ICT Policies Influencing Development of Rice Farming in Thailand: A Case Study of the Community Rice Center of the Rice Department

Norrasing Sangbuapuan

***Abstract*—This research focuses on developing farming by using Information and Communication Technologies (ICT) policy through the perspective of the Rice Department in Thailand. Community Rice Center (CRC) of Rice Department is used as a case study. There is significant evidence that ICT has transformed the lives of farmers who have access to ICT resources. We first attempt a comprehensive study of the issues in using ICT for the socio-economic development and empowerment of farmers. Next, we propose development of current ICT policies in order to address these issues. Finally, the goal is to guide the development of ICT implementation in related public sectors.**

***Index Terms*—ICT policy, rice farming, ICT master plan, Thai rice strategy, rice, farmer, Rice Department, Community Rice Center (CRC).**

I. Introduction

Thailand has been the world's largest rice exporter for many years. About 17 million Thais, or 3.7 million out of 5.6 farm families in the country, are engaged in rice farming.[1] At present, there are totally 56-58 million rais of paddy areas, divided into 2 seasons crops, which are; wet season crops figuring as 43% of total rice production area, with average yield of 330-340 kilogram per rai that produces 19-21 million tons of rice grain (12.54-13.86 million tons of milled rice); dry season crops cover 8-9 million rais of which average yield is 660-700 kilogram per rai that produce 6-7 million tons of rice grain (3.96-4.62 million tons of milled rice). The rice production of Thailand is number six of the world (4% of global rice production) which is approximately 606-636 million tons of paddy (400-420 million tons of milled rice) China is the first followed by India, Indonesia, Bangladesh, and Vietnam, respectively [1].

Nowadays, there are 20 ministries in Thailand; Rice Department under the Ministry of Agriculture and Cooperatives (MOAC) has the role to work for rice farmers. Ministry of commerce and MOAC have policy to work on Thai rice strategy. The important goal is that rice farmers gain higher income and have better livelihood together. Thai rice strategy includes a plan to develop an ICT center to be in charge of collecting, storing, analyzing, processing and reporting rice information for farmers and the public [2].

ICT policy has been important in agriculture ever since people have grown crops: famers have always sought information from one another. Farmers in a village may have planted the "same" crop for centuries, but over time, weather patterns and soil conditions change and epidemics of pests and diseases come and go [3]. ICT has taken an enormous leap beyond the costly, bulky, energy consuming equipment once available to the very few to store and analyze agricultural and scientific data. With the booming mobile, wireless, and internet, ICT has found a foothold even in poor smallholder farms and in their activities [4]. Many of the questions asked by farmers (including questions on how to increase yields, access markets, and adapt to weather conditions) can now be answered faster, with greater ease, and increased accuracy. Many of the questions can also be answered with a dialogue where farmers, experts, and government can select best solutions based on a diverse set of expertise and experience [5]. ICT enabled services often use multiple technologies to provide information. This model is being used to provide rural farmers localized (non-urban) forecasts so that they can prepare for weather-related events. In resource constrained environments especially, providers use satellites or remote sensors (to gather temperature data), internet (to store large amounts of data), and mobile phones (to disseminate temperature information to remote farmers cheaply) to prevent crop losses and mitigate effects from natural adversities [6]. These examples represent only a minute subset of the information and communication services that can be provided to the agricultural sector through increasingly affordable and accessible ICTs [7].

Importantly, ICT is not an end to agricultural development. It is too early to have a clear idea, supported by rigorous analysis, of how ICTs support rice farming development, and under what conditions. While there is credible evidence of positive impact, questions remain about how to make these innovations replicable, scalable, and sustainable for a larger and more diverse population. A goal of this paper is to analyze and disseminate evidence of the impact of ICTs policy on rice farming development [8].

The remaining part of the paper is structured as follows:

Section 2 describes background: rice farming and applications of ICT in Thailand. Section 3 provides description of policy proposals for ICT in rice farming. Section 4 proposes problems of development human capital and organization practices. The last section is conclusions proposed how to use ICT policy and how to approach ICT accessible to farmers.

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Norrasing Sangbuapuan is with Asian Institute of Technology, Klong Luang, Pathumthani 12120, Thailand (e-mail: norrasing.sangbuapuan@ait.ac.th).

II. Background: Rice Farming and Applications of ICT in Thailand

A. Thai Rice Strategy

The first rice strategic plan, 2007 to 2011, consisted of four components concerning production management and development of farmers, marketing management and product development, a drive for exports, and speedy and cost-effective product distribution. It also includes guidelines seeking to develop production, farmers, and products, to manage the marketing system, and to stabilize prices, as well as international marketing and logistics [1], [2].

In the second rice strategic plan to be implemented from 2011 to 2015, the Ministry of Agriculture and Cooperatives and the Ministry of Commerce will work more closely in order to link production and marketing for greater efficiency. Thailand has set a target to retain its rice planting area at 62 million rai, or about 21 million acres, during the period of the country's second rice strategic plan [1], [2].

The second rice strategic plan has three components. In the first, research and development will be emphasized in order to produce rice varieties of good quality, which are able to resist rice crop insects and be adjustable to the changing climatic conditions. At least 12 new varieties will be added to the existing 97 varieties by the year 2015. Eight technologies will also be developed for rice production and processing, which will help reduce chemical imports for use in production. This will lead to a decline in production costs and less dependence on foreign imports [1], [2].

The second component calls for the development of rice production and products, with a target to increase productivity from 405 kilograms to 679 kilograms per rai, an increase of about 10 percent. It seeks to lower production costs for farmers by 15 percent in 2015. Moreover, this component also involves rearrangements in the rice farming system, efficient use of water, and development of the production system. Community rice centers (CRC) will be set up as a mechanism for the mobilization of the Good Agricultural Practice (GAP) in rice production [2].

The third component seeks to empower farmers, who are regarded as the backbone of the country. A target will be set to increase their income to provide them with a more secure livelihood [1].

B. Rice Department

The Rice Department, established in 2006 under the MOAC, has the major mission to support rice farmers. Rice Department, as the government agency responsible for the development and promotion of rice production systems, plays a critical role in determining the future of rice production in Thailand. There are many challenges facing the Rice Department, including climate change, pursuing research in the development of new rice varieties and competition in production and trade. Moreover, rice farming in Thailand has faced several local crises such as water shortages, soil degradation, and outbreaks of rice pests. It is expected that the innovation and the use of ICT can play a vital role in the Rice Department as it guides the development of rice farming in Thailand [9], [10].

The supports from the Rice Department are as following:

1) ICT Infrastructure

a) Hardware: including rice farming equipment, pest and insect forecasting device, etc.

b) Software: including digital content and services such as

- Rice Knowledge Bank: knowledge sources which include rice plantation and maintenance, on-field fertilization, pests and insects control, weeds control, seed and grain production, and so on.
- Weekly rice situational report: the weekly reports include production, rice trading in both domestic and world markets, climate change, natural disasters, flooding and drought situations, pest of rice, and grain elevators.
- Natural disaster and rice's pest epidemic database: web service that integrates all information for forecasting and issuing of warning.
- 2.4) Production / distribution of rice seeds: display major production sources and location of rice seed producer, such as cooperatives group or farmers group.
- Updated price of rice seed: inform farmers about the recent price of rice seed that are being distributed via rice the seed center.
- Daily rice news: digital news/video clips about rice and farmers

c) Telecommunication: including mobile units, TV and radio broadcasting, web board, paper, poster, digital media, and so on.

2) Human infrastructure

- Rice Department Operation Center (RDOC): the war room and invited experts to attend weekly conference and published report via website and newspaper.
- Farmer Service Center: the farmer service center for consultation and receiving of complaints.

C. ICT Policy

ICT policy has, unfortunately, not been a priority to date. ICT policies are the crucial constituent of successful ICT utilization in an organization but yet their development, implementation, monitoring and evaluation are a challenging concern [11]. Tembo et all (2010) suggests that ICT use is influenced by the following: ICT training, age, race, education level, experience, attitude towards ICT and ICT literacy [12].

Three important roles which ICT can play are as following:

1) Enhancing agricultural production

Farmers often face many threats like poor soils, drought, and pests. Key areas where ICT can help improve this is by providing up-to-date information about pest and disease control, early warning systems, new varieties, new ways to optimise production and regulations for quality control.

2) Improving market access

Providing up-to-date information and consumer trends can improve a farmer's negotiating position and their livelihood, while enabling farmers to make better decisions.

3) Capacity-building and empowerment

ICT technologies can be used to strengthen communities and farmer organizations strengthen their own capacities and better represent their constituencies when negotiating input and output prices, land claims, resource rights and infrastructure projects. Rural communities are able to interact with others via the use of ICT which reduces social isolation that they would otherwise be facing. Besides that, ICT technologies are able to make processes like law-making and land-title approvals more transparent [13].

D. Benefits of ICT in Rice Farming

ICT plays role as a communication channel to the government agencies in a simple and convenient manner. In the recent years, Thai government has afforded to utilize ICT to enhance rice farming and farming-related activities [14]. For example:

1) The farmer credit card to prepay for farming supplies such as fertilizers, seeds or pesticides from the dealers who are registered with the Bank for Rice farming and Agricultural Cooperatives.
2) Rice Pledging Scheme via ICT in farmer registration, certifying, and forecasting of annual of production yield.
3) Agricultural disasters evaluation system is used to compensate the farmers who suffer from the natural disasters, such as flooding and drought.
4) Natural disaster and rice's pest epidemic database is used to warn farmers about the spreading of rice pests and natural disasters.

III. Policy Proposals for ICT in Rice Farming

Today, most of the national ICT policies aimed at the broad picture of the ICT infrastructure development and promoting the use of ICT in all sectors. In addition, the MOAC has focused on the use of ICT to enhance the agricultural production and marketing (both domestic and international markets). However, not only the current Thai government still has no ICT policy-oriented to rice farmers but also the utilization of ICT policies for the upstream agriculture has been in minimal attention since the agricultural sector in Thailand has been viewed as non-technology related in nature. Moreover, rice is the staple meal and is the major national cash crop with the value approximately 100,000 to 200,000 million THB annually. Hence, as the reason stated previously, the in-depth study and the development of ICT policies to enhancing the national agriculture sectors, especially rice farming, is important and should be highly focused for both academicians and practitioners [2].

This paper proposed the conceptual design by defining variables that affecting a research into two groups which are:

Group 1: Rice farming is a rice farmer who provides the necessary information for decision making and the design of ICT policy of the government, such as basic information, factors affecting the use of ICT, and situational problems of ICT.

Group 2: ICT policy is a group of government agencies that with authorities and roles in the defining the ICT policy to enhance the potential of rice farmers and promote more efficient rice farming.

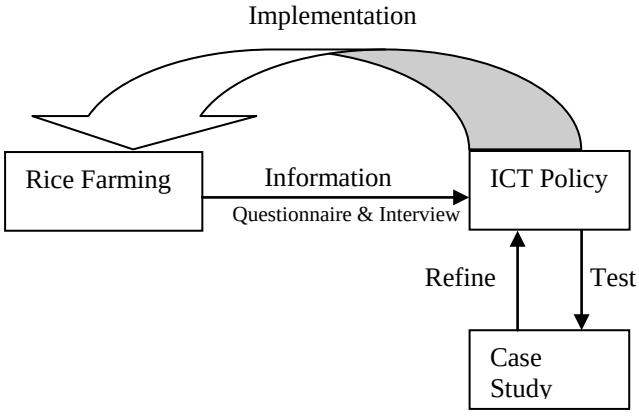

Fig. 1. Conceptual framework of the study

The components of this concept are focusing on 2 types of infrastructure including:

1) ICT infrastructure
- Hardware (electronics and computer)
- Software (Service and Content)
- Telecommunication (Communication, Networks, and Broadcasting)

2) Human infrastructure
- Government officials (attitudes, knowledge and skills in place – especially within the public sector)
- Farmers (how to approach and promote the ICT accessibility to farmers in beneficial ways such as weather forecasts, cost reduction, price of rice, price of seeds, and irrigation, and so on)

A. ICT Policy Issues Expected from the Study

1) ICT policy in rice production.

ICT can promote more efficient production of rice, under experts' advisement via ICT system infrastructure such as [15]:

- ICT for rice farming management such as ubiquitous sensors network, geo spatial system, rice production model, and precision rice farming.
- ICT for rice productivity measurement and yield prediction.
- ICT for rice GAP (Good Agriculture Practices) as ubiquitous sensors network and geo spatial system.
- ICT for the prediction modeling of pest outbreaks.

2) ICT policy in the rice product quality and production standards.

The issues include the ICT using through value preposition vision of creating a brand and product markets, selling products, and stories by ICT to support mobilization of their communities, including farmers such as:

- National ID for rice products.
- Modeling of the spreading of pests.
- ICT for traceability standards, include the international code (GS 1), GLN, and Geo spatial analysis.
- RFID / Bar code tag for logistics and supply chain.
- Sensors for storage condition

- Sensor for humidity measure.

This is the technology to support the pilot project traceability organic rice, Rice Department.

3) ICT policy in risk management of rice farming.

This highlights the main points which are the farmers' adaptability to the climate change. The technologies used include:

- Geo spatial engines.
- Predictive model -The technology supports the operations prediction model of BPH. Rice is the main agency with the Department.

4) ICT policy in the management and transmission of knowledge in the rice field.

Another important issue is the lack of information available to the system and the difficulties in the delivery of the better information to the destination, mostly regional farmers. The current agricultural information is diversified, depending on the origination and utilization. This policy is to promote the knowledge base of the rice farming, universal knowledge, academic research, field data input system, the story of a unique product, culture and traditions of origin such as:

- The rice ontology to support rice research.
- Semantic web in rice farming.
- Mobile devices as information technology should be an example of a possible tool in the agricultural knowledge to target specific groups of farmers or on-demand in the future.
- Social network website which provide the connectivity between the story of agricultural producers and consumers.

B. ICT Policy-Driven Approach for Rice Farming

1) To support the use of simple ICT for farmers such as direct information delivery (SMS), call center (one-stop-services), broadcasting (internet, TV, etc), or the uploading of videos by farmers, for farmers.
2) To build an intelligent system, promote ICT knowledge and utilize ICT for decision making and forecasting.
3) To develop the national rice farming knowledge base by interlinking related data from all related government agencies.
4) To develop an on-farm knowledge management system by using ICT and knowledge management.
5) To enable the information service system to satisfy the needs of regional rice farmers.
6) To create an online community to provide a platform for the exchange of knowledge and experience to encourage the participative community

ICTs policy concerns arrange of technologies including hardware, software, networks and media that facilitate the collection, storage, processing, transmission, retrieval, presentation and communication of information (voice, data, text, images) using electronic means. This definition encompasses both the new ICT such as e-commerce, websites and computers, and the traditional ICT such as radio and television, as well as the various services and applications associated with them such as videoconferencing and distance learning [16]. ICT Policy like community radio, internet, mobile phones, e-mail should be made readily available to empower rice farming communities by providing information on cropping style, market requirements, farm products and weather patterns and soil conditions. ICT Policy developed by 'participation' can improve the living conditions of farmers and enhance the knowledge of researchers and developmental farmers [17]. The various approaches for participation and sharing of knowledge to develop ICT, by acknowledging farmers, will lead to the rice farmers' socio-economic development and empowerment. ICT policies are the essence of the development of rice farming systems that would be useful for the enhancement of farming in the developing world, especially Thailand. We propose that the successful ICT policies in rice farming should be in consistent with the actual conditions and situational problems of the farmers [18].

IV. Problems of Developing Human Capital and Organization Practices

A. Human Capital

Yates et al (2010) stated that ICT strategic planning, competition in ICT industries, and financial investment in ICTs yield effect on the promotion of the citizen's opportunities in accessing global information society. The past research has reported the significance of human capital regarding the use of ICTs, involving with income, education, race, ethnicity, gender, language, age and disability, when measuring the national performance in terms of economic, politic, social and educational development, there is greater national digital technology adoption and utilization, on competitive basis, to provide telecommunication infrastructure and fundamental services, which leads to the higher financial investment in ICT development [19]. Prado and Figueiredo (n.d.) suggested that digital inclusion impacts these isolated communities by creating opportunities fostering human development, and proposed that individual attitude, behavior, and demographic characteristics (age, gender, and education level) are influenced on the likelihood of ICT adoption [20]. Sorj (2003) highlighted the importance of individual motivation and self esteem as a driver for ICT use [21]. Indeed, Wilson (2004) pinpointed motivation as the single common factor among individuals who are able to overcome structural and personal barriers in ICT adoption [22]. Furthermore, Proenza et al (2001) stated that an individual's ability to understand and appropriate the information accessed through ICTs can impact effective ICT adoption [23]. Regarding the environment in adopting ICTs, Liu and Hwang (2003) proposed that the organization must not only introduce new technologies, but also must initiate institutional enterprise-wide change and collaboration especially development human capital actively to ensure its successful implementation. Problems of developing human capital are mainly the establishing of strong IT leadership teams with capable supporting personnel, which is continuing to become major problem for federal agencies. Furthermore, attracting, recruiting, and retaining qualified IT support personnel are also major challenges for public sector.

The Federal CIO council has recommended improving the attractive salary, attractive benefit & compensation. This is along with the deregulate the agencies by granting local authority to assign greater flexibility working environment in order to retaining highly skilled employees and preventing "brain-drain" situation [24]. Similarly in Thailand, although the government would like to fully implement ICT policy, Thailand's major problem is that the country lacks qualified IT personnel. For government organizations, establishing the e-Government Institute will solve this problem. On a wider scale, full implementation of e-education will increase the pool of qualified IT workers as well [25].

Problems of developing human capital in this paper are divided into two groups. The first group is the government officials as actors in transferring of knowledge and ICT policy to local farmers and networks. This requires the specific and particular knowledge and skill in the use of ICTs. Most of the agents usually do not earned educational degree in ICT related disciplines. Also, the agents-to-farmers ratio is rather high since there is small number of agents, compare to the number of prospected farmers of whom the knowledge will be transferred to. Moreover, the other main problems are the attitudes, knowledge and skills in place [25]. The second group is farmers, the primary goal of implementing the ICT policies. Farmers in Thailand are diverse in terms of age, gender, religion, level of education, income, and ICT literacy level. The main problems for this group are how to approach and promote the ICT accessibility to in beneficial ways (such as weather forecasts, cost reduction techniques, current market price warning and updates, seed price updates, irrigation warning, and so on.

However, the successful implementation of ICT policy must initially concentrate on the people or human capital as driving force. If both public and private sector employees do not have sufficient capability the ICT development will be suffered because of the development of the IT sector and the development of human skills, to effectively adopt and utilize technologies, must be absolutely in parallel.

B. Organization Practices

Community Rice Center (CRC): Rice Department has recognized the importance of promoting grain production and distribution in the community, the use of appropriate technology, and the joint management of the farmers as well. This is in order to increase farmers' income level, strengthen the farmer's community, centralize the professional development, and promote the better farmers' quality of living. It has to support the operations of more than 4,000 CRCs and plan to establish a center in 7,000 CRCs to cover the rice-growing areas of the whole country [26].

Community Rice Center (CRC), established to encourage farmers to produce and distribute quality rice seeds, has been in operation adequately and continuously. Also, CRC acts as center for the development of rice production and improve farmers' capability and yield management, including the development of a strong farmer' network [26].

The roles and missions of CRC are as the following:

1) To produce and distribute varieties of high quality rice to farmers in the local community.
2) To be a technology transfer center for rice production, among leading expert farmers (as volunteers).
3) To provide inputs and services.
4) To be the products collection and distribution center in the community.
5) To be the connection portal to the nearby CRC for additional capabilities
6) To support the operation of Rice Department such as rice production reporting, warning information, and dissemination of information.

Farmers Development in Community Rice Center (CRC) of Rice Department: CRC has the total of 7,000 CRCs

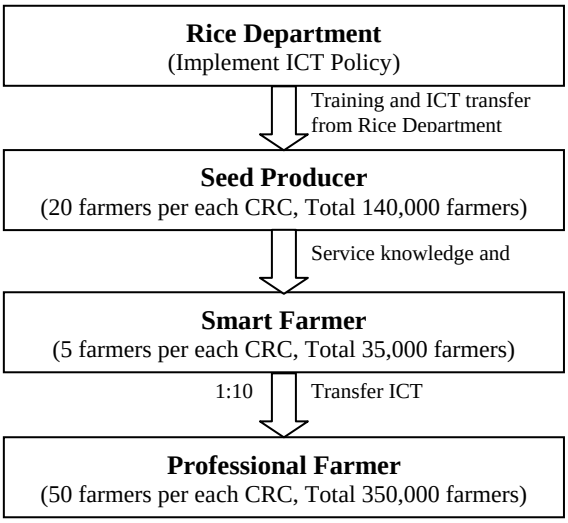

Fig. 2. Conceptual framework of the study

Rice Department has established guidelines for the development of rice farmers into three groups (based on the categorization of farmers) in which including [26]:

1) Smart Farmer: This group consists of rice farmers who are capable for efficient production and sustainable management. Smart Farmer locally plays role in the "Farmer Field School" as a manager and as a lecturer in providing counseling, servicing, collecting of information, and reporting problems (regarding the natural disasters and outbreaks of rice pests). The activities may include the transfer of ICT and the dissemination of information on the production and current marketing situation of local rice farmer to those who are interesting Smart Farmer can play role as a network to link the information of the Rice Department, as well.
2) Professional Farmer: This group is a leading manufacturer of grain standards of the community, and is the local farmers in the areas for the distributing of rice from the CRC The objective of this group is to be the medium in the transfer of knowledge and ICT in the production of rice from the smart farmers of 50 farmers per year or 1 smart farmer transfer of knowledge to 10 professional farmers per year.
3) Seed Producer: This group is the farmers who produced grain in the CRC of approximately 20 farmers who will be granted for the training and technology transfer, such as the promotion of agriculture and so on. Seed Producers have the skills and expertise in produce the grain to serve professional farmers in the CRC.

The goal of Rice Department is to develop smart farmers of 7,000 centers (for 5 farmers per each center, including 35,000 farmers in total) in which smart farmers will transfer the knowledge and ICT know how to professional farmers (at the ratio about 1 smart farmer to 10 professional farmers annually). In addition, there are 2 seed producers per each CRC (in which the total of 140,000 farmers from the total 7000 CRCs). Hence, if all farmers are well trained systematically and cover all, the quality of living in the communities will be d be improved thorough the farmers who are successfully participated in the process [26].

In particular, CRC is suitable as case study in implementing ICT polices. In the near future, the government will support and facilitate each center in association with the local government. However, the central government will initiate the collaboration. In particular, the overall objectives are the development of rice production and rice marketing, as well as the improvement of the quality of living of rice farmers with ICT policies.

V. Conclusions

This paper proposed how to use ICT policy to enhance the rice farming in the abilities in identifying their technological and farming needs and in promoting the use of ICT in rice farming. In addition, the output of this paper attempts to propose the ways how to approach and promote the ICT accessibility to rice farmers in beneficial ways (such as weather forecasts, cost reduction, price of rice, price of seeds, and irrigation, and so on). Recently, as the consequent work of this paper, the status and problems of the actual field use of ICT by rice farmer are being investigated. Finally, the expectable outcome of the stated investigation is the in-depth understanding of the influencing of ICT policy on the agricultural farming, including both human resource and ICT infrastructure aspects and the appropriated ICT policies recommended for the decision makers.

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Mr. Norrasing Sangbuapuan is a Ph.D student in the field of Information Management, School of Engineering and Technology, Asian Institute of Technology, Thailand. He was born on 17 December 1979. He earned a bachelor degree in computer science (in 2002) and a master degree in general management (in 2006) from the Rajabhat Thepsatri University, Lop Buri Province, Thailand.

He has currently worked as a computer specialist in rice strategy and policy division, Rice Department, Ministry of Agriculture and Cooperatives since 2006. He also yield experience in planning and analyzing of policy in the Department of Health, Ministry of Public Health since 2004-2006. His research interested include Participatory Approaches for the Development and Use of Information and Communication Technologies (ICTs) for Rural Farmers (Johannesburg, South Africa : IEEE, 2008) and Factors Influencing the Use of ICT by Farm Employees in the Western Cape Commercial Agriculture (Western Cape, South Africa: IIMC International Information Management Corporation, 2010).