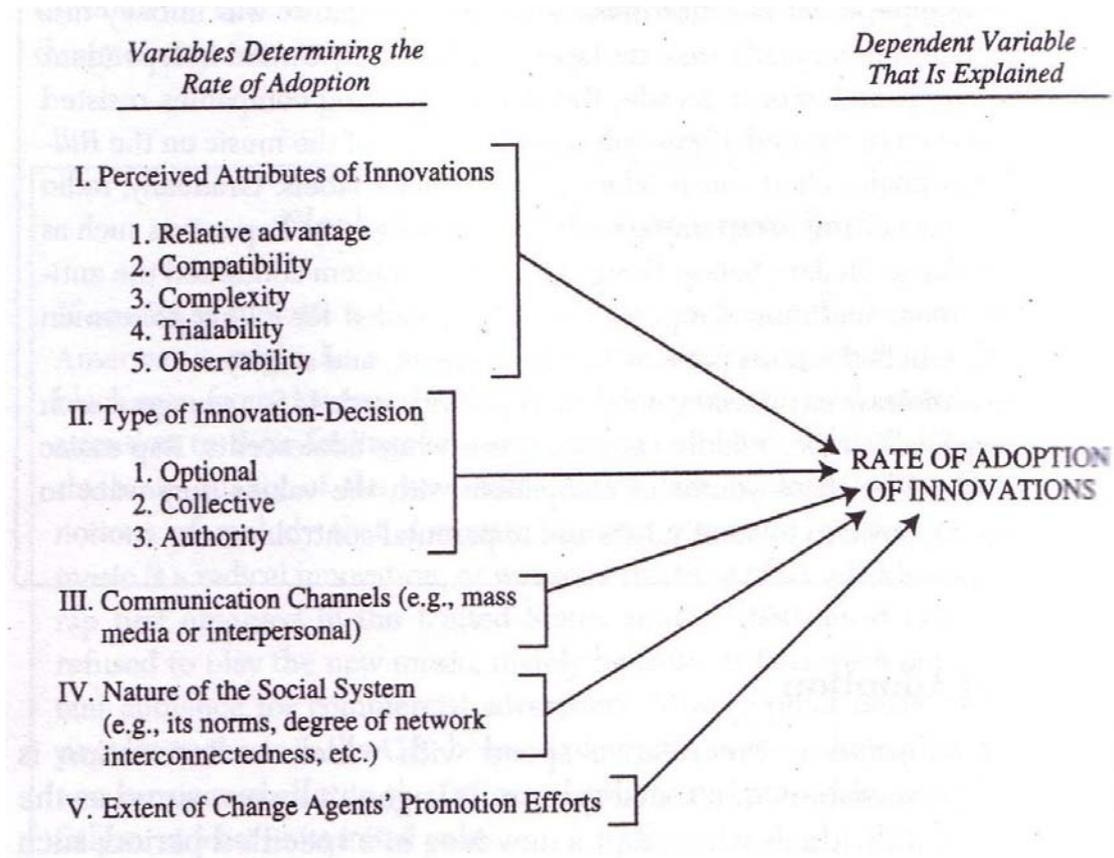


Figure 1 Variables determining the rate of adoption of innovation

Source: Rogers (2003)

Adopter Category

The criterion for adopter categorization is an innovation. The degree of individual or other unit adoption is how early he adopts new ideas compare with other members of a social system. Innovativeness is a relative dimension which considers individual who has more or less of this variable than others in a system. Figure 2 showed the adopter categorization on the basis of innovativeness. The innovativeness dimension, measured by the time that an individual adopts an innovation or innovations, is continuous. The innovativeness variables are partitioned into five adopter categories by laying off standard deviations (sd) from the average time of adoption (\bar{x}) (Rogers, 2003).

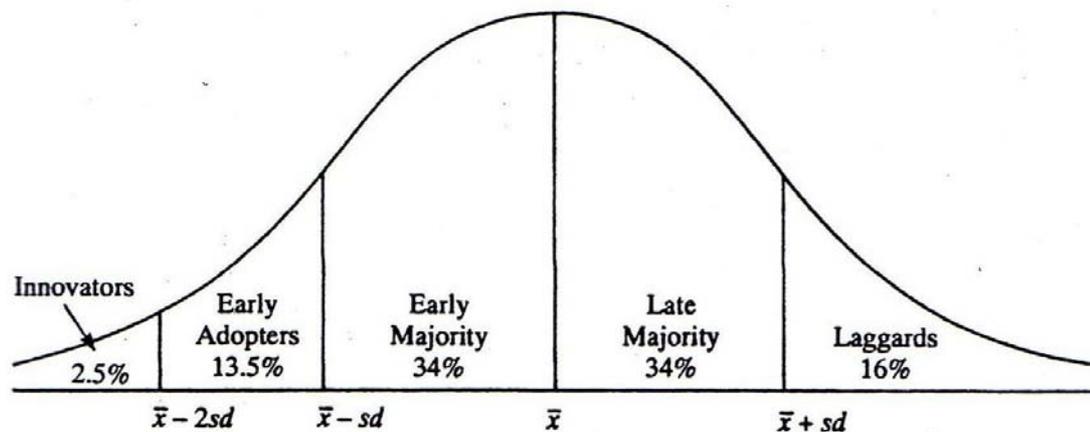


Figure 2 Adopter categorization on the basis of innovativeness

Source: Rogers (2003)

The five adopter categorization defined by Rogers (2003) are as followed:

1. **Innovators:** Venturesome: is almost an obsession with innovators. The farmers' attention to new ideas leads them out of a local circle of peer networks and forwards them into more cosmopolite social relationships. Being an innovator requires several prerequisites. The controlling of substantial financial resources is a helpful process by absorbing the possible losses from an unprofitable innovation. The ability to understand and apply complex technical knowledge is also needed. The innovator must be able to cope with high degrees of uncertainty about an innovation at the time he or she adopts.

2. **Early Adopters:** Respect: is a more integrated part of the local social system than the innovators. Whereas innovators are cosmopolites, early adopters are localites. This adopter category, has the highest degree of opinion leadership in most systems. The early adopter is considered to be "the individual to check with" before adopting a new idea. This adopter category is generally sought by change agents as a local missionary to speed up the diffusion process. Early adopters are not too far ahead from the average individual in innovativeness. Therefore, they serve as a role model for many other members of a social system. They help trigger the critical mass when

they adopt an innovation. The early adopter is respected by his or her peers, and is the embodiment of successful and discrete use of new ideas. Early adopters decrease uncertainty about a new idea by adopting it, and then conveying a subjective evaluation of the innovation to near peers through interpersonal networks.

3. Early Majority: Deliberate: adopts new ideas just before the average member of a social system. The early majority interacts frequently with its peers but seldom hold positions of opinion leadership in a social system. The early majority's unique location between the very early and the relatively late group to adopt makes it an important link in the diffusion process. It provides interconnectedness in the system's interpersonal networks. The early majority is one of the most numerous adopter categories, making up one third of all members of a social system. The early majority may deliberate for some time before completely adopting a new idea. Its innovation-decision period is relatively longer than that of the innovators and the early adopters.

4. Late Majority: Skeptical: adopts new ideas just after the average member of a social system. Like the early majority, the late majority make up 1/3 of the members of a social system. Adoption may be both an economic necessity for the late majority and the result of increasing peer pressures. Innovations are approached with a skeptical and cautious air, and the late majority does not adopt until most others in its system have already done so. The weight of system norms must definitely favor an innovation before the late majority are convinced to adopt. The pressure of peers is necessary to motivate adoption.

5. Laggards: Traditional: are the last in a social system to adopt an innovation. They possess almost no opinion leadership. They are the most localite of all adopter categories in their outlook. The point of reference for the laggard is the past. Decisions are often made in terms of what have been done previously. These individuals interact primarily with others who also have relatively traditional values. Laggards tend to be suspicious of innovations and of change agents. Their innovation-decision process is relatively lengthy, with adoption and use lagging far behind

awareness knowledge of a new idea. Resistance to innovations on the part of laggards may be entirely rational from the laggards' viewpoint because their resources are limited and they must be certain that a new idea will not fail before they start the adoption process.

Communication

Communication can be summarized as the transmission of a message from a sender to a receiver in an understandable manner. The communication has existed for thousand of years since the ancient Greeks and Romans have recognized communication as a powerful mean of influence.

Principle of communication

To appreciate the true nature of communication, it is important to understand the fundamental of its principle. There are four principles reported by William and Melissa (2005) as follows:

1. Communication is a process

Communication is considered a process, because it involves a series of actions that has no beginning or end. It is constantly changing. It also involves variables that can never be duplicated. The inter relationships among people, environments, skills, attitudes, status, experiences, and feelings all determine communication at any given moment. Communication is both ever-changing and capable of effecting change.

2. Communication is a system

A system is a combination of parts interdependently acting to form a whole. The human body is an excellent example of a system. All parts of the body are interdependent and work together to form one complex system. Systems also exist in

the workplace, in the family, and in the classroom. If the supervisor has a fight at home, that event may influence the supervisor's reaction with the workers.

3. Communication is both interactional and transactional

The interactional and transactional aspects of communication are closely related and should be considered together.

Interaction is an exchange of communication in which people take turns sending and receiving messages. The communication as an interaction is a phone conversation between two people. Each message is a separate action. Even though there is a reaction to each message being sent, the reaction and message are not simultaneous.

Transaction is used to extend the concept of interaction to include simultaneous action. Persons involved in transaction engage in sending (encoding) and receiving (decoding) message at the same time. For example, when teachers communicate to their students or supervisors to their employees, they not only send information but also receive information at the same time.

4. Communication can be intentional or unintentional

Intentional communication is a message that is purposely sent to a specific receiver. Unintentional communication is a message that is not intended to be sent or is not intended for the individual who received it.

Component of communication

William and Melissa (2005) reported that there are eight basic elements in the components of communication, its detail as follow:

1. Source: it is the creator of the message. It performs four roles such as

– Determining the meaning: a source has many decisions to make for creating a message. The meaning of some communication message is relatively simple, but others can be extremely complex and difficult.

– Encoding: Once the source has chosen a meaning, it encoded. In other words, the source translates its thoughts or feelings into words, sounds, and physical expressions. This translation makes up the actual message that is sent.

– Sending: the source then sends the message, which involves its ability to communicate overtly. To accomplish this, the source use voices and body to express the intended meaning accurately.

– Reacting: finally, the source must interpret the receiver's response to the message. The source's perception of a receiver's response in most communication situation is simultaneous with the response.

2. Message: It is the stimulus produced by the source. It comprises words, grammar, organization of thoughts, physical appearance, body movement, voice, aspects of the person's personality and self-concept, and personal style. Environment and noise can also shape the message.

3. Interference: It is a factor that changes the meaning of an intended message. Essentially, interference is anything that reduces or distorts the clarity, accuracy, meaning, understanding, or retention of a message. Interference can be external and physical, such as noise caused by the slamming of a door or the blasting of a stereo. Moreover, it can also be internal and psychological. For example, thoughts going through a person's mind can interfere with the reception or creation of a message.

4. Channel: It is the route that the message flows between sources and receivers. Social scientists recognize two types of channels: (1) sensory channels based on the five senses of sight, sound, touch, smell, and taste, and (2)

institutionalized means such as face-to-face conversation, printed materials, and the electronic media.

5. Receiver: It is the other individual who accepts the sender's message which is the goal of communication. The receiver in the S.M.C.R. model must attend to, interpret, and respond to the transmitted message. This process is called decoding.

6. Feedback: It is the response to a message, which the receiver sends back its information to the source. Feedback enables the sender to determine whether its communication is received and understood as intended. It is a natural extension of effective receiving. Receivers have the responsibility of attending to, decoding, and determining a message's intended meaning. Feedback is an essential component of the communication process, because it is a corrective device and is a means by which we learn about ourselves.

7. Environment: It refers to the psychological and physical surroundings when communication occurs. The environment encompasses the attitudes, feelings, perceptions, and relationships of the communicators as well as the characteristics of the location, for example, size, color, arrangement, decoration, and temperature of the room.

8. Context: It is the broad circumstances or situation when communication occurs. Communication does not occur in a vacuum. It can be in both informal or formal settings such as a chat between two friends or among five colleague in a business meeting, etc. The number of people, the type of communication, and the situation when the communication occurs all lend themselves to the context.

Type of communication

Type of communication is usually distinguished by the number of people involved, the purpose of the communication, and the degree of formality when it

occurs. Each type of communication involves appropriate verbal and nonverbal behaviors (William and Melissa, 2005) as defined below.

1. Intrapersonal communication

To communicate with other, the subject must understand how it communicates to itself. This process of understanding information within oneself is called intrapersonal communication. During the maturing process, one learns a lot of about itself and its surroundings. Most of the subject's learning process is gained from its own experiences. Even though there are many things that are taught by others. Still a lot of knowledge can only develop from experiences.

Intrapersonal communication also occurs anytime during the evaluation or the attemptation to understand the interaction that occurs during the process of message communication transferring. Intrapersonal communication includes diversified internal activities such as thinking, problem solving, conflict resolution, planning, emotion, stress, evaluation, and relationship development. All messages created for communication have to occur in the subject group. This makes communication a personal event, because one can never stop interacting with others, no matter how neutral or empathic one may think one are.

2. Interpersonal communication

The informal exchange of information between two or more people is defined as interpersonal communication. It is similar to intrapersonal communication that it helps us share information, solve problems, resolve conflicts, understand our perception of one self and others, and establish relationship with other. However, the sub components of the interpersonal communication differs it from the intrapersonal communication.

One of the sub components of interpersonal communication is a dyadic communication. It is simply defined as an exchange of information between two

people. It includes informal conversation, such as talk with a parent, spouse, child, friend, acquaintance, or stranger, as well as more formal conversation, such as interviews.

Another subcomponent of interpersonal communication is a small-group communication, an exchange of information among a relatively small number of persons, ideally five to seven. This group of people must share a common purpose such as doing a task, solving a problem, making a decision, or sharing an information.

3. Public communication

In public communication, a message is transmitted from a speaker to numbers of individual who listen. The most used form of public communication is a public speech. Although there are many similarities between public speaking and other types of communication. Yet, there are some differences. Public speaking almost always have higher structured than the other types. If it is done well, the speaker must have good detailed planning and preparation. Unlike participants in other types of communication, listeners do not regularly interrupt the speaker with questions or comments. It is the responsibility of the public speaker to anticipate questions that listeners may have and to attempt to answer them within the speaker.

Public speaking requires a more formal use of language and a more formal delivery style than other types. The use of jargon, poor grammar, or slang is usually not accepted or tolerated in public speeches. The public speaker must use language precisely and must speak clearly in order to be heard throughout the audience. The speaker is required to eliminate any distracting vocal and physical mannerisms. Public speeches are often presented for three purposes: to inform, to persuade, and to entertain. They are also presented to introduce, to pay tribute, to accept, and to welcome.

4. Mass and mediated communication

Mediated communication is any communication that is transmitted by some kind of mechanistic means, such as radio, television, telephone, or the internet. It can also be one-on-one communication. Mass communication, on the other hand, generally means the communication with or to a large number of people. Radio, television, newspapers, magazines, books, the World Wide Web, movies, recordings, CD-ROM, and DVD are types of mass communication. They are the means that transmits messages to a large group (mass) of people. It is usually confusing when some media form is use to communicate with large numbers of people. Despite the popularity of mass communication, there is very little interaction between the sender and the receiver of the message.

Technology has advanced very quick. It is very popular so that relatively inexpensive hardware and software can be bough. Then the users can have globally “face-to-face conversation.” Digital cameras allow the users to share pictures of themselves, our families, and special events with friends all over the world. Email message has even become a part of the international space program. As technology continues to develop and change, one thing remains consistent: Communication is the process that helps connecting people. Communication is a learning tool that helps people in their personal and family lives, their social and work lives, and in their roles as citizens of the world.

Media exposure

When discussing the use of media in extension, we must consider the role of these media in an extension program and how they can be used effectively. It is necessary to discuss the effects of using the mass media and how this media can be used to ensure the clarifies meaning of the massage. The media exposure can be as follow:

1. Printed media: is covering those communication techniques that rely principally on combinations of printed words and pictures. It is the oldest formal combination. To use the printed media effectively the education level and literacy rate of the audience must be considered. Extension programs can take a broad and creative approach in printing methods to convey news to specific audiences (Behrens, and Evans, 1984). There are many forms of the printed media such as:

Newspapers: It provides valuable channel for transmission of educational information to the place where it exists and to the people who receive and read it. Even among illiterate people, there are usually a few who can read and pass on information to their friends. It varies greatly in its audiences and coverage, from the large urban daily newspaper to the small community newspaper. The newspaper can be published by governmental, private, or other organizations (some time including extension). Also it can provide valuable channels for extension news.

Folders, Leaflets and Pamphlets: These printed media forms can be used in many ways in extension programs. They may be used singly, in series of broader subjects; they may also be used in co-ordination with other visual methods in long-range campaigns. They are useful to be a supplement for larger publications when new information is available and when reprinting the whole publication is not practical. Beside those advantages, folders, leaflets and pamphlets take less time to get their message across. Their smaller size makes it necessary for the author to eliminate non-essential information from the message.

2. Audio-visual media: It is the communication methods that rely on the audio or visual senses, either alone or in combination, help overcome the barrier of illiteracy and offer special advantaged (Behrens, and Evans, 1984) such as:

Radio: It can be one of the most useful mass communication tools for extension workers, for several reasons. It offers immediacy, as radio programming can be changed quickly to meet new conditions. It reaches large numbers of people, especially as transistor radios become used more widely. It allows listeners to take

their radio wherever they go, even where electrical power is not available. The radio provides the warmth of the human voice. It can tie into the strong oral traditions of communities and overcome literacy barriers that face print media. However, listeners cannot refer back to what they have heard on the radio, nor can they see what is being described. So the radio is limited in its ability to convey detailed complex information and, used alone, is limited as a teaching method.

Television: The broadcasting on television offers exciting possibilities for extension workers. Two types of television media are available for teaching purposes. The first and most familiar is broadcast television, in which programs are aired over a large geographical area. The second type is sometimes referred to as closed-circuit television. The closed-circuit television takes a video signal from a tape or a cassette and carries it over a cable to one or more monitors. The monitors may be in several locations or next to the video player.

Projected visuals: Motion pictures, slides, filmstrips and overhead transparencies are among the most popular and the most effective of the visual teaching aids. However, they also have important limitations along with their advantages.

3. Static media: This group of media derives its name from the fact that the material does not involve motion or sound. Examples of this type of media are posters, flip charts, wall charts, maps, chalkboards (black or colors), magnetic boards and flannel boards. Static media is the best method when used with small or intimate groups for maximum visibility. During the use of static visuals, it needs to be sure that they are displayed prominently and are well-lit, so that numbers of audience can see them clearly. They need to be secure, but do not be embarrassed by materials that fall to the floor (Behrens, and Evans, 1984).

Posters: It is a sheet of paper or cardboard with an illustration and, usually, a few simple words. It is designed to catch the attention of the passers-by, to emphasize a fact or an idea, to stimulate the audience's support of the idea, to obtain more information, or to take some kind of action. People usually do not walk around

studying posters. They look at posters in the same way they look at trees, birds, houses, cows, or other persons. A brief glance is usually the most time the average person take a look on any object to identify it. If something about the object catches the attention or stimulates interest, the passers-by will look at it longer

Exhibits and displays: They have some of the same characteristics as posters, covered in the preceding section. The main differences of exhibits and displays usually are the larger size and the more detailed information. As with the poster, the job of the exhibit or display is to catch the attention of the passer-by, impress on him or her on a fact or an idea, stimulate interest in the subject matter presented, and possibly urge him or her to take some sort of action. Due to their large size and because they usually are paced in the market place or other areas where people move slowly, exhibits and displays attract and hold attention for longer periods than posters.

Agricultural Extension

The word “extension” is well known and is accepted by people who work in extension organizations and services, but is not well understood in the wider community. However, the common meaning for the term is that extension involves the conscious use of communication of information to help people form sound opinions and good decisions. Some differences of opinion about the meaning of extension relate to questions such as the situations which concerned only with the formation of opinions, or concerned also with decision-making the concentration of the research on the increasing farmers’ knowledge, or the farmer’s awareness of problem and clarifying their goals, the choice of the extension organization to consider one opinion or one decision optimal for its farmer clients, the researcher’s satisfaction when the farmer makes one good decision, or the researcher’s assistance with decision-making as a way of teaching the farmer to make similar decisions in the future. Many extension organizations pay some attention to all these aspects of extension (Ban and Hawkins, 1997).

Definition

Maunder (1972) defined that agricultural extension is a service or system assisting farm people through educational procedures. It improves farming methods and techniques that help increasing production efficiency and income, better the farmers' life, and lift the social and educational standards of that area.

Agricultural extension as an informal out-of-school educational service is designed to train and influence farmers to adopt the new ideas and technologies in agriculture and home economy. Extension is, however, not only limited to agriculture at the farm, but it also concerns on the societal changes that will enable farm people and rural non-farm people to make a total adjustment to their own life (Zainuddin *et al.* 1987).

Contado (1997) indicated that farmers view extension as a form of assistance to improve their know-how, efficiency, productivity, profitability of their farms, and contribution to their family then community, and society. Politicians, planners, and policy makers in developing countries view extension as a policy instrument to increase agricultural production, achieve national food security, and alleviate rural poverty.

Objective

Arnon (1989) defined that the objective of extension is not only to bring about an improvement in farming practices through the application of new sciences and technologies, but also to promote the social, cultural, recreational, intellectual and spiritual life of rural people. Franco (1966) indicated that when new practices are adopted or when new skills are learned and used, it is believed that the goal of helping people has been reached. The new knowledge is important if people would like to raise their income or standard of living. This will enable them to contribute more to society.

The aim of all extension work is to teach people living in rural areas how to raise their standard of living with their own efforts and using their own resources of manpower and materials, and minimizing the assistance from government. By encouraging local leadership and a spirit of self-help, extension develops civic pride and the progressive growth of the community (Savile, 1968). It is assumed that, if farmers increase their production, the nation will be better, and also that farm families will be better off (Axinn, 1988).

The role of agricultural extension

A major goal of the agricultural development policy in most countries is to increase food production at a similar rate to that the demand for food is increasing, and at a cost which is competitive on world markets. It is appreciated more and more that such development must be sustainable, and that often it must be done in a different way than it was in the past.

The major role of extension in many countries in the past has been seen as the transfer of new technologies from researchers to the farmers. Now it is considered as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose, and by helping them to develop insight into the consequences of each option. Farmers seek information not only from their extension agent but also from ranges of sources, including their own experiences and those of their colleagues to develop this insight. Government policies, such as those on environmental problems, have an increasing impact on the options open to farmers.

The role of an agricultural extension agent is to help farmers form sound opinion and to make good decision by communicating with them and providing them with information they need. Farmers' opinions and decisions are based on their image of the reality in which they live and on their expectations of the consequences of their actions in the reality. However, these expectations are not always correct because their image of reality never agrees completely with reality itself. The extension agent therefore has a major task in helping farmers to realize the reality. This gives farmers

more control over their own lives because their actions are likely to have the desired consequences more frequently. Thus, by achieving desired consequences more frequently, the farmers would be better adapted to take control of their own lives.

People acquire their images of the reality in which they live by learning from their own experiences, by observing other people's experiences, by talking with other people about their experiences and research findings, and by thinking about information they have gained. The extension agents' role is to promote and support this learning process. In doing so they will improve their own image of reality by learning from the farmers (Ban and Hawkins, 1997).

The extension-teaching methods

The primary responsibility of extension workers is education. A substantial number of proven educational methods or techniques exist from the extension worker is choice to set up learning situations and to maximize the transfer of information and skills to young and adult learners. Once the needs of an area or community have been identified, it is the task of extension workers to choose the teaching methods that will be the most effective in achieving their educational objectives (Kang and Song, 1984). In general, extension-teaching methods can be classified into three groups as follows:

1. Individual-teaching methods: the extension worker, interacting on a one-to-one basis with the people, is utilizing an individual method of education. Although this approach is time-consuming, it is very important because it is working individually with the clientele so that the extension worker learns about the people of the area, how they think, what their needs are, and how they carry on their work. Equally important point gaining from this method is the opportunity individual contact provides for the local citizen to get to know the extension worker so that the personal bond between the extension worker and the community can be established. Through the use of this method, the extension worker's credibility and integrity can be nurtured. This method is widely used and have been found to be highly effective when dealing with illiterate farmers working in small holdings who are not normally

exposed to other educational techniques (Kang and Song, 1984). There are five methods in individual-teaching methods as following:

Method 1: Farm and Home Visit: This method provides a direct means for an extension worker to meet with a farmer or some members of his family at his home or on his farm for a specific purpose. Such purpose may be any one of the following: (1) to get acquainted with the farmer and to gain his friendship; (2) to observe and discuss individual or village problem; (3) to plan a demonstration; (4) to teach skills or to answer a request for a specific help; and (5) to observe and record result of a certain farm practice- a follow-up.

Since farm and home visit must be meaningful, they should be carefully planned. During the visit, the following point should be kept in mind:

1. Establish a friendly atmosphere with the farmer and his family,
2. Spend a reasonable time and adhere closely to the main purpose,
3. Be tactful, natural, observant and courteous,
4. Consider the social, economic and religious background of the farm family,
5. Use simple language and avoid the use of technical terms,
6. Let the farmer do most of the talking and do not interrupt him,
7. Be sincere in learning as well as teaching,
8. Let the farmer take the credit for good ideas,
9. Present the farmer some seeds or an extension publication, if useful. This will help friendship,
10. Leave the farm or home as a friend,
11. Inform the farmer if another visit is to be made,
12. Record the visit, including date, purpose, accomplishments and commitments.

Method 2: Office call and inquiries: This method is concerned with personal visits made by the clientele to the extension office, to seek information and assistance. To encourage office visits, extension workers should consider the following: (1) place

the extension office in a convenient location; (2) keep regular office hours so clients will know when the extension worker will be available. A visitors' record book must be provided, so clients may register their visit and their inquiry on the extension worker. The extension worker may then contact the visitors at a later time; (3) keep the office neat, orderly, and attractive; (4) maintain an up-to-date bulletin board and have information materials readily available; (5) make a special effort to put the visitor at ease, especially if the individual appears to be shy in the unfamiliar environment. It may be necessary for the extension worker to ask questions in order to determine the visitor's concerns or questions.

Method 3: Informal contacts: They are the unstructured and/or planned meetings with clientele in an informal setting. Such meetings provide the extension worker with an opportunity to meet clientele in an informal situation. These meetings facilitate the establishment of a personal bond, discussion of problems, and the recommendation of solutions. Informal contacts can take place on the street, in the market place or at local celebrations. These meetings often take place by chance and are casual in nature. An effective extension worker must be skillful in utilizing such informal teaching situations.

Method 4: The model farmer: It involves the identification of a farmer whose farming methods and personal attitudes are so superior that his or her operation can serve as a model for others to follow. The purpose of selecting a model farmer is to demonstrate good farming practices from an outstanding local example, to persuade the clientele to adopt a better farming practices, and to create a learning situation of the farmers. The model farmer technique will be the most effective, if the individual involved is well-liked and respected, and can follow his or her voluntarily.

Method 5: The field flag: A final recommendation concerns an individual communication technique used when farmers and their families are not at home or in their fields when the extension worker visits. This method, which is developed by Korean extension workers, functions as follows. An extension worker visits a farm to help the farmer identify plant diseases and harmful insects in a rice paddy. The result

of the crop examination and recommendation for treatment, if any, are written down and placed in the pocket of a red vinyl flag that is attached to a thin pole or a stiff wire. The red flag is placed in the field where the farmer can easily find it. After reading the message, the farmer rolls up the flag and replaces in the same location. The extension worker recovers the flag on the next trip by the field (Kang, and Song, 1984).

2. Group-teaching methods: These methods are more frequently used in extension work than individual teaching techniques. This is not surprising because, by utilizing group techniques, an extension worker can reach more people than the individual methods. This is an important factor when time and staff are limited. Group methods are especially effective in persuading extension's clientele to try a new idea or practice. A group decision to try a new practice, for example, is likely to carry more weight in an area than a similar decision made by an individual (Kang and Song, 1984). There are many methods in group-teaching techniques such as:

– *The method demonstration:* It shows a group or class how something is done step-by-step for the purpose of teaching new techniques and practices to extension clientele. A method demonstration can show how to use a tool, a new planting technique to prevent erosion, or how to cook a newly introduced vegetable. Ideally, each individual attending the demonstration would have an opportunity to practice the new skill during the session.

– *The result demonstration:* It teaches why a practice or input should be adopted by physically showing the differences between a new practice and a commonly-used local practice. This technique is often used in crop farming. The purpose of using this method is to prove that the new practice is superior to the one currently being used, to persuade extension clientele to try the new practice, and to set up a long-term teaching situation.

– *The field trip:* On a field trip, a group travels to another location to observe agricultural practices, projects or demonstrations not available locally. The trip may

consist of one or more stops. The purpose of the field trip are (1) to provide first-hand observation of practices that might be benefit to the farmer or householder and farm worker, (2) to enable the group to interact with individuals knowledgeable about the practices, and (3) to present a fresh and different learning environment for both the extension worker and the clientele.

– *The field day*: It is a day or days on which an area containing successful farming or practices opens for people to visit. Exhibitions of a related nature such as tools, seed samples and educational material are often displayed. Field days are normally held once or twice a year, usually in each crop season. They are held on farms, experimental stations or government centers to demonstrate successful farming techniques or research. The purpose of the field day is to permit extension clientele to observe and ask about successful farming practices, and to create a situation in which informal contacts and learning can take place.

– *Informal discussion*: It is another type of group teaching in a small community. The neighbours get together in a certain house at a certain period once a month, or perhaps once a week. The group will have a discussion in order to consider and communicate the common public problems, to get acquainted with the neighbours, to exchange farming information and ideas, and to share common problems, which will benefit themselves and the community. The informal discussion is carried out at the villagers' monthly meeting. This discussion group do not have any kind of professional leadership. The idea is to have responsible villagers setting together to consider and talk about common problem.

– *Workshop*: It is a co-operative gathering of individual who discuss, learn, and apply practical skills. Participants are trained in skill, procedure or practice, which can be immediately utilized. Those attendance are expected to develop a product, such as a visual aid, by the end of the meeting. The workshop normally involves between 15 and 30 people. Workshop can be a very effective teaching tool because every participant spends one or more days intensively working on a specific subject.

– *Discussion group*: It is a meeting or a conversation between two or more people discussing a topic of mutual concern. Members of the group normally share a common back-ground based on assigned readings or shared educational experiences. The purpose of this technique is to provide members of a group with an opportunity to gain a firmer grasp upon knowledge by setting up a situation which questions, problems, and feelings about a topic may be discussed.

– *Role-playing*: It is a simulation that a simple, open-ended scenario is described, and participants are assigned roles to act out the situation or problem. There is no script to follow, and participants play the roles, drawing from their own experiences. Its purpose is to involve participants in real life situations, to stimulate thought and learning, and to encourage discussion about factors involved in the drama.

3. Mass media-teaching methods: They are the transmitting of messages that involve a mass medium, such as radio, television, newspapers, magazines, slide shows, exhibits, and so on. These methods enable a source of one or a few individuals to reach an audience of many. The method can (1) reach a large audience rapidly, (2) create knowledge and spread information, and (3) change weakly held attitudes (Rogers, 2003).

Moreover, mass media-teaching methods are particularly useful in making large number of people aware of new ideas and practices, or alerting them to sudden emergencies. While the amount of detailed information that can be transmitted by mass media is limited, they will serve an important and valuable function in stimulating farmer's interest in new ideas. Once stimulated or made aware through mass media, farmers will seek additional information from neighbours, friends, extension workers or progressive farmers in the area (Behrens and Evans, 1984).

Agricultural Extension System in Asian Countries

The origin of systematic agricultural extension activities in Asia dates as far as the 16th century in the Philippines, to middle of the 19th century in some areas of the Indian continent and the beginning of the 20th century in Malaysia. Their objectives and forms are entirely different from what are seen today. Most of them are established for promoting export crops for the benefit of the colonial powers. Later on, a great majority of countries creates their respective extension system like Thailand in 1967, Nepal in 1966, and China in 1952 (Tajima, 1994).

Education is the principle objective of agricultural extension system. The effective education requires the use of the educational methods or extension approaches to transfer the improved technologies to farm producers. These extension approaches are hard to apply for all country because of differences of local, regional, and cropping patterns in each country. Pakistanian uses the farmers training, field trials, demonstrations, and T & V approaches. Indonesian uses the contact farmers, farmers' field workshop, farmer field school, and mass media. The Philippines uses T & V system, participatory, and group discussion. In Thailand, T & V system, demonstration, and on-farm trial are used by the extension agents (Jalil, 1994).

One of the biggest constrains of the extension system in Asia is the lack of transportation facilities and other essential equipment need to be used by the extension field personnel. The extension agents are expected to transport a long distances to their clients with inadequate bicycle or motorbike. Those vehicles could have facilitated their efforts. Materials for demonstration, publications, poster, and other necessary components for the extension activities are in a serious constraint and absent. In most less developed countries (LDCs), the number of extension workers is so disproportionate to the number of producers which prevents extension programs from significant reaching or influencing the majority of farmers (Swanson *et al*, 1997).

The actual ration of one extension agent to farmers varies considerably from country to country. In India and Zambia, it is about 1:800, whereas it is over 1: 8,000 in Bolivia (Arnon, 1989). Phongprapai and Setty (1988) found the ratio of the extension agents to farm family in Thailand is 1: 1,000. One-extension agent had to take care approximately one sub-district or about ten villages whilst the ratio of extension agent to farmers ranges from 1:350 in the Philippines. However, Blanckenburg (1984) found the number of farmers in Asian countries that an extension agent can actually reach in a year is about 1,000 and states that if the extension services make a major impact on rural development, a critical minimum extension density of 1,500 to 2,000 households should be reached. This statement has great implication for agricultural extension management in countries, where the extension agent to farmer's ration is still low compared to available farm producers.

Agricultural Extension System in Cambodia

Situation

The first issue focuses on the concept and policy of agricultural extension. It is was a broad consensus that extension is a central mechanism in the agricultural development process, both in terms of technology transfer and human capital development. It is recognized that economic pressure is forcing extension to justify itself on more immediate economic criteria that are closely related to technology transfer and increasing agricultural productivity. However, this viewpoint ignores extension's traditional role in human resource development, a contribution that is essential to broad-based agricultural development. It is agreed that to achieve long-term, sustainable agricultural development, both objective must be pursued in a balanced programmatic effort. It is also noted that legislation is generally essential to provide the policy mandate, direction, and necessary support to build a stable, effective extension system.

The second issue considered is the target clientele of extension. It is recognized that urban food requirements and economic factors frequently reinforce extension's tendency to focus more heavily on the commercial farm sector.

Cambodia extension is inseparable from the task of community development. The regular visits of an educated person to villages constitute a resource that communities wish to tap for many purposes. Some female extension workers have suggested that eighty percent of their village activities are the community development. Given the statistics on widowhood and literacy, it will remain the case for the medium term. Extension, like many other integrating disciplines, lacks a definition enjoying universal acclaim. At the very least however, it involves transfer of technology which is relevant and appropriate on its responding to the expressed concerns of farmers. In execution, it must use the principles of adult education. Realists will acknowledge that government policies concerning important substitution, diversification, production target, etc., will require implementation staff who are government extension workers.

Again, the non-government organization (NGO) movement in Cambodia will be a constant need to train counterparts from the agricultural sector. Accordingly the emergent government extension workers will find themselves cast in array of roles. It will be a major challenge to prepare the organization and the extension worker for this multiplicity of role (Cambodia-Australia Agricultural Extension Project, 1994).

Strategy

An institutional foundation will be established for local staff to identify needs, and plan to undertake the next stage of the development process. The strategy available to extension planners extend from the Training and Visit (T&V) system. T&V system focuses on improving organization and management through contact farmers by using the human development model that emphasizes the role of the extension worker as an adviser and learning facilitator and a cost-effectiveness model that advocated the use of mass media and private sector. Yet, the extension staffs have

not decided an appropriated extension model for Cambodia. This model needs to find a balance between the needs of the rural sector and the limited resources of the government at this stage of the country's development. Consequently, provision has been made for technical assistance and study tours to provide agricultural extension staff with the opportunity to gather the necessary information to make these judgments (Cambodia–Australia Agricultural Extension Project, 1994).

National Policy

Ministry of Agriculture, Forestry and Fisheries (MAFF) has accepted a national extension policy framework developed by an AusAID-funded policy advisor. Under this policy initiative, the government extension delivery systems will focus at the district level and create a situation where:

- Agro-ecosystems analysis or similar procedures are used at the district level to identify locally important problems or opportunities and set district extension priorities.
- District agriculture staffs, who mainly responsible for technology transfer to the farming community, are given responsibility for developing and managing extension programs for their district. These staffs are part of the District Agriculture Office under the management of the District Agriculture Chief.
- The district agriculture staffs are supported technically by subject matter specialists from the technical offices of the Provincial Department of Agriculture, Forestry and Fisheries (PDAFF) or from MAFF central technical departments.
- District agriculture staffs are supported with HRD and training managed by Provincial Office of Agricultural Extension (OAE) and central Department of Agricultural Extension (DAE) staff to upgrade their analytical, group organization and communication skills and capacity.

- District agriculture staff are supported in extension programs and activities with extension media materials produced in co-operation between OAE staff and the central DAE.

- Extension delivery systems involve key contact farmers in the design, implementation and evaluation of programs and make use of contact farmers and community/group entry points for the implementation of extension activities.

- MAFF develops an environment under the private sector and other agencies are encouraged to participate in information transfer and the provision of extension services.

The role of the district agriculture officer under the proposed structure describes in Figure 3. In essence, this shows the replication phase of any Extension Program Package (EPP) that the district agriculture staff conduct demonstrations on contact farmers fields and uses these demonstration sites as a major vehicle for transferring the specific EPP message through any of a range of appropriate extension methods.

Before the replication phase, the district agriculture staff will have been involved with research, Subject Matter Specialist (SMS) staff and contact farmers in developing and verifying the research finally into an EPP. The district agriculture staff is therefore, as shown, the bridge between research and the farmers. Figure 3 also shows the importance of farmer groups and key contact farmers in transmitting extension messages to the majority of farmers through a process of farmer to farmer extension (MAFF.2000: Guidelines for Agricultural Extension in Cambodia).

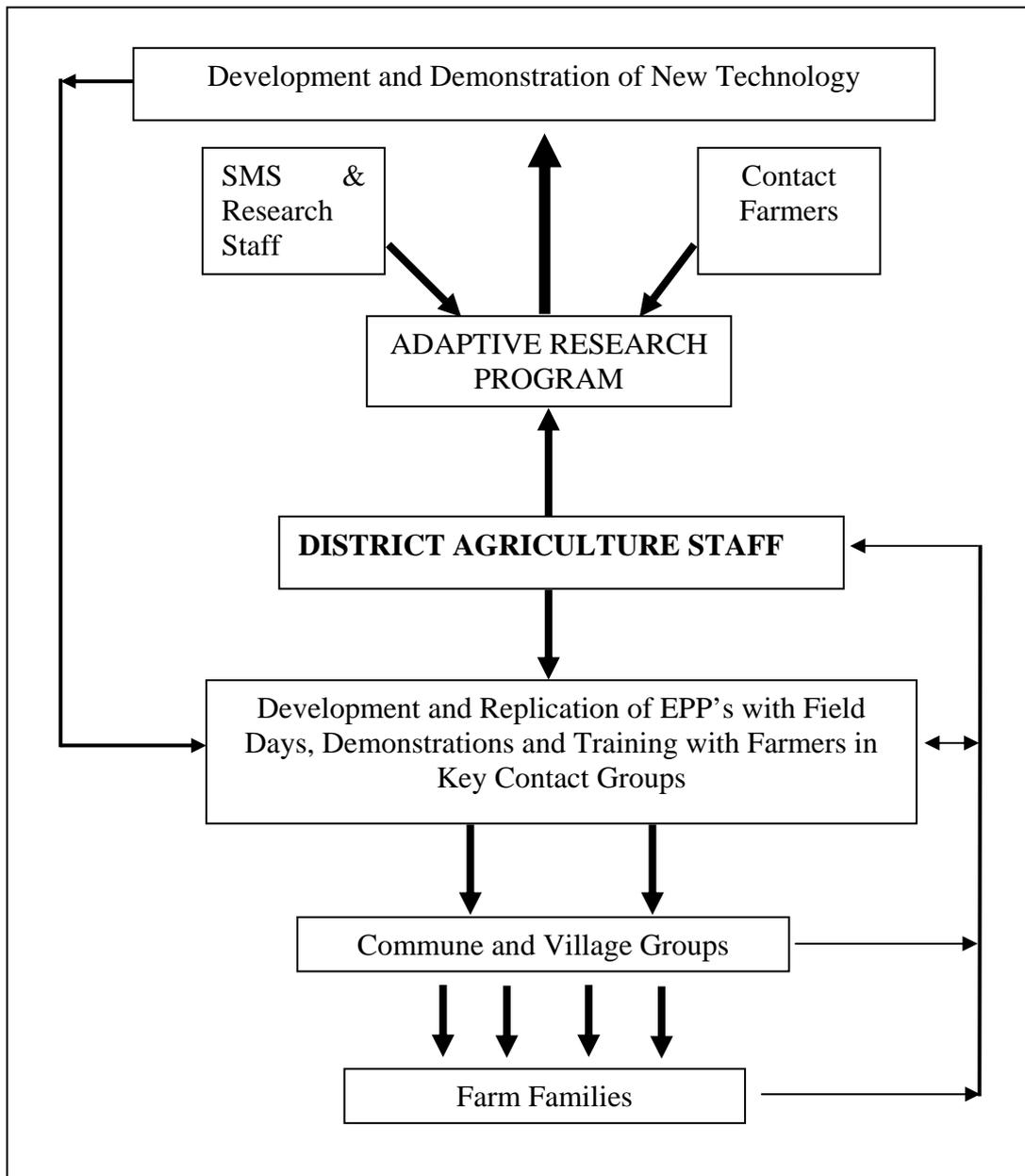


Figure 3 Schematic representation of the technology transfer role of the district agriculture staff.

Source: MAFF (2000)

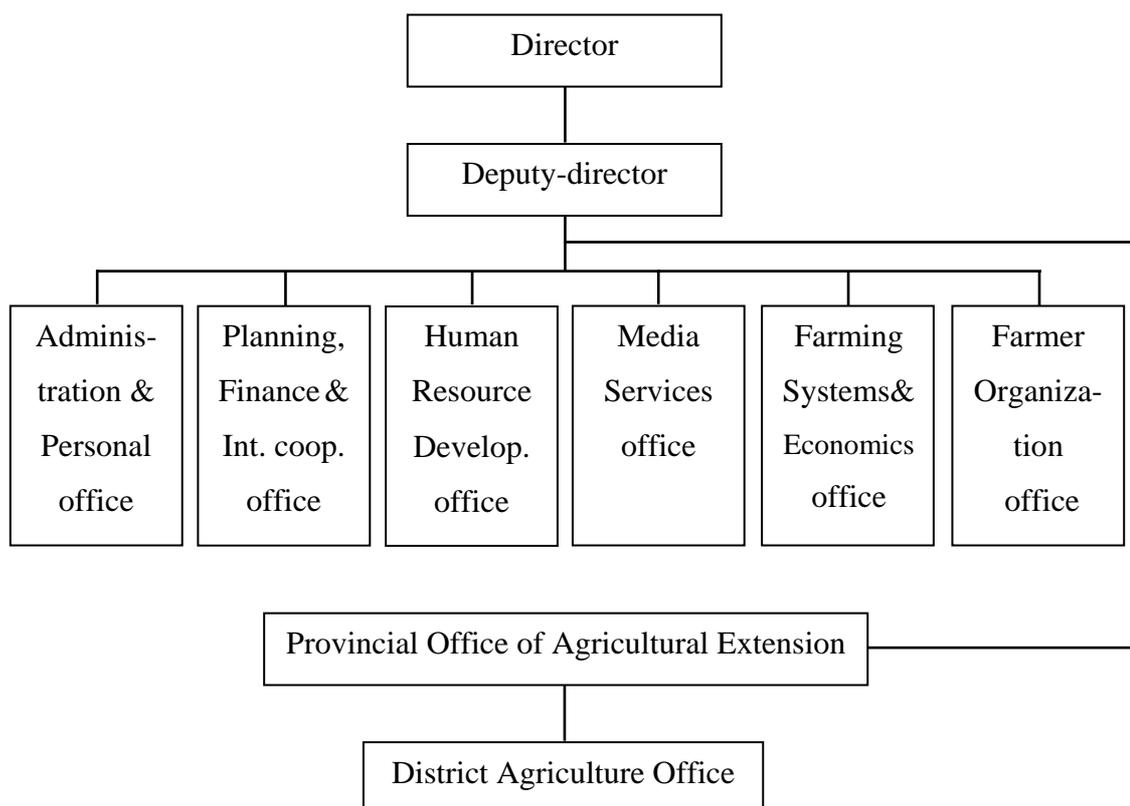


Figure 4 Organization chart of the department of agricultural extension

Source: MAFF (2000)

The System of Rice Intensification (SRI)

What is SRI?

The System of Rice Intensification, in French, le System de Riziculture intensive, is referred as SRI in English. It is called a “system” rather than a “technology” because it is not a fixed set of practices. While numbers of specific practices are basically associated with SRI, these should always be tested and varied according to local conditions rather than simply adopted.

With a good use of these practices, it is usually possible to increase rice yields by 50 to 100%, and increases of 200 to 300% have been achieved where the initial level of production is low. Such increases can be attained without requiring farmers to

change varieties or to use any purchased inputs. Only about half as much water is needed with SRI, it can be substantial water savings from this method of production.

SRI is a system of rice growing where the plant growth environment on a micro scale, particularly within the root zone, is deliberately modified. Multi-fold increase of rice yield through SRI is based on the supposition that micro-scale modification rekindles the existing genetic potential that has been suppressed by crop, soil, water and nutrient management practices used when growing irrigated rice (Uphoff, 2002).

History

SRI was developed nearly 20 years ago by Fr. Henri de Laulanié, SJ, who worked with farming communities in Madagascar from 1961 until his death in 1995. In conventional rice growing, the plants spent most of the season partially submerged in water. During a 1983 drought, many farmers could not flood their paddy fields, and de Laulanié noticed that the rice plants, in particular, their roots, showed unusually vigorous growth.

From this and other observations, de Laulanié developed the SRI practice: rice seedlings were transplanted quickly when young, spaced widely apart, and most importantly, the rice fields were kept moist but not flooded. In addition, he emphasized using organic compost over chemical fertilizers, so that both poor and rich farmers could practice SRI.

Norman Uphoff, a political scientist and director of the Cornell International Institute for Food, Agriculture and Development (CIIFAD) at Cornell University in Ithaca, New York, stepped into the picture in 1993. He was part of a team trying to find alternatives to the damaging types of slash-and-burn agriculture that was destroying Madagascar's rainforest. It was clear to Uphoff that if rice yields in the area increased about 2 tones per hectare, then a lot of forest could be saved. He came across de Laulanié's non-profit organization, 'Tefy Saina' meaning "to improve the

mind". He was looking for a yield of 4 tones per hectare, and when he heard them say they could get 5 or more, he did not believe them. His doubts were vanished once farmers in the rainforest regions started using SRI. The results were stunning. "By the end of the second growing season we were getting 8 tones per hectare". In 1997, Uphoff began promoting SRI throughout Asia (Uphoff, 2002).

Principles

The underlying principles of the system of rice intensification are:

- Rice is not an aquatic plant. Although rice can survive when growing under flooded (hypoxic) conditions, it does not really thrive in such a soil environment. Under continuous submergence, most of the rice plant's roots remain in the top 6-10 cm of soil, and mostly degenerate by the start of the plant's reproductive phase.

- Rice seedlings lose much of their growth potential if they are transplanted for more than 15 days after they have emerged in their nursery. Their potential for greater tillering and root growth can be preserved by early transplanting in conjunction with the other SRI practices.

- During transplanting, the farmer should avoid any trauma to seedlings and especially to the rice roots. Stresses, such as drying out seedling roots, can delay the resumption of plant growth after transplanting and reduce subsequent tillering, root development and grain filling. If germination is high enough, direct seeding can be used with SRI practices instead of transplanting as direct seeding can avoid root trauma entirely.

- Wider spacing of plants leads to greater root growth and associated tillering. It also provides that favorable conditions for rice growth, such as soil aeration, are provided.

- Soil aeration and organic matter create beneficial conditions for plant root growth and consequently plant vigor and health. It is the result from having a greater abundance and diversity of microbial life in the soil, which helping plants resist pest and disease damage. Increased root exudation enhances soil biotic populations.

These principles are transferred into a set of practices which should be applied, to local conditions and environments:

- First, transplant young seedlings, preferably 8-12 days old and not more than 15 days old, when the plant still has only two small leaves and the seed sac is still attached to the root. The seedling nursery should be maintained like a garden, watering intermittently and not kept submerged.

- Second, transplant seedlings quickly and carefully, allowing only 15-30 minutes between uprooting from the nursery and planting in the field. Seedlings should be put 1-2 cm deep into soil that is muddy but not flooded. They should be laid into the soil with care, with roots lying horizontally so that their root tips are not inverted upward.

- Third, plant the seedlings far apart, with one seedling per hill and relatively few plants per m². In poorer soils, two plants per hill may give more tillers per m² but certainly more plants in a hill than what recommended will inhibit root growth due to competition between plants for nutrients and light.

- Fourth, plant in a square pattern to facilitate weeding. The most common SRI spacing is 25x25 cm, but with good soil conditions, hills up to 50x50 cm apart may give the best yield. With plants in a square pattern, weeding can be done in perpendicular directions.

- Fifth, after panicle initiation, keep only a thin layer of water on the field (1-2 cm) until 10-15 days before harvest, when the field should be drained. During the period of tillering, either:

a. Apply small amounts of water daily - just to keep the soil moist but never saturated, with no standing water. During tillering, the field should be allowed to dry out for several short periods of 3-6 days to the point of surface cracking, or

b. Flood and dry the field for alternating periods, each 3-6 days, throughout the period of vegetative growth.

– Sixth, after using either method of water management, it is necessary to avoid continuous hypoxic soil conditions that will cause the roots to turn brown and die back. Aerated soil, on the other hand, supports profuse root growth.

– Seventh, there should be early and frequent weeding. This is best done with a simple hand push-weeder, often called a 'rotating hoe,' starting about 10 days after transplanting. Then weed about every 10 days, at least once more, and if possible 2 or 3 times more, until canopy closure makes weeding difficult and no longer necessary. These later weeding aerates the soil, accomplishing more than just removing weeds.

– Lastly, add nutrients to the soil, preferably in organic forms such as compost or mulch. This is optional since the above practices will increase yield in almost any soil, at least for several years. The best results with SRI come from soil that is rich in organic matter and microbial activity. SRI farmers often apply their compost to a preceding crop, such as potatoes or beans, rather than to the rice crop itself, to give it more time for decomposition and microbial multiplication. Chemical fertilizers can be used with SRI practices raise yield, but they do not contribute much to soil quality over longer time period, which is a key factor in best SRI performance (Anthofer, 2004).

The Situation of SRI in Cambodia

The Royal Government of Cambodia has integrated SRI promotion into its national development plan for 2006-2010 given the results demonstrated with these

methods. The Ministers of Agriculture, Forestry and Fisheries, and Environment are personally promoting SRI.

However, the director of the Center for Studies and Development of Cambodian Agriculture (CEDAC), first tried SRI methods in 1999 after reading about them in the ILEIA newsletter. He wanted to make sure that the methods worked before promoting them as part of CEDAC's program for farming system intensification and diversification. In 2000, CEDAC was able to get 28 farmers to try out the SRI methods. Their good results encouraged 400 farmers to use SRI in 2001, and 3,000 farmers in 2002. In 2003, the total of 10,000 farmers had used SRI methods. In 2004, even though there was less expansion than expected because of severe drought, the number of SRI users was at least 17,092. By the end of 2005, the total of farmers, who used the SRI reached as many as 50,000. The spread had been promoted particularly by farmer initiative.

Moreover, CEDAC had done a longitudinal evaluation of SRI experience of 120 farmers who had used SRI methods for three years (2001, 2002 and 2003). Even though not all had been still using all of the SRI methods as recommended, the evaluation showed that even an incomplete use of SRI enabled them to get 2.75 t/ha average compared to 1.34 t/ha with conventional means. The farm area under SRI had increased from .11 to .47 ha. The use of fertilizer had gone from 116 kg/ha to 67 kg/ha on average, and the use of chemical pesticide had declined from 35 kg/ha to 7 kg/ha. Half had reduced costs of production, and increased household income, even with use of SRI on only of their rice land has almost doubled. Fifty-five percent of the farmers said that for them, SRI reduced their labor requirements, while only 18% said it increased labor requirements; 27% said it made no difference.

Table 1 The progress of SRI practice in Cambodia

Description	Year					
	2000	2001	2002	2003	2004	2005
Number of farmer	28	500	3,000	10,000	17,092	40,000
Number of village	18	122	350	815	1,397	2,500
Number of province	4	7	11	14	17	21
Average yield (t/ha)	5	3.2	3.5	3.87	3.66	4.12
SRI land size (ha/family)	0.06	0.07	0.30	0.47	0.28	0.28
Total SRI land size (ha)	1.6	28.7	900	4,700	4,786	11,200

Source: Tech (2006)

In addition, GTZ, the German Technical Cooperation, commissioned a through evaluation of SRI in Cambodia in 2004. The data were gathered from 500 farmers, who were randomly selected in five provinces, 400 of them were SRI users and 100 were non-SRI user for comparison. Not all SRI users applied all the recommended practices, but even so, a 40% increase in yield was documented, and a 75% increase in net income per ha was reported, due to the substantial reductions in farmers' costs of production. Most significant, this study found that there was no real increase in labor requirements when using SRI. Labor savings made during transplanting (a time of peak labor demand, when 10 person/days per ha were required) offset the increased labor needed for weeding (which could be done with flexible timing). Also, it was found that reducing the need for cash expenditure at the start of the planting season, when household cash reserves were lowest, was a beneficial over the overall reduction in total expenditure for growing rice (Uhpoff).

Acceptance of the farmers on the SRI increased rapidly from 28 households during the year 2000 to approximately 82,476 households in 24 province-municipalities in 2007. It was due to the promotion and dissemination of the concept through organizations and institutions of around 71 in Cambodia. Moreover, Oxfam Great Britain (OGB), Oxfam American and GTZ played a main role in supporting local NGOs to promote SRI in Cambodia. With cooperation and support from

national and international organizations, especially SRI Secretariat of Department of Agronomy and Agricultural Land Improvement (DAALI), MAFF and other government institutions, number of farmers adopting the SRI practice increased rapidly from year to year, especially in 2007 (SRI-secretariat, 2008).

Related Research

Dhakal (1989) studied on Fertilizer Adoption, Economics of Fertilizer Use, and Allocative Error in Paddy Cultivation in Nepal. The study was conducted in three selected villages in 1988 wet season. Probit model was used to investigate relationships. Probit estimated results suggested that the risk aversion attitude, the cash flow constraints, the farm size ration of irrigated land to total farm size, the ratio of HYV to total crop area, and the price of fertilizer were the significant factors affecting an adoption of fertilizer by farm families. The most significant factor affecting adoption was the marginal effect of risk aversion.

Sudjai (1989) studied Farmers' Adoption of Rice Production Technology on Rice Promotion Project in Chachoengsao Province, Thailand. The results revealed that about 64.37 percent of the farmers adopted the technology as follows: recommended seeds, land leveling, weed control, rodent and crab control, sun-dried of paddy for 3-5 years, proper amount and time for fertilizer application, separated seed storage, and proper time for harvesting. Moreover, less than 60 percent of the farmers adopted technology as follows: draining-out water before harvesting, multiplication seed plot, insect control by counting, threshing 16 percent moisture paddy, type of fertilizer for second application, and land preparation and cleaning after threshing. On the other hand, the results from hypotheses test of 160 farmers revealed that there was no difference in rice production technology adoption among the farmers who had different education level, total annual income, size of rice production area, and frequency of government official's visits. The significant suggestions of the farmers were the disease and pest resistant seed varieties and suitability of the plant for the specific area should be provided, and the recommended formulas and enough quantity of fertilizer should be available in time.

Somsri (1995) studied Farmers' Adoption of Corn Production Technology Under the Hybrid Corn Promotion Project at Chumphon Province, Thailand. The results revealed that 65 percent of farmers adopted corn production technology. More than 78 percent of farmers adopted land preparation, fertilizer application, seed rate per rai, and harvesting, while less than 78 percent of them adopted pest and diseases control, herbicide application, and improving corn's quality. In addition, the hypotheses test from 161 farmers revealed no difference in adoption of corn production technology among the farmers with different backgrounds in educational level, total income, farm sizes, and extension activity participation.

Wilaiporn (1995) studied on Some Factors Affecting Farmer's Technology Application for Dry Season Soybean Cultivation in Phrom Piram District, Phitsanulok Province, Thailand. Results from hypotheses test of 162 farmers revealed that the farmer technology applications of dry season soybean cultivation were positively correlated to the household income, farm credit, and cultivation area.

Tekanate (1996) studied on Factors Affecting Farmer's Adoption of Asparagus Production Technology in Tamka District, Kanchanburi Province, Thailand. The results showed that age, income, farm labour, cultivated area, and farmer's exposure to technology influenced to the adoption of asparagus production technology.

Watchann (1997) studied on Adoption of Dry Season Mungbean Planting Technology of Farmers in Borommathat Operation and Management Project, Chai Nat Province, Thailand. The results from hypotheses test of 120 farmers revealed that there were significant differences between independent variable such as age, education level, income, planted area, labor, extension service that affect support, the adoption of technology on land preparation, time of planting, using of rhizobium, cropping method, weed control and harvesting.

Nobuko (2001) studied on Factors Affecting Lotus Rhizome Production in Nakhon Ratchasima Province and Roi Et Province, Thailand. The results revealed that

the socio-economic factors such as growing experience, group membership, and total family income derived from lotus rhizome production were affecting lotus rhizome production at the significant level of .05, .01 and .05, respectively. The production knowledge was found very highly significant relationship with lotus rhizome production at .001 level of significance.

Nuntawan (2003) studied on Farmers' Adoption on Safe Vegetable Production in Mueang district, Nakhon Pathom Province, Thailand. The hypotheses test from 144 farmers revealed that the farmers with differences in debt and the experience in safe vegetable production were different in adoption on safe vegetable production at .05 level of the statistically significant. The farmers with differences in land holding, household labour, income and information gained were not different in adoption on safe vegetable production at .05 level of the statistically significant.

Mendis (2005) studied on Factors Affecting Adoption of Recommended Crop Management Practices in Paddy Cultivation in Kalutara District, Sri Lanka. Results from 388 farmers revealed that adoption of soil fertility improvement and sustenance practice, and adoption of fertilizer management were significantly related to education, land, income, credit, sources of information, extension activities and visits, and membership in farmers' organization. Furthermore, adoption of cultural and preventive weed control practices were significantly related to land, income, credit, sources of information, extension activities, and extension officer visits. The adoption of herbicides recommendations were significantly related to land and income. Moreover, insect pest management practices were significantly related to land tenure, income, sources of information, extension activities, extension officer visits, and membership in farmers' organization.

According to all related researches, it is better to say that there are many factors on farmers' adoption in farming such as socio-economic characteristics, cultivation methodologies, sources of information, extension services, and innovation transferring channels, etc. However, the adopter might think about the economic profitability and sustainability before adopt innovations. On the other hand, the

agricultural extension strategies should focus on how to transferring the available technology to farmers, and how farm households obtain higher yield and income to improve quality of life. These strategies would not be reached successfully without local farmers' participation. However, the extension program has been implemented for many years in Tram Kak District (the study site). Therefore, it seems to be valuable to conduct a study on which factors affecting farmer adoption of SRI.

The Design of the Study

First part, it is needed to study the socio-economic characteristics, training, extension services, media exposure, and problems and suggestions of leading farmers on SRI adoption. Then, the sample is selected by asking local authorities, key farmers, district agriculture officers, and NGOs. After that focus group is conducted to gather the information and data of SRI adoption of leading farmers.

Second part, it is needed to study the socio-economic characteristics, training, extension services, media exposure, problems and suggestions of general farmers on SRI adoption. Moreover, the relationship between independent variables and dependent variables needs to be studied. Stratify random sampling is used to draw the sample size. The interview schedule was used to collect data and information from general farmers.

Secondary data for both parts are made available at Department of Agricultural Extension, District of Agriculture Office, NGOs, and relevant institutions.

Finally, based on the results from both parts, possible recommendations and model of SRI adoption are suggested.

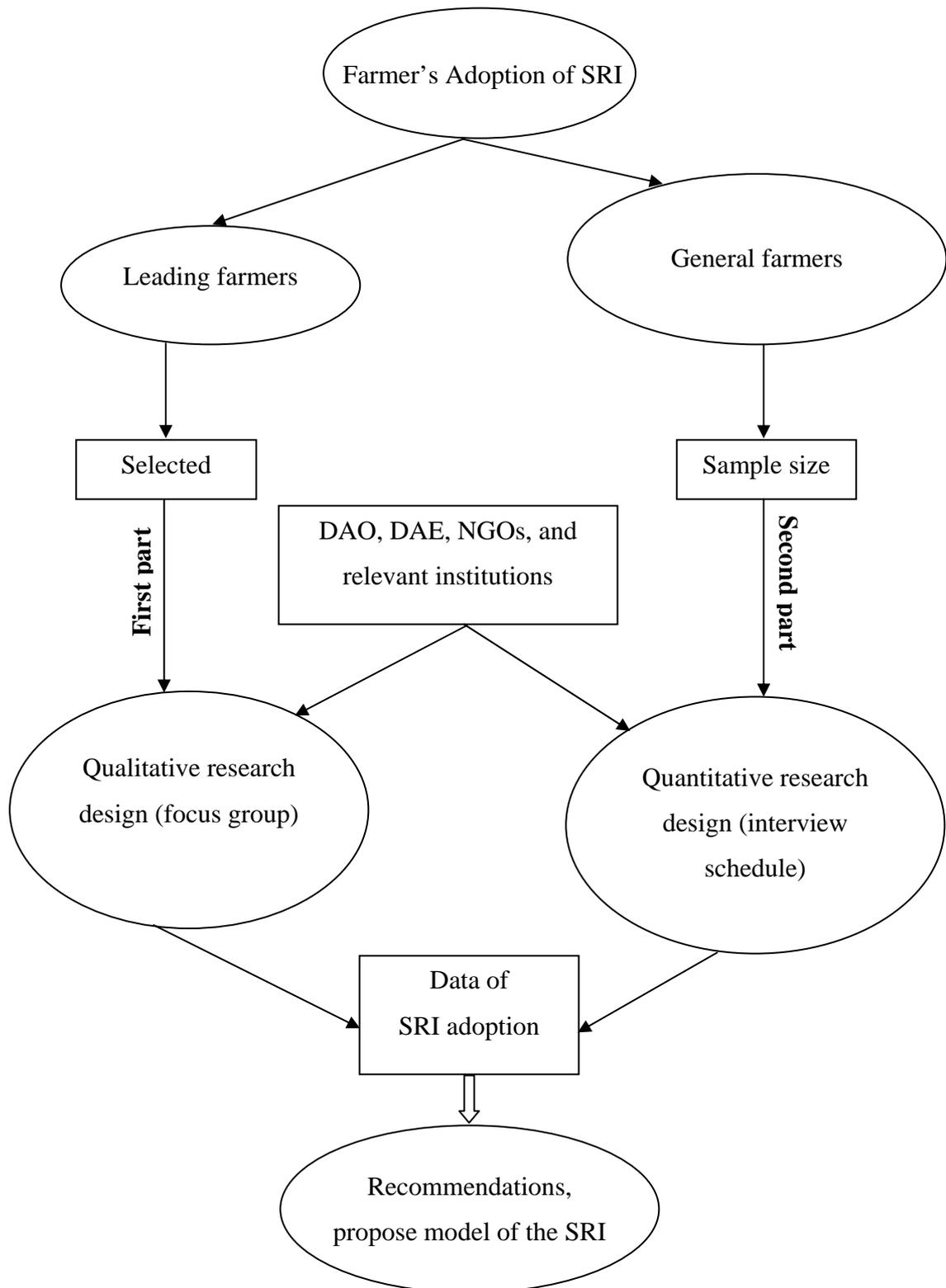


Figure 5 The design of the study

Conceptual Framework of the Study

The fourth objective of this study is to find the relationship between socio-economic characteristics, training, extension services, and media exposure and adoption of SRI in Tram Kak District. The conceptual framework of the study is present in Figure 6.

Variables in This Study

1. Independent variables

1.1 Socio-economics characteristics such as sex, age, education level, type of occupation, experience in paddy field, land holding size, family labor, family income, off-farm employment, farmer's association membership, rice production (conventional rice), and SRI yield.

1.2 Training such as farmer community school (FCS), farmer group discussion (FGD), farmer regular meeting (FRM), and farmer workshop and farmer congress (FW, FC)

1.3 Extension services such as extension agent visited farmer's field, farmer-to-farmer, exchange visit, and field day

1.4 Media exposure such as television, radio, and prints

2. Dependent variables

2.1 Adoption of SRI such as acceptance, implementation, and transferring.

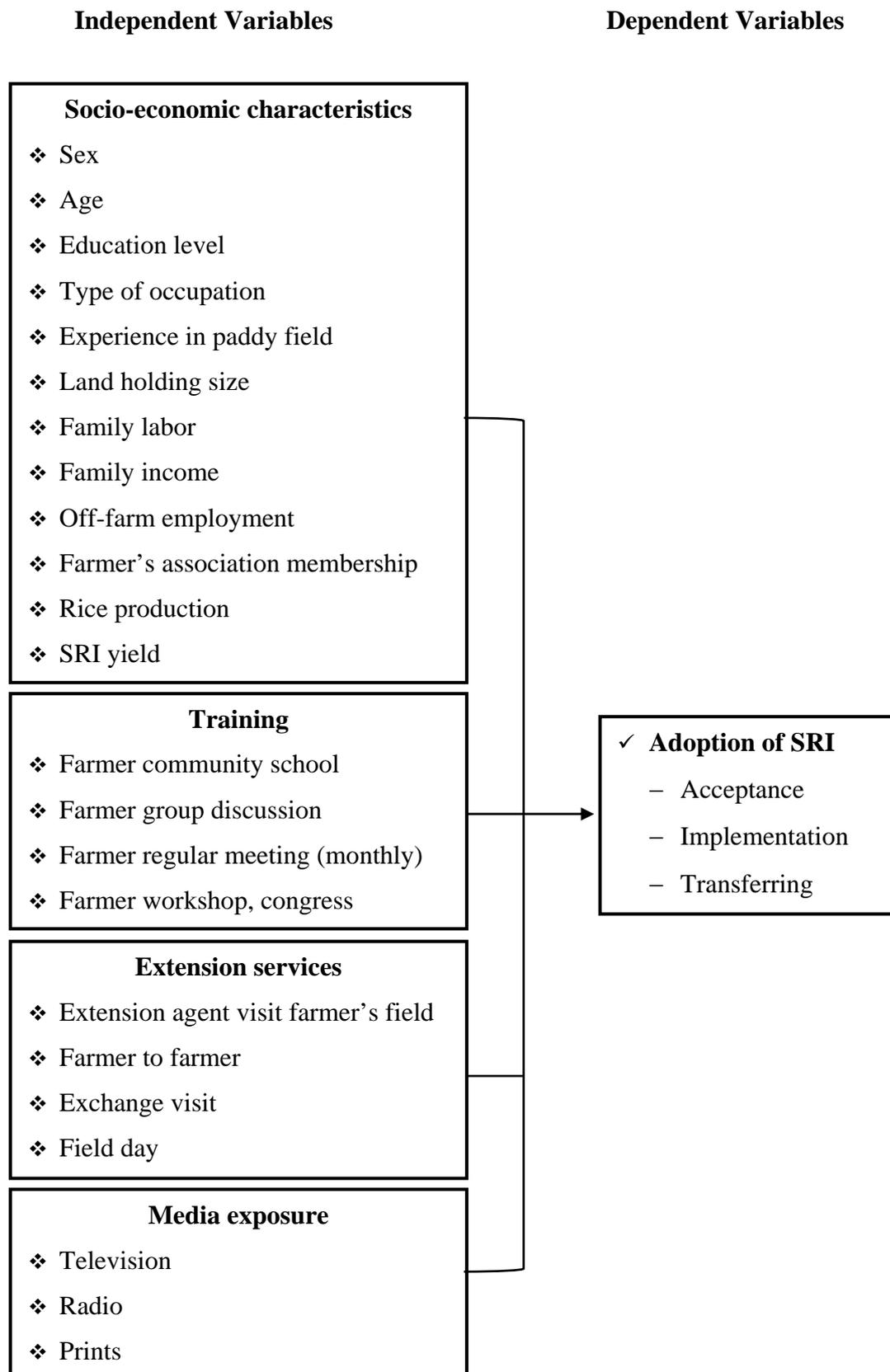


Figure 6 The conceptual framework of the study

Statement of Hypotheses

Base on the conceptual framework, the researcher would like to know what are the important factors related to the farmer's adoption of SRI in Tram Kak District Takeo Province, Cambodia. The following null hypotheses are test to find out the relationship between independent variables and dependent variables:

1. There is a relationship between the demographic variables such as sex, age, education level, type of occupation, experience in paddy field, land holding size, family labor, family income, off-farm employment, farmer's association membership, rice production, SRI yield, and adoption of SRI.

2. There is a relationship between training such as farmer community school, farmer group discussion, farmer regular meeting, farmer workshop and farmer congress, and adoption of SRI.

3. There is relationship between extension services such as extension agent visited farmer's field, farmer-to-farmer, exchange visit, field day, and adoption of SRI.

4. There is a relationship between the frequency of media exposure such as television, radio, prints, and adoption of SRI.

CHAPTER III

RESEARCH METHODOLOGY

This chapter describes the methods and procedures used in the research study. The topics were as follows:

- Site of the study
- Research design
- The population and sampling technique
- Data collection procedure
- Research instrument
- Measurement of variables
- Data analysis

Site of the Study

The domain of study was carried out at the district wide, where a certain group of farmer had involved with extension programs on SRI for more than five years. The district was called Tram Kak District at Takeo Province, Cambodia. It was bordered by Samrong District, Takeo Province and Bor Set District at Kampong Speu Province to the north, by Treang District, Takeo Province, and Ankor Chey and Chhouk District at Kompot Province to the south, by Doun Kev District at Takeo Province to the east, and by Chum Kiri District at Kompot Province to the west (Figure 7).

Research Design

The research study had divided into two parts. The qualitative research design was used with leading farmers, who were the first group involved with SRI package (first part). The quantitative research design was used with general farmers, who have adopted SRI package (second part).

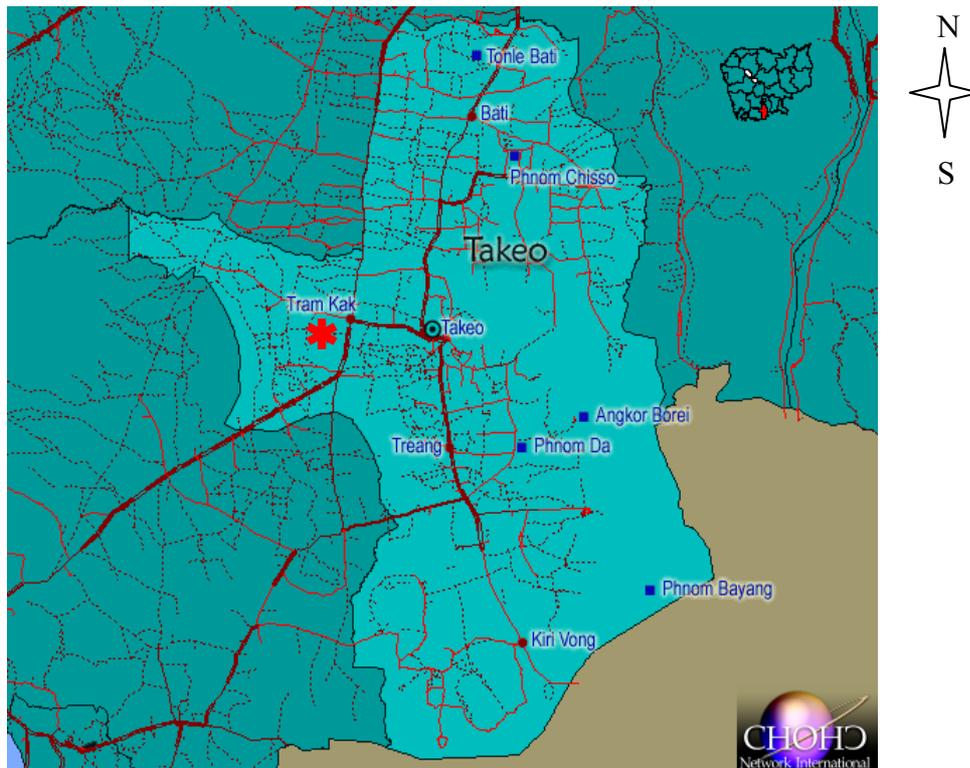


Figure 7 Map of Takeo Province

* Study area, Tram Kak District

Source: <http://www.maff.gov.kh/en/provinces/takeo.html>

The Population and Sampling Technique

For leading farmers, the selection and purposive (by asking from the district agriculture office, local farmers, local authority) method was used to select the sample as the focus group. There were 66 leading farmers household in Tram Kak District (Makaradi, 2002).

For general farmers, there were 5,305 farmer households in Tram Kak district, Takeo province, who had engaged in the system of rice intensification (SRI). Stratified random sampling technique was applied to draw the sample for data gathering.

The size of 372 samples which allows 5% error margin was calculated by using Yamane method(Yamane, 1973).

$$n = \frac{N}{1 + Ne^2} \quad n = \frac{5,305}{1 + 5,305(.05)^2} = 372$$

Where: n = Sample size

N= Population size

e = Margin of error

The proportional of sample size to the population of each commune in the district was calculated by using the formula as follow (Librero, 1996:40):

$$n_1 = \frac{N_1}{N} \times n$$

Where: n₁= Desired sample for the commune

N₁= Population of the selected commune

N= Total population in the district, who involved with SRI

n= Total sample size of the study

The 372 samples sizes were randomly selected from 15 Communes in Tram Kak District (Table 2).

Table 2 Distribution of sample size from 15 Communes in Tram Kak District

Commune	Population	Sample
Ang Ta Saom	228	16
Cheang Tong	456	32
Kus	456	32
Leay Bour	243	17
Nhaeng Nhang	556	39
O Saray	328	23
Trapeang Kranhung	243	17
Otdam Souriya	328	23
Popel	271	19
Samraong	442	31
Srae Ronoung	143	10
Ta Phem	228	16
Tram Kak	271	19
Trapeang Thom Khang Cheung	414	29
Trapeang Thom Khang Tbound	698	49
Total	5,305	372

Source: studied 2007

Data Collection Procedure

First part (qualitative research) of research used focus group method (open-ended) and investigation for collecting data and information. The main point for this part focused on the leading farmers, who were the first involved with SRI in Tram Kak District. The district of agricultural officers and NGOs, IOs, who involved with SRI were also invited. The participants in this part were out of the sample size of second part.

Second part (quantitative research) of research used interview schedules (close-ended) with the help of the research assistants for gathering data and

information from the farmers who adopted SRI package (372 samples). The research assistants were trained well and the content of interview schedule was explained to them to avoid or minimize any possible error that could occur during the data gathering.

In addition, secondary data for both parts were available from documents such as: reports, books, records, statistics report in the offices of the Department of Agricultural Extension, District Agriculture Office, NGOs, IOs, and other relevant institutions.

Research Instrument

For leading farmers, focus group and observation method was set up for using in this research study (Appendix A). The discussion was conducted in local language.

For general farmers, the research instrument, interview schedule was originally prepared in English, and then translated into Khmer (local language). The formal interview schedule consisted of a well-defined questionnaire that was built up under consultation from agricultural extension agent and the SRI technical officers (Appendix B).

Pre-testing of the instrument had done with 30 farmer households within the province, but out of the research study area. The aim of pre-testing was to screen out any unnecessary factors such as the invalidity and the weaknesses of the questions. The weaknesses gathered from the pre-test were served as the bases for improvement of the interview schedule before finalizing it.

The interview schedule had divided into four sections as follows:

1. Socio-economic characteristics data of farmer households;
2. Training, media exposure, and extension services;

3. Adoption of SRI package; and
4. Problems and suggestions of farmers regarding SRI in Tram Kak District.

Measurement of Variables

Sex was measured by gender. It was categorized into 2 groups: male and female.

Marital status was categorized into 4 groups: single, married, divorce, and widower.

Age was measured by the group of people who born in the range of years. Age was grouped into: 20 to 40 years, 41 to 50 years, 51 to 60 years, and over 60 years.

Education level of household head was categorized into 5 groups: uneducated, be able read, primary school, secondary school, and high school.

Type of occupation was measured, whether respondent is employed in: paddy rice or crops field, government sector, and private sector. The respondents were regrouped into 2 categories: farmer and non-farmer.

Experience in paddy rice cultivation of farmer was measured in number of year. It was categorized into 3 groups: less than 10 years, 10-30 years, and over 30 years.

Land holding size was measured by the amount of land in hectare (ha). This variable was categorized into 4 groups: less than 0.2 ha, 0.2 to 0.5 ha, 0.51 to 1 ha, and over 1 ha. Land was divided into 4 parts: SRI land, conventional rice land, vegetable land, and crops land.

Family member was measured by number of persons who live in respondent's house. Variable was categorized into 4 groups: 1 to 3 persons, 4 to 6 persons, 7 to 9 persons, and over 9 persons.

Family labor was measured by the number of family member's activity supported in paddy cultivation. Variable was categorized into 4 groups: 1 to 3 persons, 4 to 6 persons, 7 to 9 persons, and over 9 persons.

Hire labor was measured whether farmer found labors added in paddy cultivation. Variable was categorized into 3 groups: less than 10 days, 10 to 20 days, and over 20 days.

Farm income (on and off-farm) was calculated in Riel (Rs) per year, which received in 2006 cultivation season. It was categorized into 4 groups: less than 1,000,000 Rs, 1,000,001 to 3,000,000 Rs, 3,000,001 to 6,000,000 Rs, and over 6,000,000 Rs.

Off-farm employment was measured, whether respondents were employed in: government sector, private sector, any other organization or self-business in addition to farming. The respondents were grouped into 2 categories: employed or unemployed.

Farmer's association membership was measured as whether respondents were member of a farmers' group or association pertaining to paddy cultivation. This variable was categorized into 2 groups: member, and non member.

Rice production was measured as whether respondents used conventional rice practices for their rice cultivation or not. Variable was categorized into 2 groups: practiced and not practiced.

Training was considered for four attributes: farmer community school, farmer group discussion, farmer regular meeting (monthly), and farmer workshop and farmer congress. Variable was measured as whether farmer got knowledge from four above

mentioned attributes which related to agricultural field such as: SRI, crops, vegetables, pest, soil, animal raising, and fish raising. Variable was categorized into 2 groups: attended and not attended.

Extension services were considered for three kinds: farmer to farmer, exchange visit, field day. Variable was measured as whether respondents engaged with three kinds mentioned above. Variable was categorized into 2 groups: attended and not attended.

Media exposures were the exposure at response to any kind of media such as television, radio, prints. Variable was measured whether respondents watched, listened, and read all above mentioned attributed which related to agricultural field. Variable was categorized into 2 groups: exposed and never.

Adoption of SRI was divided into 3 parts: acceptance, implementation, and transferring.

1. Acceptance was measured whether respondents followed the principles of SRI. Variable was categorized into 2 groups: accepted and not accepted.

2. Implementation was measured whether respondents practiced SRI principles in rice cultivation. Variable was categorized into 2 groups: practiced and not practiced.

3. Transferring was measured whether respondents recommended or disseminated SRI principles to family's member or other farmers. Variable was categorized into 2 groups: ever and never.

Environmental aspects were measured whether natural enemies, population of fish, frogs, crabs, birds, etc. increased after applied SRI in the field. Variable was categorized into 2 groups: increased and decreased.

Data Analysis

All data gathered were analyzed using descriptive and inferential statistics. The computer software for social statistic analysis was used to analyze all data. Chi-square test (χ^2) at 0.05 level of significance was used to test the relationship between the dependent and independent variables. Descriptive statistics such as frequency, percentage, and arithmetic mean were used to describe all data obtained from interview.

CHAPTER IV

RESULTS AND DISCUSSIONS

This research study was divided into two parts, the first part related to leading farmers by using focus group as methodology for gathering data and information (qualitative research), and the second part concerned with general farmers and used questionnaire schedules (close questionnaire) as methodology for collecting data (quantitative research). The results of the study were presented as follows:

Part I: the Case Study of Leading Farmers

The objectives of the focus group (part 1) were studied on socio-economic characteristics, training, extension services, media exposure, adoption, and problems and suggestions of leading farmers in Tram Kak District and gathered the information and data to fill in interview schedule (part 2).

Takeo Province was located in southwest of Cambodia. The distance from Phnom Penh City was 87 and 78 kilometer (km) a long with national road number 3 and 2, respectively. The province was bounded by Kandal Province in north, Kandal Province and Vietnam in east, Kompot and Kampong Speu Province in west, and Kampot Province and Vietnam in south. The total land area is about 3,562.70 km² that equal to 1.97% of the total land area of Cambodia, 181,035 km². Takeo Province consists of 812.70 km² or 22.81% of human settlements and infrastructures areas, 2,440 km² or 68.49% of agriculture land areas, 170 km² or 4.77% of forest areas, and 140 Km² or 3.93% of water bodies and nonuse areas. The mainstreams (water resource) of province were Bati river, Takeo lake, and O Thom lake. The total population was 886,073 person or 6.6% of the total population, 13,413,892 persons, in Cambodia with growth rate at 3.08%, 435,946 persons or 49.20% were male and 450,127 persons or 50.80% were female. The above number were 650,866 persons or 77.46% of farmers, 8,000 persons or 0.95% of fishermen, 170,113 persons or 20.24% of traders, and 9,315 persons or 1.1% of government's officers. The average density was 236 persons per km² (Takeo, 2006).

Takeo Province consists of 10 districts, 100 communes, and 1,116 villages (Figure 7). Tram Kak was a district among those and located in the west part of the province. Districts headquarter was distanced 12 km from the province town. It consists of 15 communes, and 242 villages. The total land area was about 54,694 ha, which consisting of 37,539 ha of agricultural land areas. Tram Kak had large potential for growing rice and had more population than other districts. The population of Tram Kak District was 31,826 families or 163,142 persons, which 79,542 persons or 48.75% were male and 83,600 persons or 51.25 % were female. Most of people, 90%, were involved with rice production, vegetables production, livestock, and firewood. In the past, farmer cultivated rice only depends on rainfall because of water's basin and canal were ruined. Therefore, there was rice cultivation only in wet season, not dry season (Tram Kak, 2006).

There were two places for focus group, the first place held at Taphem Commune, and the second place at Otdom Suriya Commune. There were 24 participants, first place, came from Taphem, Tropeang Thom Khang Choeung and Cheang Tong Commune, and 15 participants, second place, came from Otdom Suriya and Po Pel Commune (Figure 8). The results showed as follows:

General perspective during conduct of focus group

The focus group were conducted to gather the information and experiences from leading farmers during October 2007. It started at 8 o'clock morning and 2 o'clock afternoon for first and second group, respectively. Farmers came with their bicycles and motorcycles to join focus group. They surrounded the researcher and assistances researcher which in charge of recorder and facilitator. The location of focus group was authorized by the local authority, which the first group conducted in CEDAC office at Taphem Commune, and the second group was in Cambodian People's Party (CPP) at Otdom Soriya Commune. The participants were the leading farmers, researcher, assistances researcher, CEDAC's staff, and, especially, an honorary from chief of village. Before starting, the researcher thanks to all participants for their valuable time, and thank for CEDAC and CPP for providing the places.

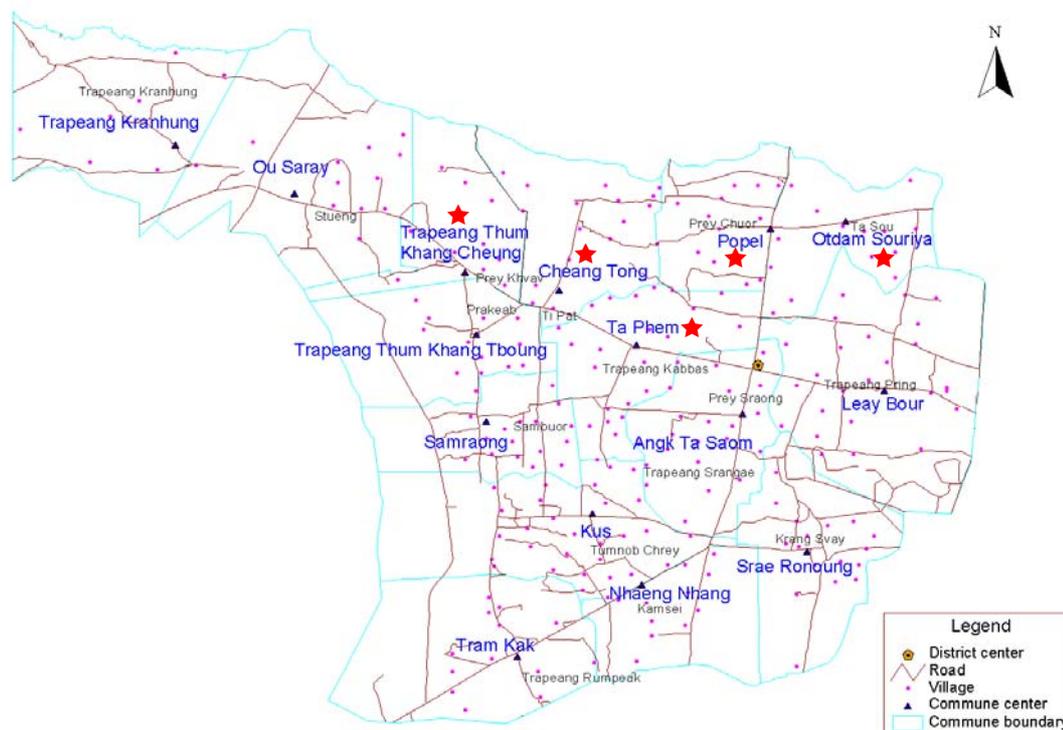


Figure 8 Map of Tram Kak District

★ Site of the study

Source: CEDAC (2006)

Participants came to join the meeting with charmingly fresh face, happy, interested in the questions, and answered with their satisfaction. The process was smoothly gone; it took around four hours (including time break, snack) in each group. Researcher had discussed with participants followed with the questions that had been prepared and corrected. When the focus group finished, participants went back home with the small souvenir. The materials used in this focus group were flip chart, clipper, A4 paper, string, pen, color pen, pencil, and tape recorder.

Socio-economic characteristics of leading farmers in Tram Kak District

Most leading farmers (39 persons attended in focus group) were male, and their ages ranged from 30 to 64-year-old. The family members were ranged from 5 to 8 persons in a family, which most families had 4-6 persons. Concerning with

educational level, most families' heads were able to read and had studied in the primary school, while a few of them had studied in the secondary school, and only one family had the high school education. All of them were farmers and their experiences in farming ranged from 15 to 50 years. In type of occupation, all of them did their on-farm work during the wet season, while some of them had extra cultivation in the dry season. Most of families' head did an off-farm employment in addition to on-farm work. In terms of off-farm employment, some of them were lecturer, carpentry, house constructor, masonry, sugar palm making, nurse, commune agricultural extensionist, worker, motor taxi, find firewood, and labor hired. Concerning with land holding per household, they ranged from 0.3 to 1.5 hectare (ha), which most of land holding ranged from 0.5 to 1 ha per family. Most farmers had their owned land cultivation, but a few farmers did not have enough land for cultivation so they had to tenant some land to increase their cultivation. Regarding to farm labor, it was ranged from 2 to 7 persons per family, which the average of farmer labor were 3-4 persons, some family did not have enough labor in cultivation they had to hire labor outside for addition, and few families had exchanged the labor for their rice production. Referred to the farmer's association membership, all of the farmers (leading farmer/first adopter) living in Tram Kak District had been members of local NGO, CEDAC (Center for Studies and Development of Cambodian Agriculture, in English, and Centre d'Etude et de Développement Agricole Cambodgien, in French), since the year 2001. In addition, some farmers had participated in other associations/organizations such as Support Program for the Agricultural Sector in Cambodia (PRASAC), Veterinaires Sans Frontieres (VSF) Agriculture Sector Development Program (ASDP), and Baksey Phnom.

Leading farmers living in Tram Kak District produced their rice production by using traditional cultivation for a long time following the practices of their ancestors. Their conventional practices were:

- Land preparation: In early of wet season, early of May, when the first rain fell, it was the time for farmers to plough their field. After that, they ploughed it again

to softened their soil. Generally, farmers ploughed their land 2-3 times depended on the fertilities of their soil. At the same time, they also prepared the seedling bed.

– Sowing seed: After preparing seedling bed, farmers dried seeds for one day, then put it in a small jar with water to purify the good seeds for sowing. After the farmers obtained good seeds, they soaked them over night and incubated them for 2 more nights, then took them to sow in the nursery. Normally, farmers sowed seeds around 80-100 kg for transplanting in one-hectare rice field.

– Transplanting: Before transplanting the seedlings, they level of their land using Urea, DAP or 16-20-00, cow dung, and green or compost fertilizers for basal. Then the farmers started to transplant the seedlings (seedlings took root up from sowing bed had been incubated for 2-3 nights before transplanting). Normally, farmers put 3-5 seedlings per hill, and seedling was 25 to 30-day-old for medium and 30 to 45-day-old for long-term rice.

– Field and water management: When they finished their transplanting, farmers kept the water level about 20-30 cm in their rice field to protect the weed growing. 40 kg/ha of Urea fertilizers was used for first time top-dressing at tillering stage and the second time at panicle initiate stage. Some farmers visited their field 2-3 times during the cultivation season, their activities were weeding, rehabilitating field bund, adding or reduced water in the field, and destroying rat hole, etc.

– Harvesting: Farmers started to harvest when their rice maturity was 85 percents or more. The average rice yield in Tram Kak District was around 2 t/ha.

The weakness points of farmer practice in conventional rice cultivation

Leading farmers practiced their conventional rice for long time; they utilized traditional methods for cultivation, which were learned and followed from their ancestors. They had good experiences in rice cultivation, but also had some bad habits

that could caused the bad effected to the rice growth. Koma (2001) reported that some methods in conventional rice were not good for growing such as:

- Keeping water in the rice field during transplanting and growing which prevented air aeration process. Lacking of aeration might increase the toxicities to rice plant, and might constraint the rice aspiration which could slow down the rice grown.

- Sowing seed in thick density (so much of seed on a small land size) and keeping to much water on seedbed, which can cause unhealthy growth of seedlings. The more healthy seedlings, the fast tiller seedlings were.

- Transplanting late or old seedling age (wet season rice varieties) might cause seedlings to have less time to grow, tiller, and develop stem (before flowering stage). However, the non-wet season rice varieties might had no time to tiller if transplanted with too old seedlings.

- Transplanting more seedlings per hill might cause rice stem and its root tightness. It means that each rice stem did not have enough free space to initiate roots and tillering.

- Transplanting too depth might cause rice roots to have no ability to acquire oxygen, this might require longer time for normally root growing. Moreover, it might delay for long time if rice field contains more water.

- Transplanting tightly or shot space (hill-to-hill) lead to the rice's inefficient absorbtion of light, water, and fertilizers, because of the stem and root tightness.

- Transplanting rice with unequal space (distance) leads to the inequality of nutrients (light, water, fertilizers) absorbance of rice stem in each hill.

– Not adding organic substances such as rice straw, rice husk, and organic fertilizers in the rice field might decrease the soil potential to feed rice stem. It means that that the rice field loosed many nutrients from harvesting.

– Keeping organic fertilizers on rice field for too long without plough could destroy and spread out of nutrients.

It can be concluded that most experiences or practices of farmers did not let rice stem completely grow. For instance, root growing was incomplete and tillering is not enough. Therefore, the traditional methods should be changed and replaced with the new method.

Training and extension services

A local NGO in Cambodia, CEDAC, initiated the system of rice intensification (SRI). During 2001-2002, sixty-six farmers had attended the training course, which organized and sponsored by CEDAC. The subject raised in that training course was the SRI package. Before conducting the training course, CEDAC's staffs had to ask the head of the village in each commune such as Po Pel, Cheang Tong, Tropeang Thom Khang Cheung, Ta Phem, and Odom Soriya Commune about the farmers who were interested in innovation technique and listed them. After listing the names and addresses of the farmers, the CEDAC's staffs started to conduct training courses, which were held in the CEDAC office headquarter in Tram Kak District and at some farmer's house. After the training course, all of participants were invited to visit the SRI practices in Kampong Speu Province (one of other provinces started to cultivate SRI, and it's a province nearby Tram Kak District, too) to help them in SRI cultivation. In the first year, the farmers did not dare to cultivate their whole land, they just tried with a smaller land portion, only 0.05 to 0.1 ha. After they obtained a good result (increasing yield) the farmers spread their land size in SRI cultivation later on. Also the number of farmers who cultivated the SRI increased.

The CEDAC staffs, government agents/Ministry of Agriculture Forestry and Fisheries (MAFF), such as: extension workers, technical staff went to farmers' field that was practiced SRI package for 4-5 times in each commune at Tram Kak District during the cultivation season to help farmers solving their farming problems. Moreover, CEDAC staff, extension agents, as well as technical officials were also organized the short-term training, group discussions, field demonstration and sharing the experience about SRI with the farmers. Farmers in Tram Kak District had been involved with the extension program since 1995 and also had participated with CEDAC since 2001. Upon their participation with CEDAC and extension program, they gained many benefits from the program such as increased the interaction among the farmers themselves and in the social affairs as well, and better thinking and confidence to make a decision in their cultivation. Furthermore, farmers were able to share experiences with the extension in order to integrate information.

Farmer's perception in Tram Kak District was very strong in fertilizers usage, SRI principles, and practices. Regarding to SRI principles, the farmers identified 12 principles as follows:

1. Leveling and water management;
2. Weeding;
3. Avoiding flood during the growth stage (only 5-10 cm water high laying on rice field);
4. Transplanting with wide spacing, 25cm x 25 cm;
5. Transplanting in row (from hill to hill is equal length);
6. Transplanting in shallow (1-2cm) with roots laying in horizontally;
7. Transplanting 1 seedling per hill;
8. Transplanting of young seedlings, preferably 12-15 days;
9. Uprooting only strong seedlings and transplanting quickly;
10. Maintaining seedling bed like a garden, watering intermittently and not keeping it submerge;
11. Using good seeds and full grain; and
12. Adding nutrients to improve soil fertility was preferable in organic forms.

Furthermore, they also indicated clearly about fertilizers usage. For instance: there were two kinds of fertilizers, chemical/inorganic fertilizers (Urea, DAP, 15-15-15, 16-20-00, 16-16-8-13s, etc.) and organic fertilizers (cow dung, green manure, legumes, compost). Most of farmers used a bag of DAP per ha and Urea. Some farmers used 16-20-00 or 16-16-8-13s as basal. Compost and cow dung were also used as a basal by mixing them with chemical fertilizers and ploughed for second time, before transplanting. Furthermore, green manure, legumes, etc. were also used as basal, but they had to chunk in small pieces and plough at the first time (first rain fall) so it would decompose at the transplanting time. On the other hand, Urea was used as top-dress fertilizers which applied twice in wet season rice cultivation; the first time applied at tillering stage and the second time at panicle initiate stage. The time for applying top-dresses fertilizers was in the morning when the sun shines clearly, which let the rice leaf dried, and/or in the evening before the sun almost set. Furthermore, the top-dress fertilizers should not be used before raining time. However, farmers also indicated the advantages and disadvantages of chemical and compost fertilizers as follows:

Chemical fertilizers

Advantages

- Growth of seedlings were fast and strengthen;
- Obtained good result (high yield);
- Received time benefits;
- Could be visibly result; and
- Could be available and easy to transport.

Disadvantages

- Caused soil hardened;
- Reduced of micro-organism, and population of fish, frog, crab, etc.;
- Obtained with-out tasty rice grain;
- Spent a lot of money;
- Caused environmental pollution, and lead to damage human health.

Compost fertilizers

Advantages

- Not affected to human health;
- Increased of micro-organism, and population of fish, frog, crab, natural enemy, etc. in the rice field;
- Reduced of environment pollution;
- Sustained in soil fertility and make it softened;
- Received tasty and whitened rice grain;
- Could be available around the house (raw materials);
- Reached good environment and home beautifulness.

Disadvantages

- Took long time to produce;
- Growth of seedlings were slow;
- Spent more labor, both making and transportation;
- Transported to rice field was difficult;
- Consisted of few amount of macro-elements.

To differentiate between conventional rice growing and SRI, they indicated as follows:

Conventional rice

- Used in large amount of seed;
- Kept more water in seedling bed and sowed in thick density;
- Transplanted both weakness and strengthen seedlings;
- Transplanted old seedlings (more than 1 month);
- Incubated seedlings 1-2 nights

SRI

- Used in less amount of seed;
- Prepared seedling bed as vegetable garden and sowed in thin density;
- Transplanted only best seedlings;
- Transplanted young seedling (less than 20 days);
- Transplanted immediately after uprooting from seedling nursery (not

- | | |
|--|---|
| before transplanting; | over than 30 minutes); |
| – Transplanted unequal distance from hill to hill and tightly; | – Transplanted in line, wide and spacing hill was equally; |
| – Kept the water all the time in paddy field during transplanting and growing stage; | – Kept a thin layer of water in the field. |
| – Could be difficultly for weeding; | – Could be easy for weeding; |
| – Depended on chemical fertilizer used, mostly; and | – Mixed small amount of chemical with compost fertilizers as basal and top-dress; and |
| – Averaged yields was around 2 tons per hectare. | – Averaged yields was around 2.8 tons per hectare. |

Awareness of farmer on rice grain storage

Rice grain could not store with the high moisture content because it might be decomposed by fungi or destroyed by insects. Leading farmer indicated that, “after threshing, we need to dry rice grain for 2-3 days (up to sunshine) in order to reduce the moisture, but, before drying, we have to observe the weather to make sure that no raining and good sunshine.” They dried rice grain in front of their house and spread it on mats. Frequently, they spread rice grain out evenly. They also stated that, “we are able to test the moisture content by using our experience, our mouth for biting rice grain into two parts, and then saw the color (whitening) and the texture of rice grain.” Sarun (2007) reported that after harvesting, the rice grain moisture content was ranged from 18-24%; and it could store around 14% of moisture content. He noted that the farmers should not dry rice grain too dry because it lead to crake and more broken during milling. Some farmers stored rice grain under or in their house (used bag and basket for putting rice grain), while others construct a small storeroom. Sarun (2007) noted that the storehouse should located on dry place, good aeration, and rat-proof. He added that if there were varieties of rice grain, the separation and labeling should be done in order to avoid of mixing.

Adoption of leading farmers in Tram Kak District on SRI

Acceptance of SRI

To relate the acceptance of SRI package, all farmers revealed similar ideas that, after attending the training course and visiting SRI cultivation at other provinces, the leading farmers decided immediately to follow the SRI package because it was a promising technique and brought farmers wealth, wisdom, and happiness. Moreover, it was the farmers' habits to eagerly learn and test something promising and innovative. Most of them said that, "we really want the possible techniques to improve our daily life. Why we would not accept the SRI package? We had seen with our own eyes that SRI increased rice yield." They added that "we do not lose anything at all, just try with a small plot (0.05 - 0.1 ha) of our rice field in the first year, if it (SRI package) is impossible we would not cultivate it again at the year after; but the result is good (yield increased) so we adopt it." Some farmers indicated that they did not only accept the SRI package but also gained more knowledge on agricultural practices such as vegetable growing, compost fertilizer making, pest and disease control, and fish raising.

Implementation of SRI

Farmers in Tram Kak District used varieties of rice such as Senpidor, Phka Mlish, CAR (Cambodia Rice) 11, Neang Mlish, Neang Khmao, Neang Tey, Chhmar Prum, Kung Sor, Bey Kour, Banla Phdau, Ed Chhmooss, Srov Kro Ham, and Srov Dom Neb in SRI cultivation. The farmers had collected seeds from research stations, self-collection, and neighborhoods.

In relation to their rice production based on SRI, most farmers ploughed their paddy field 2-3 times depending on the fertility of their soil, and then level it before transplanting. They prepared seedling nursery like a vegetable garden and divided into a small plot, then sowed rice seeds in slight density and water them two times per day (morning and evening). There were two types of farmer's experience in sowing rice

seeds; dry and wet seedling nursery. Farmers revealed that they dried seeds for one day then put it in a small jar with water and stirred it by wood or bamboo stick to separate the good seeds (the good seeds and full grain dropped to the bottom, while haft grain and incompleted rice seeds floated on the top) for sowing. After getting the good seeds, they soaked it for one night and incubated for 2 nights, then took it to sow in the seedling nursery. In this stage, they were divided in to dry and wet seedling nursery. For dry seedling nursery, they put the seed on the nursery and rolled the wood stick or sugar-palm/coconut trunk to bury seed into soil, and covered it by using soil with a small amount of ashes (the way to protect ants, in order to prevent seed in the nursery), then rolled it again and water. A week later, seedlings emerged in 2-3 cm high with 1 or 2 leaves. On the other hand, they sowed in slight density (about 0.5 kg/m²) seed in wet nursery with 2 cm high of water.

When seedlings reached for 15 to 20 days, farmers uproot the best seedlings from nursery and transplant to the paddy field in a shallow water dept (1-2cm); some farmers transplanted seedlings at the stage of 25 to 30 days. Most farmers transplanted a seedling per hill with 25cm x 25cm distanced, while other farmers transplanted 2-3 seedlings per hill with 20cm x 20cm distanced.

Regarding the fertilizers usage, all of the farmers mixed compost fertilizers, cow dung, and green manures with chemical fertilizers such as: DAP or 16-20-00 or 16-16-813s and urea (a bag/ha) as a basal fertilizers. Then they applied Urea as top-dressing fertilizers twice. The first time of top-dressing was applied at tillering stage and the second time was applied at panicle initial stage (in each stage, they used 1/2 bag per ha).

Farmers in Tram Kak District were enthusiastic with their rice production; during the cultivation season, most of them visited their paddy rice 5-7 times while some visited only 3-4 times. The farmers' activities at their paddy field were weeding, rice field bund rehabilitating, pest and disease controlling, destroying rat holes, and water drainage. All of farmers harvested their rice crop at 85-90% maturity, during December to January upon the rice early or late maturity. The importance of

harvesting was collected the rice on time in order to prevent yield losing. Decision making on harvesting should be observed properly on rice maturity. Some point need to be controlled such as: leaf flag and rice grain at the end of panicle changed to yellow color as rice straw. Harvesting on time leaded to high price at the market because its good quality, and reduced the chance of losing the rice yield that cause from stem and rice grain fallen, panicle broken, and birds or rat destroyed.

In order to be clear about SRI practice, the researcher had individual interviewed with Mr. Khon Sokha, leading farmer from Po Preah Sang Villlage, Ta Phem Commune, Tram Kak District, Takeo Province. He was 51 years old with five members in his family. He had about 0.4 ha of rice land. In the past, he revealed that rice production was not enough to support his family because he has a small area of rice field and spent a lot of money on rice production inputs such as seed, chemical fertilizers, and pesticides. Each year the yield in his farm was only 720 Kg (1.8 t/ha). When using conventional rice practiced, he did not selected purify seed, age of seedling was very old (30 to 45 days old), and he transplanted around 4 to 6 seedlings per hill. In 2001, after participated in the training course on SRI at CEDAC office headquarter, Tram Kak District, and visited farmer practices at Kompong Speu Province, he decided to try SRI practice on an area of 0.1 ha and he can get the rice yield around 360 Kg (3.6 t/ha). He revealed his experience as follows:

Seed and sowing: he used 1.5 kg of the local variety, Banla Phdau, for the experimentation. Before sowing, he washed the prepared seeds with salt-water and stir repeatedly to take out the rice with no seed or incomplete seed. Then he washed the seeds with water and soaked them in water for one night, and incubated for 2 nights.

Seedbed preparation and uprooting: he prepared the seedbed the same as vegetable seedbed and made the soil soft. Then he put in the natural fertilizers. He sowed in slight density to get big and healthy seedlings. When the seedlings reached 15-18 days old, he uprooted one by one gently and softly. He chose only healthy seedlings for transplanting, and kept them in basket then transplanted immediately.

Soil preparation and leveling: he prepared the transplanting land three times (plugging and leveling). The first time was to move and dry the soil. The second time was done when it was raining. He put in natural fertilizers (cow dung, compost) around 20 baskets (200 kg), plough and harrow to move the soil. Finally (before transplanting), the third time was to level the land and put in more natural fertilizers.

Transplanting: when the rice seedling reached 15-18 days old, he transplanted it. During the transplantation, there is no water in his rice field (the soil only moisture). Before transplanting, he used string for row. He transplanted only one seedling per hill, and transplanted very shallow and softly. He transplanted with 25cm spacing, which is about 10 to 15 cm wider than the traditional practices.

Field management: he also conducted a regular weeding and a soil loosing. He took the rice away, if it had diseases. He also drained out water, and kept the rice field dry a few day and then flowed water in. However, during the flowering stage, he always kept the water depth around 3-5 cm.

Harvesting: he noted that, one seedling has produced around 35 tillers. After harvesting, he got 360 kg yield from 0.1 ha. It is in average 3.6 t/ha comparing to the conventional production which was around 1.8 t/ha.

Transferring of SRI

Besides practicing the SRI package, farmers in Tram Kak District also shared and disseminated their experiences and knowledge to family members and other farmers in their village, commune, district, and out side district as well. The methods of farmers' extension were:

- Farmer to farmer: farmer disseminated her/his knowledge to other farmers when they came to visit his/her home or field, or other places.

– Informal meeting: it was done on festival days and other religion ceremonies at the pagoda in the village or commune. They shared their knowledge and experience to each other, there were free topics in the meeting due to the chat they wishes.

– Group discussion: it was conducted under tree shade, farmers' house, field, pagoda, or others. They discussed, shared, and disseminated their knowledge and experiences to each other.

Farmer's impression on SRI

A local NGO, CEDAC, has started to introduce SRI to Cambodia only recently, 2000. At the beginning, farmers were very hesitate to try out with SRI, although SRI implementation made more benefits to them such as using less seed, better economics (chemical fertilizers and pesticide buying), and getting more yield. Mr. Som Hoeun, a farmer from Tropeang Kabas Village, Taphem Commune, revealed that, “at the first time when I start to practice SRI in the rice field there are farmers in neighboring laughing at me and some waiting to see the results. When I get good result, there are many families from my village and neighbor house approaching me to ask about SRI practices.” Many farmers said that it was the first time they have seen rice crop grow like this (a rice seedling produced around 35-40 tillers). Mr. Touch Yim, a farmer from Po Preah Sang village, Taphem Commune, indicated that, “when the neighbors see my rice grow very good and I get more yield than using conventional rice practices, they follow and ask me about SRI cultivation. Now, 2007, there are around 50 families in my village change to practice SRI.” Most of the leading farmers indicated that SRI did not only provide more benefits to farmer but rice were also delicious and human being were healthy. Koma (2001) reported that Non-experimenting farmers were very interested after observing the progress of the trial, but many of them thought that the experimenting farmers received the special seeds from CEDAC. Therefore, they requested the "new" seeds from the experimenting farmers so that they could grow this "variety" in the next season. It was very hard to convince farmers that it was not the “new” seeds and fertilizers, but it

was the skillful management of soil, water and the crop that took the credit for the good harvest.

Differential on adoption of SRI

According to the results of investigation revealed that there was differences among the village in each commune on SRI adoption. It could be from several factors such as knowledge, education, understanding, extension methods, and local condition. The village that had local farmer group, saving money group, regular monthly meeting, available condition (soil fertility, flood and drought), and farmer's attitude might lead them to reach a high rate of adoption. In addition, it also depends on extension methods, for instance, key farmer's demonstration, field day, local and inter-exchange visit. The low rate of adoption might be reached from a little bit of the above factors and reasons.

Environmental aspects

After following the SRI package, most leading farmers said that the population of natural enemies such as fish, frog, and crab in the rice field increased from year to year because of the reduction of chemical fertilizers usage by replacing cow dung, green manure, and compost fertilizers in the field. They also added that human health was better than the previous practices. Some farmers said that they and family members rarely had headaches as previous; while another said that he seldom got sick and his respiration was also better than ever. Upon the advantages of SRI, all of farmers indicated that they would accepted and practiced SRI forever with no thought of stopping it.

Production output

The goal of farmers in rice production was to achieve the increase of yield and family income. The results from focus group showed that the average rice yield from fields using SRI technique was around 2.8 t/ha with production cost of 400,000 riels

(1 USD = 4,000 riels) while fields using conventional practices produced around 2t/ha with the production cost of 500,000 riels. This information should be available to farmers when they have to make decision on rice production techniques. Koma (2001) reported that there is still a large potential for a further increase in yield because no farmer followed all the principles of SRI entirely. Generally, farmers did not apply the principles and techniques properly.

From the results mentioned above, it should be clear about the reasons why the leading farmers adopted SRI practice. Burton (1984) reported that some characteristics of innovative people that they tend to be younger, better educated, involved with various kinds of organization and have more production resources under their control. These characteristics seem to fit well with leading farmers in Tram Kak District which are between 30-64 years of age, who were able to read with primary school, secondary school or high school education, had 15-30 years experience of farming and have participated in some organizations/programs such as CEDAC, PRASAC, ASDP, VSF, and Baksey Phnom. Anthofer (2004) found that there were significant differences between farmers practicing SRI and farmers practicing only conventional rice cultivation. SRI farmers usually have significantly higher education level than those of non-SRI farmers.

Farmers with interest in new ideas and need/want to test new techniques usually decide to adopt SRI package after attending the first training course in Tram Kak District which was organized and sponsored by CEDAC. SRI is a promising technique. It could made farmers become wealthy and healthy with their wisdom. Rogers (2003) indicated that the adoption is a decision to make full use of an innovation at the best course of action available. He also added that innovators' interest in new ideas often leads them out of a local circle of peer network and into more cosmopolitan social relationships. Furthermore, Anthofer (2004) found that farmers practicing SRI were usually innovative farmers who were willing and able to take the risk of potential crop failure when testing a new practice.

Improvement of rice productivity has been one of the objectives of any agricultural and rural development program in Cambodia. Therefore, leading farmers were encouraged and promoted to grow rice by following the SRI with technical supports from government agencies, CEDAC and other NGO's. These leading farmers will demonstrate and accelerate the dissemination of SRI achievement to other farmers.

SRI practice increases rice production through the improved cultural practices on plants, water, soil and nutrient management rather than a new or purchased inputs. These practices result in a sharp decrease of inputs such as seeds, chemical fertilizers and water supply that directly affect production cost. Anthofer (2004) reported that seed rate was reduced from 90 kg/ha in conventional fields to only 30 kg/ha in SRI fields. This is very critical to farmers at time when financial resources are scarce. Moreover, Tech (2004) found that spending on chemical fertilizer was reduced from 92,400 riels/ha in conventional fields to an average of 43,300 riels/ha in SRI fields which correspond to 113% reduction.

In addition, rice grain yield increased from 2 t/ha in conventional fields to 2.8 t/ha in SRI fields. The increase of 0.8 t/ha was accounted by the change of rice growing practices to SRI package. This benefit was observed over a wide range of agro-ecological environments and individual management practices.

Problems and suggestions of leading farmers regarding SRI

The study found seven important problems: low soil fertility, shortage of labor and high rates of labor, lack of irrigation system, lack of organic fertilizers, lack of technique for diseases and pests control, natural disaster, and difficult management of paddy field because of the distance from home. The leading farmers wish government and NGOs, especially, Ministry of Agriculture, Forestry and Fisheries (MAFF) promoted the SRI package to other farmers in and outside district, sent the technical officers to the village in order to train the farmers on agriculture field, provided the easy methods for organic fertilizers and botanical pesticide making, provided the

better seeds, constructed and rehabilitated the irrigation system, and found the available agriculture market.

Part II: the Research Study of General Farmers

This part presents the results of the survey of general farmers in Tram Kak District, Takeo Province. The quantitative research design was used in this part, interviewing schedule (questionnaire) was utilized to collect data and gather information. The results of the study were shown as follows:

Socio-Economic Characteristics

Table 3 showed the socio-economic characteristics of respondents in this study

Sex

It was found that farmer households head at 267 were males (71.8%), and 105 were females (28.2%). Regarded to marital status, 328 of them got married (88.2%), 37 were widower (9.9%), while 6 were single (1.6%), and only 1 was divorce (.3%).

Age

Farmer's age ranged from 21 years to 75 years with the average of 45 years. The largest of respondent were 153 farmers in the group between 20 to 40 years old (41.1%), followed by 111 farmers in group between 41 to 50 years old (29.8%), 72 farmers in the group between 51 to 60 years old (19.4%), and the smallest number were 36 farmers in the group more than 60 years old (9.7%).

Education level

Related to farmer educational level, 138 of farmers households head were able to read (37.1%), followed by 104 had secondary school (28%), while 92 had primary school (24.7%), around 33 were uneducated (8.9%), and the remaining 5 had high school education (1.3%).

Type of occupation

The majority of respondents 365, were farmers (98.1%), and a very small number of 7 were non-farmer, they were lecturers and members of commune council (1.9%).

Experience in paddy field

The average of farmer experience in paddy cultivation was 28.16 years; it ranged from 6 to 60 years. The majority, 234, had experience from 10 to 30 years in paddy cultivation (62.9%). The second largest, 111, had experience for more than 30 years (29.8%), while the smallest, 27, had experience less than 10 years in paddy cultivation (7.3%).

Family member

The average number of family member was 5.58, which ranged from 1 to 14 persons. Most of respondents, 61.3%, had 4 to 6 members in their family helping in paddy cultivation, followed by 26.3% had 7 to 9 members, while 10.5% had 1 to 3 members, and the smallest, 1.9%, had more than 9 members.

Farm labor

- Family labor: the average number of family labor was 3.63 persons, ranged from 1 to 10 persons. More than half of respondent, 51.6%, had 1 – 3 persons, 43% had 4 – 6 persons, while 5.1% had 7 – 9 persons, and .3% had over 9 persons.

- Hired labor: in order to add farm labor, most of respondents, 78.5%, hired labor less than 10 days in addition to family labor, while 18% hired labor between 10 – 20 days, and 3.5% hired labor for more than 20 days.

Table 3 Socio-economic characteristics of the respondents in Tram Kak district

(n=372)

Items	Number	Percent
Sex		
Male	267	71.8
Female	105	28.2
Marital status		
Single	6	1.6
Married	328	88.2
Divorce	1	.3
Widower	37	9.9
Age		
20 to 40 years old	153	41.1
41 to 50 years old	111	29.8
51 to 60 years old	72	19.4
More than 60 years old	36	9.7
	Max. 75	Min. 21
		\bar{X} 45
Education level		
Uneducated	33	8.9
Be able read	138	37.1
Primary school	92	24.7
Secondary school	104	28.0
High school	5	1.3
Type of occupation		
Farmer	365	98.1
Non-farmer	7	1.9
Experience in paddy cultivation		
Less than 10 years	27	7.3
10 to 30 years	234	62.9
More than 30 year	111	29.8
	Max. 60	Min. 6
		\bar{X} 28.16

Table 3 (Continued)

				(n=372)
Items			Number	Percent
Land holding size				
Less than .2 ha			9	2.4
.2 – .5 ha			60	16.1
.51 – 1 ha			168	45.2
More than 1 ha			135	36.3
	Max. 4.5	Min. .13		\bar{X} 1.14
Number of family member				
1– 3 persons			39	10.5
4 – 6 persons			228	61.3
7– 9 persons			98	26.3
More than 9 person			7	1.9
	Max. 14	Min. 1		\bar{X} 5.58
Farm labor				
- Family labor				
1 – 3 persons			192	51.6
4 – 6 persons			160	43.0
7 – 9 persons			19	5.1
More than 9 person			1	.3
	Max. 10	Min. 1		\bar{X} 3.63
- Hire labor				
Less than 10 days			292	78.5
10 – 20 days			67	18
More than 20 days			13	3.5
Family income (on-farm and off-farm)				
Less than 1,000,000 Riels			11	3
1,000,001 to 3,000,000 Riels			194	52.2
3,000,001 to 6,000,000 Riels			132	35.5
More than 6,000,000 Riels			35	9.4
	Max. 32,860,000	Min. 302,400		\bar{X} 3,598,210

Family income

The total of family income (on-farm and off-farm) of respondents ranged from 302,400 to 32,860,000 riels, and the average was 3,598,210 riels. More than half of respondents, 52.2% received income from 1,000,001 riels to 3,000,000 riels, followed by 35.5% received from 3,000,001 to 6,000,000 riels, while 9.4% received more than 6,000,000 riels, and the smallest, 3% of respondents received less than 1,000,000 riels per year (the last of cultivation season) (Table 3).

Land holding size

The total land holding size was 1.14 ha on average, ranging from .13 to 4.5 ha. The majority of respondents, 45.2%, cultivated .51 to 1 ha paddy land, the second 36.3%, cultivated more than 1 ha of paddy land, while, 16.1% cultivated .2 to .5 ha, and the smallest 2.4% cultivated less than .2 ha of paddy land (Table 3). All of land was owned by the farmers, but some of them had tenanted from other farmers and joined owner with other farmers in order to add their cultivation land.

Table 4 Cultivation land size of the respondents in Tram Kak district

(n=372)

Land size	SRI		Conventional rice		Vegetables		Crops	
	No	%	No	%	No	%	No	%
<.2 ha	156	41.9	107	28.8	350	94.1	354	95.2
.21-.5 ha	139	37.4	55	14.8	21	5.6	16	4.3
.51-1 ha	60	16.1	134	36.0	1	.3	2	.5
>1 ha	17	4.6	76	20.4	0	0	0	0

There were four types of cultivation land in this study: SRI land, conventional rice land, vegetables land, and crops land. Table 4 presents the cultivation land size of respondents: land size of SRI, conventional rice, vegetables, and crops less than .2 ha were 41.9%, 28.8%, 94.1%, and 95.2%, respectively; the size between .21 - .5 ha were 37.4%, 14.8%, 5.6%, and 4.3%, respectively; the size ranging from .51 - 1 ha

were 16.1%, 36%, .3%, and .5%, respectively. For the land size, more than 1 ha of SRI and conventional rice were 4.6% and 20.4%, respectively.

Off-farm employment

Most of respondents 60.2% had engaged with other occupation in addition to farming. The remaining 39.8 % of respondents had not been employed in other off-farm works (Table 5). Table 5 also showed that farmers employed with motorcycle taxi driver were 7.14%, garment factory workers were 9.37%, workers (labor rental in district) were 16.07%, and self-businesses (vender, spices seller) were 10.71%. And the rest were 69.19% they employed with other works such as slaughtering, hairdresser, traditional medicine seller, baskets and mat braider, ice cream seller, carpentry, masonry, charcoal and fire wood seller, battery charging service, rice mill, khmer noodle (rice noodle) seller, and sugar palm maker.

Table 5 Off-farm employment of the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Off-farm employment	224	60.2
Type of off-farm work (n=224, multiple responses)	No	%
Motorcycle taxi driver	16	7.14
Garment factory worker	21	9.37
Worker (labor rental)	36	16.07
Self-business (vender, spices seller)	24	10.71
Other	155	69.19

Farmer's association membership

Table 6 showed the data on farmer's association/organization membership and number of year the farmer attended. All most of respondents 93.3% were member of association/organization, while 6.7% were non-member. Farmers attended in one organization were 85%, while two organizations were 12.1%, and the last were 2.9%

which farmer attended three organizations. Farmers attended in CEDAC were 98.55%, while 17.87% attended in other organizations/associations such as ASDP program, MCC, PACT, Rice Bank Association, Amarith Credit, CIDSE, JICA, VSF, and CDA. The farmer attended in CEDAC and other organizations/association from 1-3 years were 78.4% and 79%, respectively. Moreover, the attended farmers from 4-6 years were 17.8% and 16.1%; and the number over 6 years were 3.8% and 4.9%, respectively. The average year of farmers attended in CEDAC was 3.1 year, ranging from 1 to 7 years. While the farmers attended in another organizations/association was on average 2.74 years, ranged from 1 to 14 years.

Table 6 Farmer's association membership and number of year attended

				(n=372)	
Items				Number	Percent
Membership of organizations				347	93.3
Number of association being member of (n=347)		No	%		
1 association		295	85.0		
2 associations		42	12.1		
3 associations		10	2.9		
Member of association (n=347, multiple responses)					
CEDAC		342	98.55		
Other organizations/associations		62	17.87		
Number of year attended in CEDAC (n=342)					
1– 3 years		268	78.4		
4 – 6 years		61	17.8		
More than 6 years		13	3.8		
		Max.7	Min. 1	\bar{X} 3.1	
Number of year attended in other associations (n=62)		N	%		
1– 3 years		49	79.0		
4 – 6 years		10	16.1		
More than 6 years		3	4.9		
		Max. 14	Min. 1	\bar{X} 2.74	

Rice production

The total number of 372 respondents, most of them 75.3% conducted rice production by using conventional practices, while a quarter of them, 24.7%, did not follow the conventional rice practices (Table 7).

Table 7 Conventional rice practice of the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Conventional rice practice	280	75.3
Reason (multiple responses)		
Low cost cultivation	70	18.8
Easy to cultivate	260	69.9
Tasty grain	29	7.8
No need much labor	84	22.6
Have more time to do other jobs	94	25.3
Get more income	30	8.1
High yield	61	16.4
Other	2	.5

Table 7 also showed the reason of respondents in conventional rice practices. The majority reason at 69.9 % of conventional rice practices was the ease of cultivation, and other reasons such as having more time to do other jobs, low labor requireemnt, low cost cultivation, high yield, higher income, and tasty grain were 25.3%, 22.6%, 18.8%, 16.4%, 8.1%, and 7.8%, respectively.

Table 8 showed the problems of farmer faced in conventional rice practices. Nearly half of respondents, 47.3% and 45.5%, were faced with pests, insects and weeds problem, respectively. The problems such as natural disaster (flood and drought), diseases, mature not uniform, soil toxicity, and other (rat, crab) were 40.3%, 18.8%, 16.1%, 4%, and .8%, respectively.

Table 8 Problems of conventional rice practice of the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Pest and insect	176	47.3
Diseases	70	18.8
Weeds	173	45.5
Soil toxicity	15	4.0
Mature not uniform	60	16.1
Natural disaster	150	40.3
Other	3	.8

Note: Multiple responses

In order to solve those problems, more than half of respondents, 57.2%, were having difficulties to solve their problems, while 34.88% were stated to have a normal level, the easy level were 4.18%, and the very difficult level were 3.72% (Table 9).

Table 9 Problems solved by the respondents in Tram Kak District

(n=215)

Items	Number	Percent
Very difficult	8	3.72
Difficult	123	57.2
Normal	75	34.88
Easy	9	4.18

In terms of fertilizers usage, 357 (96%) of respondents used chemical fertilizers, while 100% of respondents used organic manure in paddy cultivation. Concerned with seeds usage, most of respondents, 99.2%, used traditional varieties. The reason of their usage were to keep seeds by own-self, easy to find seeds, lack of organic fertilizer, and seeds resistant to pests and diseases which were accounted for 68.83%, 46.07%, 1.35%, and 5.69%, respectively. The respondents at 22% used improved varieties and they found seeds by own-self kept (6.1%), neighbors (43.9%),

agriculture office (7.32%), NGOs/IOs (23.17%), and private sector (19.51%) (Table 10).

Table 10 Fertilizers and rice varieties utilized by the respondent in Tram Kak District (n=372)

Items	Number	Percent
Applied chemical fertilizer	357	96
Applied organic manure	372	100
Used traditional varieties	369	99.2
Used improve varieties	82	22
Reasons of usage traditional varieties (n=369, multiple responses)	No	%
Kept by own-self	254	68.83
Easy to find	170	46.07
Lack of organic fertilizers	5	1.35
Resistant to pest and diseases	21	5.69
Place get improve varieties (n=82)		
Kept by own-self	5	6.1
Neighbors	36	43.9
Agriculture office	6	7.32
NGOs/IOs	19	23.17
Private sector	16	19.51

Training

Table 11 showed the farmers' attendance in farmer community school (FCS), farmer group discussion (FGD), farmer regular meeting (FRM), and farmer workshop and farmer congress (FW, FC).

Table 11 Training of the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Farmer community school	251	67.5
Farmer group discussion	275	73.9
Farmer regular meeting (monthly meeting)	323	86.8
Farmer workshop and farmer congress	152	40.9

Note: Multiple responses

Farmer community school (FCS)

There were 67.5% of all respondents attending in the farmer community school (Table 11). More than half of respondents, 51.4%, attended in 1- 3 courses, while 29.1% attended in 4 - 6 courses, and the remaining, 19.5%, attended more than 6 courses. The average number of courses one farmer attended were 4.37, ranged from 1 to 14 courses (Table 12). With regard to organizer, table 11 showed that 75.5% were organized by NGOs/IOs, 13.5% were organized by local authority, and the rest, 10.8%, were organized by government sectors. It was showed that after attending the FCS, approximately 47% of respondents were immediately adopted, followed by 41% do experience by own-self, and the remaining, 12%, look at other practices first. Most of respondents, 84.1%, revealed that FCS was very useful, while 15.9% said it was useful. Table 16 showed the percentage of farmer attended in each subject such as SRI (99.6%), crops (67.2%), vegetables (43%), pest (37.1%), soil (31.5%), animal raising (82.9%), fish raising (63.3%), and other, for instance: money saving, organic and compost fertilizers making, mushroom germination, and botanical pesticide making, (31.9%), respectively.

Table 12 Number of course, organizer, and ideas of the respondents in Tram Kak District after attended FCS

(n=251)

Items	Number	Percent
Number of course attended		
1 – 3	129	51.4
4 – 6	73	29.1
More than 6	49	19.5
Max. 14	Min. 1	\bar{X} 4.37
Organizer		
Government sector	27	10.8
Local authority	34	13.5
NGOs/IOs	190	75.5
Ideas after attended training course		
Immediately adopted	118	47
Do experiment by own-self	103	41
Look at other practices first	30	12
Advantage of FCS		
Useful	211	84.1
Very useful	40	15.9

Farmer group discussion (FGD)

There were 73.9% of all respondents joined in farmer group discussion (Table 11). This study revealed that 40.7% of respondents joined group discussion from 4 – 6 times, followed by 32.4% of respondents joined group discussion more than 6 times, and the last 26.9% of farmers joined from 1–3 times. The time of joined group discussion were 5.73 on average, ranging from 1 to 10 times. Most of respondents, 98.9%, like to join in farmer group discussion (Table 13). With regards to the subjects raised in the group discussion, Table 16 showed that most of respondents, 99.3%, discussed on SRI subject, followed by 90.9% on animal raising, 82.9% on crops, and 74.2% on fish raising, respectively. Farmers discussed on pest

and vegetables were 59.6% in each subject, 40.4% on soil, while 45.1% on other subjects such as saving money, village or commune security prevention, and health care.

Table 13 Times of joining in FGD of the respondents in Tram Kak District

(n=275)

Items	Number	Percent
Number of FGD had joined		
1 – 3	74	26.9
4 – 6	112	40.7
More than 6	89	32.4
Max.10 Min. 1 \bar{X} 5.73		
Like to join FGD	272	98.9

Farmer regular meeting (monthly meeting), (FRM)

There were 86.8% of respondents participated in farmer regular meeting (Table 11). Table 14 showed that, more than half of respondents 55.4% participated in FRM more than 6 times, while 30.7% participated from 4–6 times, and the rest 13.9% participated from 1–3 times. The participation of respondents were 7.12 times on average, ranging from 1–12 times. With regards to benefit of FRM participation, approximately 92% were sharing experience each other, 67.2% got new ideas, 65.3% solve farming problems, 77.4% were relationship strengthening, and 1.5% was other subjects (good consolidation, solve some village issues). Most of respondents, 83.6%, revealed that FRM was useful in daily cultivation, while 15.2% were very useful, the rest .9% and .3% were little and useless, respectively. Table 16 showed the percentage of the topics raised in FRM, there were SRI (99.1%), crops (78.9%), vegetables (67.8%), pest (65.6%), soil (51.1%), animal raising (92.6%), fish raising (75.5%), and other 64.1%, (saving money, environment, village security), respectively.

Table 14 Time and benefits of the respondents in Tram Kak District participated in FRM

(n=323)

Items	Number	Percent
Number of FRM had participated		
1 – 3	45	13.9
4 – 6	99	30.7
More than 6	179	55.4
Max.12	Min. 1	\bar{X} 7.12
Benefits of FRM participation (multiple responses)		
Sharing experiences	297	92
Get new idea	217	67.2
Solve farming problems	211	65.3
Relationship strengthening	250	77.4
Other	5	1.5
Advantage of FRM		
Useless	1	.3
Little bit useful	3	.9
Useful	270	83.6
Very useful	49	15.2

Farmer Workshop and Farmer Congress (FW, FC)

There were 40.9% of respondents participated in FW and FC (Table 11). Table 15 showed that 91.2% of respondents participated in FW from 1–3 times, and the rest 8.8% more than 3 times. The average of farmer participation was 1.74, ranged from 1 –5 times. Moreover, some farmers were also participated in FC, which absolutely 100% of them attended from 1–3 times, while the average was 1.14 and ranged from 1 to 3 times. With regards to benefit of farmer participation in FW and FC, most of them, 92.8%, revealed that they had shared their experiences with each other, approximately 77% got new ideas, while building up relationship were 72.5%, and accumulated experiences were 71.7%. Most of respondents, 78.3%, attended in FW

and FC revealed that it was useful in their farming, and remaining 21.7% said it was very useful. Table 16 showed the percentage of farmer attendance in each subject as follows: SRI (96.1%), crops (50.7%), vegetables (36.1%), pest (14.5%), soil (6.6%), animal raising (50%), fish raising (48.7%), environment (11.2%), natural disaster (7.9%), and association management, cultivation planning (2%), respectively.

Table 15 Time and benefits of the respondents in Tram Kak District attended in FW and FC

				(n=152)
Items			Number	Percent
Number of FW and FC had attended (multiple responses)				
FW				
1 – 3			135	91.2
More than 3			13	8.8
Max. 5	Min. 1	\bar{X} 1.74		
FC				
1 – 3			51	100
Max. 3	Min. 1	\bar{X} 1.13		
Benefits of attended (multiple responses)				
Sharing experiences			141	92.8
Get new ideas			117	77
Accumulate experience			109	71.7
Build up relationship			110	72.5
Advantage of FW and FC				
Useful			119	78.3
Very useful			33	21.7

Table 16 Topics raised in FCS, FGD, FRM, and FW and FC for the respondents in Tram Kak District

Items	FCS (n=251)		FGD (n=275)		FRM (n=323)		FW,FC(n=152)	
	No	%	No	%	No	%	No	%
SRI	250	99.6	273	99.3	320	99.1	146	96.1
Crops	169	67.2	228	82.9	255	78.9	77	50.7
Vegetables	108	43	164	59.6	219	67.8	55	36.1
Pest	93	37.1	164	59.6	212	65.6	22	14.5
Soil	79	31.5	111	40.4	165	51.1	10	6.6
Animal raising	208	82.9	250	90.9	299	92.6	76	50
Fish raising	159	63.3	204	74.2	244	75.5	74	48.7
Environment	-	-	-	-	-	-	17	11.2
Natural disasters	-	-	-	-	-	-	12	7.9
Other	80	31.9	124	45.1	207	64.1	3	2

Note: Multiple responses

Extension Services

Table 17 showed that most of respondents (89.5%) need extension agent comes to visit their field during the cultivation season; in contrast, a little bit of them (10.5%) did not need. The purposes of farmers need of the extension worker visitation were getting more advice from extension worker or researcher (22.8%), discussing and consulting (64.9%), and identifying pests and diseases (12.3%). The extension visitation farmer's field in the cultivation season was 1.55 time on average, and ranged from 1 to 5 times; mostly (98.5%) extension worker visited from 1-3 times, and the rest (1.5%) visited more than 3 times in the cultivation season. The respondent revealed that extension agent had done some activities concerning with farmer daily life such as rice, crops, and vegetable cultivation problems (93.9%), SRI (51.8%), introduces innovation to farmer (19.1%), inform the training course (10%), conduct of field demonstration (34.2%), data collection (7%), and implement project (23.3%).

Table 17 Activities of extension agent for the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Need extension agent visit paddy field	333	89.5
Purpose (n=333)	No	%
To get more advices	76	22.8
To discuss and consultation	216	64.9
To identify pest and diseases	41	12.3
Time of extension agent visit farmer's field (n=333)		
1 – 3	328	98.5
More than 3	5	1.5
Max. 5	Min. 1	\bar{X} 1.55
Activities during visited (multiple responses, n=330)		
Rice, crop, and vegetable cultivation problems	310	93.9
SRI	171	51.8
To introduce innovation	63	19.1
To inform the training course	33	10
To conduct field demonstration	113	34.2
Data collection	23	7
To implement project	77	23.3

Farmer-to-farmer

Table 18 showed the results of extension services (farmer-to-farmer) in this study. There were 79.3% of respondents obtaining SRI knowledge and experiences from neighbor or other farmers, while 80.9% of respondents had disseminated their SRI to other farmers live in village together as well as out side the district, for instance, in the village (99%), in commune (65.8%), in district (22.9%), and out side district (3.7%). A disseminator (farmer) had extended his/her knowledge and experiences on agricultural field to other farmers from 1 to 100 persons, and the average was 16.23. There were 82.7% of disseminators who had extended from 1 to 20 farmer, while 7.6% had extended from 21 to 40 farmers, and the rest 7% and 2.7% had extended from 41 to 60 farmers and more than 60 farmers, respectively.

Concerning with the topics of dissemination, approximately 97% were on SRI, followed by 83.4% on animal raising, 73.1% on crops, 59.5% on fish raising, 58.8% on pest, 48.8% on vegetables, 34.9% on soil, and 38.5% on other (money saving, financial management, farmer association management), respectively.

Table 18 Extension services (farmer-to-farmer) for the farmers in Tram Kak District
(n=372)

Items	Number	Percent
Obtained agricultural knowledge and experiences from neighbors or other farmers	295	79.3
Disseminated agricultural knowledge and experiences to other farmers	301	80.9
Number of farmer disseminated (n=301)	No	%
1 – 20	249	82.7
21 – 40	23	7.6
41 – 60	21	7
More than 60	8	2.7
Max. 100	Min. 1	\bar{X} 16.23
Location (n=301, multiple responses)		
In village	298	99
In commune	198	65.8
In district	69	22.9
Out side district	11	3.7
Topic raised for dissemination (n=301, multiple responses)		
SRI	292	97
Crops	220	73.1
Vegetables	147	48.8
Pest	177	58.8
Soil	105	34.9
Animal raising	251	83.4
Fish raising	179	59.5
Other	116	38.5

Exchange visit

Table 19 showed that 37.6% of respondents had joined an exchange visit. The average of farmer joining in the exchange visit were 2.12, ranged from 1–8 times; which farmer joined from 1–3 times were 85.7% and more than 3 times were 14.3%. Approximately 65% of the farmers joined exchange visit in their district, while 38.6% joined out side province (Kandal, Prey Veng, Kampong Speu, Kampong Thom, Svay Rieng, Siem Reap, and Kampong Cham province), followed by 34.3% joined out side district, 25.7% joined in village, and 3.6 % joined abroad such as Thailand and Viet Nam. Concerning with the subjects which farmer had joined in exchange visit was SRI (95.7%), crops (52.1%), vegetables (31.4%), pest (9.3%), soil (9.3%), animal raising (80.7%), fish raising (66.4%), and other (3.6%) such as bio-gas, mushroom germination, multi purposes (home garden, eel and frog raising), and cooperative managing. The respondents revealed that they got the benefits from exchange visit, for instance, sharing experiences (90%), getting new ideas (76.4%), building up relationship (76.4%) and other (1.4%) such as getting new knowledge and experiences.

Table 19 Extension services (exchange visit) for the respondents in Tram Kak

District		(n=372)	
Items		Number	Percent
Had ever joined exchange visit		140	37.6
Number of joining (n=140)	No		%
1 – 3	120		85.7
More than 3	20		14.3
Max. 8	Min. 1		\bar{X} 2.12
Location (n=140, multiple responses)			
In commune	36		25.7
In district	91		65
Out side district	48		34.3
Out side province	54		38.6
Other	5		3.6

Table 19 (Continued)

(n=372)

Items	Number	Percent
Subjects raised during exchange visit (n=140, multiple responses)	N	%
SRI	134	95.7
Crops	73	52.1
Vegetables	44	31.4
Pest	13	9.3
Soil	13	9.3
Animal raising	113	80.7
Fish raising	93	66.4
Other	5	3.6
Benefits of joining (n=140, multiple responses)		
Sharing experiences	126	90
Get new ideas	107	76.4
Build up relationship	107	76.4
Other	2	1.4

Field day

Approximately 43% of respondents had joined a field day. Nearly, 99.4% of them had joined from 1–3 times, while .6% had joined more than 3 times. The average of time joining in the field day was 1.43, which ranged from 1 to 4 times. Most of farmers, 63.8%, joined field day in their commune, while 35.9% of farmer joined in their village, followed by 27.5% joined in their district, 1.3% of them joined out side district, and another 1.3% joined at other province (Kampong Speu, and Prey Veng province), respectively. Concerning with subjects of field day, the result showed that 98.1% of respondents joined on SRI, while 45.3% joined on fish raising, followed by 35.2% on animal raising, 28.3% on crops, 18.9% on vegetables, 6.3% on pest, and 4.4% in soil, respectively (Table 20).

Table 20 Extension services (field day) for the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Had ever joined field day	160	43
Number of joining (n=160)	No	%
1 – 3 times	159	99.4
More than 3 times	1	.6
Max. 4	Min. 1	\bar{X} 1.43
Location (n=160, multiple responses)		
In village	59	35.9
In commune	102	63.8
In district	44	27.5
Out side district	2	1.3
Other	2	1.3
Subjects raised during field day (n=160, multiple responses)		
SRI	156	98.1
Crops	45	28.3
Vegetables	30	18.9
Pest	10	6.3
Soil	7	4.4
Animal raising	56	35.2
Fish raising	72	45.3

Media Exposure

Radio

Table 21 showed the results of farmer listened to radio in study area. It was found that 71.8% of respondents had listened to radio; which most of them, 82.4%, listened everyday, 7.1% listened from 3 to 4 days, 6.7% listened from 5 to 6 days, and 3.7% listened from 1 to 2 days, respectively. The respondents often listened to radio at noon (36.7%) and at night (32.6%); in the evening (10.5%), early morning (8.6%),

afternoon (6%), morning (3.7%), and mid-night (1.9%). Concerning with agricultural field, more than half of them (58.4%) had listened about it.

Table 21 Media exposure (radio) for the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Listened to radio	267	71.8
Number of day listened to radio (n=267)	No	%
1 – 2	10	3.7
3 – 4	19	7.1
5 – 6	18	6.7
Everyday	220	82.4
Listened agricultural field (n=267)	150	58.4
Time often listened to radio (n=267)		
Early morning	23	8.6
Morning	10	3.7
Noon	98	36.7
After noon	16	6
Evening	28	10.5
Night	87	32.6
Mid-night	5	1.9

Television

Table 22 showed the results of respondents who watched television (TV) in study area. More than half of respondents 67.5% had watched TV. 85.3% of respondents watched TV everyday, while 6.4% watched from 3 to 4 days, followed by 5.2% watched from 5 to 6 days, and 3.2% watched from 1 to 2 days. Most of farmer 72.9% watched TV at night, 16.7% watched in the evening, 8.8% watched at noon, 1.2% watched in the morning, and .4% watched in the afternoon. Concerning with agriculture field, 60.6% of respondents had watched some program related to agriculture, and approximately 59% had watched the SRI spot.

Table 22 Media exposure (television) for the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Watched television (TV)	251	67.5
Number of day watched TV (n=251)	No	%
1 – 2	8	3.2
3 – 4	16	6.4
5 – 6	13	5.2
Everyday	214	85.3
Time often watched TV (n=251)		
Morning	3	1.2
Noon	22	8.8
After noon	1	.4
Evening	42	16.7
Night	183	72.9
Watched program concerned with agricultural field (n=251)	152	60.6
Watched SRI spot (n=251)	148	59

Prints

Table 23 showed the results of respondents prefer to read prints media. It was found that 69.4% of farmer prefer to read prints media such as technical book, newspaper, magazine, poster/leaflet, pamphlet, and broacher. 69.4% of respondents had read any prints media which concerning with agriculture field, while 69.1% had read about SRI. The place of prints media that farmer could found were extension agent (49.9%), local authority (52.7%), government sector (9.3%), private sector (1.6%), NGO/IO (78.7%), and neighbor (18.2%). Moreover, the respondents can get those prints media by participated in workshop, training course, and meeting (22.5%), borrowing from another farmer (2.7%), and no need to buy or get free (74.8%).

Table 23 Media exposure (prints) for the respondents in Tram Kak District

(n=372)

Items	Number	Percent
Prefer read print media	258	69.4
Read any prints media concerned with agricultural field	258	69.4
Read any prints media concerned with SRI	257	69.1
Place of getting (n=258, multiple responses)	No	%
Extension agent	126	49.9
Local authority	136	52.7
Government sector	24	9.3
Private sector	4	1.6
NGO/IO	203	78.7
Neighbor	47	18.2
Ways to get prints media (n=258)		
Workshop, training course, meeting	58	22.5
Borrowing	7	2.7
Get free	193	74.8

Adoption of SRI

Table 24 showed the results of the SRI adoption such as acceptance, implementation, and dissemination of the respondents in Tram Kak District.

Acceptance

The SRI package that was practiced in Cambodia consists of 12 principles. According to the result of this study, all farmers (100%) accepted land leveling, water management, weeding, and add nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility. Nearly all of respondents, 99.7%, accepted that water should not flooded during the growth stage. Moreover, most of them 99.2% accepted transplant method in shallow (1-2cm) with roots lays in horizontally, and seedling nursery should be maintained like a garden, watering

intermittently and not kept submerge. The results also showed that 98.4% accepted using good seed and full grain, while 95.4% accepted planting seedling far apart 25cm x 25cm. In addition, 91.4% accepted to transplant 1 seedling per hill, 90.3% accepted to transplant seedlings that were less than 15-day-old, 88.7% accepted uprooting only best seedlings with care and transplanting with speed. Furthermore, the last, 69.4%, accepted to transplant in row (from hill to hill is equal length).

Implementation

It was found that, 99.7% of respondents had practiced SRI principles by adding nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility, while 98.7% had practiced to not flood water during the growth stage, and 96.7% accepted weeding. In addition, 96% had used good seed and full grain, followed by 95.7% had practiced on principle the seedling nursery should be maintained like a garden, watering intermittently and not kept submerge, and 91.9% had transplanted in shallow (1-2cm) with roots lays in horizontally. Moreover, there were some principles that farmers practiced over 50%, for instance, land leveling and water management (74.2%), planting seedling far apart 25cm x 25cm (64.8%), and transplanting 1 seedling per hill (50.5%). In contrast, there were also some principles that farmers practiced under 50%, such as transplanting seedlings that were less than 15-day-old (41.4%), uprooting only best seedlings with care and transplanting with speed (36.4%), and transplanting in row (31.2%).

Transferring

The results of this study showed that some farmers had disseminated their knowledge and experiences of SRI to family members and other farmers, for instance, 78.5% of respondents had disseminated about land leveling and water management, and add nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility. Moreover, they had disseminated on weeding (78.2%), not flooding water during the growth stage, and using good seed and full grain (77.7% in each principle), and seedling nursery should be maintained like a garden, watering

Table 24 Adoption of the respondents in Tram Kak District on SRI principles

(n=372)

SRI Principles	Acceptance		Implementation		Transferring	
	No	%	No	%	No	%
1. Land leveling and water management	372	100	276	74.2	292	78.5
2. Weeding	372	100	360	96.8	291	78.2
3. Water is not flooded during the growth stage	371	99.7	367	98.7	289	77.7
4. Transplant seedling far apart 25cm x 25 cm	355	95.4	241	64.8	224	60.2
5. Transplant in row (from hill to hill is equal length)	258	69.4	116	31.2	113	30.4
6. Transplant in shallow(1-2cm) with roots lays in horizontally (roots tip are not inverted upward)	369	99.2	342	91.9	281	75.5
7. Transplant 1 seedling per hill	340	91.4	188	50.5	189	50.8
8. Transplant young seedling (less than 15-day-old)	336	90.3	154	41.4	129	34.7
9. Uprooting only best seedlings with carefully and transplanted quickly (15-30 minutes between uprooting from the nursery)	329	88.7	136	36.6	108	29
10. Seedling nursery should be maintained like a garden, watering intermittently and not kept submerge	369	99.2	356	95.7	285	76.6
11. Using good seed and full grain	366	98.4	357	96.0	289	77.7
12. Add nutrients to the soil, preferably in organic forms to improve soil fertility	372	100	371	99.7	292	78.5

intermittently and not kept submerge (76.6%). Furthermore, they also disseminated on transplanting in shallow (1-2cm) with roots lays in horizontally (75.5%) and transplanted seedling far apart 25cm x 25 cm (60.2%). In addition, some principles of SRI the farmers had disseminated less than or approximately 50%, for example, transplant 1 seedling per hill (50.8%), seedlings for transplanting are less than 15-day-old (34.7%), transplanting in row (30.4%), and uprooting only best seedlings with carefully and transplanted quickly (29%), respectively.

Environmental aspects

After applied SRI in their paddy, 98.9% of respondents revealed that they had the increasing natural enemies in the field, while 99.7% revealed that they had an increasing population of fish, frogs, crabs, birds. On the other hand, 54.8% of farmers applied chemical fertilizers in their paddy cultivation, while 99.2% applied any organic manure in paddy, for instance: cow dung, green manures, compost, leguminous plants. Regarding to their perception on advantages of organic manure, 98.9% of farmers were well aware on its usage and making (Table 25).

Table 25 Environment aspects in Tram Kak District after apply SRI package

(n=372)

Items	Number	Percent
Natural enemies have increased	368	98.9
Population of fish, frogs, crabs, birds, etc. have increased	371	99.7
Have headache or sick	274	73.7
Applied chemical fertilizer in rice field	204	54.8
Applied any organic manure in rice field	369	99.2
Understanding the advantages of organic manure	368	98.9
Often had the problems in SRI cultivation	242	65.1
It is easy to solve problems	254	68.5
Never though to stop cultivated SRI	357	96.0

Hypotheses Testing

The results of hypotheses testing presented the relationship between the independent variables (socio-economic characteristics, training, extension services, and media exposure) and the dependent variable (adoption of SRI) based on the conceptual framework. The hypothesis was tested by employing Chi-square with significance level at .05. The results of hypothesis testing were shown as follows:

Socio-economic characteristics and adoption of SRI

Table 26 showed the result of Chi-square test relationship between socio-economic characteristics of the respondents in Tram Kak District and adoption of SRI

Chi-square test results showed that sex of household head of farmers was not significantly related to adoption of SRI. Hence, these results supported the rejection of the null hypothesis. It can be explained that sex of the respondent was not a factor affecting adoption of SRI, even the result in Table 3 showed the most of farmer head were male (71.2%).

Age of farmers' household head was not significantly related to adoption of SRI. Hence, these results reject the null hypothesis. It could be because SRI practice was not different from conventional rice cultivation. It only changed some field management practice. Koma (2001) reported that children can also grow rice by following SRI principle. The result of this study was also the same as Sunthorn's study (1993) that there was no significant difference in technology adoption among farmers of different age groups. Moreover, Sakda's study (1999) revealed that the relation of farmer's age to the adoption level of neem extract used was not statistically significant at .05 level.

The result of Chi-square test showed that education level was significantly related to adoption of SRI (acceptance), (.005). Therefore, these results accept the null hypothesis. It may be because farmer households have more time to study even in or

out of school, they gained more knowledge, awareness, and skills in farming practice, and were able to decide whether to accept or not accept on available technique in order to improve and increase family income. The result of this study showed that 69.4% of the respondents had read prints media. It can be concluded that most of farmers were educated, only 8.9% were uneducated. Sunthorn's study (1993) revealed that farmer having different educational level differently adopted technology of mango production in Sing Buri, Thailand. In addition, Sakda's study (1999) found that there was significantly related to the education level to use neem extract for insect pest control of farmers in Sophan Buri, Thailand.

There was not significantly relationship between farmers' experience in paddy field and adoption of SRI. Therefore, these results reject the null hypothesis.

Chi-square test results revealed that land holding size and conventional rice land size was significantly related to the adoption of SRI (implementation), (.002 and .030). Hence, these results accept the null hypothesis. It can be explained that at the first year SRI introduced in Cambodia, in wet season 2000, there were only 28 farmers who tried out the principles and technique of SRI in four provinces. During that time, the average land size was 0.06 ha per family and the total land size was 1.6 ha, but at the year 2005, land size (on average) increased to 0.28 ha per family and total land size increased to 11,200 ha. Due to farmers adaptation and realization on the SRI principles, it leads to an increase of land size to cultivate SRI, for instance, Mr. Khon Sokha, leading farmer from Po Preah Sang Villlage, Ta Phem Commune, Takeo Province, indicated that for the next season he will do SRI in all area (0.4 ha) of his rice field.

There was not significantly relationship between SRI land size and adoption of SRI. Hence, these results reject the null hypothesis. In contrast, the percentage of SRI land size had significantly related to adoption of SRI (acceptance (.007) and transferring, .034). Hence, these results accept the null hypothesis. Somsri's study (1995) found that there was no difference in adoption of corn production technology among the farmers with various farm size.

In terms of land holding size, for instance, the percentage of SRI land size had significantly related to adoption (acceptance and transferring). It may be because farm households with huge land size cultivate SRI on just a small plot of their land. On contrary, some farmers with small land size used all (100%) or more plots of land to cultivate rice with the SRI principles.

There was not significantly relationship between family labor and adoption of SRI. Therefore, these results reject the null hypothesis. It may be because SRI practice was not different from conventional rice. Anthofer (2004) reported that SRI required the same amount of labor as conventional practices. Nuntawan's study (2003) revealed that farmers with different in household labor were not different in adoption on safe vegetable production in Mueang District, Nakhon Pathom Province, Thailand, at .05 level of the statistically significant.

The result of Chi-square test showed that the family income (on-farm and off-farm) was significantly related to adoption of SRI (transferring), (.014). Hence, these results accept the null hypothesis. This result can be explained that normally, the willingness of farmers went with an increase of their income; new discovery technique in rice cultivation (SRI) gave higher production yield than traditional practices, which influenced the amount of production. Koma (2001) revealed that even SRI didn't get a much higher yield than a traditional or conventional practice, SRI can saved a lot of seeds (the amount of seeds needed is less than 10 kg/ha, while traditional practice require amount 80 to 90 kg seeds per ha). Moreover, SRI can save input (chemical fertilizers) costs at a time when financial resources are scarce. An evaluation study conducted by GTZ, Anthofer (2004) showed that an average increase in yield of 660 kg/ha, or 41% (from 1,629 kg/ha to 2289 kg/ha), while gross profits per hectare went from \$120 per ha with conventional methods to \$209 per ha with SRI methods, an increase of \$89 or 74%. This consisted of a \$23 per ha saving in variable costs such as seeds and mineral fertilizer, and an increase of \$66 in the income from higher yield. Furthermore, Watcharin's study (1997) found that there was significantly different between income and adoption of technology.

Chi-square test results revealed that off-farm employment had significantly related to adoption of SRI (implementation), (.044). Therefore, these results accept the null hypothesis. It may be because SRI was not different from conventional rice cultivation; it just changed some field management practices. Anthofer (2004) reported that SRI requires the same amount of labor as the conventional practices. He added that in some location where weeding is not part of the common management practice, farmers seek off-farm employment after transplanting and leave their farm.

The results of Chi-square test showed that farmer association membership was significantly related to adoption of SRI (implementation), (.047). Therefore, these results accept the null hypothesis. It may be because farm households who were member of association had more opportunity to gain best knowledge, experiences, and participate in the training course to practice in their daily work (rice cultivation and management). Farmer's participation in association was desirable, because they gained more information, which can improve their living standard and improve opportunities for collective decision-making. Anthofer (2004) reported that farmer appear to be much more confident to solve their problems through farmer associations. Raykha's study (2000) revealed that the respondents adoption of technology were significantly positively correlated to the level of knowledge in growing vegetables in nylon net house and being a member of farmers' group.

The results of Chi-square test showed that rice production (conventional rice) was significantly related to adoption of SRI (acceptance), (.029). Therefore, these results accept the null hypothesis. It can be explained that the conventional rice method had done by Cambodian farmer long time ago, but the result that received from cultivation was not so good. Since at the year 2000, SRI had introduced to Cambodia, farmers had change from their cultivation on conventional rice practice to SRI. SRI could made more benefits such as less rice seed, labor, timely, economic (fertilizer expand), and get more yield.

Table 26 Relationship between socio-economic characteristics of the respondents in Tram Kak District and adoption of SRI

Items	Adoption		
	Acceptance	Implementation	Transferring
Sex	.066	.155	.378
Age	.636	.060	.394
Education level	.005*	.168	.171
Type of occupation	.008*	.676	.574
Experience in paddy field	.782	.493	.599
Land holding size	.559	.002*	.961
- SRI land size	.985	.785	.599
- % of SRI land size	.007*	.057	.034*
- Conventional land size	.237	.030*	.436
Family labor	.582	.235	.644
Family income	.657	.066	.014*
Off-farm employment	.678	.044*	.229
Farmer's association membership	.731	.047*	.903
Rice production	.029*	.106	.088
SRI yield	.799	.000*	.148

* Significant at .05 level

The results of Chi-square test showed that SRI yield was significantly related to the adoption of SRI (implementation), (.000). Hence, these results accept the null hypothesis (Table 26). It can be explained that SRI was an alternative sustainable rice farming technology for farmers. All farmers who had adopted SRI considered it as a good solution to them because they gained higher yield with less expenditure on purchased inputs. Anthofer (2004) reported that the advantage of SRI was a reduction of input costs, together with an increased gross income through high yield and unchanged overall labor demand. Thy (2006) revealed that rice grain yield increased from 1.6 with traditional method practice to 2.2 t/ha with SRI. On average, the rice

yield increased 0.7 t/ha or 41% in condition of technical practices, ecological, and other variety seeds.

Training and adoption of SRI

Table 27 showed the results of Chi-square test relationship between training of the respondents in Tram Kak District and adoption of SRI

The results of Chi-square test revealed that farmer community school (FCS) and farmer group discussion (FGD) was significantly related to the adoption of SRI (transferring), (.000). Therefore, these results accept the null hypothesis. It can be explained that due to respondents attendance the FCS had more chance to learn and practice some activities related to their daily works. Moreover, FGD was also the good way for respondents because they had a chance to meet each other in regular time in order to revise the subjects or technique that they learned, sharing experiences, and added more new ideas. Ban and Hawkin (1997) reported that formal lectures normally provide fewer opportunities than group discussion, although informal talks usually involve adequate interaction and feedback opportunity. Attending of respondents in both FCS and FGD lead them to have a confidence to decide by themselves in farming matters and the adoption of new ideas and innovations. Anthofer (2004) reported that farmers practicing SRI were found to have a better resource endowment than other farmers.

Chi-square test results revealed that farmer regular meeting (FRM) was significantly related to the adoption of SRI (implementation and transferring), (.001 and 000). Therefore, these results accept the null hypothesis. It may be because the respondents who joined FRM had received the information quickly and had open mind than other. They were able to share their experiences and received new ideas and knowledge from participants. Regular meeting enable to reinforce farmer group and give an opportunity to be intimately and friendly with extension agents. Anthofer (2004) reported that most farmers (75%) received their information about SRI through

training events. Cross visit and field demonstration were usually part of the training program.

The result of Chi-square test showed that farmer workshop (FW) and farmer congress (FC) had significantly related to the adoption of SRI (acceptance and transferring), (.005 and 000). Hence, these results accept the null hypothesis. It can be explained that farmer who participated in FW and FC had more opportunity to joint in social affaire and gain knowledge and perception than other. The aims of FW were to accumulate the experiences of SRI development and disseminate and review the progress of SRI. Rice crop cutting was conducted during the workshop in order to compare the yield of SRI and traditional practice. The respondents who were participated in FW and FC were able to acquire knowledge, ideas, and techniques depend on their needed. Thy (2006) revealed that farmer satisfied this method (FW) because they had chance to share SRI experience together.

Table 27 Relationship between training of the respondents in Tram Kak District and adoption of SRI

Training	Adoption		
	Acceptance	Implementation	Transferring
Farmer Community School	.140	.460	.000*
Farmer Group Discussion	.987	.560	.000*
Farmer Regular Meeting (monthly)	.809	.001*	.000*
Farmer Workshop and Farmer Congress	.005*	.781	.000*

* Significant at .05 level

Extension services and adoption of SRI

Table 28 showed the results of Chi-square test relationship between extension services for the respondents in Tram Kak District and the adoption of SRI.

Chi-square test results revealed that farmer need extension agent come to visit their paddy field had significantly related to the adoption of SRI (implementation and transferring), (.027 and .030). Hence, these results accept the null hypothesis. It can be explained that the farm visits were made for a variety reasons; for instance, giving information to the farmer, sharing experiences between extension agent and farmers, assisting farmers to identify the problems in paddy field which they have not yet recognized and adjusting general recommendations on farm practices to fit the farmer's own situation and problems. Kang and Song (1984) reported that although farm visit is time-consuming, it was important because it was through working individually with the farmer that the extension worker learns about the people of the area, how they think, what their need are, and how they carry on their work. Also farm visit helps the extension worker to gain the local knowledge essential for planning extension programs.

Chi-square test results showed that the extension service (farmer-to-farmer), both farmer got SRI experience from neighbors or other farmers and farmer disseminated SRI to other farmers had significantly related to the adoption of SRI (implementation and transferring), (.015, 000 and .003, 000). Hence, these results accept the null hypothesis. It can be explained that farmers had disseminated their experiences and everyday practices which was available to the local situation and their communication by using local language. So it leads other farmers understand and adopt easily. Thy (2006) revealed that although extension method (farmer-to-farmer) is not as regular as extension agent but it can cause other farmers quickly trust and adopt. However, Rogers (2005) reported that most individuals do not adopt an innovation without first trying it on a probationary basis to determine its usefulness in their own situation.

Chi-square test results revealed that the extension service (exchange visit) was significantly related to the adoption of SRI (transferring), (.000). Therefore, these results accept the null hypothesis. According to the observation on adoption of SRI, at the first year farmers were hesitating to adopt because they had never heard and seen before. For instance, Tech (2006) reported that SRI started with 28 farmers in year

2000, then 400 farmers in 2001, after that 3,000 farmers in 2002, 40,000 farmers at the end of 2005, and so on. It can be explained that due to a small group of farmer (innovators/leading-farmers) started to practice the SRI package and giving an opportunity to other farmers and stakeholders (general farmers) came to visit, study more about SRI advantages, and accumulate to concrete experiences through learning by seeing and talking, thus it lead them interested, followed, and disseminated. Thy (2006) revealed that exchange visit or study tour gave an opportunity to farmers and other stakeholders to learn, understand, and sight seeing in order to concentrate on, implement, and disseminate to other. If they did not see by themselves, it was not trust and follow.

There was not significantly relationship between field day and the adoption of SRI. Hence, these results reject the null hypothesis.

Table 28 Relationship between extension services for the respondents in Tram Kak District and adoption of SRI

Extension Services	Adoption		
	Acceptance	Implementation	Transferring
Extension agent visit farmer field	.915	.027*	.030*
Farmer to farmer			
-Obtained from neighbors	.561	.015*	.000*
-Disseminated to other farmers	.759	.003*	.000*
Exchange visit	.082	.804	.000*
Field day	.864	.504	.577

* Significant at .05 level

Extension work is a key factor in technical transferring to farmer in order to improve agricultural production and increase farmer household income, which followed poverty reducing policy of Royal Government of Cambodia. The department of agricultural extension has tried to set up the extension planning programs for dissemination to farmers through theory training combine with practical such as:

demonstration field, study tour (exchange visit), broadcasting on radio and television, and publishing on agricultural journals/leaflets, which help farmers get information, knowledge, and available skills on agriculture field.

Media exposure and adoption of SRI

Table 29 showed the results of Chi-square test relationship between media exposure for the respondents in Tram Kak District and the adoption of SRI.

Chi-square test results revealed that television and radio were significantly related to the adoption of SRI (transferring), (.000). Therefore, these results accept the null hypotheses. It can be explained that radio was one of the best communication tools; it was available to most rural people around the world, especially as transistor radios were used more widely. The listeners could bring their radio wherever they went, even where electricity power was not available. The result of this study showed that most of farmers (71.8%) had listened to radio, while 67.5% watched television, it can be say that the more listened, watched, the more frequent the exposure to the mass media channels to get information. However, since dissemination of information primarily comes from mass media, television, information generated from them will help the respondents to understand the principles and advantage of SRI. Ban and Hawkin (1997) reported that the media were an important tool for making people aware of innovations and for stimulating their interest.

Chi-square test results showed that prints media such as technical books, newspapers, magazines, posters, leaflets, pamphlets, brochures, etc. were significantly related to the adoption of SRI (acceptance), (.018). Therefore, these results accept the null hypothesis. In addition, especially, the prints media concerned with agriculture was significantly related to adoption of SRI (acceptance), (.018). Moreover, the prints media concerned with SRI was significantly related to the adoption of SRI (acceptance), (.023). Hence, these results accept the null hypothesis. Generally, prints media was the cheapest media (compare to radio and television) for sending message to large number of people. Unfortunately, prints media such as newspaper, magazines,

etc. were not so available for farmers in rural area because of transportation and the marketing (poor farmer can not purchase). It was only available for farmers when they participated in training, workshop, or meeting, and by getting it from extension agent. Thy (2006) revealed that every month CEDAC had delivered farmer bulletin, farmer and nature, (monthly issue), which compiled all the experiences in SRI and farming, to farmer in target areas.

Ban and Hawkin (1997) reported that print and electronic media such as newspapers, radio and television help extension agents to reach large numbers of farmers simultaneously. The media specialize in news. While “man bites dog” would attract attention as news, “dog bites man” would be regarded as too commonplace to warrant media attention. New ideas diffused through the media are more acceptable if they link up with existing knowledge than when they attempt to modify this knowledge.

Table 29 Relationship between media exposure for the respondents in Tram Kak District and adoption SRI

Media Exposure	Adoption		
	Acceptance	Implementation	Transferring
Television	.309	.769	.000*
Radio	.673	.468	.000*
Prints media	.018*	.242	.161
- Concerned with Agriculture	.018*	.162	.161
- Concerned with SRI	.023*	.135	.186

* Significant at .05 level

Problems and Suggestions of Farmers Regarding SRI

The problems faced by farmers in SRI cultivation in Tram Kak District were derived from this research study base on the results of findings. The results revealed that 71.5% of respondents faced with more weed growth in paddy field, followed by

43.5% lack of water resource and natural disasters, while 32.8% lack of organic fertilizer such as cow dung, green manures, compost fertilizer, and 30.6% lack of technique in pest, insect and weed management. In addition, 11.8% of respondents faced with low soil fertility, and 39.2% faced with other problems, such as irrigation and drainage problems, labor shortage, difficult management of paddy because of the distance from home, difficult transplanting in line and in square pattern, rodents, insect and diseases (dwarf disease, fungal disease, grassy stunt, orange leaf, stem rot, stripe stemborer, etc.) (Table 30).

Table 30 Problems and suggestions of respondents in Tram Kak District

(n=372)

Items	Number	Percent
Problems		
More weed in paddy field	266	71.5
Lack of technique in pest, insect, and weed control	114	30.6
Lack of water resource, and natural disasters	162	43.5
Lack of organic fertilizers	122	32.8
Low soil fertility	44	11.8
Other	146	39.2
Suggestions		
Organize training course	264	71
Reforestation	55	14.8
Promote farmer on compost fertilizer making	100	26.9
Rehabilitate canal, stream, dump, etc.	88	23.7
Need extension agent came to visit	235	63.2
Other	174	46.9

Note: Multiple responses

The farmers' suggestions derived from this study were presented as follows: approximately 71% of respondents suggested to government agencies and NGOs organized training course for farmer, followed by 63.2% needed extension agent came to visit their field, 26.9% promoted farmer on compost making, and 23.7%

rehabilitate irrigation system such as canal, stream, dump, etc. Moreover, 14.8% of respondents suggested to reforestation, and 46.9% were other suggestions such as providing good and high yield paddy seeds, establishing farmer cooperative, exchange visiting at other provinces, finding available agricultural market, providing new knowledge and skills in animal (cow, pig, chicken, etc.) and fish raising, and crop cultivation (Table 30).

The Model of Extension in SRI Adoption

Depending on the results of both parts (leading farmer and general farmer), the propose model of SRI adoption under Cambodia conditions could design as follows:

1. Extension sector (Department of Agricultural Extension, DAE) was an institution, which had full of expertise, human resources, and infrastructure in extension services nationwide (from national level to village level). DAE will take responsibility for setting the planning a framework, strategy, and extension service for transferring the innovation. On the other hand, stakeholders (government and non-government institutions) and NGOs in cooperate with extension sector would provide mechanisms for coordination, consultation, and technical or financial support.

2. Extension sector, first step, prepares the materials and documents that related to the pilot study (budget proposal, schedule, human resources, questionnaires, etc.), and then starts to implement the pilot study in the target site to study on attitude, living culture, and socio-economic characteristics of farmers. The results of the study will be an important factor for extension sector to evaluate the local situation, priorities locally important problems and opportunities.

3. After the pilot study, the extension sector through Provincial Office of Agricultural Extension (POAE) will fine out the contact farmers and facilitate them to prepare and conduct the On-Farm Adoptive Trial (OFAT), which is a vital role in technology and innovation transferring. POAE in cooperate with contact farmers will take responsible for OFAT management, data record, writing report, etc. The results of OFAT will be useful for extension sector in SRI transferring.

4. After conducted the pilot study and OFAT, the source of information on SRI will disseminate through transferring channel (mass media) such as television, and prints media in order to local authorities and local farmers get the basic information of SRI. Then, the detail and in depth of information would be transferred through people media such as face-to-face, group discussion, informal meeting, and the responsible person should be provincial and district officers of agricultural extension. Moreover, people media could be transferred through farmer-to-farmer, neighbors, farmer's relative, stakeholders or NGOs in the local site, and local authorities.

5. Then, the extension services (training) to transfer innovation, SRI, such as farmer community school, farmer regular meeting, farmer workshop will organized for local authorities and local farmers, which it is responsible by POAE with supported both technical and financial from extension sector.

6. When finished the training course, POAE will organized extension services such as exchange visit, field day, field demonstration for participants in order to make them confidence on innovation adopted and practiced.

7. Through the transferring channel and extension services, local authorities and local farmers will make decision whether accept or reject innovation, SRI. The decision making will do within individual or group. After they accepted, the farmers will be disseminated and transferred those knowledge and practices to family member and other farmers.

8. At the end, after receiving a message (SRI), the receivers (local authorities, local farmers, farmer adopted of SRI) respond in some way and signal that responses to the sender (extension sector or stakeholders and NGOs). The signal of feedback may take the form of a spoken comment, a long sigh, a written message, a smile, or some other action. The respond (feedback) of receivers will be an important point for extension sector in innovation transferring process because it allows the sender to evaluate the effectiveness of the message, and it ultimately provides an opportunity for the sender to take corrective action to clarify a misunderstood message.

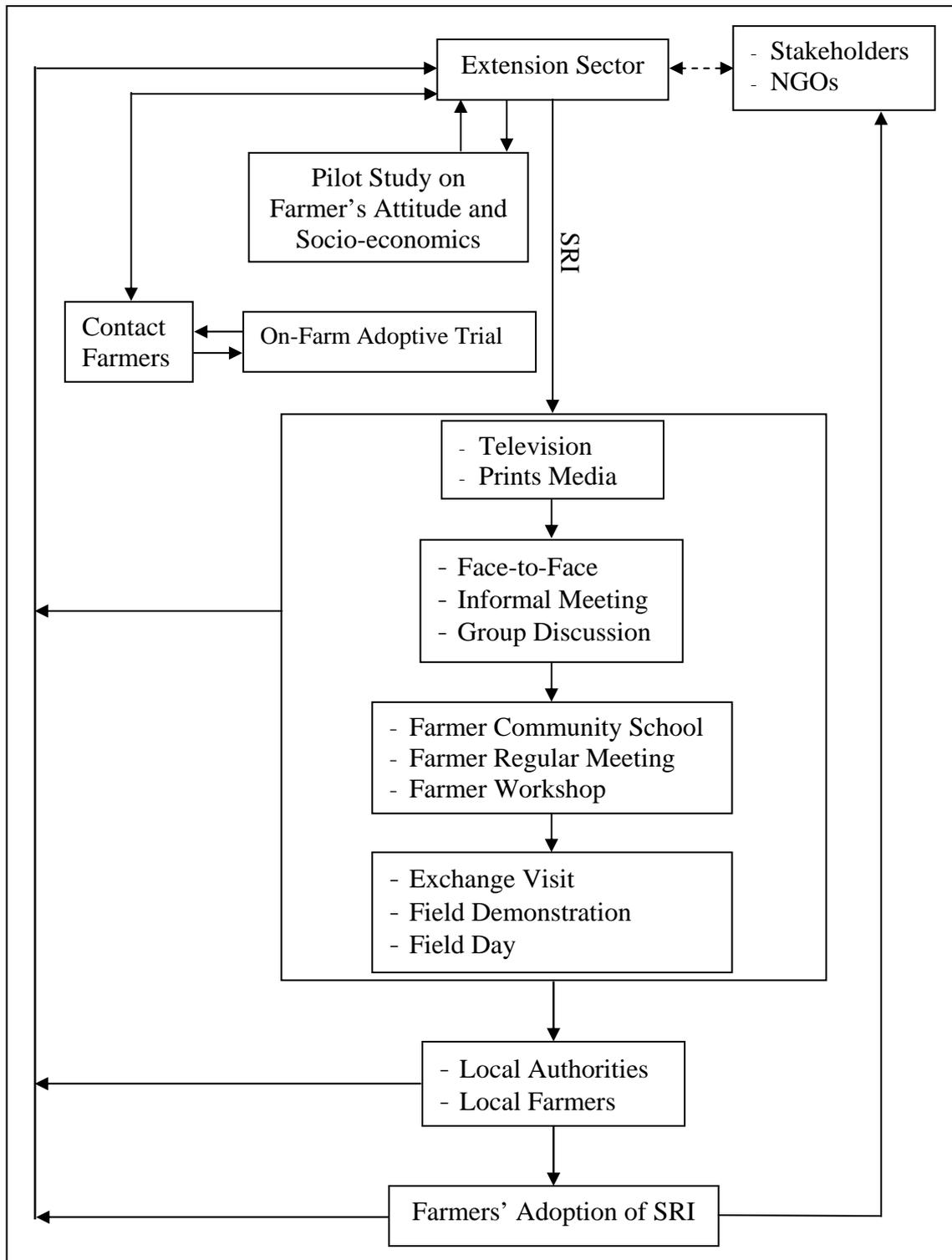


Figure 9 The Model of extension in SRI adoption

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions were derived from this research study base on the results of findings presented above.

The results revealed that leading farmers have followed the steps of the SRI after attending the training course which organized by CEDAC. They utilized the trained knowledge especially in fertilizer usage, and the advantages and disadvantages of chemical and organic fertilizers. In addition, the perception of leading farmers on the SRI principles and practices were at very high adoption level, and they also disseminated knowledge, practices, and experiences to family members and other farmers both in and outside district by farmer-to-farmer, informal meeting, and group discussion methods. The rice paddy yield increased from the former average 2 tons (t) per hectare (ha) to 2.8 t/ha when farmers changed to SRI implementation. The problems found in this study were: low soil fertility, labor shortage, lack of irrigation system, drainage and water sources, lack of organic fertilizer, natural disaster, and lack of diseases and pests control knowledge. Farmers were looking forward for help to ease their problems from either government or NGOs.

The results of research study revealed that farmers' households mostly headed by male (71.8%) and married 88.2%, widower 9.9%, single 1.6%, and divorce 0.3%. The average age of farmer was 45 years, ranged from 21 to 75 years. Concerned with education, 37.1% were able to read, 28% obtained secondary school education, 24.7% obtained primary school education, 8.9% were uneducated, and 1.3% obtained high school education. Most of them were farmers, 98.1% with the 28.16 years average experience of farmers in paddy cultivation. The average size of land holding was 1.14 ha, ranged from .13 to 4.5 ha, which 41.9% of farmers cultivated SRI on their land less than .2 ha, 37.4% cultivated from .21 to .5 ha, 16.1% from .51 to 1 ha, and 4.6%

over 1 ha. On the other hand, approximately 36% of farmers cultivated conventional rice on their land from .51 to 1 ha, 28.8% less than .2 ha, 20.4% more than 1 ha, and 14.8% from .21 to .5 ha. The average of family member was 5.58 persons, ranged from 1 to 14 persons, with average farm labor 3.63 persons, ranged from 1 to 10 persons. In order to add farm labor, 78.5% of farmer hired labor less than 10 days, 18% hired from 10 to 20 days, and 3.5% hired over 20 days. The average of family income (on and off-farm) was 3,598,210 riels, ranged from 302,400 to 32,860,000 riels. In order to add more income, 60.2% of farmers were engaged in off farm employment, while 93.3% participated in association/organization. Although, all the respondents practiced SRI but 75.3% of them still use conventional rice practice.

Concerned to training of the respondents, the results revealed that 67.5% had attended the farmer community school (FCS) with the average of 4.37 times ranged from 1 to 14 times. 73.9% had joined the farmer group discussion (FGD) with the average of 5.73 times, ranged from 1 to 10 times. 86.8% had joined the farmer regular meeting (FRM) with the average of 7.12 times, ranged from 1 to 12 times. And 40.9% had participated in the farmer workshop and the farmer congress (FW and FC) with the average of 1.74 times, ranged from 1 to 5 times and 1.13 times, ranged from 1 to 3 times, respectively. The subject raised in training course were SRI, crops, vegetables, pest, soil fertility management, animal raising, fish raising, saving money, etc.

Most of respondents (89.5%) needed extension agent visiting their field for discussing and consulting about farming problems (64.9%), obtaining more advice (22.8%), and identifying pests and diseases (12.3%). The average time of extension agent came to visit per cultivation season was 1.55 time, ranged from 1 to 5 times. Regarding to extension services (farmer-to-farmer), 79.3% of respondents obtained agricultural knowledge and experiences from neighbors or other farmers, while 80.9% had disseminated their knowledge and experience to neighbors and other farmers. The average of dissemination was 16.23 farmers ranged from 1 to 100 farmers. 37.6% of respondents had joined another extension services (exchange visit) with the average of 2.12 times ranged from 1 to 8 times. Approximately 43% had joined extension services (field day) with the average of 1.43 times ranged from 1 to 4 times.

The results revealed that 71.8% of respondents listened to the radio. Most of them (82.4%) listened to the radio everyday, 36.7% listened at noon and 32.6% listened at night. 58.4% of them listened on agricultural field. On the other hand, 67.5% of respondents watched television with the 85.3% watched everyday and 72.9% watched at night. The respondents had watched the program concerned with agricultural field (60.6%) and SRI spot (59%). However, 69.4% of respondents prefer to read prints media with 69.4% had read any prints media which concerning agriculture field and 69.1% had read about SRI. The place of prints media that farmer could found was extension agent, local authority, government sector, private sector, NGO/IO, and neighbor. Moreover, the respondents can get those prints media by participated in workshop, training course, meeting, borrowing from another farmer, and getting free copies from extension agents.

The research revealed that the acceptance of farmer on 12 principles of SRI was very high (69.4% up). While few of principles was implemented and transferred below 50% such as transplanting in row (31.2% and 30.4%), transplanting young seedlings, age less than 15 days (41.4% and 34.7%), uprooting best seedlings and transplanted quickly (36.6% and 29%), respectively, and the remaining 9 principles were implemented and transferred over 50%.

Socio-economic characteristics such as education level, type of occupation, land holding size, percentage of SRI land size, conventional rice land size, family income, off-farm employment, association membership, rice production, and SRI yield were the most important factors of farmer's adoption of SRI.

Training such as farmer community school, farmer group discussion, farmer regular meeting, farmer workshop and farmer congress were the most important factors of farmer's adoption of SRI.

Extension services, for instance, extension agent came to visit farmer field, farmer to farmer, exchange visit were the most important factors of farmer's adoption of SRI.

Media exposure such as television, radio, prints were the most important factors of farmer's adoption of SRI.

The problems such as more weed in paddy field, lack of water resource and natural disasters, lack of organic fertilizer such as cow dung, green manures, compost fertilizer, lack of technique in pest, insect and weed control, low soil fertility, irrigation and drainage problems, labor shortage, difficult management of paddy field because of the distance from home, difficult transplanting in row and in square pattern, rodents, insect and diseases (dwarf disease, fungal disease, grassy stunt, orange leaf, stem rot, stripe stemborer, etc.). Farmers expected government agencies and NGOs intervention to solve their problems.

Recommendations

In order to improve the adoption of SRI practice, the recommendations should be considered as follows:

1. National policy

The government, especially, Ministry of Agriculture, Forestry and Fisheries (MAFF) should strengthen the supporting services to the research and extension sectors through existing SRI task force to eliminate the weakness of farmers in rice cultivation. Promote and encourage farmers to raise animals and reforestation. Moreover, small scale irrigation system should be constructed in district wide. Improving and updating extension services such as radio, television (broadcasting time should be adjusted to suit farmers' convenience), prints (leaflet, bulletin, broacher, guideline book, etc.), organize the training course, exchange visit, are very important for farmer obtaining the information and adoption. On the other hand, the existing farmer cooperative should be further encourage, support, and coordinate the process in new cooperative establishment in order to diffuse the innovations, for instance, SRI. However, agriculture market should be made available for them.

2. Capacity building

The type of activities in capacity building should be based on the farmer's need. Key farmers and respected people in local area should be trained well and encouraged them to disseminate knowledge, experiences to other farmers (because key farmers can communicate in their local language). The extension agent should concentrate on what's farmer needs rather than interested in. Moreover, the talented of extension worker with the full of knowledge and skills, and sufficiency of training materials would increase the number of farmer's adoption. On the other hand, the information or results of experiments of SRI which gathered from local or international should disseminate to farmers or relevant stakeholders as fast as possible.

3. Participatory opportunity

Participatory approach can be practiced through the different activities. In order to ensure SRI to be widely adopted by farmers, there is a need to let farmers having opportunities to meet and visit SRI practice in or out of country. Furthermore, the demonstration experiment should be participated from farmers, and should pay more attention to learning and documenting from farmer innovations. Moreover, farmers have to adopt SRI practices as a system or as a package rather than just portion of it. However, the Department of Agricultural Extension (DAE) should seek all available ways to promote and encourage non-SRI farmers to follow SRI practice.

4. Cooperation among stakeholder

The extension workers and researchers should contact each other to solve the SRI farmers' problems as early as possible to minimize losses. The technical aspects of SRI should be discussed with research institutions and, where found necessary, modified according to new insight. Moreover, researchers and practitioners should learn from each other with combination of efforts to understand well on SRI. However, researcher need to study and conducting research more on potential and remain critical of SRI, and investigation the long-term sustainability of such a system. Stakeholders, NGOs, should get involve with government official to conduct the training course on pest control, organic fertilizers making, crop cultivation, etc. In addition, relevant officials should be widely promotion, encouragement and strengthen the SRI practice to farmer.

Suggestions for Further Study

Based on the results of the study, suggestions for further study are: in depth study on farmer's adoption of SRI should be done at other district. Moreover, the study of factor influencing on long-term sustainability of SRI, and the experimentation and available recommendations on SRI practice in each zone should be done.

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APPENDICES

APPENDIX A

Key questions (assist in focus group)

KEY QUESTIONS

(Assist in focus group, leading farmers)

Factors Affecting Farmers Adoption of the System of Rice Intensification (SRI) in Tram Kak District, Takeo Province, Cambodia.

Instruction:

- Your answer will be used only in this research study; and
 - Please participate in the focus group by yourself (head of family).
1. Please describe your socio-economic such as age, education level, type of occupation, field experiences, land holding size, family labor, family income, off-farm employment, and farmer's association membership?
 2. How is your conventional rice cultivation?
 3. When, where, whom (organizations/institutions), do you know the SRI (farmer community school, group discussion, monthly meeting, farmer workshop/congress, extension agents, exchange visit, field day, television, radio, prints)?
 4. Did you have ever participated in training course, group discussion, exchange visit, field day...etc. which concern with agriculture field, especially SRI package? What topics did they raise in that time? Did it is useful for your daily life? Why?
 5. Why did you accept the SRI package? (The reasons are: investment, knowledge, feeling, perception, encouragement, promotion, natural disasters, rice yield increasing, and family's income increase).
 6. Did government agencies, for example, extension agency, and local authority etc. come to visit you during the cultivation season? What did they do?
 7. Did you apply the chemical and/or organic fertilizer (compost, green manure, straw, cow dung, poultry manure, and burn paddy husk) in your field? Why? Do you know the advantages and disadvantages of them?
 8. How many principles does SRI consist? Could you describe all of them?
 9. Did you have ever practices those principles in your rice production?
 10. Did you have recommended or disseminated those principles to families' members or other farmers? How many? What ways did you used (face-to-face, group discussion, informal meeting, invite to see your field, etc.)?

11. After you applied SRI package in your field, did it different from the previous practices (the population of natural enemies, fish, frogs, crabs, birds , etc., and the pest, diseases, insects weeds, have increase or decrease)?
12. After you applied SRI package in your field, how is your health and daily life (get sick, headache, respiration, physical strengthening, etc.)?
13. Have you ever faced the problems (pest, insects, diseases, weeds, soil toxicity, maturity not uniform, natural disasters, etc.) in your SRI field? Did it is easy to solve?
14. Have you ever though to stop followed the SRI package? Why?
15. Please calculate the expenditure on SRI cultivation
 - Land size.....ha
 - a) Land preparation.....riel b) Transplanting.....riel
 - c) Seed..... riel (name.....)
 - d) Fertilizer.....riel
 - e) Pesticide.....riel f) Harvesting.....riel
 - g) Yield.....tones (.....riel)

Thank you very much for your kindness cooperation.

APPENDIX B
Questionnaire

13- Rice production

13-1 Did you cultivate conventional rice? 1) Yes 2) No

If yes, why? (multiple responses)

a) Low cost cultivation

b) Easy to cultivate

c) Tasty grain

d) No need much labor

e) Have more time to do other jobs

f) Get more income

g) High yield

h) Others (specify).....

13-2 Have you ever faced the problems? 1) Yes 2) No

If yes, what is it? (multiple responses)

a) Pest, insects

b) Diseases

c) Weeds

d) Soil toxicity

e) Maturity not uniform

f) Natural disasters

g) Others (specify).....

13-3 If yes, is it easy to solve?

a) Very difficult

b) Difficult

c) Normal

d) Easy

e) Very easy

13-4 Do you apply chemical fertilizers to your field? 1) Yes 2) No

13-5 Do you apply organic manure to your field? 1) Yes 2) No

13-6 Do you use traditional varieties? 1) Yes 2) No

13-7 Do you use improved varieties? 1) Yes 2) No

If yes, where do you get it?

- a) Kept by own-self
- b) Neighbors
- c) Research stations
- d) Agriculture/extension office
- e) NGOs/IOs
- f) Private sectors
- g) Political parties
- h) Farmer's association
- i) Others (specify).....

13-8 Please, calculate the expenditure on conventional rice cultivation.

- Land size.....ha

- a) Land preparation.....riel b) Transplanting.....riel
- c) Seed..... riel (name.....) d) Fertilizer.....riel
- e) Pesticide.....riel f) Harvesting.....riel
- g) Yield.....tones (.....riel)

Section 2: Training, Extension Services, and Media Exposure

I- Training

A- Farmer Community School

14- Have you ever participated in training course on agricultural techniques?

- 1) Yes
- 2) No

14-1 If yes, how many courses?..... courses.

14-2 If yes, what topic do they raised for training?

- a) SRI
- b) Crops
- c) Vegetables
- d) Pest
- e) Soil
- f) Animal raising
- g) Fish raising
- h) Other (specify).....

15- After participated in the training course, what was your idea? (check one)

- a) Immediately adopted
- b) Do experiment by own-self
- c) Look at other practices first
- d) Follow neighbors house
- e) Unbelievable
- f) Others (specify).....

16- Which (organizations/institutions) is organizer?

- a) Government agencies
- b) Local authority
- c) Private sector
- d) Political party
- e) NGOs/IOs
- f) Others (specify).....

17- Does farmer community school is usefully for your farm cultivation?

- a) Useless
- b) Little
- c) Normal
- d) Useful
- e) very useful

B- Farmer Group Discussion

18- Have you ever met other farmers to conduct the group discussion/consultation?

- 1) Yes
- 2) No

18-1 If yes, how many time? times.

18-2 If yes, what subjects do they discussed? (multiple responses)

- a) SRI
- b) Crops
- c) Vegetables
- d) Pest
- e) Soil

f) Animal raising

g) Fish raising

h) Other (specify).....

19- Do you like to join the farmer group discussion? 1) Yes 2) No

C- Farmer Regular Meeting (Monthly Meeting)

20- Have you ever participated in farmer regular meeting (monthly meeting)?

1) Yes b) No

20-1 If yes, how many time?times

20-2 If yes, What subjects did they discussed? (multiple responses)

a) SRI

b) Crops

c) Vegetables

d) Pest

e) Soil

f) Animal raising

g) Fish raising

h) Other (specify).....

21- What are the benefits do you get from farmers farmer regular meeting (monthly meeting)? (multiple responses)

a) Sharing experiences each other

b) Get new ideas/knowledge

c) Solve farming problems

d) Relationship strengthening

e) Others (specify).....

22- Does farmer regular meeting is usefully for your farm cultivation?

a) Useless

b) Little

c) Normal

d) Useful

e) very useful

D- Farmer Workshop and Congress

23- Have you ever participated in the workshop and congress? 1) Yes 2) No

23-1 If yes, how many?.....workshops, congresses

23-2 If yes, What subjects did they raised for presentation/discussion?

- a) SRI
- b) Crops
- c) Vegetables
- d) Pest
- e) Soil
- f) Animal raising
- g) Fish raising
- h) Environmental
- i) Natural disasters
- j) Other (specify).....

24- What are the benefits do you get from workshop, congress? (multiple responses)

- a) Sharing experiences each other
- b) Get new ideas/knowledge
- c) Accumulate experience
- d) Build up relationship
- e) Others (specify).....

25- Does workshop, congress is usefully for your farm cultivation?

- a) Useless
- b) Little
- c) Normal
- d) Useful
- e) very useful

II- Extension Services

26- Do you need extension agents come to visit you? 1) Yes 2) No

26-1 If "Yes" (check one)

- a) To get more advices

- b) To discuss and consultation
- c) To identify pest and diseases
- d) Others (specify).....

26-2 How many times did extension agents visit your field during last year?
.....times

26-3 What did they discuss? (multiple responses)

- a) Rice, crops, and vegetables cultivation problems
- b) SRI
- c) To introduce an innovation
- d) To inform a training course
- e) To organize a field experiment/demonstration
- f) Data collection
- g) To implement project
- h) Others (specify).....

A- Farmer-to-Farmer

27- Have you ever gotten experience and knowledge of agriculture field from neighbors or other farmers?

- 1) Yes 2) No

28- Have you ever disseminated your agricultural knowledge and experience to other farmers?

- 1) Yes 2) No

28-1 If yes, how many? farmers.

28-2 If yes, where do they live? (multiple responses)

- a) In your village
- b) In your commune
- c) In your district
- d) Out side your district
- e) Others (specify).....

28-3 What topic do you discussed with them? (multiple responses)

- a) SRI

- b) Crops
- c) Vegetables
- d) Pest
- e) Soil
- f) Animal raising
- g) Fish raising
- h) Other (specify).....

B- Exchange Visit

29- Have you ever joined the exchange visit program? 1) Yes 2) No

29-1 If "yes" how many?.....times. Where?

- a) In commune
- b) In district
- c) Out side district
- d) Out side province
- e) Others (specify).....

29-2 If yes, what topics did you have joined? (multiple response)

- a) SRI
- b) Crops
- c) Vegetables
- d) Pest
- e) Soil
- f) Animal raising
- g) Fish raising
- h) Other (specify).....

30- What are the benefits do you get from exchange visit? (multiple responses)

- a) Sharing experiences each other
- b) Get new ideas/knowledge
- c) Build up relationship
- d) Others (specify).....

C- Field Day

31- Have you ever participated in field day? 1) Yes 2) No

31-1 If "yes" how many? times. Where?

- a) In village
- b) In commune
- c) In district
- d) Out side district
- e) Others (specify).....

31-2 If yes, what topics do you had participated in? (multiple responses)

- a) SRI
- b) Crops
- c) Vegetables
- d) Pest
- e) Soil
- f) Animal raising
- g) Fish raising
- h) Other (specify).....

III- Media Exposure**A- Radio**

32- Have you ever listened to the radio? 1) Yes 2) No

33- How many day per week do you listen to the radio?

- a) 1-2 days
- b) 3-4 days
- c) 5-6 days
- d) Everyday

34- Have you ever listened to any broadcasts from the government or NGOs/IOs
concerned with agricultural field? 1) Yes 2) No

35- When often do you listen to the radio?

- a) Early morning
- b) Morning

- c) Noon
- d) After noon
- e) Evening
- f) Night
- g) Mid-nigh

B- Television

36- Have you ever watched TV? 1) Yes 2) No

37- How many day per week do you watch TV?

- a) 1-2 days
- b) 3-4 days
- c) 5-6 days
- d) Everyday

38- When often do you watching TV?

- a) Morning
- b) Noon
- c) After noon
- d) Evening
- e) Night

39- Have you ever watched any programs that providing knowledge on agricultural field? 1) Yes 2) No

40- Have you ever watched the spot of SRI? 1) Yes 2) No

C- Prints Media (Technical Books, Newspapers, Magazines, Posters, Leaflets, Pamphlets, Broachers, etc.)

41- Would you preferred read the prints media? 1) Yes b) No

42- Have you ever read any prints media concerned with agricultural field?

- 1) Yes 2) No

43- Have you ever read any prints media provided knowledge on SRI?

- 1) Yes 2) No

44- Generally, from where do you get prints media?

horizontally (roots tip are not inverted upward)			
47-7 Transplanted 1 seedling per hill			
47-8 Seedlings for transplanting are less than 15-day-old			
47-9 Uprooting only best seedlings with carefully and transplanted quickly (only 15-30 minutes between uprooting from the nursery and planting in the field)			
47-10 Seedling nursery should be maintained like a garden, watering intermittently and not kept submerge			
47-11 Using good seed and full grain			
47-12 Add nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility			
48- Did you have ever practices those principles?	YES	NO	Obs.
48-1 Land leveling and water management			
48-2 Weeding			
48-3 Water is not flooded during the growth stage			
48-4 Plant seedling far apart 25cm x 25 cm			
48-5 Transplanted in row (from hill to hill is equal length)			
48-6 Transplanted in shallow (1-2cm) with roots laying in horizontally (roots tip are not inverted upward)			
48-7 Transplanted 1 seedling per hill			
48-8 Seedlings for transplanting are less than 15-day-old			
48-9 Uprooting only best seedlings with carefully and transplanted quickly (only 15-30 minutes between uprooting from the nursery and planting in the field)			
48-10 Seedling nursery should be maintained like a garden, watering intermittently and not kept submerge			
48-11 Using good seed and full grain			
48-12 Add nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility			
49- Did you have recommended or disseminated those principles to families' members or other farmers?	YES	NO	Obs.

49-1	Land leveling and water management			
49-2	Weeding			
49-3	Water is not flooded during the growth stage			
49-4	Plant seedling far apart 25cm x 25 cm			
49-5	Transplanted in row (from hill to hill is equal length)			
49-6	Transplanted in shallow (1-2cm) with roots laying in horizontally (roots tip are not inverted upward)			
49-7	Transplanted 1 seedling per hill			
49-8	Seedlings for transplanting are less than 15-day-old			
49-9	Uprooting only best seedlings with carefully and transplanted quickly (only 15-30 minutes between uprooting from the nursery and planting in the field)			
49-10	Seedling nursery should be maintained like a garden, watering intermittently and not kept submerge			
49-11	Using good seed and full grain			
49-12	Add nutrients to the soil, preferably in organic forms such as compost or mulch to improve soil fertility			
50-	After you applied SRI package in the field,	YES	NO	Obs.
50-1	Do natural enemies have increased?			
50-2	Does population of fish, frogs, crabs, birds, etc. have increased?			
50-3	Do you often have headache or sick?			
50-4	Do you apply chemical fertilizer?			
50-5	Do you apply any organic manure?			
50-6	Do you know the advantages of organic manure?			
50-7	Have you often had the problems in SRI cultivation?			
50-8	When you had the problems, did it is easy to solve?			
50-9	Do you have ever though to stop cultivated SRI?			
50-10	Does your rice yield have increase?			
50-11	Does your income have increase?			

51- Please, calculate the expenditure on SRI cultivation.

- Land size.....ha
- a) Land preparation.....riel b) Transplanting.....riel
- c) Seed..... riel (name.....)
- d) Fertilizer.....riel
- e) Pesticide.....riel f) Harvesting.....riel
- g) Yield.....tones (.....riel)

**Section 4: Problems and Suggestions of Farmers Regarding SRI Cultivation in
Tram Kak District, Takeo Province**

52- What are the problems identified by you relevant to SRI cultivation?

- a)
- b)
- c)
- d)
- e)

53- What are your suggestions/recommendations to overcome the problems above
and/or improve the SRI?

- a)
- b)
- c)
- d)
- e)

Thank you very much for your kindness cooperation.

APPENDIX C

Figure



Appendix Figure 4 Interviewing of assistant researcher with respondent



Appendix Figure 5 Activities during group discussion

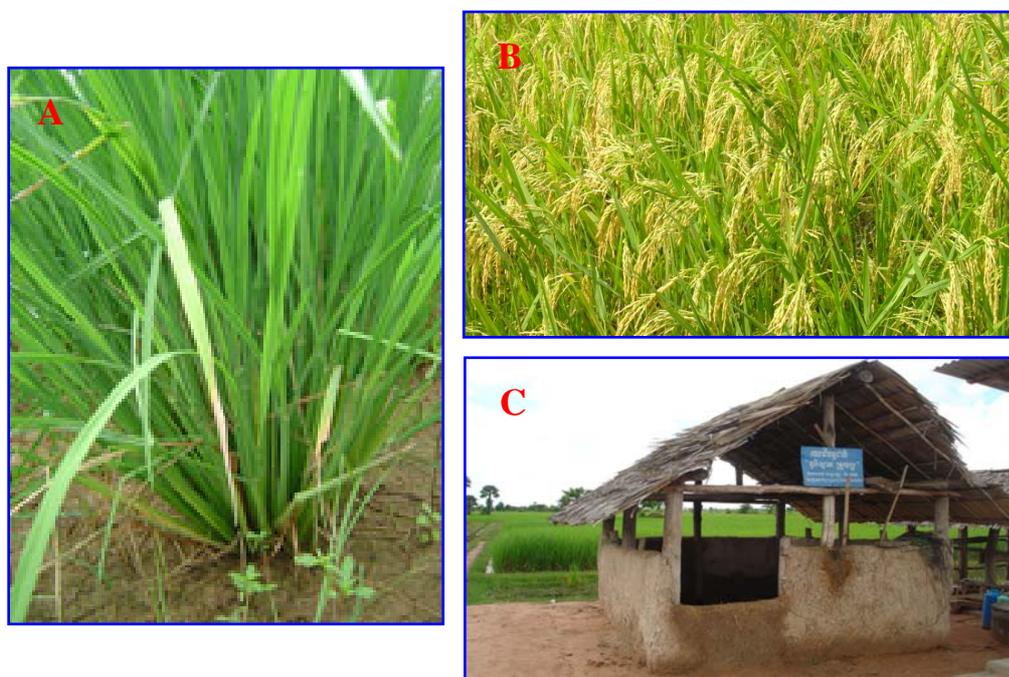


Appendix Figure 6 Group photo (leading farmers)



Appendix Figure 7 Activities of SRI practice

A. Land preparation, B. Transplanting, C. Three weeks after transplanting, D. Weeding



Appendix Figure 8 Tillering and maturing of the SRI

A. Tillering, B. Maturing, C. Compost house

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