ASSESSMENT OF COMPANION MODELLING EFFECTS FOR INTEGRATED FARMING AND SUSTAINABLE RENEWABLE RESOURCE MANAGEMENT IN LAM DOM YAI WATERSHED, UBON RATCHATHANI PROVINCE

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(Miss Manitchara Thongnoi)

Researcher

บทคัดย่อ

เรื่อง : การประเมินผลแบบจำลองเพื่อนคู่คิดสำหรับการเกษตรผสมผสานและการจัดการทรัพยากรทดแทนอย่างยั่งยืนในเขตลุ่มน้ำลำโดมใหญ่จังหวัดอุบลราชธานี

โดย : มาณิชรา ทองน้อย

ชื่อปริญญา : วิทยาศาสตรมหาบัณฑิต

สาขาวิชา : เกษตรผสมผสาน

ประธานกรรมการที่ปรึกษา : รองศาสตราจารย์ ดร. นันทิยา หุตานุวัตร

ศัพท์ : แบบจำลองเพื่อนคู่คิด การติดตามประเมินผลแบบมีส่วนร่วม เกษตรผสมผสาน ผลด้านการเรียนรู้ ความสามารถในการคิด

แบบจำลองเพื่อนคู่คิด (Companion Modelling, ComMod) ซึ่งเป็นวิธีการแบบมีส่วนร่วมวิธีหนึ่งได้ถูกนำมาใช้เพื่อศึกษาความซับซ้อนของความสัมพันธ์ระหว่างการจัดการพื้นที่ การจัดการน้ำและแรงงาน ในระบบนิเวศที่ราบลุ่มนาน้ำฝนของลุ่มน้ำลำโดมใหญ่ จังหวัดอุบลราชธานี ในระหว่าง ปี พ.ศ. 2548 ถึง พ.ศ. 2551 โดยมีเกษตรกรจากบ้านหมากมาย ตำบลกลาง อำเภอเดชอุดม จำนวน 11 ครอบครัวเข้าร่วม ซึ่งแบ่งเป็น 3 รูปแบบตามการถือครอง คือ เกษตรกรที่มีที่นาขนาดเล็ก (type A) เกษตรกรที่มีที่นาขนาดปานกลาง (type B) และเกษตรกรที่มีที่นาขนาดใหญ่ (type C) เครื่องมือสำคัญที่ใช้ในแบบจำลองเพื่อนคู่คิด ได้แก่ เกมส์บทบาทสมมุติ (Role-playing game = RPG) และ แบบจำลองคอมพิวเตอร์ (Agent-based model = ABM)

ในการศึกษาครั้งนี้เป็นส่วนหนึ่งของงานวิจัยดังกล่าวข้างต้น โดยมีวัตถุประสงค์ คือ 1) เพื่อติดตามและประเมินผลการใช้แบบจำลองเพื่อนคู่คิดที่มีผลต่อผู้เข้าร่วม 2) เพื่อทดสอบวิธีการติดตามและประเมินผลแบบต่างๆ และ 3) เพื่อให้ข้อเสนอแนะสำหรับการปรับปรุงแบบจำลองเพื่อนคู่คิดและการประยุกต์ใช้ในพื้นที่ ในการเก็บข้อมูลได้ดำเนินการตลอดช่วงกิจกรรมของการใช้แบบจำลองเพื่อนคู่คิด ในระยะเวลา 3 ปี (2549 ถึง 2551) โดยใช้วิธีวิจัยเชิงคุณภาพ กล่าวคือ การสังเกตแบบมีส่วนร่วม การสัมภาษณ์รายบุคคล และการเล่าเรื่อง การวิเคราะห์ใช้วิธีเชิงคุณภาพ โดยเปรียบเทียบผลที่เกิดขึ้นต่อเกษตรกรแต่ละครอบครัวในฟาร์มประเภทเดียวกันและต่างประเภทกัน และเปรียบเทียบผลที่เกิดขึ้นกับตัวแทนองค์การบริการส่วนตำบลกลาง (อบต.กลาง) และตัวแทนหน่วยงานรัฐ ผลการศึกษาพบว่า 1) แบบจำลองเพื่อนคู่คิด ที่ประกอบด้วยแบบจำลองคอมพิวเตอร์

และเกมส์บทบาทสมมุติเอื้อให้เกิดการแลกเปลี่ยนความรู้ ความคิดและความเข้าใจแบบมีส่วนร่วมระหว่างเกษตรกรและนักวิจัยได้ 2) แบบจำลองเพื่อนคู่คิดช่วยให้ผู้เข้าร่วมเพิ่มเติมความรู้เกี่ยวกับการทำการเกษตรและความเข้าใจต่อความคิดและสถานการณ์ของผู้เข้าร่วมคนอื่นดีขึ้น 3) ความรู้ที่เพิ่มขึ้นในเรื่องน้ำ นำไปสู่การเปลี่ยนแปลงรูปแบบการผลิตในฟาร์มและการปรับปรุงการใช้น้ำ 4) สำหรับเครื่องมือที่ใช้ในแบบจำลองเพื่อนคู่คิด พบว่า เกมส์บทบทบาทสมมุติให้รายละเอียดขั้นตอนของการทำนาและกระตุ้นการเรียนรู้โดยการลงมือทำ อย่างไรก็ดีผู้เข้าร่วมที่มีอายุมากบางคนเห็นว่า เกมส์บทบาทสมมุติมีความซับซ้อนและสับสน 5) ส่วนแบบจำลองคอมพิวเตอร์ พบว่า เป็นวิธีการที่ทำให้การเชื่อมโยงจินตนาการและการประมวลความคิดของผู้เข้าร่วมง่ายขึ้น แต่ผู้เข้าร่วมบางคนเห็นว่าแบบจำลองคอมพิวเตอร์เป็นทฤษฎีมากเกินไป และเหมาะสมกับเกษตรกรที่มีอายุน้อย และ 6) ผู้เข้าร่วมที่ไม่ใช่เกษตรกร พบว่า ตัวแทน อบต.ได้เรียนรู้วิธีการใหม่สำหรับการตัดสินใจแบบมีส่วนร่วมที่มีประโยชน์สำหรับการวางแผน และตัวแทนหน่วยงานรัฐได้เรียนรู้เกี่ยวกับการจัดการกิจกรรมแบบจำลองเพื่อนคู่คิด สำหรับการแลกเปลี่ยนความคิดแบบมีส่วนร่วมกับคนในชุมชน จากการศึกษาวิจัยในครั้งนี้ มีข้อเสนอแนะในการปรับปรุงการใช้แบบจำลองเพื่อนคู่คิดสำหรับการเกษตรผสมผสานและการจัดการทรัพยากรทดแทนอย่างยั่งยืนให้ได้ผลยิ่งขึ้น คือ ผู้เข้าร่วมจะมีส่วนร่วมเพิ่มขึ้น ถ้าได้เข้าร่วมในช่วงการวิเคราะห์ปัญหาและในช่วงการเตรียมสื่ออุปกรณ์ นอกจากนี้ผู้เข้าร่วมที่เป็นคนใหม่ควรจะเข้าร่วมในเกมส์บทบาทสมมุติสองครั้งเป็นอย่างน้อยก่อนเข้าร่วมในแบบจำลองคอมพิวเตอร์

ABSTRACT

TITLE : ASSESSMENT OF COMPANION MODELLING EFFECTS FOR INTEGRATED FARMING AND SUSTAINABLE RENEWABLE RESOURCE MANAGEMENT IN LAM DOM YAI WATERSHED, UBON RATCHATHANI PROVINCE

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KEYWORDS : COMPANION MODELLING APPROACH / PARTICIPATORY MONITORING AND EVALUATION / INTEGRATED FARMING / LEARNING EFFECT / CAPACITY BUILDING

Companion modelling (ComMod), a participatory research approach, was used to better understand the complex interaction among land, water and labour management in the rainfed lowland rice ecosystem of the Lam Dom Yai watershed, Ubon Ratchathani province. Eleven local farming households took part in five field workshops spanning a period of four years from 2005 to 2008 at Ban Mak Mai village, Klang sub-district, Det Udom district. They were divided into three farm types of size: small (type A); medium (type B); large (type C). The main tools used were role-playing games (RPG) and agent-based models (ABM).

This research was one part of the main research project mentioned. It was conducted to: 1) monitor and evaluate the different types of ComMod effects on the participants; 2) test a proposed monitoring and evaluation (M&E) methodology; and 3) make recommendations to improve that methodology and the local use of ComMod. The M&E process was conducted throughout the ComMod activities over three years (2006 to 2008). Data were gathered by integrating qualitative research methodology: participatory observation, individual interview, and story telling. Qualitative analysis was done to compare ComMod's effects on households, farm types, a Tambon Administrative Officer (TAO) and government agency.

The results showed that 1) the ComMod participatory approach that combines computer simulations and role-playing game tools was able to facilitate collective sharing of knowledge, ideas, and perceptions between local farmers and the researchers. 2) the ComMod approach helped the participants to improve their farming knowledge and to improve their understanding of other participants' perceptions and situations. 3) Knowledge acquisition on water issues has led to changes in farming practice and improved use of water. 4) With regards to ComMod's specific tools, RPGs provided a detailed account of RLR transplanting and encouraged a 'learning by doing' approach. However, some elderly participants found the RPG complex and confusing. 5) The ABMs easily enabled the participants to use their imaginations and generate ideas, but the ABM's features were deemed by some participants to be too theoretical, and thus more suited to younger farmers. And 6) The non-farmer participants, the TAO representative learned a new methodology for collective decision-making useful for planning and the government agency learned about organizing a ComMod workshop for collective sharing of ideas with villagers. It is recommended that, in order to improve the use of ComMod for integrated farming and sustainable renewable resource management more effectively, the collaboration among the participants would increase if they took part in problem analysis sessions and in preparing supporting tools. Also, new participants should participate in a RPG at least two times before taking part in the ABM.

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LIST OF ABBREVIATIONS

ACRONYM	DESCRIPTION
ABM	Agent-Based Model
ADD	Agricultural Development Durable
ARD	Agricultural Research and Development
CGIAR	Consultative Group on International Agricultural Research
ComMod	Companion Modelling
DQ	Designer Questionnaire
DIT	Department of Internal Trade
DOA	Department of Agriculture
DAI	Distributed Artificial Intelligence
IFOAM	International Federation of Organic Agricultural Movements
INRM	Integrated Natural Resource Management
KDML 105	Khao Dawk Mali 105
LRA	Land Reform Area
M&E	Monitoring and Evaluation
MAS	Multi-Agent Systme
NGO	Non-Government Organization
OFNT	Organic Farming Network of Thailand
OAE	Office of Agricultural Economic
PEF	Participant Evaluation Framework
PM&E	Participatory monitoring and evaluation
RID	Royal Irrigation Department
RLR	Rainfed Lowland Rice
RD6	Rice Department 6
RPG	Role-Playing Game

LIST OF ABBREVIATIONS (CONTINUED)

ACRONYM	DESCRIPTION
TAO	Tombom Administrative Office
UML	Unified Modelling Language

CHAPTER 1

INTRODUCTION

1.1 Overview of the agricultural context and its dynamics in lower northeast Thailand

Thailand consists of five regions (figure 1.1). Rice production is a backbone economic sector, utilizing 20% of total land area as farm land. The northeast is the largest plateau covering one third of the 513,000 km² country size. The lower northeast region is located at a latitude of 14-16º N and longitude of 101-106º E S (Srisa-Arng Kaocharoen et al., 2004). It has the largest land area used for agricultural production, especially rice growing under rainfed conditions. The evolution of agricultural production has been influenced by agro-ecological changes, economic incentives, technologies and infrastructure improvement. This chapter discusses the landforms, soil and climate conditions, and water management practices, which have all influenced and contributed to low levels of farm production, a reality farmers in the lower northeast region know all to well.

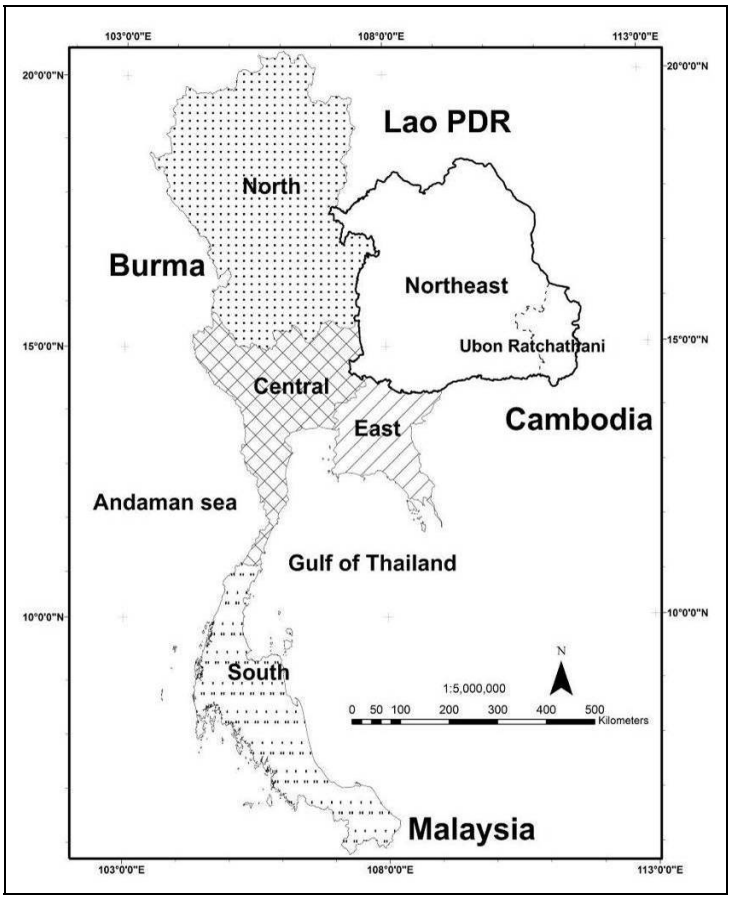


Figure 1.1 Map of Thailand displaying five regiond and its neighbouring countries (Thailand on a disc 1996, Thailand Environmental Institute, TEI adapted by Warong Naivinit, 2008)

1.1.1 Current characteristics of local agricultural systems

1.1.1.1 Geology, geomorphology, landform and soil conditions

Thailand's lower northeast region is located in the southern part of the Korat basin, which lies on a massive Cretaceous sandstone plateau causing low agricultural productivity. The Chi, Mun, and their tributaries, Lam Phung Chu, Lam Plubpla, Lam Tao, Lam Seaw, Lam Chi, Lam Sa Bai, Lam Sa Bok, Lam Dome Yai, and Lam Dome Noi, are main rivers situated in this basin (figure 1.2).

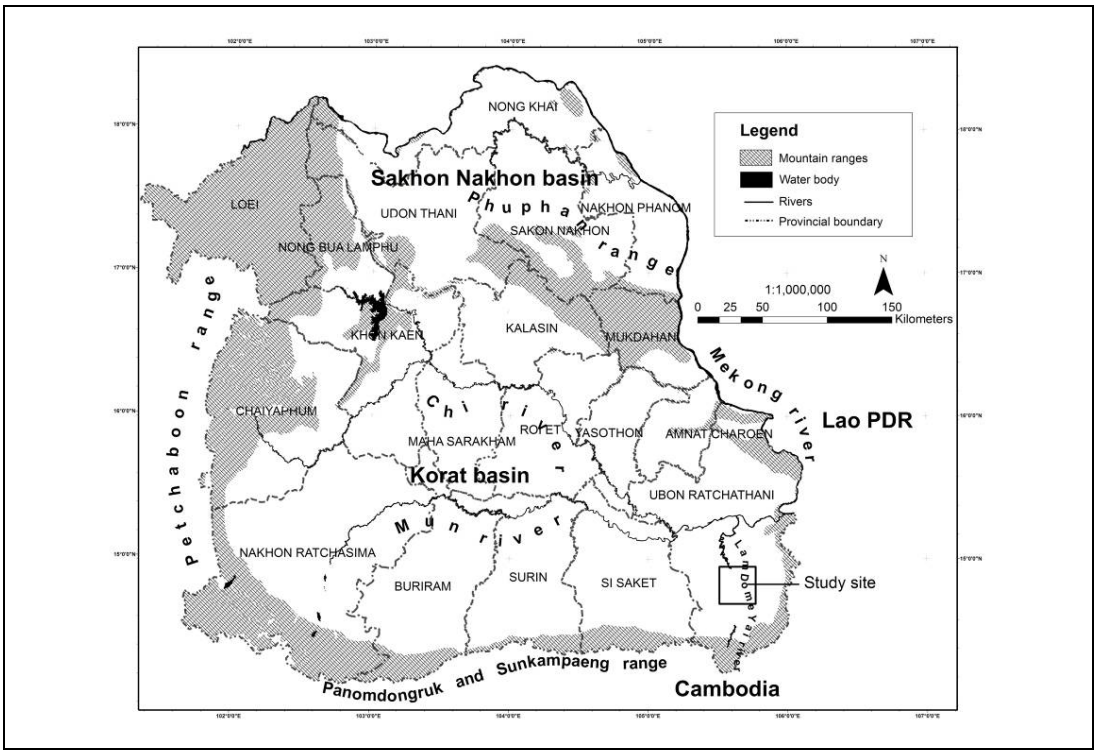


Figure 1.2 Simplified topographic map displaying Korat basins situated in lower northeast Thailand (Geographic Information Centre, Faculty of Engineer, Ubon Rajathanee University, Ubon Ratchathani, 2002 adapted by Warong Naivinit, 2008)

The landforms in the region consist of river levees, flood plains, low terraces (non-flood plains), and undulating middle terrace and high terraces (figure 1.3). Different landscapes on different soil types create contrasting agro-ecosystems. Alluvial soils (Ustifluvents) lie along the Chi and Mun rivers covering the natural levees. Nam Pong is a key soil series found in Ubon Ratchathani province. The soils in the region are very poorly drained, sandy texture soils, with low water holding capacity, and low levels of physical and chemical fertility; but they are still used for rainfed lowland rice (RLR) cultivation.

However, not only do landforms and soil conditions influence agricultural production: erratic rainfall distribution also limits crop production in the region.

1.1.1.2 Climatic conditions

The total annual rainfall distribution varies greatly and is unpredictable within a year and from year to year; rainfall is also difficult to predict within a rainy season and reliable rainfall is from August to early October (figure 1.4).

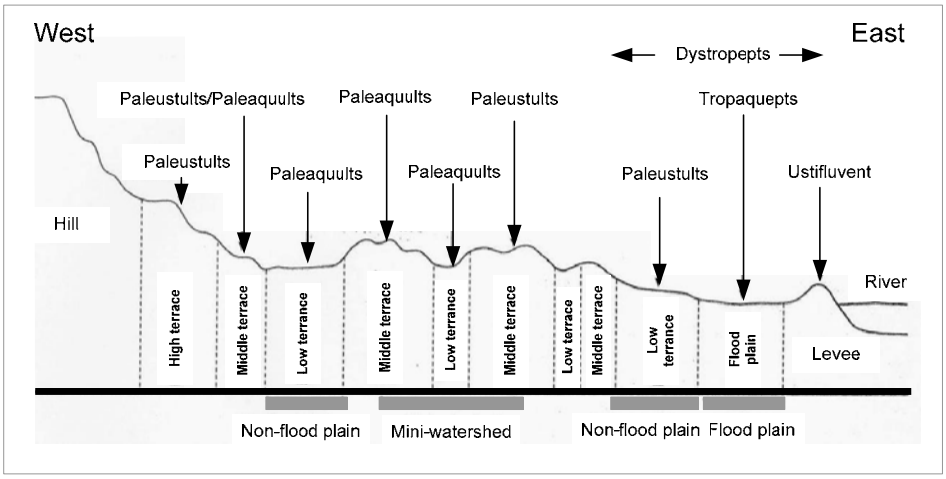


Figure 1.3 Transect of typical soils in relation to landform found in the northeast of Thailand (The Northeast Agricultural Extension Centre, 1995 cited in Warong Naivinit, 2008)

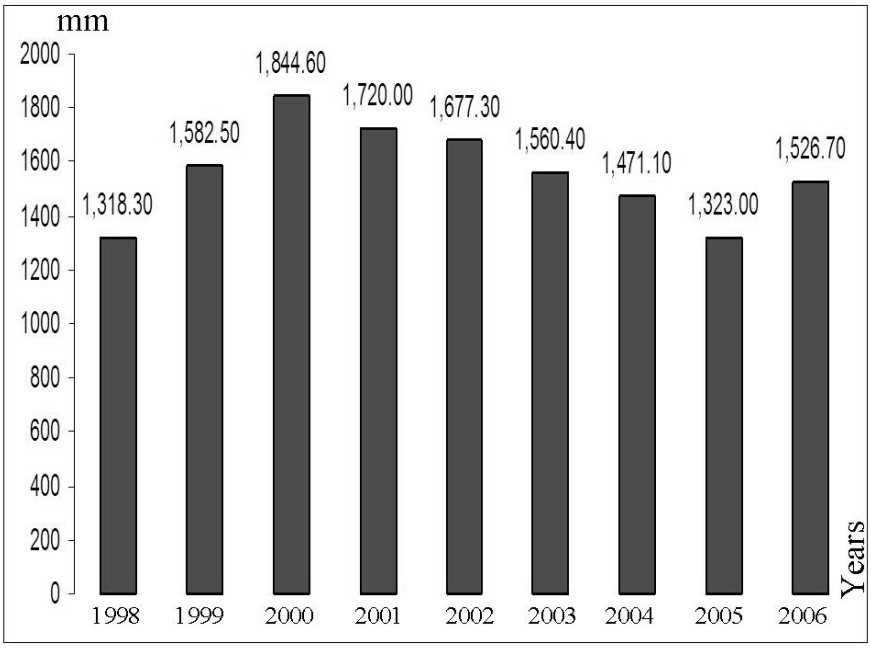


Figure 1.4 Variation of rainfall in Ubon Ratchathani province, Thailand 1998 to 2006 (Ubon Ratchathani Statistical Office, 2007)

Rainfall patterns are influenced by the mountain range in the west, blocking the wet monsoon and tropical depressions. The climate in Ubon Ratchathani can be described in three successive seasons as follows: (i) rainy (wet) season, from May to October, particularly August to September. Flooding occurs if the region experiences cyclone depressions originating in the South China Sea; (ii) winter period as a result of the northeast monsoon in the cool period from November to January, and ; (iii) a very dry and hot season from February to April (figure 1.5).

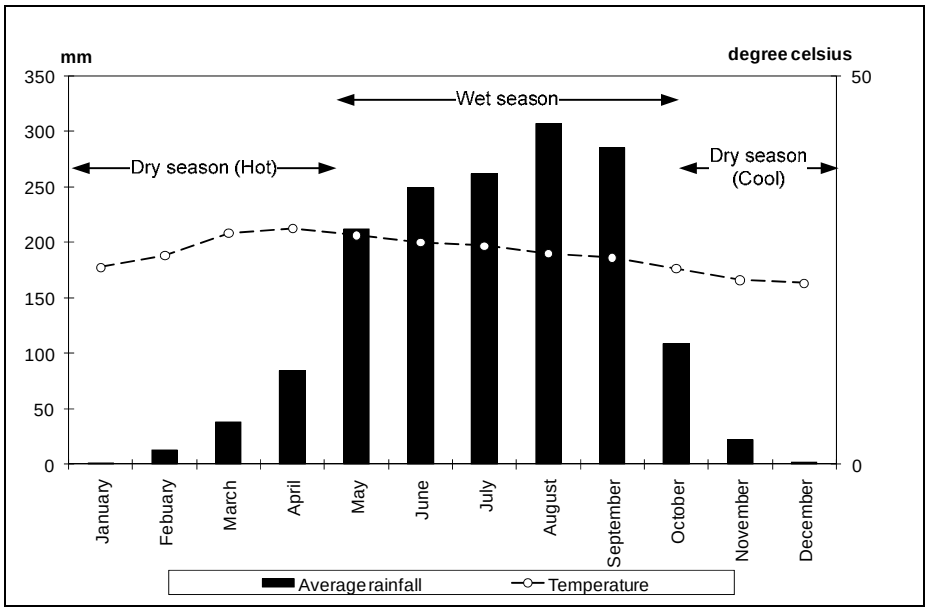


Figure 1.5 Average monthly rainfall and temperature of Ubon Ratchathani province, Thailand (Regional Meteorological Centre, Ministry of Information and Communication Technology, Ubon Ratchathani)

1.1.1.3 Current land use patterns

Rainfed lowland rice (RLR) is the main type of agricultural production in Ubon Ratchathani province. In 2006 Ubon Ratchathani province had a land total of 1,574,484.16 ha, 47.33 % (745,189.92 ha) that was used for agricultural production. 35.48 % of agricultural area (558,646.08 ha) is used for RLR production (table 1.1).

In the 2007/2008 crop year, 46.70 % of agricultural area was used for the production of glutinous rice particularly RD6 (23,926 ha), while 53.30 % was used for

nonglutinous rice, KDML 105 (273,059.8 ha). The government guaranteed the price of rice at 8,500 to 8,750 baht per ton (Department of Internal Trade: DIT, 2007).

Table 1.1 Ubon Ratchathani land use in 2006 (Department of Agricultural Extension, DAE, 2006)

		Ha	**Percentage**
Whole area		1,574,484.16	
Forest		271,160.00	17.22
Settlements		23,941.28	1.52
Other activities		534,192.96	33.93
Agriculture		**745,189.92**	**47.33**
	Rice production	558,646.08	35.48
	Agronomy	43,782.72	2.78
	Fruit and Plant	36,089.76	2.29
	Vegetable and flowers	3,392.32	0.21
	Grassland	7,038.24	0.44
	Other agriculture	24,878.72	1.58
	Uncultivated land	71,362.08	4.53

Other agricultural areas are used for fish farming, cattle rearing, and crop plantation by using rainwater for example cassava, peanut, fibre crops. Fish farming is popular among people who live along the Mun River. Previously, cattle were reared for land preparation and pulling carts. Recently, farmers have been rearing these animals as a source of food, for sale, and as a source of manure used in agricultural production.

1.1.1.4 Characteristics of farming households and livelihoods

Laotian, Khmer, and Korat peoples are the major ethnic groups living in the lower northeast region of Thailand (figure 1.6).

The region consists of nine provinces, covering 8.4 million ha, with 17,357 villages and 11.5 million people (Chirawat Vejpas, 2005). In 2007, the population in Ubon

Ratchathani province was 1,785,709 (Office of Agricultural Economic: OAE, 2007). The Laotian ethnic group makes up the majority of people living in all nine provinces. The Khmer ethnic group lives in provinces along Thai-Cambodian border: Ubon Ratchathani, Sisaket, Surin, Buriram. The Korat ethnic group predominantly lives in Buriram and Nakhon Ratchasima. The Laotian ethnic group predominately lives in Ubon Ratchathani province.

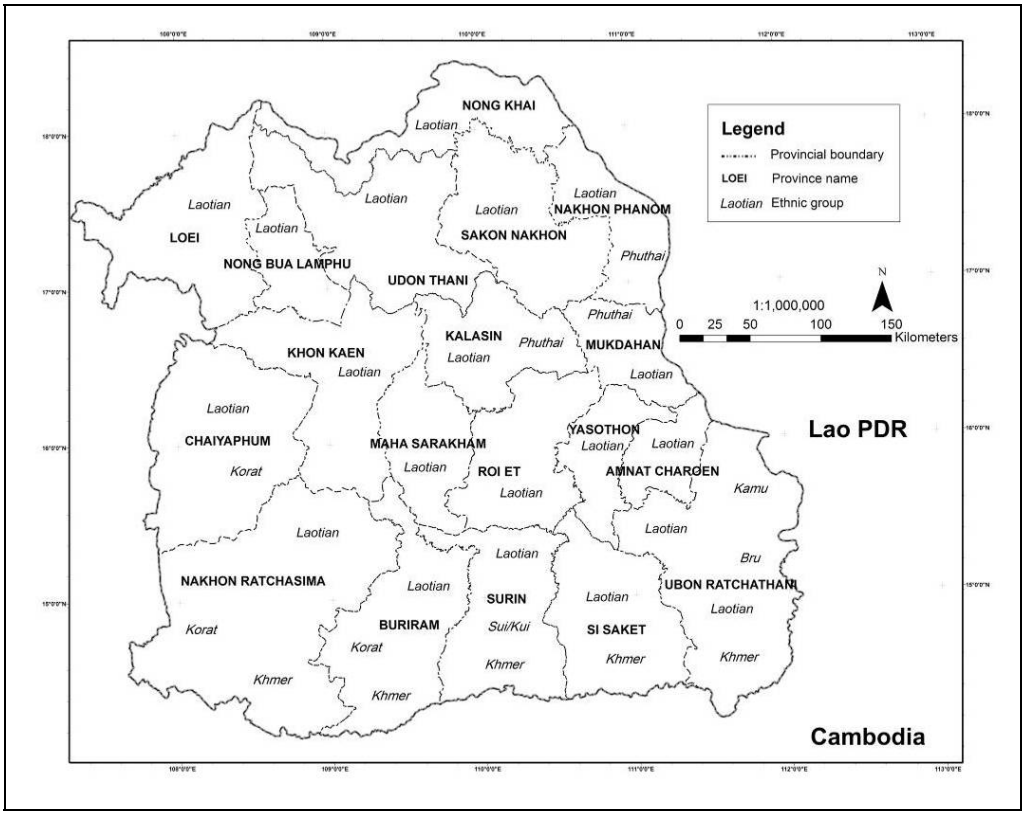


Figure 1.6 Distribution of ethnic groups throughout the northeast region of Thailand (Warong Naivinit, 2008)

People in the region produce nonglutinous rice varieties, particularly KDML 105 as a commercial variety for sale, while they produce the glutinous, RD6, and other late maturing rice varieties for family consumption and bartering. The population that lives in the 'Thung Gula Rong Hai' area in part of Roi-Et, Mahasarakham and Surin, provinces rears cattle, especially cows; although it is a second farm activity, it is the main source of family income. In the phase of economic booming, the buffalo population declined by 25% because farmers now used (hand)tractors for land preparation; however, cattle, pig, and poultry numbers increased due

to the promotion of contract farming systems. Another activity is the production and sale of forest products. This is a more popular activity in several provinces which are located near mountain ranges, or on higher land, for example in Yasothon, Amnatcharoen, Ubon Ratchathani, Roi-Et and Mahasarakham provinces.

1.1.2 Recent agricultural changes in local farming systems

1.1.2.1 Evolution of the agricultural system in relation to national economic growth

Since the early 1960s, the Thai government has been promoting a market-based economic development pattern. Agricultural production changed from being based on self-reliance to a production system based on exports. Most Thai farmers produced agricultural products based on the demand of the market, aiming for high yield agricultural production. Monoculture crops such as cassava, corn, and some kinds of fibre crop (roselle, kenaf, cotton) productions with chemical inputs were very popular; meanwhile landowner numbers, particularly small farmers, were declining. Later on, development efforts aimed at raising rural income by promoting income generation and economic activities. This resulted in general economic growth, but the rural people's income appeared to remain low as Thailand' economic growth was not equally distributed to all regions (Warong Naivinit, 2008). The economic growth pattern also indicated major changes in labour of northeast region. About 15 % in 1986 and 40% in 2007 of the northeast's farm workers moved to the non-farm sector to find new jobs (figure 1.7).

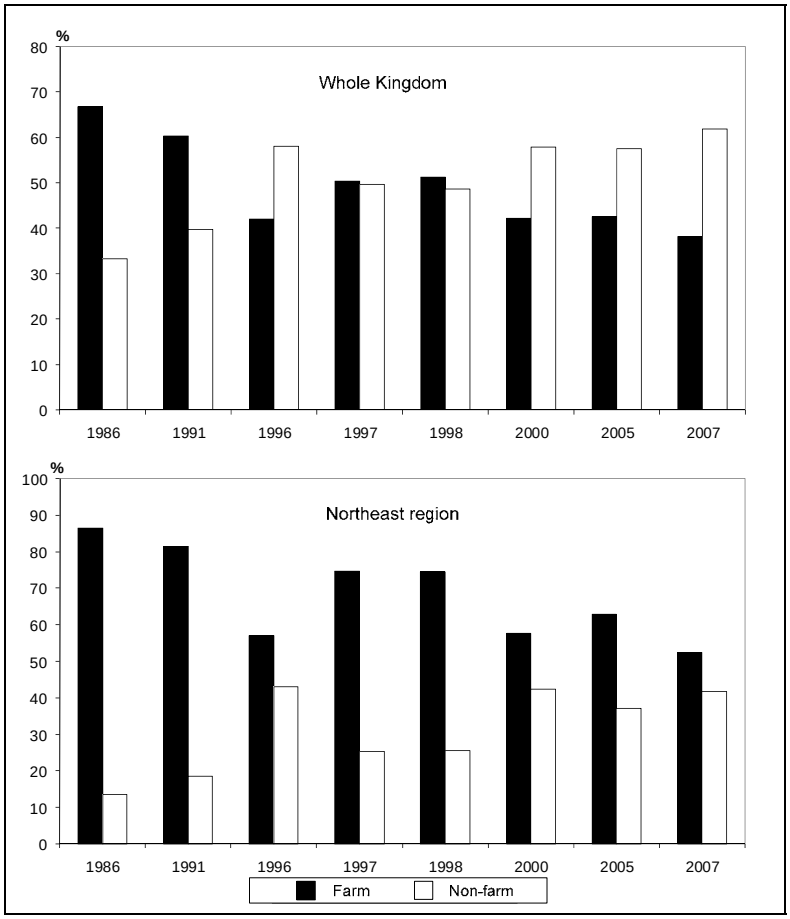


Figure 1.7 Changes in the share of labour force between farm and non-farm sectors in 1986-2007 (The Labour Force Survey, National Statistical Office, Ministry of Information and Communication Technology, Bangkok)

A decreasing trend in farming related labour activities became evident, while non-farm labour increased. Off-farm income has become an important strategic means of supporting and maintaining agricultural production systems.

1.1.2.2 Evolution of water management and irrigation infrastructure

Water management and irrigation infrastructure projects have been established in the region since the 1960s, and several irrigation projects were completed for the purpose of water storage for domestic consumption, industrial purposes and agricultural cultivation (Royal Irrigation Department: RID, 2002). Since the first National Economic Development Plan of Thailand in 1961-1966, large-scale irrigation projects began in the northeast region. In 1978, water improvement projects started with the development of large and small

water reservoirs to serve the requirements of many local communities. Recording to Warong Naivinit (2008), only 6% of paddy fields in the region are irrigated. Ubon Ratchathani province started small-scale infrastructure projects in 1981 to store water for agricultural activities at the community level. Many types of water resources and irrigation infrastructures can be found in this province (table 1.2).

Ubon Ratchathani province also has two important dams: the Sirinthon dam in Sirinthon district supports both the production of 36,000 kilowatts of electricity and 150,000 rai of agricultural farming land. It is located 70 km. East of from Ubon city. The second important dam, the Pakmun dam, is located in Kong Jiam district, which is 82.5 km. East of Ubon Ratchathani town. It produces 280 million kilowatts of electricity and support 160,000 rai for agricultural land.

Water improvement and irrigation infrastructure have been the main influenced on agricultural activities, particularly in dry seasons. For rice production, rainwater is also important for RLR production in this region because the lower northeast is a major RLR area in Thailand. So, unpredictable rainwater distributions cause low and unstable RLR production.

1.1.2.3 Characteristics of RLR agro- ecosystems and production practices

Mackill, D., et al. (1996) defined RLR ecosystems as areas where rice is grown in non irrigated, level to slightly-sloping bunded fields that have non-continuous flooding of variable depths and duration with rainwater. Farmers manage their farm production based on landforms, soil types, and water availabilities (figure 1.8).

Table 1.2 Types and number of water resources and irrigation infrastructures by district in Ubon Ratchathani province, 2004 (Irrigation Office, Region 7, Royal Irrigation Department, Ministry of Agriculture and Co-operatives, Ubon Ratchathani, 2004)

	Total	Type of water resources							
		Reservoirs		Concrete weirs	Dams	Ponds	Canals & ditches	Artesian wells	Hollow wells
		Medium	Small						
Districts and Total	63,017	74	745	1,794	7	18,606	1,075	14,163	26,553
Muang Ubon	11,853	7	22	82	3	688	78	2,069	8,904
Kut Khaopun	1,605	0	15	139	1	613	35	412	390
Khemarat	1,955	0	78	106	0	638	37	517	579
Khuang Nai	2,703	7	59	40	1	1,150	119	408	919
Khong Chiam	1,358	2	16	102	0	474	13	364	387
Don Mot Daeng	744	1	1	17	0	412	15	95	203
Det Udom	**4,460**	**0**	**18**	**223**	**0**	**1,963**	**138**	**1,204**	**914**
Trakan Phutphon	2,827	5	75	99	0	1,077	67	680	824
Tan Sum	1,198	0	24	118	0	386	44	174	452
Thung Si Udom	1,248	1	1	21	0	720	25	115	365
Na Chaluai	2,372	3	63	51	0	980	24	470	781
Muang Samsip	3,976	1	48	76	0	1,209	65	828	1,749
Nam Yun	3,009	18	36	141	0	630	34	433	1,717
Buntharik	2,519	7	73	95	0	842	49	813	640
Phibunmangsahan	4,923	7	36	88	1	954	38	2,643	1,156
Pho Sai	893	1	31	73	0	301	21	252	214
Warin Chamrap	5,356	5	32	105	1	917	50	866	3,380
Si Muang Mai	2,128	0	29	72	0	881	34	431	681
Samrong	3,658	0	24	70	0	1,750	86	483	1,245
Sirindhorn	1,287	5	32	24	0	664	21	280	261
KA.* Na Year	624	0	6	12	0	324	18	133	131
KA.* Lao Sua Kok	973	4	0	15	0	376	21	106	451
KA.* Na Tan	528	0	10	15	0	236	17	169	81
KA.*Swang Wirawong	558	0	8	2	0	265	21	148	114
KA.* Nam khun	262	0	8	8	0	156	5	70	15

KA.* = King Amphoe

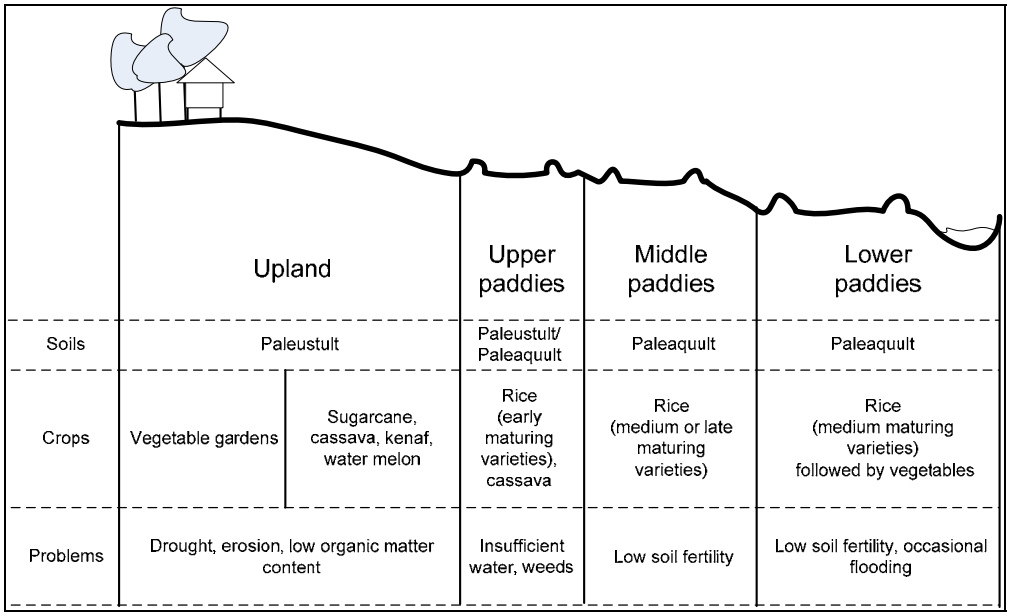


Figure 1.8 Cropping system, soil and ecological problems in relation to spatial organization of mini-watersheds in rainfed lowland rice ecosystems of northeast, Thailand (Warong Naivinit, 2008).

More than 1,500 rice varieties have been grown in northeast Thailand (Chaidee and Thongpitak, 1992 cited in Chirawat Vejpas et al, 2005). Rice is a main staple in the local household food systems. There are glutinous such as RD6, RD8 and non-glutinous such as Hom Mali 105, RD15 are most popular transplanted in RLR system. Glutinous rice varieties are grown mainly for family consumption in the majority of households, while nonglutinous production, often referred to as “Hom Mali rice” is mainly grown for sale. However, RLR production contributes only 17-20% of the total cash income providing for households’ expenditures (Warong Naivinit et al., 2008).The sandy, loam and clay soil are the most suitable for RLR system. This RLR system is transplanted in July and harvested in November depending on rice variety. Different period of rice harvesting provides opportunity for farmers to manage their farm and labour. In rainwater abundance year, the RD6 yield averages 670 kilogram per rai and RD8 yield 585 kilogram per rai, while Hom Mali 105 yields 365 to 515 kilogram and RD15 is 560 kilogram per rai (Department of Agriculture, DOA, 2008).

Farmers in Ubon Ratchathani usually grow staple glutinous rice in the well-watered lower paddies while early-maturing rice is grown in the upper paddies. In drought

years, non-glutinous rice is the first variety to be transplanted for family consumption. Average rice yields in this province are very low (table 1.3).

Table 1.3 Diversity of RLR varieties, planted areas and yields in Ubon Ratchathani, 2006/2007 crop year (OAE, 2007)

	Rice production area (ha)	**Rice harvesting area (ha)**	**Production (tons)**	**Average yield (kg/rai)**
Total area	512,320	484,183	970,269	321
Traditional varieties	7,845	7,444	14,798	318
RD 6	221,078	210,349	421,172	320
RD 15	27,112	26,001	47,888	295
KDML 105	242,936	228,208	459,747	322
Photosensitive varieties	10,205	9,234	20,254	351
Non-photosensitive varieties	3,143	2,946	6,410	348

1.1.2.4 Changes in farm labour management

Because of low agricultural income and high rates of poverty, off-farm employment is an alternative source of family income to maintain agricultural activities and for the survival of smallholdings. Many 20-35 year old people are migrant workers. Income received from agricultural production is mainly used for daily expenses while remittances from migrants are used for other household' activities such as building houses, hiring non family labour or education. Labour migration has caused labour scarcity on some large farms and a need to adapt agricultural strategy and practice. Farmers who have access to water at the beginning of the transplanting rice period are able to hire neighbours at low wages. On other farms, seasonal migrants return to help their relatives in the village at RLR transplanting and harvesting and do not hire labour. However, if the labour shortage is really critical, farmers are likely to have somebody

rent their land (Warong Naivinit, 2008). Direct sowing techniques are employed by farmers in order to replace the labour intensive transplanting technique used in crop establishment. Another practice employed by some villagers facing lack of labour is a return to the use of traditional custom, such as cooperative field work ("Long kaek").

The higher education levels attained by younger generations also affect agricultural farming practices because income derived from farming activities and production does not meet younger workers' desires. Most of them move to towns to undertake higher education, or work in various industries or the service sector. In the villages, children and/or older people, usually with disadvantaged histories, work on the farms. Such a situation calls for the need to find new strategies in the management of agricultural farming and to train younger farmers in agricultural techniques and agribusiness management skills. These strategies might lead to an increase in productivity and income, and balance out employment numbers in both the farm and non-farm sectors.

1.1.3 Importance of the integration of land / water and labour management

1.1.3.1 Integration in traditional local farming systems

The objective of traditional agricultural production is for a subsistence livelihood and for self-consumption. Local farmers have used natural resources in local areas. Biodiversity of plant and animal varieties have had an influence on agricultural farming systems. Cattle have not only been reared for labour use, but also for manure, which can be used in agricultural farming. Two to three cattle can provide about two to three tonnes of manure, enough for a rice production area of about one hectare (Vitoon Lianjumroon, 1987). Plant and animal varieties have been selected using traditional knowledge, culture, and ecologies of local communities.

According to Vitoon Lianjumroon (1987), the original patterns of integrated farming systems can be divided into three types: (i) shifting cultivation was an original agricultural practice, which brought about a change from hunting and forest farming activities. Farmers logged forest land to grow different kinds of plants in 8-10 year cycles a time on the same land; (ii) agro-forestry, during this period, local communities did not want to move to other place, but they want to grow plants and rear animals in a permanent pattern such as most land close to rivers, which were used for rice transplanting by using traditional technology and human labour;

and (iii) mixed farming, this pattern was also employed in the production of food for self-consumption, so traditional technology and human labours were still main technique used in the management of their farms. Livestock and crop activities helped farmers to use the manure as fertilizer for crops, and the crop residues as feed for livestock. These farming practices created a diversity of agricultural products. Local communities had enough food for home consumption and bartering arrangements, such as the exchange of rice and salt, and rice and tobacco. Nevertheless, integration systems based on local traditional knowledge did not expand much beyond their initiation because government agencies did not support and promote the concept.

1.1.3.2 Integrated farming systems in the region

Initially, integrated farming systems in this region essentially meant rearing fish in paddy fields. This technique was promoted by government agencies in the late 50s, but it was not popular because farmers are abundance fish from natural water resource. In addition, farmers had already constructed paddy ponds to catch natural fish only. Later on, fish disease occurred particularly in the Thung Kula Rong Hai area, chemical fertilizer cost increased, and some local farmers wanted to change to alternative agricultural farming. Alternative agricultural system including integrated farming was the one choice and it became more interesting for several organizations. The Appropriate Technology Association and GRID foundation were the first non-government organizations (NGO) wanting to conduct research on integrated farming knowledge, and to promote new alternative agricultural production techniques for farmers in the lower northeast region in 1977. In 1985, these organizations started out by gathering data on traditional knowledge and patterns of agricultural systems from Pow Maha-U Sunthonthai, a philosopher from Surin province. He had been applying integrated farming systems borrowed from farmers in Thailand's central region. At the same time, integrated farming systems were also practiced in Amnart Charoen district (at that time) by Mr. Chalee Marasang, who dug farm ponds using his own labour. Their main objectives were to produce food for home consumption and reduce household expenses.

Pow Maha-U Sunthonthai's whole land area totals about 16 ha. 12 ha were used for the production of five rice varieties; 4 ha were used for intensive integrated farming. About 4 ha contained a house he constructed, rearing picks, and five ponds for rearing fish.

5 paddy fields were re-constructed for rearing fish and growing different kinds of fruits and vegetables on the ridges. Rice straw was used for fruit and vegetable production, and to improve soil structure. Five cattle were reared by letting them into his field after rice harvest. He also looked after 200 ducks, feeding the ducks by letting them into the rice plots after the rice is transplanted to eat shells, crabs, and rice weed. This technique provides natural manure for the rice fields without cost.

Later on, other alternative agricultural patterns were popular in 1987. Organic farming, natural farming, agro-forestry, and new theory farming were promoted by organizations known for natural and soil conservation. In the same year, integrated farming systems expanded to other provinces, including Yasothon, Ubon Ratchathani and Roi-Et. In Roi-Et, GRID foundation subsidized farmers who wanted to do integrated farming in 1988. Some farmers applied Pow Maha-U Sunthonthai's knowledge and adapted the farming patterns to improve their farm activities. At first, mixed farming of rice and fish was the most popular form of integrated farming. Examples of integrated farming included combinations of the rearing of fish in ponds and paddy field farming; the rearing of fish in canals and rice field farming, and the cultivation of various kinds of vegetables in pond ditches. During the period 1983–1991, about 20,000 farmers changed their conventional farming practices to integrated farming (Anusorn Unno, 2003). After 1989, government agencies also became interested in integrated farming systems. They started to subsidize the construction of farm ponds, and gathered data related to integrated farming practices, such as the Ministry of Education's analysis of integrated farming patterns and incomes in Roi-Et, Nakhon Ratchasima, Khon Kaen, and Buriram provinces.

1.1.3.3 Integrated farming after farm ponds project

In 1997, farm pond projects were popularly promoted in the lower northeast region by government agencies. The Department of Agriculture had researched and developed integrated farming. In Ubon Ratchathani province, integrated farming projects focused on rearing fish in rice fields. The government agencies experimented on integrated farming project in 1989. The main types of fish are the Nile (Tilapia nilotica), Nai (Cyprinus carpipo) and Tapian (Puntius gonionotus). The experimentation was made with RD6, KDML 105, and other traditional rice varieties on rice paddies of about 19.68 ha. The results indicated that the farmers in Umnart Charoen, Khuang Nai, and Det Udom districts who practiced integrated farming get average rice

yield 405.90, 411.4, and 424.1 kg.per rai respectively, while non practiced integrated farming farmers get average rice yield 322.2, 379.5, and 388.3 kg. per rai respectively (Niran Thongphun and Chanurn Rattanavaraha, 1989). Niran Thongphan (1989) analyzed rice-fish farming in farmers' fields in both rainfed and irrigated areas in Ubon Ratchathani province. He concluded that rice yield on average is at least 15% higher on farms rearing fish than those not rearing fish.

Presently, integrated farming has been adapted to form several different patterns of farming. One of them has been the adaptation of integrated farming into organic farming. Some farmers living in Yasothon, Surin, and Ubon Ratchathani provinces have applied and subsequently adapted integrated farming practices into an organic farming system. Nuntiya Hutanuwatr et al (2007) researched integrated farming in organic Hom Mali rice systems in the lower northeast region (Ubon Ratchathani, Srisaket, Yasothon, Surin, Roi-Et, and Amnartcharoen provinces). They concluded that integrated farming in organic Hom Mali rice as a main crop is a convincing alternative for poverty alleviation of lower northeast farmers because: (i) the farmers who adopted the practices have more confidence in their career; (ii) they spend less on food and associated costs and eat more hygienic food; (iii) they spend less on chemical fertilizers and pesticides; (iv) they earn a sufficient income for meeting basic living costs; and (v) they have accumulated human capital in terms of collective skills, knowledge in organic farming, organic farm infrastructure, and biodiversity.

As a result of the economic crisis in 1997, which caused changes in government policy, irrigation development had to switch from a large-scale approach to a farm level approach. In the lower paddy fields, farmers often constructed small ponds for use in vegetable production for home consumption after harvesting rice. Some farmers, particularly in Roi-Et and Yasothon, also dug shallow wells for irrigation to grow tobacco after rice. Farm ponds were constructed in different parts of the land, and they were used for watering RLR nurseries and small-scale dry season crops. For farmers using an integrated farming system, farm ponds were constructed to store water for vegetable cultivation, particularly in the dry season and for rearing fish. In Ubon Ratchathani province, the government supported 4,008 farm ponds (survey in 2004); farmers benefited from the availability of about 10,153 rai (Suwat Terapongtanakorn and Nopamas Namdang, 2006). The reorientation of rice production monoculture to integrated farming requires considerable financial support for the initial farm pond investment. But not all areas are

suitable for farm ponds. The most suitable land for farm pond is lowland, which is also more suitable for RLR production.

Integrated farming systems provide higher economic viability than rice monoculture production, averaging net income of approximately 300-500 baht per rai (Sumpan Tacha-Atik et al, 1997). Such information indicates that integrated farming systems can increase farmers' incomes. Farmers employing such systems can also undertake farming activities all year round; moreover, irrigation infrastructure projects that have been constructed to increase water capacity allow for various agricultural activities to be undertaken. However, not all water management projects have been satisfactory and local people still migrate.

1.1.4 Need for further improvement of interaction between land / water use and labour management

1.1.4.1 New water-related projects affecting land / water use and labour management

Top-down policy is not suitable for local adaptive resource management and rural development. Results of previous development experienced point to the fact that the interaction between land and water use, and labour management, is very complex and difficult to understand. Therefore, to better understand these interactions, new integrated approaches need to be examined. According to Taweewong Sriburi (2007), the future improvement of resource management needs more in-depth study (figure 1.9).

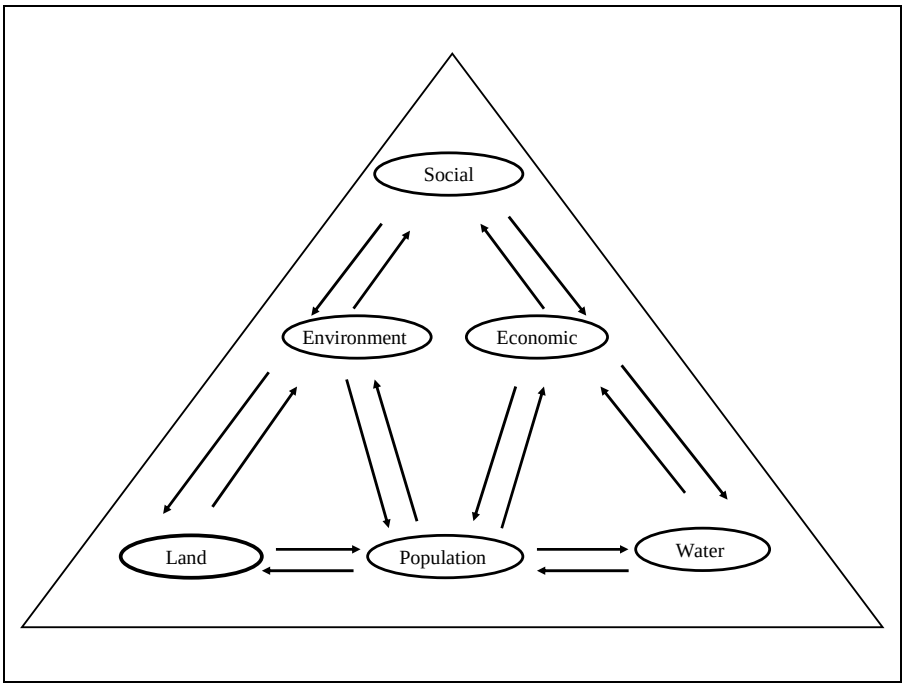


Figure 1.9 The interaction between resources and stakeholders (adapted from Taweewong Sriburi, 2007)

The interactions between land and water resources, and humans, are important in the consideration of suitable management strategies; the mismanagement of one interaction directly affects another. Better land & water and labour management calls for a holistic understanding of the interactions.

1.1.4.2 A new integrated approach to better understand the interaction between land & water use and labour management

Simple and linear innovations are not adequate for land & water use and labour migration aimed at improving the well-being of poor farmers. It needs an integrated approach to support discovery, negotiation, and use to represent the different perceptions of various stakeholders on a natural resource rather than to predict detailed conditions or behaviour of complex systems in the future (Hagmann, J. et al., 2002; Douthwaite, B., 2003; Bousquet F., and Trébuil, G., 2004). The modelling issue comes down to a choice between theoretically designed knowledge and empirically elicited knowledge (Becu N. et al., 2005). Empirical collaborative modelling is the most suitable approach for integrating knowledge from various sources: indigenous and scientific fields; integrated knowledge across bio-physical sciences; ecology and social sciences at several relevant and complementary levels. The Companion

Modelling approach (ComMod) is one innovative kind of collaborative modelling that we put to use at our Lam Dome Yai Watershed study site.

1.1.5 Companion modelling (ComMod) approach at Lam Dome Yai Watershed study site, Ubon Ratchathani Province

1.1.5.1 Definition, objectives and main principles of ComMod approach

ComMod approach is a highly interactive collaborative modelling process (Trébuil, G., 2008). The main principles and objectives of the companion model are: (i) to understand the management of resources in a complex socio-ecosystem and (ii) to facilitate the collective management of these resources with concerned stakeholders by using participatory modelling and simulations within platforms that allow for communication and collective learning. The purpose of ComMod is for users to look at renewable resource management by integrating the farming dynamics of the agro-ecological, social dimensions, and to elicit their interactions. The ComMod researchers consider the decision-making process as a series of interactions among stakeholders who have various objectives, different perceptions, levels or kinds of information and resources, and varying degrees of influence.

The general objective of ComMod users working on such a complex system is to try to understand the interactions between key biophysical and social processes: the social ones being driven by various interacting points of view. ComMod belongs to the family of action research approaches and incorporates two core activities: field work and modelling in the lab. This approach is a promising one to deal with complex systems that provide information on the state and deliver increased understanding of the interactions in complex systems (Dryzek, 2000; SLIM, 2004a, cited in Blackstock K.L. et al, 2006), to understand the characteristics of complex management systems and to explore a diversity of problems at individual scales and system level (Jones, N.A. et al., 2008). Similar to economic or ecological systems, forecasting the exact future outcomes of farming and agro-ecosystems is not possible. So, computer enhanced modelling effectively becomes a tool for interactive learning instead of a tool for testing the system. Various ComMod tools, particularly Agent-Based Model (ABM) and Role-Playing Game (RPG), are used to tackle issues regarding decision making processes, common property, and co-ordination among actors (Barreteau, O., 2003; Bousquet F. and Trébuil, G., 2005).

1.1.5.2 Characteristics of the ComMod process implemented at the Lam Dome Yai Watershed

The Lam Dome Yai watershed is a typical RLR growing area characterized by coarse textured, low chemical fertility soils and erratic rainfall distribution. In general, there is a severe shortage of water from December to May. Farmer poverty is partly due to these unfavourable agro-ecological conditions leading to low farm productivity and incomes. To manage rainfall and economic risk, farmers try to diversify their sources of income, especially through off-farm employment. A common response is temporary or permanent labour migrations. The government has launched water improvement programs to alleviate the risk of drought and to encourage farmers to diversify and better integrate their farming activities while increasing on-farm labour employment (farm pond projects, integrated farming projects, etc.). But how better access to water affects farmers' decision-making regarding farming activities, and particularly labour migrations, is not yet documented (Warong Naivinit, 2006). Better understand local farmers' making decisions could be useful and providing for policy-makers with relevant information to make decisions (Hisschemoller et al, 2001 cited in Natalie N.A. et al., 2008).

It is to examine this research question that a ComMod experiment was initiated in Det Udom District by Warong Naivinit, PhD candidate at both Paris X and Chulalongkorn Universities. In 2005, he used a conceptual model linking land and water use with labour management and migrations at a pilot site and built a role-playing game (RPG) that was then presented to the stakeholders in Ban Mak Mai village on 9-10 July 2005. The objectives of the gaming sessions were: (i) to validate the existing knowledge about the migratory behaviour of different types of farming systems; and (ii) to improve the research team's understanding of the decision-making processes used by these different local farmers regarding RLR production and labour migration in relation to water availability. Based on the results from this first field workshop and the subsequent interviews of the players, the conceptual model and the RPG were modified and a first multi-agent computer model was implemented. In April 2006, a second field workshop was held at the same location and several migrants were invited to play a modified RPG and to discuss a first presentation of the MAS computer model. Later on, participatory simulations were introduced to the villagers in October 2006 and April 2007. Finally, an Agent-Based Model (ABM) was implemented and presented at the same location in May 2008 (see more detail in

chapter 5). The ComMod participants were carefully selected to represent all main farm types based on a typology of farming systems identified in 2004. The evaluator was a research team helping to organize these field workshops in order to familiarize myself with the ComMod approach, its tools, and how to use them with local farmers.

ComMod activities were implemented over a four year period in the Lam Dome Yai case study (April 2004 to May 2008). Following the preliminary modelling and field activities, there was a need to develop monitoring and evaluation procedures adapted to such highly participatory and adaptive processes, such as how to measure the learning effects and the impact of ComMod (Barnaud, C., at al, 2006) and how such techniques play out in practice (Siebenhuner and Barth, 2005 cited in Jones, N.A. et al., 2008). The monitoring and evaluation process of the effects could be set up and implemented under my research to assess the extent to which different participatory modelling practices reinforce or divert from the theoretical assumptions on which the Lam Dome Yai research team was built.

1.2 Justification of research

1.2.1 Lack of suitable Monitoring and Evaluation (M&E) methods adapted to participatory modelling processes

ComMod approach has been used and applied in more than thirty case studies on various issues around the world, including at the Lam Dome Yai Watershed study site. Because of the recent development of all these case studies, no in-depth ex-post evaluations of the effects and impacts of using the ComMod approach with stakeholders have been performed (Bousquet, F. and Trébuil, G., 2005). An adapted methodology to assess the effects of such collaborative modelling processes on their participants and their impact, is needed, as well as new ways to assess the improvement in stakeholders' capacity for collective learning in ComMod.

1.2.2 A proposition to be tested

The M&E process in the Lam Dome Yai study site is the part of 30 ComMod evaluating case studies across the world for the program on Agricultural and Sustainable Development (Agricultural et Dévelopment Durable, ADD). Three important elements of the proposed M&E process in this case study were tested and used as important sources of information on ComMod.

1.2.2.1 A logbook of the Lam Dome Yai case study was used to chronologically gather data on the ComMod process and activities at the study site and to interview ComMod users;

1.2.2.2 A Designer Questionnaire (DQ) was used as a template to be filled out by the project designer (Warong Naivinit);

1.2.2.3 A Participant Evaluation Framework (PEF) was used to gain an understanding of the participants' experiences of the project based on perceptions of the issues, learning, relations, and practical issues.

1.3 Research questions and related objectives

1.3.1 Research questions

1.3.1.1 On the different types of ComMod effects on participants, the question is: what are the different types of effects on stakeholders generated by the participatory ComMod process at the study site?

1.3.1.2 On suitable methodology for monitoring and evaluation of a ComMod process, the question is: what kind of methodology is appropriate for the monitoring and evaluation of the ComMod process?

1.3.2 Research objectives

1.3.2.1 To monitor and evaluate the different types of effects of the ComMod approach on participants;

1.3.2.2 To test the proposed M&E methodology at Lam Dom Yai site;

1.3.2.3 To make recommendations to improve the proposed M&E methodology.

1.4 Research site and participants

1.4.1 The ComMod process was implemented in Ban Mak Mai village in Klang sub-district, Det Udom district, Ubon Ratchathani province with a heterogeneous group of participants playing different roles.

1.4.2 The various roles included: local farmers; local non-government organizations (NGO) playing the role of a public service organization; local government agencies playing the role of supporting agricultural development; a Tambon Klang Administrative Officer

(TAO Klang) playing the role of a key local administrative & planning agency, and local researchers playing their roles as designers, main facilitators and stakeholders in the ComMod process (figure 1.10).

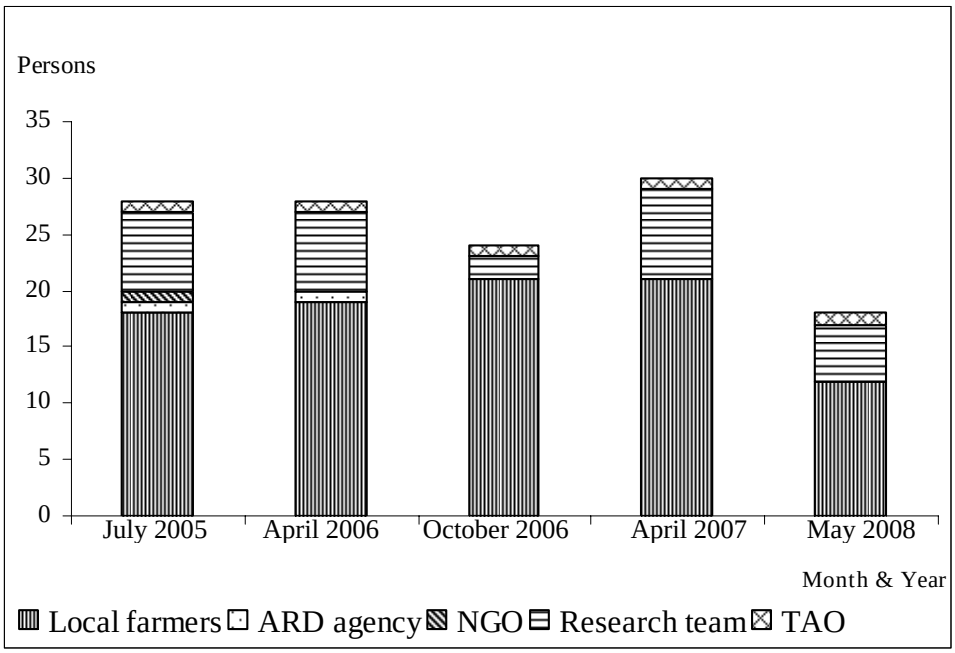


Figure 1.10 Stacked bar histogram of the ComMod participants who participated in each workshop

1.5 Expected outputs

1.5.1 Different types of effects of the ComMod approach identified and analyzed;

1.5.2 Recommendations for methodological improvement proposed.

1.6 Keywords

1.6.1 Companion modelling approach (ComMod) is a highly interactive collaborative modelling process used by researchers and local stakeholders to co-construct a shared representation of a given complex issue, and to use it to explore possible solutions of their choice through simulations.

1.6.2 Participatory monitoring and evaluation (PM&E) are processes implemented and constructed as a way to measure the effects of the ComMod activities implemented at Lam Dome Yai study site by use of observation, storytelling, and individual interview surveying techniques.

1.6.3 Integrated farm management combines the best of traditional farming methods with appropriate modern technology balancing responsible their resource. Under this research, integrated farm management is study on the integration of local farmers at Ban Mak Mai village to manage their asset: land &water and labour.

1.6.4 Learning effects are the various kinds of new knowledge that the ComMod participants gained from being involved in the ComMod activities.

1.6.5 Capacity building is essentially an upgrading of the participants' ability to analyse and share ideas regarding community situations and issues, particularly those focusing on land / water and labour management.

CHAPTER 2

LITERATURE REVIEW ON PARTICIPATORY APPROACHES, COLLABORATIVE MODELLING, AND MONITORING AND EVALUATION PROCESSES

2.1 Diversity of participatory approaches in agricultural development

Agricultural development needs participatory approach: (ii) to communicate among local stakeholders and outsiders; government agencies, NGOs, local institute etc. and (ii) to plan for collective development. Diversity of participatory approaches using for collective agricultural development are presented in following.

2.1.1 Rapid Rural Appraisal (RRA)

The development of RRA was led by Robert Chambers and Gordon Conway during the 1970s to1980s in response to communication problems, as perceived by local people, between locals and 'outsiders'. The communication problems were essentially about the measures aimed at improving the cost-effectiveness, and quality, of development work and rural development-related research (Somluckrat, W. et al., 1989). Outsiders used the RRA as a rapid learning process to improve their knowledge and understanding about rural conditions, rather than relying on laboratory and research station findings and conventional research attempts; such attempts were considered irrelevant as they failed to take into account locally specific, real-life situations (Chambers, R., 1985; Beebe J., 1985). RRA consists of a series of techniques for "quick and dirty" research that recognizes the need to consult the poor on their needs; for example, the use of interviews and direct observation to collect data. RRA quickly showed the inherent limitations of local community's realities, and claimed to generate results of less apparent precision. RRA was considered by some to provide greater evidential value and a more economical means for data collection for the researcher. However, the RRA process remained a tool strictly employed by outside researchers when gathering local information. Therefore, it was

thought that the technique needed to be replaced by an approach that emphasized the empowerment of local people.

Later on, a new participatory approach, called participatory rural appraisal (PRA), was developed.

2.1.2 Participatory Rural Appraisal (PRA)

PRA is a family of approaches that enable people to express themselves, share learning experiences, and analyse the realities of their lives and conditions. It also facilitates a local community's in-depth look at itself and possibilities with outsiders (Chamber, R., 1996.) Other people, organizations, and government officers have used PRA as a crucial component in the implementation of their development programmes. Important tools of this approach include group animation and exercises, which are used to facilitate the sharing of information, analysis, and action among stakeholders. The PRA approach stimulates and helps participants feel empowered by their participation; moreover, it enables participation regardless of literacy levels. RRA and PRA are very similar in their approaches. However, the difference is that PRA emphasises processes which empower local people, whereas RRA is mainly seen as a means for outsiders to gather information (table 2.1).

RRA and PRA share closely related principles, as follows: (Forests, Trees and People Newsletter, 1995):

2.1.2.1 Offsetting biases: spatial, project, person, seasonal, professional, and courtesy;

2.1.2.2 Rapid progressive learning: flexible; exploratory, interactive, inventive;

2.1.2.3 Reversal of roles: learning from, with and by local people; eliciting and using their criteria and categories; and finding, understanding, and appreciating local people's knowledge;

2.1.2.4 Optimal ignorance and appropriate imprecision: not finding out more than is needed and not measuring when comparing is enough. Trained to make absolute measurements but often trends, score or ranging are required;

2.1.2.5 Triangulation: using different methods, sources and disciplines, a range of information from a range of places, and cross-checking to get closer to the truth through successive approximations;

2.1.2.6 Principle investigators' direct learning from and with local people;

2.1.2.7 Seeking diversity and differences.

Table 2.1 RRA and PRA compared

Issues	RRA	PRA
Developed in	late 1970s, 1980s	late 1980s, 1990s
Key Resources	local people's knowledge	local people's capabilities
Main innovations	methods	change of behaviour and attitudes
Mode	extractive	facilitating, participatory
Dominant type of instruments	semi-structured, verbal interviews, discussions; partly visual	visual, participatory and empowering tools
Outsider's role	investigator	catalyst and facilitator
Insider's role	respondent	investigator, analyst and planner
Ideal objectives	learning from insiders by outsiders	empowerment of local people
On whose demand	outside (donor) organizations	insiders (ideally)
Longer term outcomes	plans, projects, publications	sustainable local action and institutions

RRA and PRA are key pioneer original participatory approaches and were widely used by on-farm researchers and extension workers during the 80s and 90s. However, some scientists have developed other participatory approaches that aim to further understand the local rural conditions and empower local stakeholders.

2.1.3 Participatory Technology Development (PTD)

The PTD approach encourages the mutual merging of the power and capacities of outsiders and local people in the process of identifying, improving, and adapting a technology to develop productive and sustainable farming systems based on the community situations, resources, and the available local knowledge (AERDD, 1994, Thijssen, R., 2002). Because experimentation by local people is encouraged, the knowledge that locals gain autonomously spreads to other people (figure 2.1).

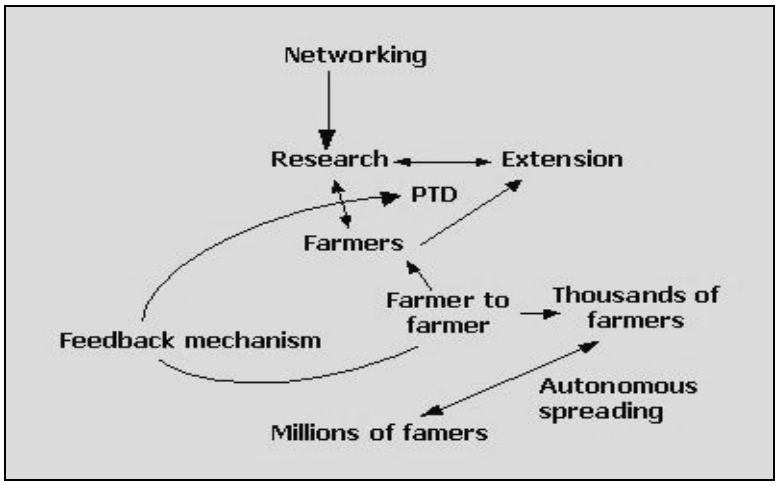


Figure 2.1 PTD interactions through peer exchange and feedback mechanisms (Veldhuizen, Bayer W. and de Zeeuw, 1997)

PTD consists of six principles (ILEIA, 1988):

2.1.3.1 How to get started: building a relationship of confidence aimed at cooperation with local farmers' networks and other actors; making a joint analysis of the existing situations, farming systems, and problems; and start from simple experiments to complex ones;

2.1.3.2 Looking for things to try: identifying indigenous technical know-how, formal and relevant knowledge; screening and selecting topics for further development, using criteria leading to optimal use of local resources and sustainable systems of production;

2.1.3.3 Design of the experiments: planning and designing experiments based on farmers' criteria and measuring techniques, and outsiders' improvements and suggestions;

2.1.3.4 Trying out: actual implementation of the experiments and evaluation of the results with the local farmers;

2.1.3.5 Sharing results with others: communication of results with other local and scientific networks to scrutinize and interpret them, and to encourage others to adapt and test the results for their circumstances;

2.1.3.6 Sustaining and consolidating the process of PTD: creating favourable conditions for farmers' organizations, local institutions and support at policy level. Establishing the physical infrastructure and educational facilities to strengthen local experimental capacity and local management of the processes of innovation.

PTD is more than research because it combines the generation, testing and application of new techniques with the creation of the physical and institutional infrastructure for further innovation of the technology. However, the PTD approach does have its disadvantages; for example, PTD is a time consuming process, demanding the patience and humility of outsiders.

2.1.4 Participatory Action Research (PAR)

PAR is a more activist approach which works to empower the local community or representatives to deal with the higher level power structures. Paulo Freire, Orlando Fals-Borda and Mohammad Anisur Rahman make up the group of social scientists who created and developed the PAR (see main publication on Participatory Research for Sustainable Livelihood: A Guide for Field Projects on Adaptive Strategies, UNDP Empowering People: A Guide to Participation, The World Bank Participation Sourcebook). Action research in organizations, action research in schools, farmer participatory research and technology generation, and participatory evaluation are the main fields of PAR. Researchers employing this approach work directly with stakeholders, guided by seven major principles.

2.1.4.1 Common values such as the value of local knowledge and a commitment to non-violent social change;

2.1.4.2 Ownership of the research lies with the community involved;

2.1.4.3 Commitment to action by the researcher in partnership with the community based on the learning that occurs;

2.1.4.4 Participants are to be included at every stage of the research;

2.1.4.5 Research methods are selected based on their appropriateness to the situation and should be taught to local participants so that they can continue the inquiry process independently of the researcher;

2.1.4.6 Outcomes are intended to benefit the community;

2.1.4.7 Ownership of product in terms of methods used, interpretation of results, and dissemination of results.

PAR requires an in-depth understanding of its principles and objectives from its users. Importantly, if researchers are able to clearly understand the local power structure, and relationships within the community, the PAR approach becomes more effective. PAR seeks to involve poor traditional considered the object of research as more active participants in the

question-making, analysis and data gathering aspects of research. Participatory Learning and Action (PLA), the next generation of PRA, considers and seek to involve more explicitly stakeholders in analyzing, sharing and taking action on issue at stake.

2.1.5 Participatory Learning and Action (PLA)

Participatory approaches have recently shifted in scope and focus. There has been an increased emphasis on sub-national, national and international decision making, not just local decision making; a move from projects to policy processes and institutionalisation; greater recognition of issues of difference and power; an emphasis on assessing the quality and understanding the impact of participation rather than simply promoting participation. Based on such broad changes, PLA spread rapidly throughout the world during the 1990s.

PLA is an umbrella term for a wide range of similar participatory approaches and methodologies: PRA, RRA, PAR, and Farming Systems Research (FSR). This approach borrows elements from PRA that seek and more explicitly involve local people in analyzing, sharing, taking action on issues affecting them, and learning about their needs and opportunities (Neef, A., 2005). It is a wonderful source of practical ideas, experience about participatory learning and action approaches or methods. It provides up-to-date information on the use of participatory methods. This approach needs local people to be willing to learn with and from outsiders.

With all of the participatory approaches mentioned above as reference, scientists, social scientists, and other researchers who have worked with local people in particular, have all tried to develop other participatory approaches. Some of them have used modelling as a part of participatory research approaches that are focused on integrated resource management. Participatory modelling approaches are currently available to use because of multi-scale research and interdisciplinary closely collaboration with local stakeholders.

2.2 Participatory modelling approaches for integrated resource management

2.2.1 Sustainable resource use

Local resource users have always integrated resource management from their own complex livelihood perspectives. The degree of sustainability in resource use is largely a result of rural people's knowledge, culture, values, norms, and capacity to act and organize

themselves (Hagmann J. et al., 2002). So it follows that sustainable development might be based on different things to different people, and that different definitions exist. It is an emergent property of a soft system and outcome of the collective decision-making among resource users and managers (Röling, N. and Wagemakers, M.A., 1998). Sustainable resource use requires the collective management of stakeholders' resources because poor coordination among stakeholders leads to inefficient resource use, economic and environmental damage, negative externalities, and social conflicts (Bousquet, F. & Trébuil, G., 2004). Moreover, diverse stakeholders use resources for different purposes with different perceptions (figure 2.2).

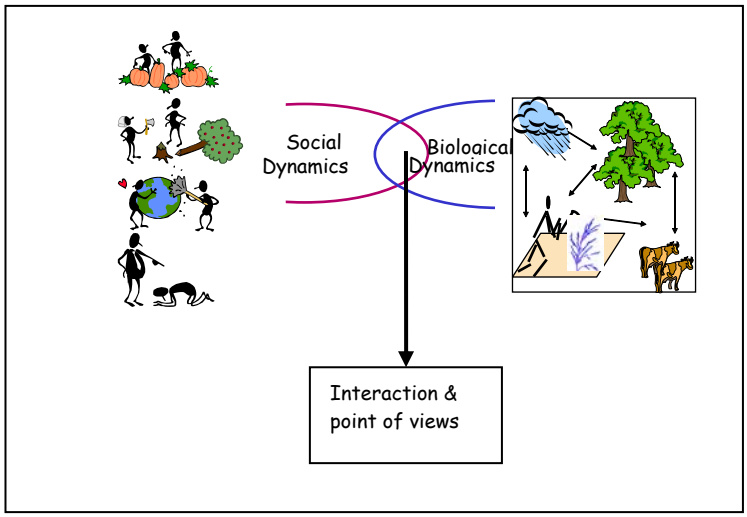


Figure 2.2 Diverse stakeholders use resources for different purposes with different perceptions (Bousqute, F. and Trébuil, G., 2005)

The complexity of interaction between resources and resource users is difficult to understand. The demand for innovative approaches and tools to improve coordination processes among stakeholders to manage these problems is important. Sustainability requires an integrated approach, institutional and personal transformation in understanding and practice (Blackstock, K., et al., 2006).

2.2.2 Integrated Natural Resource Management (INRM)

INRM is "an approach that integrates research on different types of natural resources, into stakeholder-driven processes of adaptive management and innovation to improve livelihoods, agro-ecosystem resilience, agricultural productivity, and environmental services at

community, eco-regional, and global scales" (CGIAR, 2001). Natural resources refer to land, water, forest, and biological resource base (including genes). INRM aims to sustain agricultural productivity, avert degradation of potential productivity (CGIAR-INRM-Group, 1999), and facilitate collective learning processes and management; in other words, it is the management not only of increasing the adaptability of the ecosystem but also of the social process leading to ecological states (Bousquet, F. and Trébuil, G., 2005). It is an approach that has emerged from experiences and community-based learning processes that encourage the sharing of ideas and collective learning among local people and external services. To strengthen the adaptive capacity of the natural resource management system at the local level, the INRM approach is based on four objectives (Hagmann, J. et al., 2002):

2.2.2.1 To strengthen the collective capacity of local groups, institutions, and organizations for self-organization, collective action, negotiation, and conflict management, as well as their articulation and bargaining power vis-à-vis authorities, service providers, and policy makers ("local organizational development");

2.2.2.2 To enhance farmers' capacity to adapt and develop new and appropriate innovations by encouraging them to learn through experimentation, building on their own knowledge and practices, and blending them with new ideas in an action learning particularly agricultural technologies and practices, social, organizational, and economic innovations. This objective is similarity with PTD approach;

2.2.2.3 To enhance collective learning through action and social learning, facilitation of self-reflection, sharing knowledge, and networking;

2.2.2.4 To negotiate the management of natural resources and related services, policies, etc., through stakeholder platforms of communities, service providers, and other key players.

Recently, the relationships between natural resource and users became very complex and difficult to understand. The creation of new knowledge and the improvement of suitable methods have been invented and studied continually because the conventional linear models, methodologies, and tools do not fit INRM. Various alternative approaches and methods are being developed, rediscovered from other scientific fields and adapted to INRM (Lewin, C. 1946); participatory built models used for simulations have become one promising choice Without the

use of participatory models, it is extremely difficult to communicate the characteristics of INRM intervention processes for competency development because simple, linear models are not adequate for NRM aimed at improving the well-being of poor farmers. NRM needs models to support discovery and negotiation, used to represent the different perceptions of various stakeholders on a natural resource rather than to predict detailed conditions or behaviour of complex systems in the future (Hagmann, J. et al., 2002; Douthwaite, B., 2003; Bousquet, F. and Trébuil, G., 2004). The key output of the learning by modelling and simulating is a holistic type of representation of knowledge of a complex system seen as a set of dynamic and interconnected hierarchies (Trébuil, G. et al., 2002).

2.2.3 Characteristics of the participatory modelling approach for INRM

Using new images and ideas is a means of creating shared understandings that will allow us to do new things in new ways. One central participatory modelling issue is the choice between theoretically designed knowledge and empirically elicited knowledge (Becu, N. et al., 2005). The objectives of participatory modelling approach are: (i) gaining a common understanding of a problem or issue; (ii) assisting collective decision making processes. The objectives of methodology are: (i) explicating tacit knowledge, (ii) preferences and values; (iii) improving the legitimacy of a model; (iv) reducing conflict; (v) enhancing both individual and social learning; (vi) promoting creativity and innovation; (vii) investigating individual behaviours and collective dynamics in a controlled environment; (viii) and information and enhancing collective action (Daniell and Ferrand, 2006; Barreteau, O. et al., 2007 cited in Jones, N. A. et al, 2008).

The companion modelling approach (ComMod) was selected as a participatory modelling for INRM. ComMod is an iterative process combining participatory procedures with modelling techniques used in a participatory way to develop simulation models integrating various stakeholders' points of view to better understand how a given social agro-ecological system facing a practical resource management problem is structured and is evolving (figure 2.3). ComMod is also used within the context of platforms for collective learning to facilitate multiple stakeholders' coordination, and to support collective decision-making and the adaptive management capacity of local communities (Trébuil, G. et al., 2002; Barnaud, C. et al., 2006; Trébuil, G., 2008).

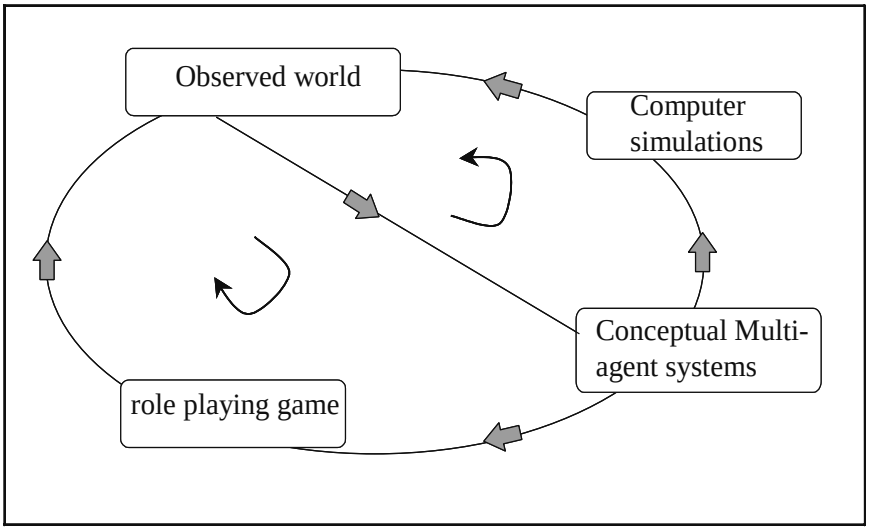


Figure 2.3 The RPGs are used collaboratively with conceptual models and ABM (Bousquet, F. et al, 2003 cited in Barnaud, C. et al., 2006)

Multi-agent system (MAS) is an approach used to build role-playing game (RPG) or agent-based model (ABM) to examine several concrete INRM problems, to tackle issues regarding decision processes, and facilitate co-ordination among actors leading to new questions, new discussions, and changes in the modelling (Barreteau, O. at al., 2003; Bousquet, F. and Trébuil, G., 2004; Trébuil, G. and Bousquet, F., 2005).

2.3 Companion modelling tools used

2.3.1 Role-playing game (RPG)

RPG is a powerful tool that supports communication, dialogue, learning and negotiation processes among players and / or organizers in training and research to grasp information on the social system studied, and can also be used to test economic theories (Funtowicz and Ravetz, 1993 cited in Daré W., and Barreteau, O., 2003). Different types of games are used with different goals in sight; for example, RPGs have been used as a tool for collective conceptualization, field survey, and co-sharing knowledge. In ComMod process, the RPG is used based on three hypotheses (Daré, W. & Barreteau, O., 2003):

2.3.1.1 The game is accepted by stakeholders as a schematic representation of their reality;

2.3.1.2 The social background of stakeholders interferes with role-playing in the game;

2.3.1.3 The game reveals relationships between players.

In ComMod processes the RPG is designed as a simulation tool focussing on communication, learning and negotiation processes that would stimulate and support coherent group change (Tsuchiya, 1998). It consists of three components: the game describes the world in which the party will be developed; the animator sets the rules of the game and helps players to progress in the game; and the players mean the people taking part in the game, self-creating their roles by following the game rules (Mucchielli, 1983). RPG is formalized to "open the back box" of the associated MAS-based computer model (the Agent-Based Model – ABM) for stakeholders with the objective of inviting real stakeholders to play the game and for collective learning and action (Bousquet, F. and Trébuil, G., 2005). Several scientists set up an RPG similar to the associated ABM with stakeholders to:

(1) Understand the computer model, what it does when running a simulation, and more precisely, to understand the difference between the model and reality;

(2) Validate it by examining the individual behaviours of agents and properties of the system emerging from their interactions, and by proposing modifications;

(3) Be able to follow MAS simulations on the computer, and to propose scenarios of interest to them to be simulated and the simulation results collectively discussed.

The degree of freedom given by the game and animators is crucial in allowing people to express behaviours in the game; this makes the game's contents, and operations, more explicit to its potential users (Daré, W., 2004). Such MAS-based models are presented to stakeholders to gain a more in-depth understanding of their decision-making, ideas, and perceptions.

2.3.2 Multi-agent systems (MAS) and agent–based models (ABM)

MAS originated within the domain of computer science (computational systems) and more precisely distributed artificial intelligence (DAI). A MAS is made up of a set of computer processes in which various autonomous agents interact in a given common environment; their interactions can be used to look for solutions to a natural resource management problem (Ferber, J., 1999; Trébuil, G. et al., 2002; Bousquet, F. and Trébuil, G., 2005). Figure 2.4 shows a schematic representation of MAS. A computer MAS, or Agent-based model (ABM), can be

constructed from a RPG, for example under the CORMAS simulation platform (Le Page C. and Bommel, P., 2005), to represent dynamic phenomena occurring in complex socio-agroecological systems (Promburom, P. et al., 2005). MAS agents are able to act autonomously in their common environment to meet their own objectives (Trébuil, G. and Le Page, C., 2006). ABM simulations can be used to deal with complex ecological and socioeconomic issues arising from the management of scarce environmental resource with multiple uses by multiple users (Trébuil, G. et al., 2002). Usually, RPGs are used collaboratively with conceptual models and ABM. The RPG and ABM are complementary tools used by researchers to verify enrich, and validate their conceptual model. They can originate from the same or different conceptual models (table 2.2).

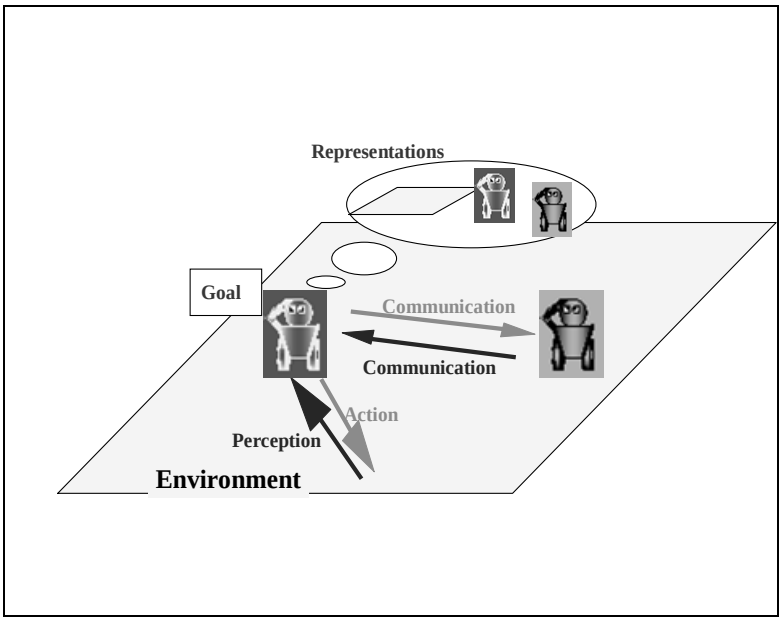


Figure 2.4 Schematic representation of MAS (Ferber, J., 1999)

Consequently, conceptual models, RPGs, and ABM tools based on the MAS-based ComMod approach have been selected for the purpose of collaborative modelling research in various case studies, particularly in Asia (table 2.3). All the case studies developed tools from real-world situations to examine key questions identified in the field. The problems being investigated were generally chosen for their relevance to users and decision-makers (Bousquet, F. and Trébuil, G., 2005).

Table 2.2 Classification of the categories of joint use of a computerized model (ABM) and a RPG based on the similarities of conceptual model and time of use (Bousquet, F. and Trébuil, G., 2005)

	Underling conceptual models are different	**Same conceptual models**
Model and game are used at the same time	The model supports the game	The game is the model
	The model is included in the game	
	The game is a communication tool between the model and reality	
Model and game are used in succession	The game helps to teach players how to use the model	The model is used to repeat the game rapidly
		The game is used to validate the model
		The model is used to support game design
		The game is used to support model design
		Co-construction of the model and game
		The model is a benchmark

For all these pioneer ComMod activities presented in the table above, no in-depth ex-post evaluations were conducted. Thus, a future challenge for the ComMod approach is measuring the diversity of ComMod effects in areas such as interests and perceptions, learning on the ecological, social system etc. with stakeholders who taking part in the ComMod process and it needs to develop monitoring and evaluation procedures adapted to such highly participatory and adaptive process (Barnaud, C., 2006; Trébuil, G., 2008).

Table 2.3 Present several ComMod case studies with various objectives in Asian case studies (adapted from Bousquet, F. and Trébuil, G., 2005)

Topic	Study site	Objectives of ComMod process
Conceptual model based on observed reality	Watershed management in northern Thailand by P. Promburom et al.	To analyze actors and processes to be taken into account for the simulation of land and water-use dynamics at the watershed level
	Agro-forestry systems in Mindanao, Philippines by D. Manadog et al.	To design different conceptual models for the study of the diffusion of agro-forestry systems
	Watershed management in northern Thailand by N. Bécu et al.	To deal with the methodological problem of eliciting and modelling stakeholders' representations
Association between ABMs and RPGs	Land-use change in northeast Thailand by N. Suphanchaimart et al.	To analyze actors and processes to be taken into account during gaming sessions before to simulate land-use change at catchment level with an ABM
	Rice seed management in lower northeast Thailand by C. Vejpas et al.	To represent the structure and dynamics of the seed system at the provincial scale: 2 different RPG were used and then merged into a single ABM
	Sharing irrigation water at rice transplanting between two villages in Bhutan by T.R. Gurung et al.	To settle an old conflict about irrigation water use between two highland communities by using an RPG, then an ABM to simulate scenarios
	Land use change in the uplands of north Vietnam by S. Boissau et al.	To collectively assess the driving forces of land use changes by alternate use of MAS and RPG
MAS models	Land degradation in a highland watershed of north Thailand by G. Trébuil et al.	To understand the interaction between soil degradation and agricultural diversification by using a complex ABM simplified in an RPG
	The coastal management of an island in the Philippines by P. Campo	To facilitate negotiation about the management of an island between stakeholders and policies by using a MAS-GIS model
	Rice, shrimps and water salinity management in the Mekong Delta, Vietnam by L. Dung et al.	To examine economic differentiation among households producing rice and shrimps depending on water salinity by using a RPG to build an ABM
	The spatial configuration of forest plantations in Indonesia by H. Purnomo and P. Guizol	Models to facilitate the co-existence between smallholders and industrial tree plantations

2.4 Monitoring and Evaluation processes

2.4.1 Generalities on M&E

2.4.1.1 Definitions

Monitoring and evaluation (M&E) are usually components of a project planned to measure the progress and impact of a given development intervention, but M&E plays a different role. Monitoring is the systematic and regular collection of information and occasional analysis of information during project implementation, while evaluation is systematically carried out during project implementation, at completion, or several years after (French, D., 1985; FAO, 1985; W.K. Kellogg Foundation, 1998; McAllister, K., and Vernooy, R., 1999; Shapiro J., 2001; Smith, D.R., 2006). Four important distinctions, specifically bounding the topic, timing, purpose and focus, need to be considered when designing an evaluation process (McKenzie, M. H. et al., 2006). Generally, there are two M&E patterns:

1) Conventional M&E processes tend to be more donors focused and linear. The donors usually have the key control of the evaluation process. The process is used to fulfil an institutional need, rather than for the project or recipients themselves. Recipients provide information, but do not participate in the process. Monitoring extension programs are heavily influenced by a planning ethos emphasising prediction and control (Dart, W., 1999).

2) Participatory monitoring and evaluation (PM&E) is the systematic recording and periodic analysis of information that has been chosen and recorded by insiders with the help of outsiders attempting to include all stakeholders in all aspects of the process (McKenzie M. Holte et al., 2006). It should be based on transparency and sharing of information (Coupal, F. P. 1995), with stakeholders central to and agents of the process. PM&E seeks to engage key project stakeholders more actively in reflecting and assessing the progress of their project and the achievement of results. However, arguments against participatory evaluations are often heard. Moreover, the evaluations have even been discouraged by some because: a) participatory evaluations can only be done with projects designed in a participatory manner; b) participation takes time and is costly; c) project participants cannot "objectively" evaluate projects, and d) evaluations require external "experts." (Coupal, F. P., 2001). The decision to use conventional or participatory monitoring and evaluation depends on the collective agreement among a project's stakeholders, and a project's objectives and goals.

Table 2.4 presents some of the differences between conventional and participatory M&E methods.

Table 2.4 Some differences between conventional and participatory monitoring and evaluation (Coupal, F.P., 2001)

Characteristics	Conventional M&E	Participatory M&E
Who initiates?	The donor	The donor and project stakeholders
Purpose	Donor accountability	Capacity building, increased ownership over results, multi stakeholder accountability
Who evaluates?	External evaluator	Project stakeholders assisted by a PM&E facilitator
TOR	Designed by donor with limited input from project	Designed by project stakeholders
Method	Survey, focus group, questionnaire, semi-structured interviewing,	Range of methods such as PLA
Outcome	Final report circulated in- house	Better understanding of local realities; stakeholders involved in decision-making around analysis and what to do with information to adjust project strategies and activities to better meet results

2.4.1.2 Principles and objectives

General objectives of M&E are: (i) to assess project results; (ii) to improve project management and process planning; (iii) to promote learning; (iv) to understand stakeholders' perspectives; and (v) to ensure accountability (McAllister, Vernooy, R., 1999). The monitoring process aims to provide a basis for decisions on subsequent stages of the research to inform judgments on performance. The evaluation process assesses how far the research has achieved its objectives, and examines any unplanned outcomes. (Farrington, J., 1997). M&E systems are designed and undertaken with a focus on: efficiency; effectiveness; impact; and relevance or appropriateness in describing the usefulness, ethics and flexibility of participation (Bhattarai, T. N. and Campbell, J. G., 1985; Dale, R., 2001; Shapiro, J., 2001).

M&E can help project stakeholders identify problems and their causes; suggest possible solutions to problems; raise questions about assumptions and strategy; stimulate the project team to reflect on where they are going and how they are getting there; provide stakeholders with information and insight; encourage action on the information and insight; and finally increase the likelihood that a positive development difference will be made (Shapiro, J. 2001).

Participatory monitoring and evaluation (PM&E) aims to build the local capacity of project stakeholders to reflect, analyse, propose solutions and take action; to learn, adjust and take action by taking corrective action to ensure the achievement of results; to provide accountability at all levels, from the community and organizational levels, to those responsible for the implementation and funding of the project; to celebrate and build on what is working (Coupal, F.P., 2001).

2.4.1.3 Diversity of M&E methodologies

M&E system is oriented towards problem-solving; many different types of projects must be flexible and dynamic (Clayton, E., 1985). Evaluators combine and apply several techniques in M&E process to gather the effects and impacts of a project or program. Interviews, key informant interviews, questionnaires, and participant observation are popularly used techniques in such a process (table 2.5)

Table 2.5 The different kinds of techniques used to collect information in M&E processes (adapted from Shapiro, J., 2001; W.K. Kellogg Foundation, 1998, Dart, J., 1999)

Method and Tool	Description	Usefulness	Disadvantages
Interviewing	Can be structured, semi-structured, and unstructured asking specific questions either open-ended or closed answers.	It provides a mean of cross-checking complementing the information collected, and provides an in-depth understanding of hard-to-measure concepts.	Requires some skill in interviewing on the part of interviewer.
Observation	This involves direct observation of events, processes, relationships and behaviours.	Useful way of confirming information, formulating questions for in interviews, and observing how project activities change.	It is difficult to observe, participate, very time consuming, and it has limited usefulness in certain situations.
Key informant interview	A series of open-ended interviews carried out with individual knowledge and experience. Interviews are qualitative, in-depth, and semi-structured, relying on an interview guide.	Key informants often have little to do with the project or organisation, and provide something of the "big picture" where people more involved cannot.	Needs a skilled interviewer with a good understanding of the topic. Care needs to be taken to ensure that something is not turned into an absolute truth.
Community meetings	This involves a gathering of a fairly large group of questions, problems, situations for input to help in measuring indicators.	It is useful for getting a broad response from many people on specific issues, giving a sense of ownership of the process.	Difficult to facilitate and requires a very experienced facilitator. Require breaking into small groups followed by plenary sessions when everyone comes together again.
Questionnaire	These are written questions that are used to get written responses which, when analysed, will enable indicators to be measured.	Saves lots of time if it can be self-completed. It gives people a feeling of anonymity, and they may say things they would not say to an interviewer.	With people who do not read and write, no time is saved. Expert help is needed in designing questionnaires and computerised analysis.
Focus group	A group of people are interviewed together by a skilled interviewer / facilitator with a carefully structured interview schedule. Questions are usually focused around a specific topic or issue.	This can be a useful way of getting opinions from 8-12 carefully selected participants with similar backgrounds.	It is quite difficult to do random sampling findings may not be generalised, and sometimes people influence one another. It should be recorded, transcribed, required special equipment.
Storytelling	It is essentially an open-ended story. The beginning of the story is usually about a problem, the middle about a solution, and the end about the outcome. This approach was developed by Rich Davies in1994. It is a qualitative approach.	Very useful for facilitating discussion within a group. It was adapted from the evolutionary approach to organization learning. It can be especially useful with non-literate groups who have a rich oral or folk-story background	A good storyteller with good two-way communication skills may be difficult to find. The Performance Story Approach appears to meet project management's need for description of a variety of farmer experiences.

2.4.2 M&E of participatory modelling processes

2.4.2.1 Literature review

The conception of an appropriate M&E methodology to be applied to participatory modelling processes, particularly the ComMod process, needs to be based on literature review to identify important elements for the design of an evaluation framework and selection of appropriate evaluation paradigms (Jones, N., 2007). Evaluation systems focusing on predicting outcomes or measuring impacts are invalid for INRM research because an ex-post evaluation process does not fit with the dynamics of complex systems. NRM research aimed at sustainability that improves the well-being of small farm holders is complex and M&E is an essential tool in coping with this complexity (Sayer and Campbell, 2001 cited in Douthwaite, B. et al., 2003). M&E in participatory modelling processes need innovative systems to view the innovation that co-evolves with the technologies actors generate and iterative experiential learning with high stakeholder participation (Rosenberg, 1982; Nelson, 1993; OECD, 1999, Rycroft and Kash, 1999 cited in Douthwaite et al., B., 2003). Process evaluation focuses on its operation and suggests how the outcome is being produced rather than on the outcome itself. Evaluation processes need clear criteria (table 2.6) selected with reference to the type of evaluation method. The choice of evaluation methods depends on the objective, the focus of the research project, the purpose, and timing of the evaluation.

Table 2.6 Evaluative criteria for participatory research (Blackstock, K.L., Kelly, G.J. and Horsey, B.L., 2006)

Criteria	Description
Accountability	Referring to whether the representative's core constituencies are satisfied, including expectations
Capacity building	Referring to developing relationships and skills to enable participants to take part in the future project or processes
Quality of information	Referring to the adequacy, quality and quantity of information provided
Capacity to influence	Referring to the participant's ability to influence the process (being heard, competencies in technical and process techniques, influence on each other)
Capacity to participate	Referring to the individual's ability to value different points of view and willingness to learn as well as their competence
Leadership	Referring to leadership and the role of the critical outsider
Context	Referring to the political, social, cultural, historical, environmental context in which the project / process occurs
Develop a shared vision and goals	Referring to the creation of an agreed and clearly defined vision, objectives, and goals for the process / project
Emergent knowledge	Referring to the influence of local knowledge on the outcome of the research
Legitimacy	Referring to whether the outcomes and process are accepted as authoritative and valid
Opportunity to influence	Referring to the participant's opportunity to influence (enough time; involved early enough; access to policy makers and leaders; organizational structure)
Quality of decision-making	Referring to establishment and maintenance of agreed standards of decision-making
Recognized impacts	Referring to whether participants perceive that changes occur as a result of the participatory process
Relationship	Referring to issues of social capital through new and existing social networks developed during the process / project e.g. trust, reciprocity and collaboration
Representation	Referring to the spread of representation from affected interests; including how legitimate the representations seen to be; the diversity of views not just representatives'
Social justice	Referring to the distributive dimension of the costs and benefits associated with the outcomes
Social learning	Referring to the way that collaboration has changed individual values and behaviour, in turn influencing collective culture and norms

A comprehensive literature review of community-based and collaborative resource management highlighted the important aspects that need to be explored within the framework; the importance of selecting the appropriate criteria; appropriate data collection techniques; and sharing evaluation results with the participants and sponsors (Blackstock, K.L., 2006). The complexity of participatory modelling processes require the design of evaluation frameworks being able to better understand: (i) the capacity of participatory modelling to achieve a collective decision and integrate local actors in a collective decision making process; (ii) the influence of the researchers upon the outcomes of the participatory process; (iii) the level of integration and inclusiveness of the approach; and (iv) the capacity of local actors to engage with the design and implementation of the approach (Jones, N. A. et al., 2008).

2.4.2.2 M&E methodology proposed by the ADD ComMod project

ComMod is an innovative type of collaborative modelling process. No suitable M&E methodology exists yet to assess the different effects and impacts of such highly interactive ComMod processes. An innovative system proposes needed to gather data from a variety of stakeholders to capture the diversity of objectives, criteria, and outcomes (Bellamy et al., 2001; Martin, 2001; Douthwaite, B. et al., 2003; Rowe et al., 2004 cited in Blackstock, K.L. et al., 2006). The ComMod evaluation must be informed by the voice of the participants themselves thanks to the use of various sources of information. The “Agriculture et Development Durable” (Agriculture and Sustainable Development in French) ComMod project (ADD ComMod) team aimed at testing such an M&E system for ComMod processes. They were primarily interested in learning what consequences arose depending on how the different stages of the approach would be implemented, and how to improve the implementation of this approach to increase its desirable effects on the participants. They were also interested to analyze on-going evaluations and the impact ComMod outcomes. The proposed investigation process was broken down into four themes (Jones, N., 2007):

1) The influence of ComMod process on sustainable resource management;
2) Exploration of the most influential aspects of the process itself;
3) Alignment of the process with the ComMod approach;

4) Improvement of the methodology used.

Through the analysis of more than 30 case studies globally, ADD ComMod project team was interested to assess: (i) the capacity of ComMod to achieve the objective of collective decision making; (ii) the influence of such collective decision making upon a sustainable development process; (iii) the influence of researchers upon the outcomes of the ComMod process; (iv) the capacity of ComMod to better integrate local actors in a collective decision process; (v) the capacity of local actors to engage in the design and implementation of the approach; and (vi) the integration of the approach into the existing social and institutional networks (Jones, N., 2007). To cover the ADD ComMod project team wide range of interests, several components of the evaluation system were designed to be used as the main procedures to gather information on ComMod effects namely the Designer Questions (DQ); the logbook; and the Participants Evaluation Frame (PEF) (see the forms for these documents in appendices).

(1) DQ is a template to be filled out by the ComMod process designer at the studied site or another member of the ComMod project team, and to be filled in and reviewed by the evaluator. DQ consists of four main topics and four tables to be completed as follows: Initial Context Table; Method Table; Artefact Table, and Contextual Change Table.

(2) The logbook contains all the information in chronological order about the implementation of the process and is to be filled by the project team at the study site. It consists of ten sections: date of activity; time duration; organizers; participants; moderator or leader; language; type of activity; objective; location; supporting tools or equipment; and outcomes or outputs.

(3) PEF are guidelines which mirrors questions from the DQ, used to gain an understanding of the participants' experiences of the project, to test the methodologies of the M&E process, and to assess the different effects of the ComMod process. The corresponding guide for interviewing participants stipulates what information needs to be collected from them. Of particular interest to the ComMod evaluation project are: (i) changes in the perception of the issue being examined; (ii) learning individually and collectively; (iii) relationships among stakeholders and with non-participants; and (iv) change in behaviour, practices or action taken.

An early M&E process based the tools designed by the ADD ComMod project was carried out by Jones, N. A. et al. (2008) on an Australian case study. They set up a framework entitled the 'Protocol of Canberra' to assess the extent of effects and impact created by different participatory modelling practices with people. This framework was also taken into account to evaluate the ComMod process at the Lam Dome Yai watershed study site. DQ, Logbook, and PEF tools were completed by the research team and used as key sources of information on the ComMod process carried out at this site. The specific M&E framework and related methodology used at the Lam Dome Yai watershed study site is discussed in the next chapter.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Overview of the methodological framework

The proposed research methodology was designed by several researchers belonging to the ComMod international network, and tested at 30 different sites for either on-going or already completed case studies. This led to interesting comparisons of ComMod's effects according to local contexts and kinds of resource management problems. Participatory monitoring and evaluation (PM&E) in the Lam Dome Yai case study was an on-going process, accompanying the implementation of the ComMod activities held in Ban Mak Mai village, Klang sub-district, Det Udom district, Ubon Ratchathani province during the period 2006 to 2008. This research was carried out closely with the main designer of this ComMod case, Warong Naivinit, in the preparation and implementation of the field activities. The conceptual framework of the PM&E process used at the study site is presented in figure 3.1.

The M&E framework seeks to assess how ComMod approach actually plays out, what circumstance does participatory modelling facilitate collective communication, what series of project for whom, in what situation, when implemented and how, what the outcomes are. This framework is also structured around indentifying a projects' context: objective to be achieved, tools used, and underlying theoretical thread tying it all together (Jones, N. A. et al., 2008). The ComMod is often carried out in an iterative and flexible process; the M&E framework should capture reflexive dimensions. This framework helps to clarify the main principles of the PM&E process used in this research and facilitates the understanding of how the monitoring and evaluation activities were conducted and according to what priorities; the sources of information and methods to be used.

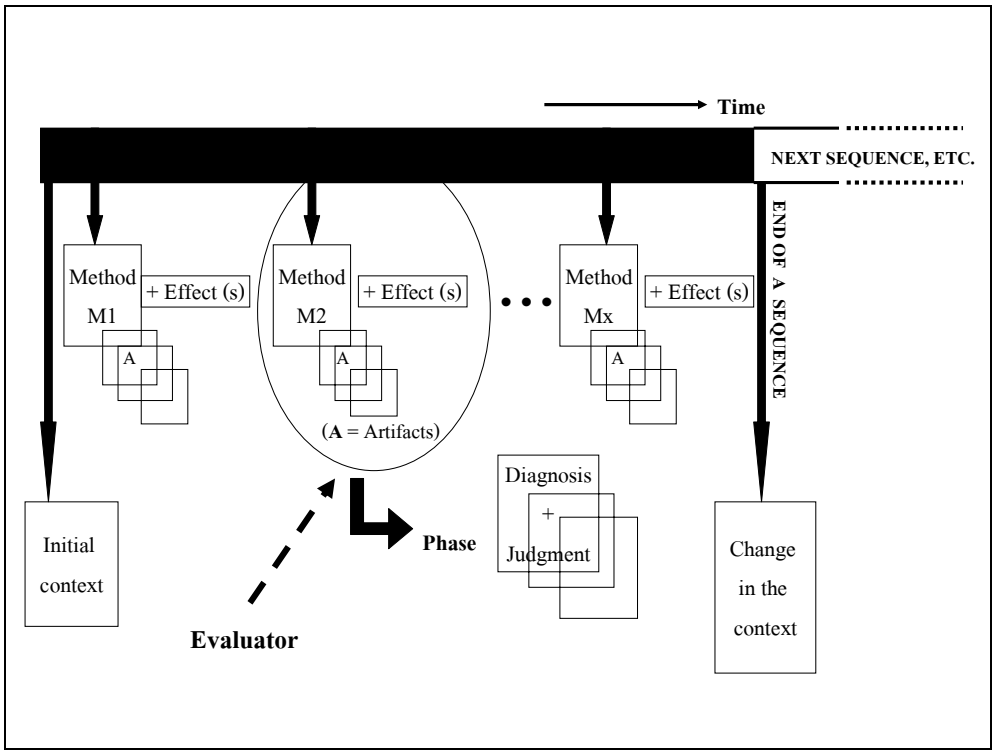


Figure 3.1 The conceptual framework of the ADD ComMod project participatory M&E Process used at the study site, 2006 to 2008

3.2 Selection of respondents in the PM&E process

A variety of different people participated in the ComMod activities. Purposive sampling technique was used to select them. A representative sample of local farmers, TAO, government agency and the main research team were the main respondents in the information gathering process. Each M&E activity was carried out with different respondents, representing all groups of participants (figure 3.2).

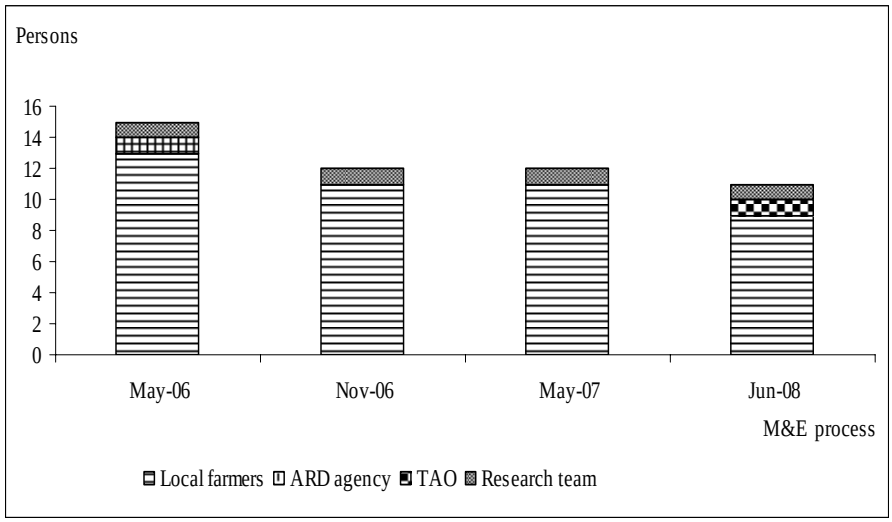


Figure 3.2 Type of respondents who participated in the PM&E activities at the Lam Dome Yai study site

The main respondents were the local farmers dividing into three farm types: farm type A, farm type B, and farm type C. Farm type A referred to local farmers who have small size paddies, off-farm employment is a source of income. 70% of farmers belong to this farming system. Farm type B referred to farmer who have small to medium sized farm, practiced integrated farming system for home consumption. Farm type C referred to local farmers who have large size farm. The migrant do not returned to help in farm activities (see more detail in chapter 4). The main respondents were representative of the three main farm types: eight households represented farm type A; two households represented farm type B; and one household, farm type C. The selection of local respondent is depends on ComMod participants. The other respondents were one officer of Agricultural Research & Development Region IV, Ubon Ratchathani (ARD) and TAO representative respectively, and the research team.

To compare the various effects of the local farmers who took part in the ComMod field workshops, repeating the same set of M&E activities were carried out after each field workshop. In the first set of M&E activities (on: 25 to 27 May, 2006), data were gathered by using interviewing and story telling tools. Interviewing was carried out with seven local farmers from farm type A, one from farm type B, the ARD representative, and the main research team. The story telling tool was used with three

local farmers and a returned migrant from a type A farm, and one local farmer from farm types B and C respectively. The second set of M&E activities (on: 27 to 30 November; 1 to 2 December, 2006) was undertaken by interviewing eight local farmers and returned migrants from farm type A, two from farm type B, one from farm type C, and the research team. Four local farmers from farm type A, two from farm type B, one from farm type C and the research team were interviewed in the third set of M&E activities (on: 10 to 12 May, 2007) . In the final set (on: 18 to 21 June, 2008), four farmers from farm type A, two farmers from farm type B, one from farm type C, and one main researcher were interviewed. Two farmers from farm type A and the TAO representative provided data through the use of the storytelling tool.

At the very beginning of the research, evaluator participated in some of the agricultural activities performed by the local farmers, using this time to discuss various topics and issues related to their lives; this was done in order to develop a better relationship with the interviewees. Such a process has been found to help create a good atmosphere during the observation, interviewing, and storytelling processes (Becu, N. et al., 2005).

3.3 Data gathering tools

Both primary and secondary data on the ComMod effects at the study site were gathered.

3.3.1 Secondary data

In the early stage of the assessment process, a close reading of the details of the various ComMod activities, the desired outcomes of each filed workshop, and the diverse range of participatory approaches in agricultural development literature was undertaken to identify who the main respondents were and to understand the ComMod process of which evaluator had to assess. Several ComMod activity documents, which presented a number of related issues and study sites for the various ComMod activities, were then studied: (i) conclusion of the RPG field workshop, 9-10 July, 2005; (ii) conclusion of the participatory modelling field workshop: land, water, and labour management in Lam Dome Yai watershed, 20-21 April 2006; (iii) conclusion of

participatory gaming simulations: relationship between stakeholders' water perception, rice-growing practices, and labour management across farm types,10-11 October 2006; (iv) conclusion of participatory simulations field workshop: stakeholders' collective discussion to validate the Multi-Agent System model regarding land/water use and labour management across farm types, 24 April 2007; (v) participatory simulation workshop: BanMakMai Agent-Based Model validation and scenario exploration,13-14 May 2008.

The ComMod documents provided a rich source of background information, and conceptual overview of the project (Jones, N.A. et al., 2008). It helped the evaluator to understand the history, philosophy, goals and outcomes of a particular project, providing clues about important shifts in program development. It was also a stimulus in the formulation of questions for use in both the observations and interviews (W.K. Kellogg Foundation, 1998). Participatory modelling approaches for integrated resource management articles were also studied to understand the participatory modelling definitions, main principles, objectives, characteristics and participatory modelling intervention in integrated natural resource management. Companion modelling publications particularly using of the RPG and ABM tools were studies to understand the characteristics, objectives, their rules and results in each ComMod case study. Publications in Monitoring and Evaluation (M&E) processes were studied to better understand definitions, principles, objectives, and the diversity of M&E methodologies. All secondary data sources provided useful points of comparison for the implementation of the ComMod PM&E activities at the study site, a broad overview of the project, and a foundation for the formulation and planning of the PM&E system used at this study site.

3.3.2 Primary data

Selecting appropriate tools for gathering primary data on the ComMod activities' effects was an important initial step. The PM&E process, a participatory research method, was selected because the ComMod activities promote an approach that involves stakeholders at different levels, including women and men of different ages, backgrounds and perceptions. Data were gathered by integrating qualitative research methods, which was considered the best way to avoid a lack of data for analytical purposes. Thus, observation, story telling and interviews were the main research

techniques used. All data gathered were translated into both Thai and English. Figure 3.3 presents a diagrammatic overview of the primary data gathering process throughout the implementation of the various ComMod activities at study site.

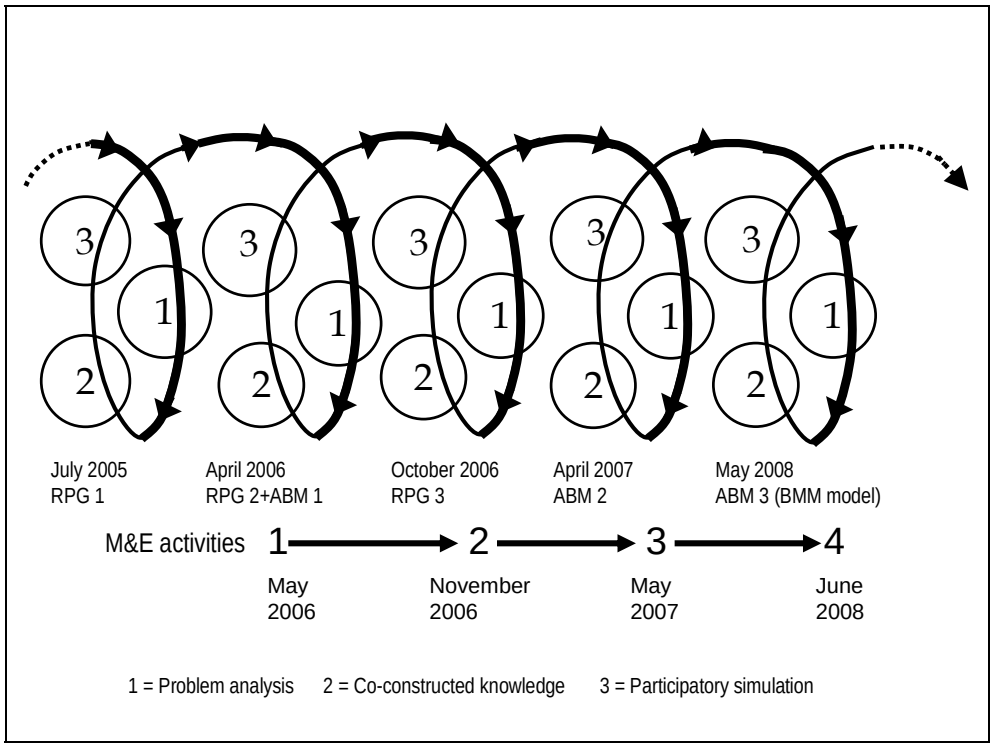


Figure 3.3 The on-going data gathering process throughout the implementation of the ComMod activities at the Lam Dome Yai watershed study site, 2006 to 2008 (adapted from Warong Naivinit, 2008)

3.3.2.1 Participatory observation

This tool was used to provide complementary information to the more in-depth discussions. Participatory observation is considered to be a more direct data gathering tool that enabled this researcher to observe and visualize particular participants' actions and behaviour when the ComMod activities were carried out. Observation is a basic research technique; it is most useful when conducting context and implementation evaluation because it may indicate strengths and weaknesses in the operation of a project and may provide researchers with opportunities to offer suggestions for a project's improvement (W.K. Kellogg Foundation, 1998).

During the implementation of the observation process, information can be reviewed and new questions created to use in the designing of individual interview guidelines. The eyes and the ears are basic equipment for the recording of activities (Sin Panpinit, 2006). Unstructured observation technique was used because it has been shown to be an effective research tool for researchers who have taken part in the early stages of evaluation (Parichart Valaisatian, 2002). It is an exploratory research technique that may suggest alternative research directions and approaches. In addition, unstructured observation protects against unwanted influences and other external problems during the data collection process. Observers are also able to come face to face with the raw data, which is a key strength of unstructured observation. Participatory observation was used in the 20 to 21 April 2006 field workshop to get a general overview of the ComMod activities, the participants' actions and behaviours, and to investigate the participants' answers to the lecturers' questions. The main purposes of these first observations were:

1) To observe the participants' actions during the implementation of the ComMod activities;

2) To find representative ComMod participants who could be storytellers.

Due to the fact that the ComMod field workshops were implemented five times in four years, a complete and detailed observation of everything was not possible. Therefore, it was decided that the observational research would be concentrated on the most important aspects of the ComMod activities, and on what could not be learned from other data sources. However, observation could not provide in-depth information; interviews were the second tool used to gather data.

3.3.2.2 Individual interview

Individual interviews with the ComMod participants were used regularly after each key field workshop of the ComMod process. The design of semi-structured interviews was the first step. The interview guidelines were designed based on each of the successive ComMod workshops specific objectives and the results of the observations (see example of such guidelines in appendix). The individual interview

process was conducted one month after the field workshop. Barnaud, C. et al. (cite Cécile's work in Mae Salaep here) have shown that this is the best time to interview workshop participants about their experience because exchanges among villagers continue to occur for several weeks after the field workshop. Before the actual interviews commenced, a brief description of the details of the previously implemented ComMod activities was given in order to refresh the interviewee's memories and to stimulate their interest. The main topics that formed the basis of the individual interview guidelines were: (i) learning effects, (ii) specific effects of ComMod tools, (iii) capacity building effects, (iv) collective engagement effects, (v) networking effects, and (vi) practice or action effects.

At times during the interviews, questions of an impromptu nature were asked if the interviewee responded with interesting answers, or if the answers were unclear. The unscripted questions helped form a better understanding of the interviewees' perceptions and ideas. All individual interviews were audio recorded and extensive notes were taken to ensure against any loss of interview data. Following the actual interviews, a re-reading of the notes to complete missing parts was undertaken. In addition, parts of the interview conversations were rewritten in the way that the interviewee had expressed those parts (Becu, N. et al 2005). The tape recordings of the interviews were then referred to for the purposes of transcription and exact quotes (W.K. Kellogg Foundation, 1998). Interview sessions presented in following.

1) Interview duration: the interviews were usually 1-2 hour long between 09:00 am and 02:00 pm. The whole set of individual interviews took three to four days to complete. However, the second workshop interviews were an exception because the workshop was implemented in the early stages of the rice transplanting season. Thus, the interviewing process only took place in the morning (7 am - 9 am) because the interviewees had to work in the field. Consequently, six days were needed to complete the interview process.

2) Language: interviews were conducted in the Thai E-san language and then translated to standard Thai and English.

3) The interviewees: the first time the interviews were conducted, no specific selection of interviewees was made. It was assumed that such a selection process would cause the prospective interviewees to lose courage and worry about the interview. For the other rounds of interviews, it was made clear that household representatives who were participating actively in the ComMod sessions were needed for interviews.

3.3.2.3 Storytelling

Story telling was used to overcome several of the difficulties associated with monitoring the ComMod effects, and to locate what specific aspects of the ComMod activities impressed participants and/or remained in their minds. The approach had no strict guidelines, with one to three main questions used to focus discussion. In addition, storytellers were encouraged to be as open and frank as possible. Storytelling was undertaken one month after the initial ComMod activities to overcome several of the difficulties associated with other methods. It was also carried out after the second and last ComMod field workshops.

1) After the second ComMod workshop, five storytellers narrated their ComMod experiences. The five storytellers were selected based on the results of observation and data from the semi-structured interviews. Storytellers from four categories were selected, as presented in table 3.1. The details of the workshop were used to refresh the interviewees' (storytellers') memories. Each of the storytellers was recorded individually. Three days were used to conduct the storytelling recordings in places such as huts or in their houses.

Table 3.1 The selection criteria for the storytellers after the ComMod workshops

Categories	The number of player representatives	
	The first time	**The second time**
Participants in ComMod workshops	4 out of 15	2 out of 5
Returned migrants	1 out of 1	-
Participants who seemed to understand ComMod well	1 out of 5	1 out of 3
Observer & TAO representative		1 out of 1

2) After the final ComMod workshop was held on the 13th and 14th of May, 2008, the storytelling research tool was used a second time with four storytellers: three local farmers and the TAO representative.

3.4 Data analysis

Based on data gathering process, and the key monitoring and evaluation indicators, the effects of the ComMod activities were assessed based on the qualitative process. The analysing process was based on the following three main objectives:

3.4.1 A detailed analysis of the different kinds of effects and impact of ComMod on local stakeholders and farm resource dynamics at the study site;

A discussion on the monitoring and evaluation methodology used in this research: observation, story telling and interviews;

3.4.2 A series of propositions to improve the use of the ComMod approach, its methodology, and tools in the local context, especially to promote integrated farming.

The data analysis stages consisted of transcription, translation, presentation, formatting, coding, and interpretation. Analysis was undertaken after each stage of the M&E process was completed.

3.4.1 Transcription

Transcriptions were processed to condense and summarize all the data and details gathered. After each stage of the M&E process was completed, a re-reading of

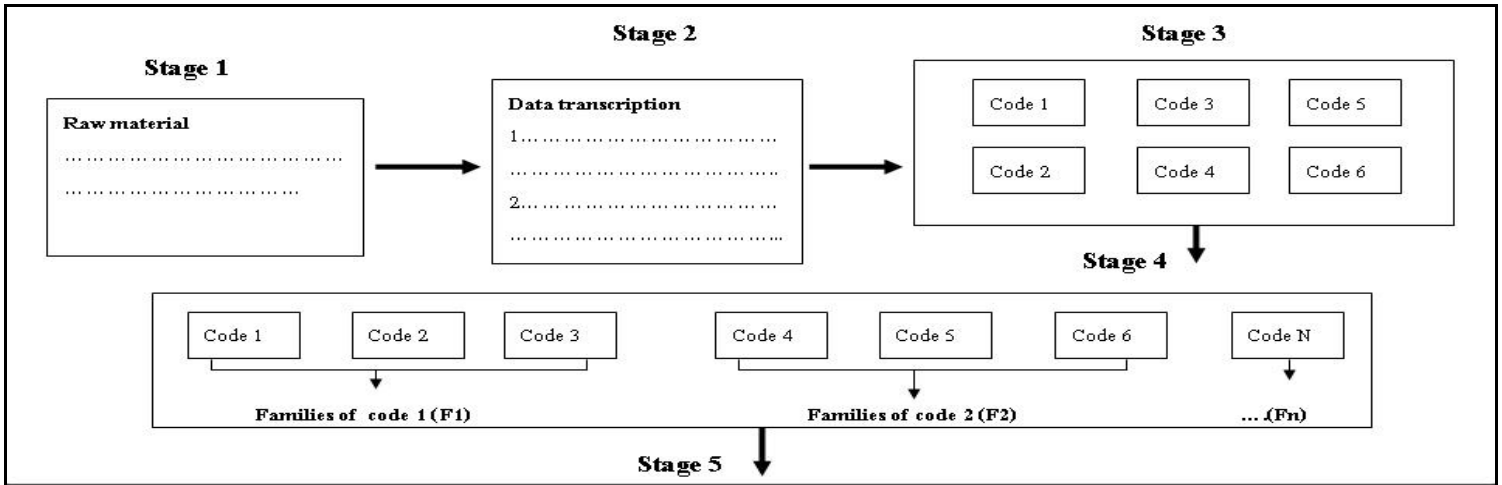
the raw data gathered was undertaken immediately as a first step in the analysis. Some information was deleted because it was not useful. Subsequently, the condensed versions of the transcriptions were written in standard Thai. Translation into English was undertaken as the last stage of the transcription process.

3.4.2 Data presentation

This process involved the presentation of the data, in different formats, gathered from the individual interviews and storytelling. The core aims of the data presentation were to make it easily comprehensible and interesting. The data gathered from the individual interview process was presented through the use of an extensive coding system, while the storytelling was also presented by using a coding system, and narration (see sample story in appendix).

3.4.3 Data coding

Data coding means the arranging and transformation of our data gathered from individual interview and storytelling tool into coded information arranged in categories. The interviewees' transcriptions were re-read, assigned codes, and ideas grouped into various categories. After that, the creation of families of codes was undertaken to split each players' transcript into various themes for each of the ComMod participants, and ComMod field workshops, including: learning effects, specific effects of RPG and ABM tools, capacity building and new practices or action taken (see sample coding in figure 3.4 and appendix E).



Topics	Families of codes	Related codes
1. Learning about issue examined	F1. The RPG's questions increased knowledge	Code1. The simple question guided players to get ideas what they should do if they cannot hire labour and what it will happen in the future Code 2. The questions of the game enable me to learn and get more knowledge about agriculture
	F2. Gained new knowledge	Code 3. The best knowledge that I gained about plant and vegetable cultivations Code 4. I learnt that I have to work for a living, if I do not work, I will not have anything to eat
2. Learning about other players' situation and opinions	F3. Understood other players situations	Code 5. I learnt about labour migration: who has gone to work in the city in dry season and who came home on rice transplanting season Code 6. The computer shown the final decision of each player about how to plant the rice and how to solve the problems of hiring labour

Figure 3.4 Stages of each data analysis by using data coding technique (5 stages round per 1 households and 1ComMod field workshop)

Table 3.2 Coding sample after 2nd ComMod field workshop held on 20-21 April, 2006

Topic	Code and families of codes	Related codes
1 Learning about the issue being examined	F 1 RPG's questions increased knowledge	1.The simple question guided players to get ideas what they should do if they cannot hire labour and what it will happen in the future 2. The questions of the game enable me to learn and get more knowledge about agriculture 3. I gain new ideas from the players' answers the game's question
	F 2 The game would be useful in the future	1. The player could learn new ideas and teach them to transfer to next generation 2. The game provided more creative knowledge and it will be more useful in the future
2 Learning about other peoples' situation and opinions	F 3 I understood other players situations	1. I learnt about labour migration e.g. who has gone to work in the city in dry season and who came home on rice transplanting season 2. The computer shown the final decision of each player about how to plant the rice and how to solve the problems of hiring labour
	F 4 RPG helped to discuss together	1. I leant and got knowledge from discussion the other players and the lecturer 2. I could share and exchange knowledge from each other 3. I discussed on planning in farm activities and in their children e.g. where and what they did, when they returned home, how to manage the labour, and when they hired labour 4. Participation in the game was like the family discussion

After each ComMod filed workshop, evaluator gathered data and analyzed effects immediately household by household in each farm type.

3.4.4 Data synthesis and interpretation

The last stage of the data analysis was data synthesis and interpretation of the findings in the context of ComMod approach. A longitudinal analysis, used to monitor the evolution of ComMod effects over time for each farmer of each farm type, was performed by using data from each workshop that took place in April and October 2006, April 2007, and May 2008 respectively. The M&E results were interpreted as follows:

3.4.4.1 Comparisons of the ComMod effects between households belonging to the same type;

3.4.4.2 Comparisons of the ComMod effects between farm types; and finally;

3.4.4.3 Comparison of the ComMod effects on the TAO officer and government agency.

Participatory observation, individual interview, and story telling are used to gather the effects of the ComMod process with local farmers at Ban Mak Mai village. To better understand such study site, the context and agricultural system are discussed in the next chapter.

CHAPTER 4

INTEGRATED FARMING IN BAN MAK MAI VILLAGE OF KLANG SUB-DISTRICT, DET UDOM DISTRICT, UBON RATCHATHANI PROVINCE

4.1 Overview of study site

Ubon Ratchathani province is located in the lower northeast region of Thailand. The area is about 1,611,040 ha. There are 25 districts, 214 Tambon Administrative Offices, 219 sub-districts, 2,699 villages, and 1.78 million people (figure 4.1).

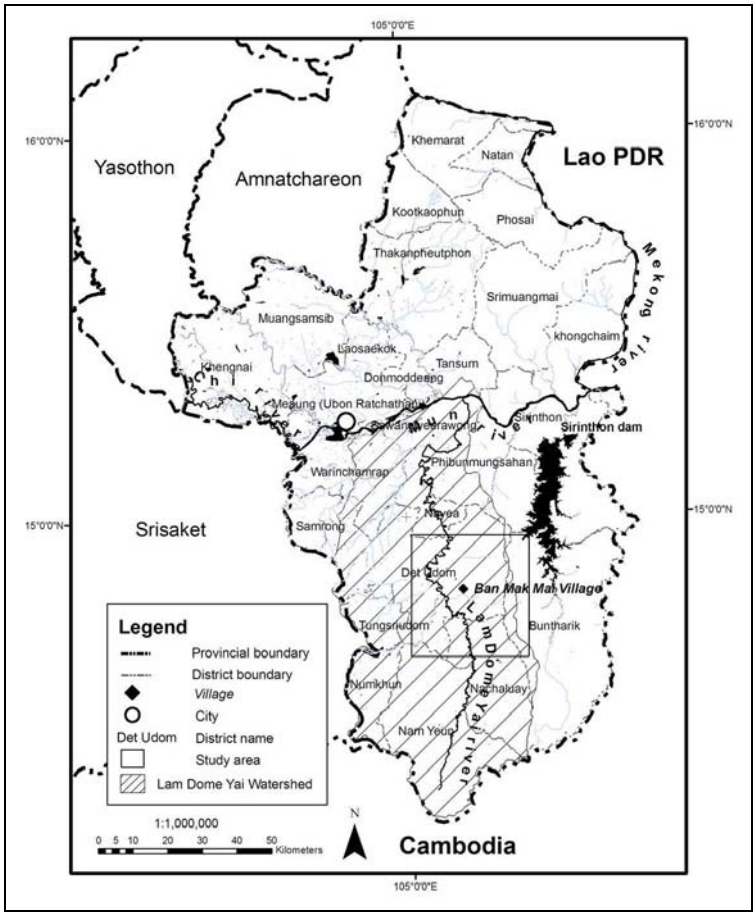


Figure 4.1 Location of the study site in Ubon Ratchatani province

Klang is a sub-district in the Det Udom district of Ubon Ratchathani province. Located in Ubon Ratchatani's southeast, Klang is 10 km (6.21 miles) from Det Udom's district centre and 52 km (32.21 miles) from Ubon Ratchathani city. Klang is located in the central part of the Lam Dome Yai watershed and consists of 18 villages (table 4.1).

Table 4.1 Recent population and hamlets in Klang sub-district in 2006 (TAO Klang, 2006)

Village No.	Name of village	Population			Total
		Families	Males	Females	
1	Ban Klang	263	532	556	1,088
2	Ban Bok	134	309	323	632
3	**Ban Mak Mai**	220	554	511	1,065
4	Ban Mek Yai	183	452	465	917
5	Ban Non Sa Wun	243	571	574	1,145
6	Ban Lub Lao	172	638	384	1,022
7	Ban Mek Noi	167	326	327	653
8	Ban Non Suksan	194	473	478	951
9	Ban Bua Taim	212	437	454	891
10	Ban Non Yai	130	308	278	586
11	Ban Kum Sumran	79	203	171	374
12	Ban Non Kumklang	116	272	250	522
13	**Ban Mak Mai**	124	346	286	632
14	Ban Bok	174	463	454	917
15	Ban Klang	201	464	450	914
16	Ban Mek Noi	200	498	516	1,014
17	**Ban Mak Mai**	140	391	347	738
18	Ban Mek Yai	79	220	204	424
	Total	**3,030**	**7,457**	**7,028**	**14,485**

Ban Mak Mai village is located in Klang sub-district (figure 4.2) and in the Lam Dome Yai watershed, which is a tributary of the Mun River originating in the Panom Dongruk mountain range.

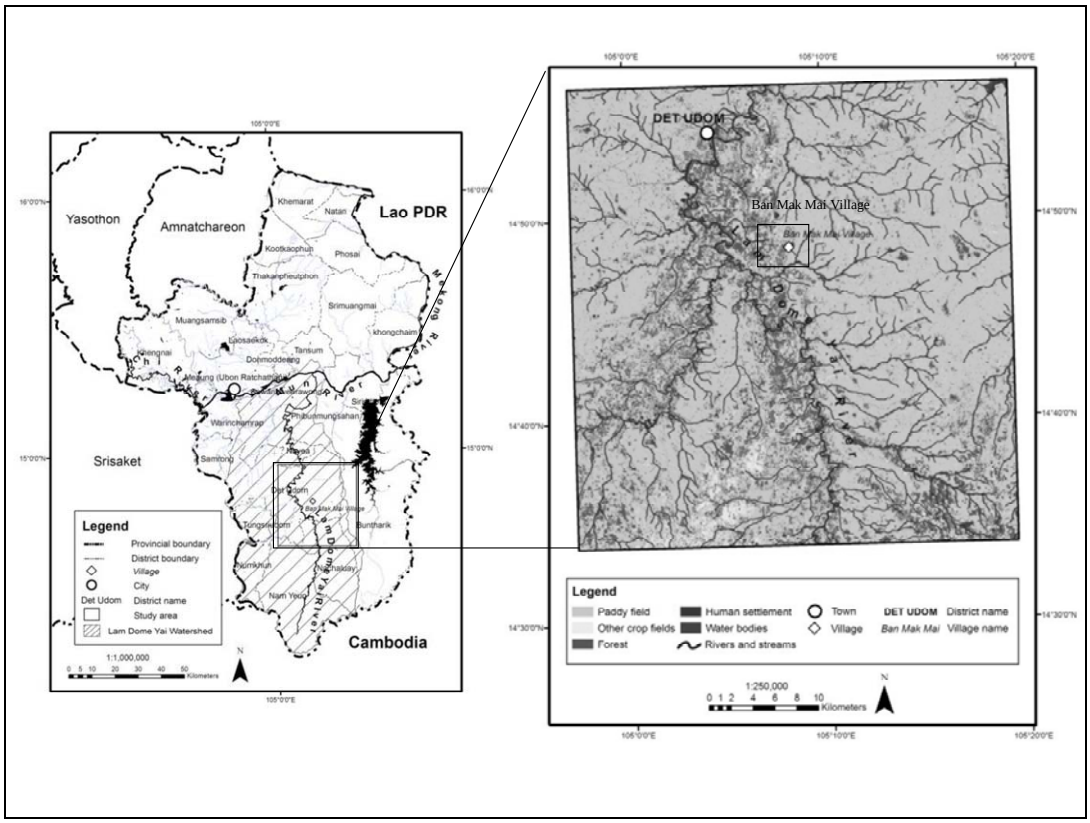


Figure 4.2 Location of the in Ban Mak Mai study site in Det Udom District (adapted from Warong Naivinit, 2008)

The first Ban Mak Mai settlers consisted of about 20 people who were forced to migrate to this area from Ban Sang Sa village, a settle is located near Ban Mak Mai, because of an epidemic that had occurred there in 1867. The village was officially established in 1927 and a temple school was founded. Ban Mak Mai now consists of three hamlets: Moo 3, 13, and 17. 90% of Ban Mak Mai land is located in the Land Reform Area (LRA). Most of land is covered by forest, which is a source of food, fuel, and medicines. Pioneer Ban Mak Mai settlers from Moo 3 hold land for agricultural production and housing and later on Ban Mak Mai Moo 13 and 17 were established (figure 4.3).

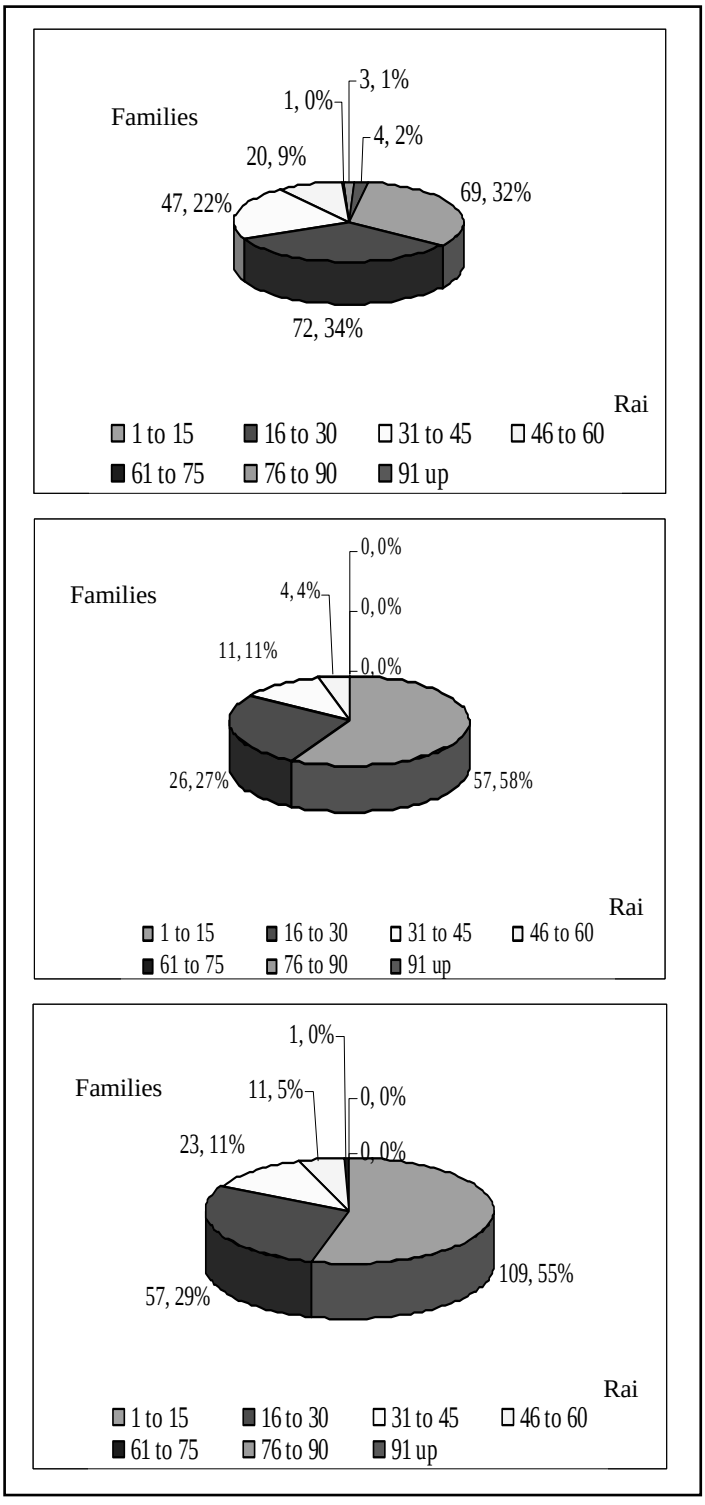


Figure 4.3 Number and percentage of landowners and their land holdings in the three hamlets of Ban Mak Mai village in 2006. Top: Moo 3; central Moo 13, and bottom: Moo17

As indicated by the pie graph, many villagers of Ban Mak Mai Moo 3 own land of about 16 – 30 rai (2.4 to 4.7 ha). In Moo 13 and Moo 17, the majority of villagers own 1 – 15 rai (0 to 2.4 ha). The majority of villagers owning smaller parcels of land can be explained by inheritance: the villagers in Moo 13 and Moo 17 inherited land, from their father or mother, for example, which was then divided up among the family members. As for the 8 large land owners of Moo 3 who own more than 61 rai (9.6 to 12 ha), most of them are the relatives of the first group of pioneer settlers who established Ban Mak Mai (Village chief of Moo 3, personal communication in 2008). Some of them are presently very rich families who they bought the land at very low cost. The families of Moo 3 have 2 – 5 blocks of small plot (including paddy field) per household, whereas Moo 13 and Moo 17 families have 1 – 2 block of small plots per household. In addition, five people (Moo 3) who own land are investors from outside the village. They bought land to establish eucalyptus and para rubber plantations. Mak Mai villagers use most of the land for small-scale agricultural production in different patterns and with differing objectives.

4.2 Agro-ecological zonation

All three hamlets in Ban Mak Mai village have soil types that are sandy with low nutrient values and low water holding capacity. RLR, eucalyptus, and cashew nut are the main crops grown (Boontiam Lersupavithnapa et al., 2008). The agro-ecological zonation is best described between upland and lowland areas. Agro-ecological zonation analysis was done under two techniques: (i) a farm survey was used to gather data on local household–based agricultural production systems in order to construct the farm typology and to understand the determining factors of labour migration among the various farm types within that typology; and (ii) an agro-ecological analysis and an analysis of the recent agricultural transformations were conducted to identify the main uses of land units, changes in land use, and causes of land use changes.

4.2.1 Uplands have soils with poor water holding capacity and a sandy texture. These former upper paddy areas are also used for para rubber, cassava, cashew nut, and eucalyptus production. In some parts of the uplands, Mak Mai villagers have conserved a community forest in an area called Don Pu Ta. The Don Pu Ta has been conserved because the villagers believe that it is the place where their ancestors' spirits dwell. Moreover, the individually-owned and community areas are also used to rear cattle and buffaloes, particularly in the RLR transplanting period. The

village can access water resources, so different kinds of vegetables, for example, sweet corn; beans; cucumber; and traditional species, are grown for home consumption in small areas and with little effort.

4.2.2 Lowlands are usually used for RLR production. They can be divided into medium and lower paddies. The late-maturing rice varieties, such as KDML 105 and RD6, are transplanted in lower paddies for sale and self-consumption. The early-maturing rice varieties, such as RD15, Do Yee, and Luang Boonma, are grown in medium to upper paddies for home consumption, sale, temple offerings, and poultry feed. In the dry season, when water resources are available and there is no significant migration, the lowland areas are used for other agricultural production such as watermelon, chilli, sweet corn, cucumber, onion, garlic, and other kinds of vegetables grown according to market demand. The main objectives of agricultural production in the dry season are the sale of the products first and household consumption second. Usually, agricultural production in dry season is harvested from February to early April. Then the land is prepared for RLR production.

4.3 Recent village history and agricultural transformations

The first pioneers of Ban Mak Mai village settled in the uplands and transplanted RLR in the lowlands. Diversified agricultural production was practiced at the family level for self-consumption through the use of organic fertilizer produced mainly from animal manure. Cattle and buffaloes were raised for the purposes of draft labour and RLR transportation. In regards to water resources, community ponds were used to rear fish and animals; however, the ponds were not able to yield benefits for crop production purposes.

Many factors have led to change in the farming systems of this village, particularly in the period of Thailand's economic development plan. Government agencies promoted and supported the sale and use of agricultural inputs such as chemical fertilizers, pesticides, and new crop varieties; they also constructed infrastructure. In Ban Mak Mai, a dirt road called Chokchai - Det Udom was constructed in 1975 to connect Ban Mak Mai village to Det Udom district, which served as a terminal point in a main transportation network delivery system that enabled the transport of agricultural products to and from Nakorn Ratchasima province (Warong Naivinit, 2007). Glutinous photosensitive RLR variety (RD6) was introduced in 1977, and the villagers

started planting new rice varieties. In 1992 government agencies promoted and subsidized integrated farming but it was not popular. Later on, 42 households started to grow para rubber; the first plantations were promoted by The Rubber Replanting Fund in 1993. This fund subsidized chemical fertilizer, ploughing and seedlings. In 1995, the government agencies also promoted cashew nut production; this, along with the para rubber plantations, caused a decrease in the village community forest area (figure 4.4).

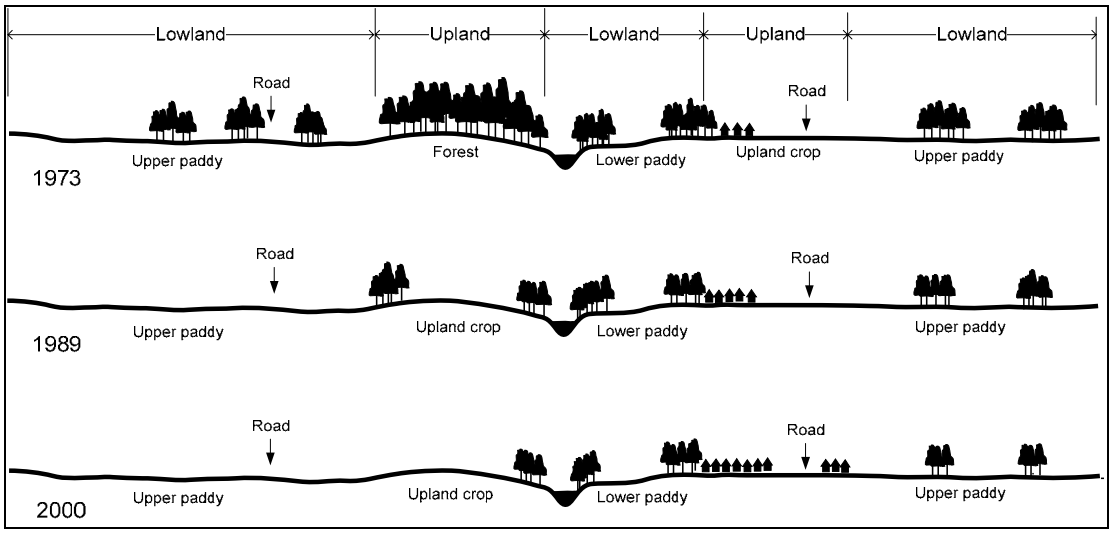


Figure 4.4 Changes in forest and farm land use of Ban Mak Mai village (Warong Naivinit, 2008)

During this period, irrigation infrastructure was built in Ubon Ratchathani province and particularly in Klang sub-district (table 4.3). The main objective of these infrastructure projects was better access to water for intensive agricultural production and increased family labour employment. Some of the villagers who had cultivated para rubber since 1993 started to receive returns on their investments and subsequently bought new cars and other consumer goods. Their visible returns stimulated other villagers to plant para rubber; they wanted to log the forest to cultivate para rubber. Another reason influencing rapid decreases in forest area was the split of Ban Mak Mai village: Moo 13 was separated from Moo 3 in 1993 and Moo 17 was split from Moo 13 in 2001.

Table 4.2 Irrigation infrastructure in Klang sub-district, Det Udom district, Ubon Ratchathani Province (adapted from Warong Naivinit, 2008)

Year	Project name	Village Name	Type	Storage capacity (million m^3)	Area (ha)
1983	Hua Bua		Concrete weir	63	10.0
1985	Hua Bua	Mek Yai	Concrete weir	63	10.0
1990	Nong Saned	Klang	Canal	125	20.0
1992	Hua Buatium	Buatium	Concrete weir	63	10.0
1995	Mek Noi	Mek Noi	Electric pump water station	1,320	211.2
1996	Hua Phai	Mek Noi	Canal	41	6.6
1998	Hua Keaw	Mak Mai Moo 3	Canal	35	5.6
1998	Hua Phai	Klang Moo 1	Canal	54	8.5
1999	Hua Phai	Klamg Moo 1	Canal	18	2.9
1999	Hua Ku Ee Sing	Klang Moo 15	Canal	38	6.0
2000	Hua Saned	Bok Moo 2	Canal	26	4.1

Because of on-going developments in Ban Mak Mai village, land use has changed, and water resources have been improved. Table 4.4 presents current water resources and land use in Ban Mak Mai village.

The land use in Ban Mak Mai village is similar to other neighbouring villages. Most of the land, 67.52 %, is used for RLR production with an average yield of 212.8 kg per rai (1.3 t h^{-1}). 70.6 % of household income is from the sale of rice and the average net income is 9,947.55 baht household and per year (Boontiam Lersupavithnapa, 2008).

Table 4.3 Current water resources and land use in three hamlets of Ban Mak Mai in 2007 (Mak Mai Village Plan, 2007)

Land use	**Moo 3** (rai, ha)	**Moo 13** (rai, ha)	**Moo 17** (rai, ha)	**Total** (rai, ha)
Transplanted rice	2,716 (441.8)	2,600 (416)	3,534 (565.4)	8,895 (1,423.2)
Field crops	420 (67.2)	na	248 (39.7)	668 (106.8)
Horticultural crops	323 (51.7)	na	690 (110.4)	1,013 (162.1)
Community forest (including temple ground)	135 (21.6)	21 (3.4)	75 (12)	231 (36.9)
Human settlement	136 (21.8)	207 (33.1)	114 (18.2)	457 (73.1)
Community ponds & natural water resources	57 (9.1)	6 (1.0)	4 (0.6)	67 (10.7)
Others	1,705 (272.8)	18 (2.9)	120 (19.2)	1,843 (294.8)
Total	5,537 (885.9)	2,852 (456.3)	4,785 (765.6)	13,174 (2,107.8)

na = not available.

As Ban Mak Mai village has undergone extensive change since its establishment, an overview of the socioeconomic and agro-ecological evolution at the village level is useful to record (table 4.5).

These important agricultural transformations led to the current extensive differences among the socio-economic status of the farming households in Ban Mak Mai. A farmer classification to be used in the ComMod modelling activities is presented in the following section.

Table 4.4 Historical profile of Ban Mak Mai showing main changes in its socio-economic and agro-ecological conditions (Adapted from Somkit Promjuy et al., 2003 and Warong Naivinit, 2008)

Socio-economic transformation	Agro-ecological transformation
• Ubon Ratchathani Train station established in 1930. • Friendship Highway built from Chok Chai district to Det Udom district • A dirt road was built to connect the village with Det Udom District and in 1981, a concrete road was constructed at Ban Mak Mai	• The Sri Vilai store and Sun Seng Rice Mill were established at Ban Klang in 1994 and 2002 to collec agricultural products for export to Nakhon Ratchasima. • Job brokers first appeared in the village to recruit labourers to work at Kanchanaburi province.
⟷	
• The government established the Bank for Agriculture and Agricultural Cooperative (BAAC) in 1966 and extended credit for individual farmers in 1968. • 1st National Economic Development Plan was used to promote and support agricultural extension based on export-orientation during 1968- 1972	• Start growing fibre crops, corn, sugar-cane, tobacco and sale rice (1970-1975). • Extensive slash and burn farming and RLR production. • Chemical fertilizers and pesticide were introduced to the village in 1972. • 3 villagers of Ban Mak Mai Moo 3 migrated to work in Saudi Arabia and Taiwan in 1983.
⟷	
• Department of Agriculture Extension introduced integrated farming Ubon Ratchathani 1984 • The Rubber Replanting Fund supported a para rubber project in 1993, and launched small water resource development projects.	• The community forest was damaged rapidly as para rubber is planted between 2000 and 2005.
⟷	
• Drought occurred in 1990	• Some households sold land and moved to the south of Thailand in 1995. • Thai economic crisis occurred in 1997, causing some migrants to return home.

4.4 Farmer typology and labour migration

Most of Mak Mai villagers' farm lands provide very low yields, leading to income uncertainty and losses of family labour force through out migration. Labour migration is a costly farming household survival strategy to alleviate poverty through the search for more profitable urban employment. It is a widespread one in many agricultural contexts and a significant component of small-holders household incomes in developing countries (Mendola, M., 2008). Villagers usually migrate to urban areas to find jobs after completion of the main RLR harvest. During booming economic times in Thailand, the number of out migrants in Ubon Ratchathani province has been high; whereas, in periods of economic crises, this number has been low as migrants loose their jobs and many are forced to return home in rural areas (figure 4.5). However, the decision to migrate is often collective and is taken among family members. For Ban Mak Mai villagers, there have been both international and domestic migrations.

4.4.1 International migration occurred for the first time in 1983, when three village members of Ban Mak Mai Moo 3 formed the first group to migrate to Saudi Arabia and Taiwan to work in the construction industry. The migrants usually work there for at least a 2 -3 years. Nowadays, the most popular destination for Mak Mai labour migrants is South Korea, where they seek employment with higher net income in industrial companies (monthly salary of 20,000-30,000 baht). Other destinations include Taiwan, where employment is found in the agro-industry and weaving, and Israel, where work is usually found on agricultural farms. Of late, Malaysia and Brunei have become popular destinations for migrants who usually work on farms (especially sugarcane plantations) or as industrial workers (Jiangkom Lekdee, 2007). All of these occupations are generally unwanted by the local population of these countries because of the inherent nature of the work: the work usually consists of ground floor positions that require manual labour, offering the workers only low social status (Koopkun Rayanakorn, 2007). At present, the number of migrants from Mak Mai is increasing every year as a new trend emerges; most of the migrants abroad are economically better-off, or have access to household credit, which positively impacts crop productivity. Moreover, income from migration can serve as a source of capital accumulation in rural households (Lucas, 1987; Rozelle et al., 1999 cited in Mendola, M., 2008). Usually, potential migrants have to pay a commission of at least 200,000 baht to companies who run job placement programs. Alternatively, potential migrants might have to pay fees of about 50,000 baht

to the Labour Department. Villagers who do not get an opportunity to work outside the country will try to find jobs domestically.

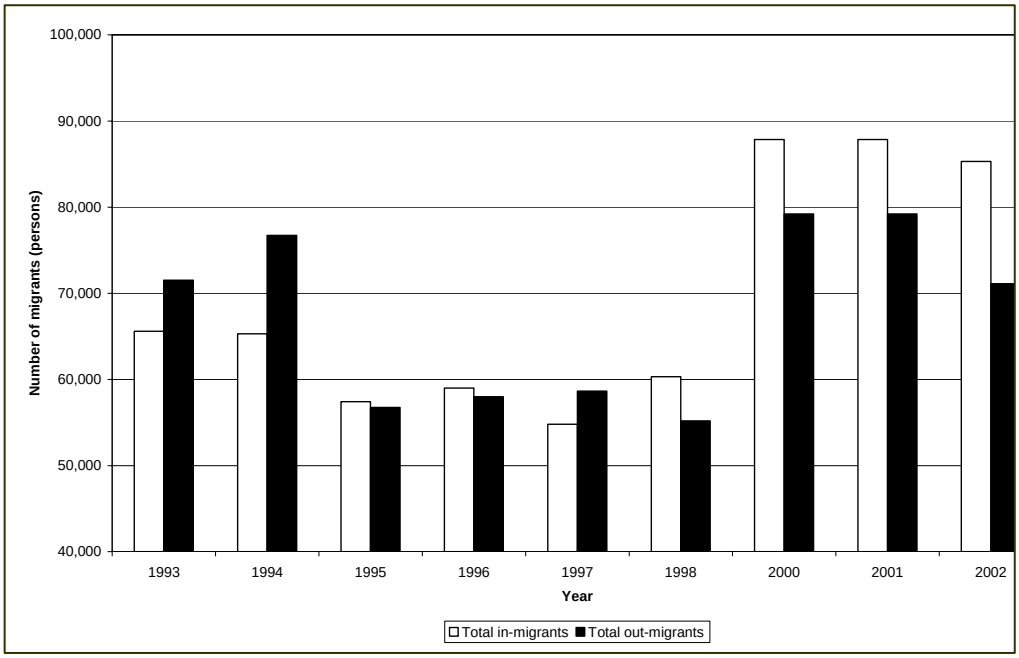


Figure 4.5 Changes in the numbers of immigrants and out-migrants in Ubon Ratchathani province, 1993-2002 (Warong Naivinit, 2004)

4.4.2 Domestic migration usually means that most of the Mak Mai villagers migrate to find jobs mainly in Bangkok, Samut Prakran and Chonburi. The most popular jobs are in the construction, weaving and retail sector, which usually means working as sales staff in big department stores. In 2006, 125 family members of Ban Mak Mai Moo 17 migrated to work in various provinces, while only 15 family members did not have migrants (Jiangkom Lekdee, 2006). The Ban Mak Mai migration situation is in agreement with Wathinee Boonchaluksee's (1997) findings, who highlighted the fact that 70% of northeast Thailand's migrants intended to migrate in the dry season. In 1995, a critical situation occurred at Ban Mak Mai as some villagers sold their paddy land and migrated to invest in tea farming in the southern region of Thailand. But they lost out their investments and could not travel back to the village where they did not own land anymore.

In summary, there are three migratory patterns in Ban Mak Mai: (i) returned migration or seasonal-migration by those who move to work or search for off-farm employment

domestically after the RLR transplanting and harvesting seasons, or when there is no local employment. They return home to help in RLR transplanting. This migration pattern is widespread on small-holdings; (ii) permanent migrants are those Mak Mai villagers who have migrated to work outside and inside the country with their families, and who rarely make visits in the village anymore. They transfer cash for the household expenses of their relatives, and generally do not return to help them with farming chores. Permanent migration is rather frequent on medium-sized and large land holdings; (iii) commuters refer to workers who are employed in off-farm jobs close to their homes. These workers go to work in the morning and return back home in the evening. They usually work in convenience stores, district department stores, or restaurants. In 2007, the minimum daily wage rate in Ubon Ratchathani province was 145 baht or about US$ 4 (Royal Thai Government, 2007).

Ban Mak Mai farmers could be classified into three main types based on differences in their respective socio-economic situations, agricultural production objectives and strategies, farming systems resources and the amounts of assets they manage.

4.4.3 Farmer typology, farm type functioning diagram was used for classifying Ban Mak Mai farmers into farm types. Three farm types were presented in following.

4.4.3.1 Farm type A

Almost 70% of local farmers belong to this type. They are farmers who have small amounts of paddies with an average of 3.2 ha. RLR is produced in upper slopes even when the soil has a low water holding capacity because the farmers simply have no choice. Late-maturing nonglutinous rice, such as KDML 105, is mainly grown for sale, while the popular RD6 glutinous rice and traditional rice varieties are grown for home consumption. The share of land use between glutinous and nonglutinous rice depends on family needs and the targeted amount of household annual income. The holding size is about 4-6 ha and the total average annual household income is 1,150 euros (or 51,347 bahts)[1]. Buffalo and cattle are sometimes reared, are a source of manure and are sold in case of emergency financial needs. Type A farmers are supply labour to other larger farms in times of shortage, which generally occur at RLR harvesting time when labour demand is particularly high. As their own rice areas are small, they can work off-farm after completing theirs own harvest. Off-farm employment from seasonal migration is

1 rate exchange 1 euro = 44.65 baht, 1 U$ = 34.54 baht

a source of income that can be used to implement farm activities. However, this farm type needs help from returned migrants during the RLR transplanting and harvesting periods because they want to complete these tasks rapidly so that they can hire their labour after. Water access issues are important, but these small farmers have refused to construct farm ponds because they do not want to loose any piece of their limited farmland (Warong Naivinit, 2004).

4.4.3.2 Farm type B

This farm type refers to farmers who have small to medium-sized farm holdings with an average size of 7.2 ha. The average annual household income is 2,100 euros (or 97,765 baht). They produce KDML 105 for sale and RD6 for home consumption. Usually, nonglutinous rice areas produce more than glutinous rice areas. Type B farmers can also practice integrated farming systems for home consumption thanks to their savings and high remittances received from migrants and they rear livestock as a main source of income. Farm ponds are a main source of water used for farm production all around the year and it allows them to start growing RLR seedlings earlier. This farm type has opportunities to manage their farm based according to land properties: lowlands are used for RLR production, while kenaf, para rubber, and cassava are grown in upland areas. Because labour shortage is a key constraint, land preparation always requires the use of farm machinery and the hiring of labour for RLR transplanting and harvesting. The migrants from this farm type do not return to help in farming but send money to their families to hire labour. Permanent migrations, both inside and outside the country, are also present among these households.

4.4.3.3 Farm type C

This type of farm is characterized by a medium to large size of the land holding with an average size of 8.6 ha. The average annual household income is relatively high at 4,900 euros (or 218,785 baht). Small tractors are usually used for land preparation, and the use of family labour in RLR production is preferred. Growing various rice varieties and making investments in farm pond construction are main farm management strategies with farm ponds constructed in the upper and lower paddies. They have also invested in artesian wells near their homes for domestic use and home gardening. These are the well-off farmers receiving complementary income from international and domestic migrants, but these migrants do not return to the village to help in farming. KDML 105 production and sales is the main source of farm

income. Therefore, most of the paddy land is planted to KDML 105 production, while smaller paddies land are used to grow glutinous rice for home consumption. This farm type is also an employer of hired labour, but only during the RLR harvesting when they seek higher returns on their rice production by securing good paddy quality and farm get price thanks to a rapid harvest. Based on this farm typology, a total of 11 households from Ban Mak Mai village representing all the farm types were invited to participate in ComMod activities throughout the 2005 to 2008 period (table 4.6).

Usually, people decision-making emerges from a complex system of interactions occurring in real life (Nancarrow and Syme, 2002 cited in Warong Naivinit, 2004). Based on the different types of Ban Mak Mai farmers summarized in this typology, it was important in this research to observe differences in the effects of ComMod activities on these various types of farmers, who have contrasting socio-economic objectives and farming strategies to achieve those objectives. It was hypothesized that the different amounts of assets managed by farm types A, B, and C (land, labour, cash, etc), under different sets of constraints, obstacles and opportunities, will affect the participants behaviour and decision making in the gaming and simulation exercises.

Table 4.6 Characteristics of the participating households in the ComMod activities in Ban Mak Mai village, 2005-2008

Households	Household size (number)	Size of holding (ha)	Farm type	Migrants
1	8	2.56	A	1 works abroad and 1 seasonal migrant
2	6	2.40	A	1 permanent migrant and 1 commuter
3	5	3.20	A	1 seasonal migrant
4	8	4.32	A	1 seasonal migrant
5	3	2.40	A	1 seasonal migrant
6	4	3.20	A	No migrants
7	11	4.16	A	2 members work abroad
8	5	3.20	A	1 seasonal migrant
9	6	7.0	B	No migrant
10	5	7.04	B	No migrant
11	7	8.80	C	2 members work abroad

The implementation of, the ComMod activities with these 11 local households at Ban Mak Mai village and their results are presented in the next chapter.

CHAPTER 5

ANAYSIS OF THE COMPANION MODELLING PROCESS IMPLEMENTED IN THE LAM DOM YAI WATERSHED

5.1 Overview of the whole ComMod process

According to Nile Röling (1996), "based on their intentions and experience, people construct reality creatively with their language, labour, and technology. Different groups do this in different ways, even if they live in the same environment. The same people change their reality during the course of time in order to adjust to changing circumstances". Thus, natural resource management initiatives are increasingly turning towards participatory modelling procedures to effectively integrate local and scientific sources of knowledge (Jones, N.A. et al., 2008). The origins of the ComMod approach at this study site were a result of researchers' "poor understanding of interactions between land / water use and labour migration that could lead to the failure of state-funded development of water infrastructures" in the Lam Dome Yai Watershed, Ubon Ratchathani, according to Warong Naivinit, a PhD candidate at both Paris X and Chulalongkorn Universities. At this study site, the ComMod approach was used as a platform for knowledge sharing, collective learning, and for improving the adaptive capacity of stakeholders. Moreover, the ComMod approach was used in an attempt to improve the understanding of the interactions between land/water use and labour migrations, so that the results of this research could then guide the design and adaptation of local water resource development projects in the future. RPG and ABM were the main participatory modelling tools used with the various stakeholders. This lengthy ComMod process from July 2005 to May 2008 was divided into four sequences. The details and results of those sequences are presented below.

5.2 Sequence one

5.2.1 Objectives

The first sequence of ComMod activities was implemented after the initial agricultural system (AS) diagnosis and characterization of the different types of farms or agricultural production systems (APS). The core objective of this sequence was to better understand land, water and labour management on the local farms, and their relationships in the RLR ecosystem, by involving all the existing main farm types in Ban Mak Mai.

5.2.2 Method and tools

5.2.2.1 A conceptual model constructed using different Unified Modelling Language (UML) diagrams was used for the sharing of knowledge and communication of ideas between the modeller and other specialists, including villagers. Moreover, these UML diagrams were an important base for model implementation as they represented the structure and relationships of the components in the system related to the study issues. They were also used as a blueprint to design the first RPG. Only three researchers participated in this method.

5.2.2.2 The first RPG was designed in early 2005 and used with farmers on 9-10 July, 2005 to validate the research team's understanding of the interactions between land and water use, and labour management across the different farm types in the typology. The research team used new data related to local farmers' decision-making processes to enrich the initial conceptual model. The theoretical assumption was that with more transparent structures and rules available to stakeholders, the RPG would be a method to acquire knowledge, validate the future ABM model, and to facilitate collective learning among stakeholders, resulting in a better systematic understanding.

5.2.2.3 Follow-up individual interviews were undertaken on the second day to clarify the participants' ideas, actions, and decision-making processes during the gaming sessions. Comparisons to real circumstances were explored with the interviewees. In addition, the interviews sought to identify concrete water, land and labour management strategies on the farm. The findings of follow-up individual interviews were used to enrich the initial conceptual model and to prepare the improved second RPG. The players were divided into two groups. Each group consisted of six players and one researcher. One research assistant interviewed a member of each household.

5.2.3 Artefacts

Artefacts were used as supporting tools during the gaming sessions. They were important in helping the players better understand game features, sequences and the general gist of the RPG. The various artefacts were designed and utilized according to the different objectives of the various research methods (figure 5.1).

Guidelines were also used to interview ComMod players individually and to improve the researchers' knowledge.

5.2.4 Main results

The main results of the first ComMod sequence are described below:

5.2.4.1 The research team better understands how the diversity of farming systems plays a major role in supporting the local labour market, and how different farm types use different calendars for rice production.

5.2.4.2 During the transplanting and harvesting periods when labour demand is high, the family members of the small farm type return to help their families to produce rice, while family members of large farm type did not return; they just send remittance for RLR production. Commuter, seasonal, and repeated migrations are the existing migratory patterns found in Ban Mak Mai village.

5.2.4.3 In drought years, farmers who produce rice only (small farm type) tend to increase their migrations to work in cities, but farmers who practice more diverse farming do not.

5.2.4.4 When water is available, the areas allocated to RD6 and KDML 105 RLR varieties are no change; small farmers grow the both RD6 and KDML 105 in equal, while large famer grow KDML 105 more than RD6. In drought year, small farmers made decision on the RD 6 transplanting area increase significantly to ensure sufficient food supplied for home consumption.

5.2.4.5 However, there were many things that needed to be improved in the preparation for the next sequence, but some of the greater concerns were that no current migrants had participated in this first set of activities, and that there was a lack of communication and poor collective dynamics during the implementation of the gaming sessions.

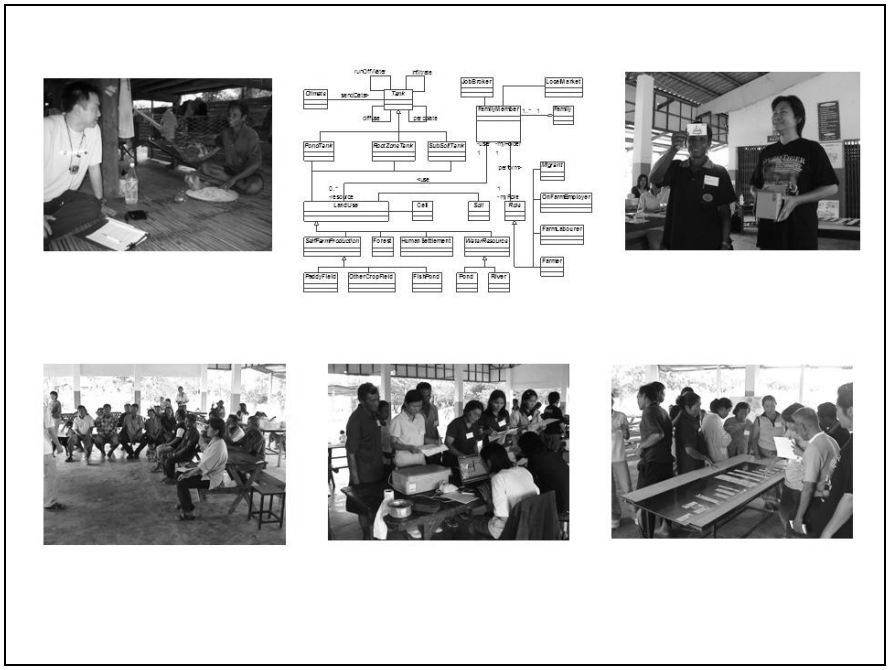


Figure 5.1 Phases and main features of the initial sequence of the ComMod process in Lam Dome Yai watershed in 2005. Top left: researcher conducting field survey; top center, UML class diagram; top right, a player drawing rainfall condition. Bottom left: plenary discussion; bottom centre, players' decision recorded on computer; bottom right, player making decision on RLR production

Box 5.1 Details of the first RPG sessions and the use of artefacts

The first RPG

Date: 9-10 July 2005

Meeting place: Ban Mak Mai School.

Participants: Seven researchers, one NGO representative, one extension worker, seven research assistants and eighteen local farmers from eleven households; eight households came in pairs (husband and wife), and three with only one member.

Objectives: To validate the research team understanding of land / water use and labour management on the different types of farms, and to train and engage villagers in the action research process. Moreover, to initiate a collective learning process on land, water and labour management.

Main issue: Focus on rice-growing steps and labour management as influenced by internal factors such as age, education, and household income and by rainfall variability, an external factor.

Gaming sessions: 1) On the first day, the team leader introduced the research project in the first session. The RPG then commenced, moving through rice-growing phases that affect the players' decision making in regards to issues of migration. The phases focussed on rice growing in nurseries, crop establishment through to the transplanting of rice, harvesting, and both post-harvesting and dry season activity. They played four rounds (four crop years per gaming session) over five hours. The players played in different roles: farmers, migrants, and hired labour. 2) On the second day, ninety minutes were spent on individual interviews and two hours were spent in a plenary discussion which was held with the participants to discuss the results of the previous day gaming session and possible next steps as proposed by the players.

Equipment and materials: Thailand map; tokens; currency role cards; dice; computer software (Excel package); flipchart; post-it notes; camera; video camera and recorder.

Artefacts: Game boards; game cards; writing pads to record players decisions.

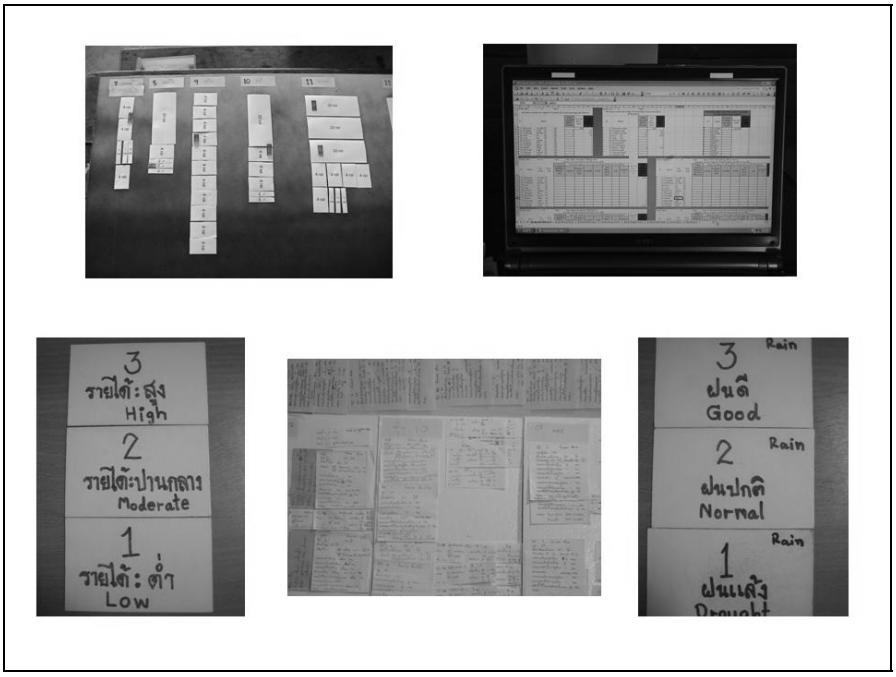


Figure 5.2 Various artefacts and their objectives used in the initial sequence of the ComMod process in Lam Dome Yai watershed in 2005. Top left: farm land board representation; top right: Excel package. Bottom left: wage chance cards; bottom centre: players' decision writing pad recorded; bottom right: rainfall card conditions.

5.3 Second sequence

The second sequence was implemented similarly to the previous one as presented in figure 5.3.

5.3.1 Objective

Four methods were implemented in the second sequence to observe and investigate changes in the players' farm and labour management decisions that were made under different rainfall conditions and irrigation canal scenarios.

5.3.2 Methods and tools

5.3.2.1 Farm surveys were carried out before (in August, 2005) the implementation of the second RPG in order to gather missing data on farmers' RLR production decisions, hiring of labourers, sources of hired labour, and farmers' purposes for hiring of labour. The underlying assumption of the research team was that the decision-making processes regarding the management of hired labour on farms of the same type (11 households) were likely to be the

same. The information findings were used to design a new conceptual model and the second RPG features and rules based on it.

5.3.2.2 The second RPG was implemented in early 2006 and used with farmers just after the Thai New Year, at the end of the dry season and when many migrants visit the village. It was designed based on the findings of the farm surveys (box 5.2). An assumption was made that the RPG could be used to enrich farmers' decision making processes on their farms both during severe drought conditions, and under improved water availability conditions. Returned migrants and new participants, as suggested by the players, were invited to participate in this second round of gaming sessions.

5.3.3.3 Follow-up individual interviews were conducted by four research assistants in a workshop session; follow up interviews were also conducted by RPG designers one month after the workshop's completion. The follow up interviews aimed at gaining a better understanding of concrete farm and labour decisions made under prolonged drought and good water availability conditions (irrigation canal scenario) simulated during the gaming session, and to compare those decisions to reality.

5.3.3.4 Computerized game simulations were used to stimulate collective learning and discussion on RLR production and labour management issues among the players. It also helped players better understand their own and others situations because the RPG attempted to represent their real life situations pertaining to land, water and labour management in particular.

5.3.3 Artefacts

Artefacts used in this second ComMod sequence were similar to those used in the first sequence and with similar objectives. The only exception was the computer game simulation introduced this time. The computer game simulation was used to stimulate collective exchanges and learning through the plenary presentation of the results of the players' rice production and labour management decisions made under the given conditions.

5.3.4 Main results

Based on the rainwater variation, and irrigation canal scenarios were simulated in the RPG. The observed adaptations of the players' decisions were as follows:

5.3.4.1 In the irrigation canal scenario, very small land holders were the more adaptive, taking advantage of better water access to grow more cash crops in the dry season for

home consumption, to improve their income, and reduce their labour migration. In prolonged drought years, cattle are sold to compensate for the loss of household income;

5.3.4.2 Farm and labour management decisions made by people living in the same households do not differ in cases where water is accessed from an irrigation canal. However, the players commented that it was impossible to access the irrigation canal, so a common pool resource was added as a new feature for the next workshop.

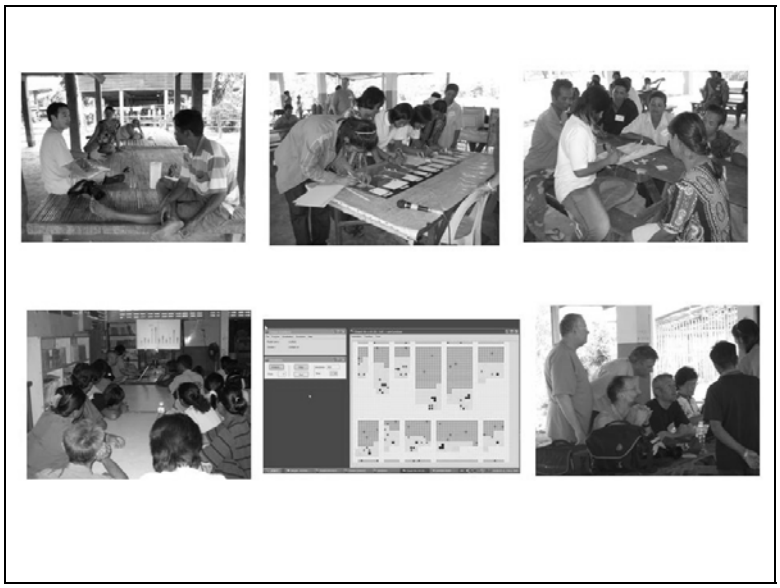


Figure 5.3 A summary of all the steps of second field workshop and features of the second sequence. Top left: RPG designer individual interviewed; top centre: players making decision on RLR production area; top right: players making decision on labour management. Bottom left: computer presented the players' decisions; bottom centre: results of players' decisions recorded in Excel file; bottom right: observers discussing the players' decisions.

Box 5.2 Details of the second RPG sessions and the use of artefacts

The second RPG and ABM 1

Date: 20-21 April 2006.

Meeting place: Ban Mak Mai School.

Participants: The 11 households with 19 people, only one of them being a returned migrant. Nine households came in pairs and two sent a single member. Seven people were part of the research team. One extension worker and four research assistants participated in the workshop.

Objectives: 1) To validate existing knowledge with the new migrant player, a member of a family who had participated in the first gaming sessions; 2) to investigate the players' decision-making process regarding farm and labour management under prolonged drought and irrigation canal scenarios; 3) to train the research team in the action research process; 4) to introduce computer game simulations as a collective learning support tool and validate the new model.

Main issue: Farm management with returned migrants and farm management under drought and irrigation canal scenarios.

Gaming sessions: The gaming sessions were carried out over two days: 1) on the first day, the RPG was used to simulate scenarios with and without irrigation canals, taking five hours for six rounds of (crop years): four crop years under rainfed conditions and the last two crop years with an irrigation canal. During the gaming sessions, traditional songs (Mo Lum) were sung by female players to entertain the other players. The wage chance cards were removed after the morning session because of a lack of players' interest and consideration; consequently, this helped to speed the game up; 2) the second day started with a three hour plenary discussion about the game's proceedings on the first day and the computer simulation replaying the gaming session was projected on the screen to help local farmers understand what the ABM is doing and what is happening during a simulation. Later on, individual interviews with 11 households were conducted by four research assistants.

Artefacts: A game board and Excel package were used with the same objectives than in the first sequence.

5.4 Third sequence

5.4.1 Objective

The third sequence of ComMod activities was implemented to gain a more in-depth understanding of the players' decisions regarding the management of individual farm and community ponds, labour and RLR farm management with the participation of three small groups representing the different main farm types.

5.4.2 Methods and tools

5.4.2.1 A third RPG was designed with a community pond and individual ponds to better understand the players' decisions on the use of available water across all the farm types. Ponds were added to the computer game simulations in order to: (i) acquire knowledge on the players' use of community and individual ponds and labour migration strategies across the different farm types; (ii) to improve the water-use rules of the first ABM (LdyModel); and (iii) to provide the players with a thorough understanding of the RPG simulated conditions before introducing them to more sophisticated computer simulations.

The gaming sessions were carried out on 10-11 October, 2006 at the community hall of Ban Mak Mai Moo 17. The first day focused on individual farm pond use. In the first session, the research team presented differing weekly rainfall conditions, which influenced how the players made decisions on their use of water and the management of farm activities; water pond levels and farm pond levels were shown to make it easy for the players to understand the water level conditions. Definitions of the water levels are explained below:

1) **Pond water levels:** Level 1: There is no water; Level 2: Water availability is adequate for rearing livestock; Level 3: Water availability is sufficient to be pumped for establishing rice-seedling nurseries; Level 4: Water availability is sufficient to be pumped for establishing rice-seedling nurseries and some parts of the RLR transplanted areas; Level 5: Water availability is good for all of the above, including vegetable production after RLR harvest.

2) **Paddy field ponding water levels:** Level 1: There is no standing water; Level 2: The soil is saturated; Level 3: Water availability is sufficient to establish rice-seedling nurseries; Level 4: Ponding water is too deep for establishing rice-seedling nurseries; Level 5: Deep ponding water in the field.

On the second day, a presentation of the game steps was made in the first one hour session. Afterwards, the community pond scenario was presented. The players were then separated into two groups: high and low farm land locations. The core rules of the game were that all the players would benefit equally from the pond and weekly rainfall conditions would be presented by the research team. The research team would then hold discussions with group members before water use decisions were made. The simulation took three hours; there was a one hour plenary discussion in the last session of the second day. The plenary discussion session was about weekly rainfall distributions related to local farmer real live and scenario they propose for future field workshop. The participants were 21 local farmers from 11 households; 10 households were represented by two members, while one household was represented by a single member. Two participants, from the same family, were new young players. The other participants were two researchers and two research assistants.

5.4.2.2 A participatory gaming simulation based on the second ABM 2 was implemented to validate the knowledge and representation of interactions between water dynamics and labour migration through the use of computer simulations.

5.4.2.3 Illustrations of model algorithms of rule-based agents using drawings were also provided. The field workshop objectives were to validate the comprehensive process of interaction between water dynamics and labour migration with small homogenous groups of farmers. The underlying theoretical assumption was that the ABM simulation was spatially explicit enough to display the changes in land use as a result of the interaction between the computer agents and their virtual environments, but it could not explicitly show the algorithms of intra-object or inter-object dynamics regarding the decision-making process of computer agents. The simple drawings based on corresponding UML diagrams could be a more effective method to clarify the decision making process behind the actions of computer agents to stakeholders and could increase communication.

The session included: (i) the presentation of algorithms that were built in the form of UML diagrams and used to implement the computer model. They were translated to simple drawings on transparencies: algorithms of agents' decisions during RLR crop establishment, RLR harvesting and after RLR harvesting; (ii) the participants in this workshop were divided into three small groups; three households (six people) of farm types B and C were

grouped together. Farm type A, with the largest portion of farmers, was separated into two groups, with each group having four households (eight people). The two key scenarios were presented. The first scenario was based on actual situations that farmers currently face; one situation offered the use of a pond, while the other situation did not. This scenario aimed to help the players refresh their memories of their participation in the previous workshop. The second scenario was based on extreme drought conditions; 'what if' questions were asked (hypothetical situations) in an attempt to stimulate the participants to think beyond their actual circumstances. The second scenario aimed to better enable the identification of other 'what-if' scenarios that would be more relevant to the players.

The workshop was implemented at Jiangkom's house (a TAO representative for this village) on August 5, 6 and 10, 2007. The meeting place for the workshop needed to be quieter and darker than previous locations. 22 local farmers participated; one was a returned migrant and one was an observer. Two researchers and one research assistant participated in the workshop. The workshop was implemented a second time at the same place on 5-6 January, 2008. A smaller group of participants was invited to participate this time and were selected based on their capacity to follow simulations and their degree of involvement in the discussions during the previous sessions. The objectives and the artefacts were the same, but the research team adapted the simulation based on the recommendations of the previous group of participants.

Figure 5.4 The main steps and features used in the of the third ComMod sequence at Lam Dom Yai watershed study sit in 2006. Top left: collective sharing about the rules of ABM 2; top centre: making RLR harvesting decision; top right: making decision on labour migration. Bottom left: rainfall conditions confused participants; bottom centre: results of the players' RLR harvesting decision; bottom right: result of the players' RLR and labour management decisions.

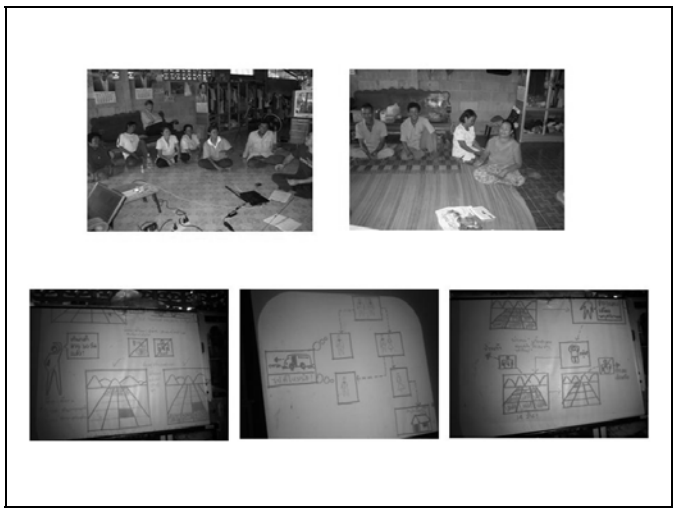


Figure 5.5 Farmers groups and drawings used to discuss the algorithms. Top: three farm types collective sharing the RLR transplanting steps. Bottom left: water pumping algorithm; bottom centre: players' labour migration decision algorithm; bottom right: RLR harvesting period

Box 5.3: Characteristics of the prototype model **ABM 2 (**LdyModel) and simulation sessions

The ABM 2

Date: 24 April 2007.

Meeting place: Community hall of Ban Mak Mai Moo 17.

Participants: 21 local residents participated; three of them were new participants from three households. Only nine research team members were involved in the implementation of the activities.

Objectives: 1) To validate the comprehensive process of interaction between farm pond / community pond dynamics and labour management; 2) to calibrate the hydrological module of the LdyModel representing the water dynamics according to the rainfall and players' decisions; 3) to discuss such scenarios with the players to define possible future scenarios to be explored by using the ABM simulations.

Main issue: Community and farm pond water use and their interactions with labour management.

Gaming sessions: This participatory gaming and simulation exercise was a new step in an evolving research process. Moreover, it was the second time the research team had jointly designed, implemented and used both RPG and ABM tools in the process. The structures, components and rules of these tools were similar to the third RPG. "All the game features used graphical illustrations as an interface for communication with the players. This field workshop mentioned to observe the comprehensive RLR process across three farm types by separating into three small groups. The assumption was that the joint-use of ABM simulation and co-constructed games would make it easier for the participants to understand the ABM model. The ABM model allowed the moderator to introduce a virtual farm where the actions of rule-based agents could be collectively criticized by all the participants, who could also suggest modifications. The sessions were organized in two parts: the 'simple' initial part introduced scenarios with two different paddy fields: one field with a pond while the other did not have it. The players' were acting like consultants giving their recommendations for rice transplanting to the moderator who acted as a new farmer. The second more complex part considered the decisions made by farmers (from 11farms) in the last gaming session. The moderator presented heterogeneous groups of farmers from across the farm types (displayed on a spatial grid) and asked the participants questions concerning the decisions farmers made with regard to rice transplanting steps and pumping-water, household by household.

Artefacts: Players' decision sheets as recorded by the players, weekly rainfall condition bulletin board, pond and paddy field water level boards, and ABM simulation.

5.4.3 Artefacts

In this sequence, various artefacts were used with different objectives. Most of the artefacts aimed at improving the players' understanding so that they could make more informed decisions on water use and labour management during RLR transplanting and harvesting periods. Moreover, the use of the artefacts gave the researchers a more precise understanding of the players' decisions.

5.4.3.1 Paddy field ponding water level boards were used to describe the meanings of different water levels in the paddy fields (figure 5.6).

5.4.3.2 Drawings on the farm pond water levels were used to describe the meanings of different water levels in the farm ponds (figure 5.7).

5.4.3.3 The weekly rainfall conditions were presented in a way that made them easier to understand compared to previous presentations On the ABM interface, the traditional calendar was used to help villagers follow the chronology of the rainfall distribution and RLR growing practices (figure 5.8).

5.4.3.4 The ABM simulation and the result of rainfall distributions board were used to facilitate discussion among players and to help local famers to follow computer simulations (figure 5.9).

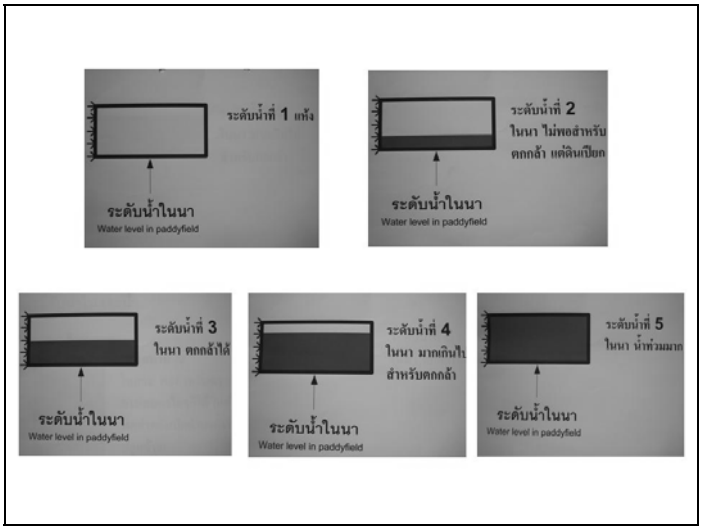


Figure 5.6 Drawings describing the paddy field ponding water levels and their dynamics in the model. Top left: no water; top right: soil is wet. Bottom left: water is enough to establish RLR seedling; bottom centre: water is enough to transplant RLR; bottom right: there is flooding

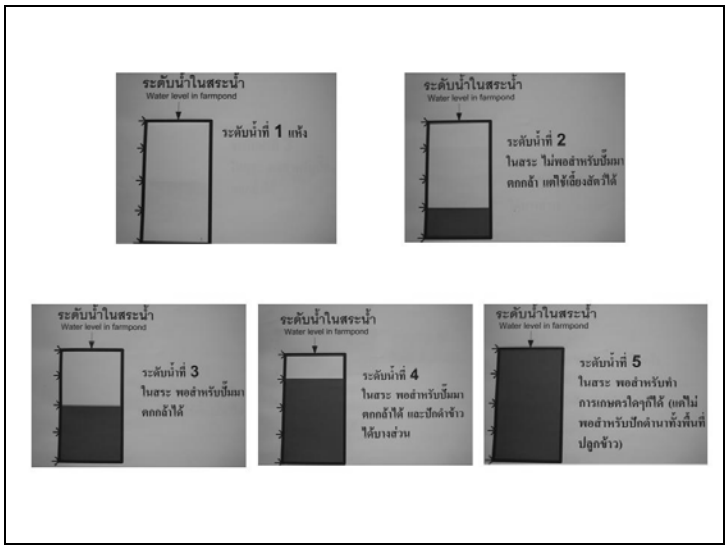


Figure 5.7 Drawings describing the farm pond water levels and their dynamics used in the model. Top left: no water; top right: water is enough for rearing livestock. Bottom left: water is enough for establishing RLR seedling; bottom centre: water is enough for transplanting RLR production; bottom right: water is enough for all farming activities

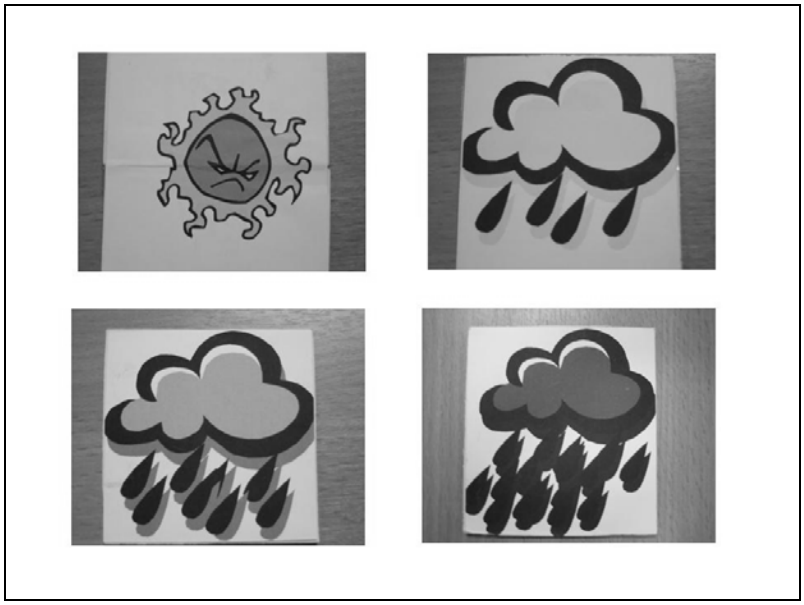


Figure 5.8 Illustrations of the weekly rainfall conditions presented on the bulletin board: Top left: no rainfall; top right: little rainfall. Bottom left: more rainfall; bottom right: hardly any rainfall

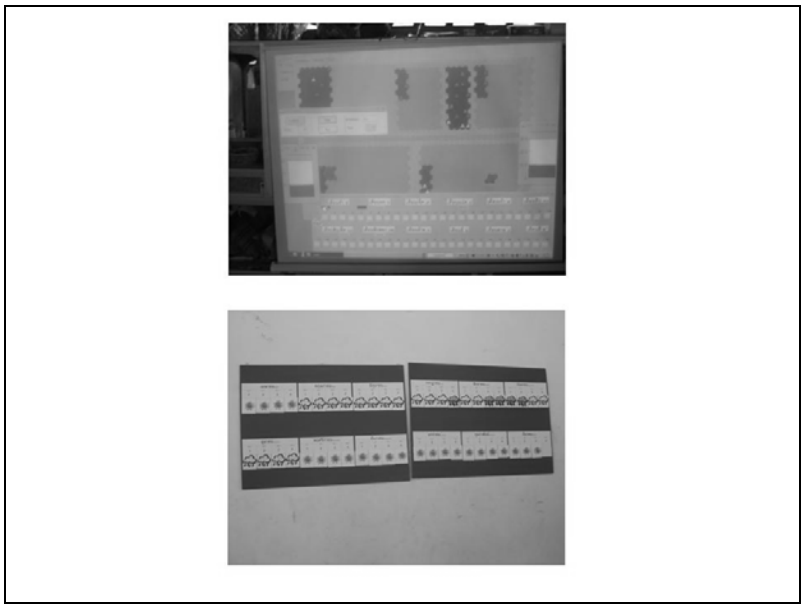


Figure 5.9 AMB and rainfall distributions**.** Top: the new ABM main interface during the run of a simulation displaying four different farms, the weekly rainfall distribution, the village and a city**.** Bottom: result of rainwater distribution in one year round

5.4.4 Main results

5.4.4.1 Water use patterns and players' decisions on growing rice were different in the individual and community pond scenarios. There was collective discussion and agreement among high and low farmland players before water was pumped from the community pond. However, the players tended to pump water when other players pumped water as well, even in periods with no water shortage as they were afraid that the water from the community pond would not be enough for all farms. In contrast, the players made decisions to use the water from the individual pond whenever they felt that it was needed. Importantly, the players would not pump water from the individual pond beyond the low water depth level that might negatively affect the fish that were being reared in the pond.

5.4.4.2 The new presentation of the weekly rainfall conditions provided more precise information to indicate when the soil moisture was enough for the establishment of rice seedlings. Two new RLR farmers: one with pond and another one without pond, and community pond scenarios successfully encouraged communication among players. The players consulted the two farmers to make decisions during RLR production periods.

5.4.3.3 The drawings of the algorithms helped participants to get a clear picture of the causal effects of the actions taken by rule-based agents. The algorithms showed how farm type A did not hire labour if they had calculated that the family labour could finish transplanting of late-maturing rice within 21 days; farm type B hired labour as soon as possible; and farm type C managed labour by transplanting four different rice varieties leading to different harvesting dates.

5.4.3.4 Quantitative interpretations of the water levels of individual farm ponds and paddies were difficult to make. The household-based simulation could not satisfactory stimulate collective discussion. However, the players better understood the ABM simulation; this enabled the research team to plan simulated scenarios that could explore 'what-if' conditions in the last sequence.

5.5 Fourth and final sequence

5.5.1 Objective

The last sequence of the ComMod process used participatory ABM simulations to validate the final BanMakMai model (BMM model) with all participants, and to explore scenarios proposed by local farmers.

5.5.2 Method and tool

Participatory simulation was implemented to validate the BMM model and to stimulate all farm types to discuss about available water sources and scenarios related to the hiring of foreign labour (window 5.4). The BMM model consists of five main interacting components: Climate; Hydrology; Spatial setting; Household; and Rice. The spatial setting represents land use, paddies, ponds, and human settlements: houses; village; and city. Household is made of heterogeneous "Members" agents having different demographic characteristics (age, gender, and marital status). The players made decisions within three main stages: (i) during nursery establishment and rice transplanting; (ii) at rice harvest; and (iii) decisions after rice harvest regarding dry season crop production and migration.

5.5.3 Artefacts

The final BMM agent-based model was used to present the human-environment interactions between water dynamics and labour management of Ban Mak Mai farmers (figure 5.10).

5.5.4 Main results

The important results of the last sequence were as follows:

5.5.4.1 In the scenario with no water constraints, the farmers had farm ponds full of water; all farms were able to start establishing a RLR seedling nursery as soon as they wanted, producing rice at the same time. Consequently, there was a lack of labour to hire during the RLR transplanting period.

5.5.4.2 In the limited water availability scenario, one farm seeded rice early, but could not complete transplanting when the heavy rains came late and the rice seedlings were too old to be used.

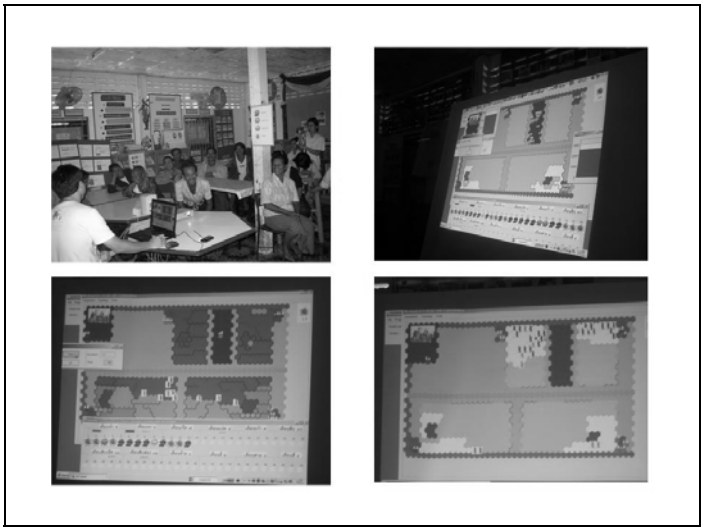


Figure 5.10 The participatory simulation room and three successive phases of the simulation of a crop year with the BMM model. Top left: players talking about ABM simulations they purposed; top right: ABM simulation of after RLR harvested. Bottom left: ABM simulation of water is available; bottom right: ABM simulation of haring foreign labour

5.5.4.3 In the scenario where hired labour from outside the village was cheap and abundant, farms A and B lost some income usually received from their employment on the large households, while farm C and D earned higher incomes from the sale of paddy of a higher quality, which was brought about by a faster rice harvest and the hiring of cheaper labour;

5.5.4.4 Because all ComMod sequences and co-constructed simulations were implemented with agro-ecological and sociological perspectives in mind, the participants proposed that a macro-economist should join future simulations so that a better representation of the dynamics of the rice market could be offered.

Box 5.4 Characteristics of main methods and tools used in the fourth sequence

Participatory simulations with ABM 3 (the final BMM model)

Date: 13 -14 May 2008.

Meeting place: Ban Mak Mai School.

Participants: 15 people from eight households: seven households were represented by two members. Eight people were part of the research team participated in the workshop.

Objectives: 1) To validate the final BMM model and; 2) to explore the water availability and hiring labour scenarios.

Main issue: The BMM model, which was co-constructed with knowledge gained over the previous three sequences by local farmers and the research team, needed to be validated.

BanMakMai model: The BMM model included: 1) the spatial configuration that consisted of two small farms (21 rai; 3.36 ha) called farm A and B, two large farms (41 rai; 3.56 ha) called farm C and D, and different farm pond sizes; 2) farm A had 3 farm labourers and 3 dependants, farm B had 4 farm labourers and 2 dependants, farm C had 2 labourers and 1 dependant, and farm D had 3 labourers and 4 dependants; 3) different rainfall distribution patterns, whereby daily and weekly rainfall pictograms were fed into the simulation and displayed on a projector screen.

Gaming sessions: The steps of the sessions were: (1) introductory VDO presentation about the previous workshops to refresh the players' memories; (2) running the BMM model step by step and allowing the players to identify all the features of the simulation, to discuss them, and to propose possible scenarios (4 farms had no individual pond and 4 farms had individual farm ponds, hiring labour among 8 actual farm representatives, and hiring out-village labour); (3) plenary discussion about scenarios local farmers proposed.

Artefacts: Agent-based simulations with the BMM model**.**

The final BMM model was found to be representative of Ban Mak Mai's real situations regarding water / land and labour management by the researchers and farmers alike. The various tools did indeed depict the Mak Mai villagers' situations; however, simulated 'play' is not reality. The link between interactions in the game and those occurring in real world processes must be further clarified (Daré, W., 2004). Consequently, the monitoring and evaluation of the effects of the ComMod activities on the local farmers in this study is a necessary step in the improvement of the ComMod approach. In the next chapter, the evaluator present the various effects of this ComMod process on participants.

CHAPTER 6

ASSESSMENT OF COMMOD EFFECTS ON LOCAL STAKEHOLDERS

The monitoring and evaluation (M&E) activities carried out to assess the effects of the ComMod approach on the participants started in 2006 focused on 'what works' and tried hard to answer 'why it works' and 'how it could be better' (Jones, N.A. et al., 2008). In this chapter, the various effects the ComMod approach had on the different types of farmers are explored. Especially evaluator looks into the effects on: the participants' awareness of the importance of the issue being examined; the acquisition of knowledge about this issue; their own and other players' perceptions of the problem; their behaviour, communication and networking; and decision-making, actions and practices related to the issue at stake; and finally capacity building aspects. The specific effects generated by the main RPG and ABM tools used in this ComMod process are also presented.

6.1 Awareness of the issue being examined

Several questions that arose from the ComMod field workshops throughout the four sequences were examined to stimulate collective thinking and discussions. One practical outcome from this process was the improvement of the players' awareness of possible future situations created by the interactions between land/water use and labour migrations.

6.1.1 Labour shortage may occur because of labour migration

Local farmers' decision-making on labour management issues was examined in the process. RPG was designed around the core phases of RLR production i.e. RLR transplanting, harvesting, and post-harvest periods, in order to observe how the farmers' made their decisions in the RLR production process. Moreover, the simulated hiring of labour, also built into the RPG's design, from both inside and outside the village was also observed.

The farm type A perception was similar to farm type B. They highlighted the fact that Ban Mak Mai villagers migrated to work in many of the bigger cities and abroad, this situation created labour shortage problems, which affected farmers who have large areas of land. They said that the RPG increased their understanding of how essential labour is for farming. They could not produce their desired amount of rice on their farm because of the lack of labour supply that could take good care of farming activities. However, this scenario did not have much influence on farm type C farmer, even though he had large farm areas and two family members who migrated to work at abroad. A farm type C farmer had enough family labour and was able to solve labour shortage by growing various rice varieties.

6.1.2 Gaming sessions stimulated thinking about the causes of and effects from decisions made on RLR production and water use

The ComMod scenarios were created over a framework of "what if" issues intended to motivate the players to consider future possible community situations, especially when simulating the community pond and irrigation canal scenarios. In the interview process, farm type A and B representatives pointed out that both the community pond and irrigation canal scenarios guided them through conflicts and problems that might possibly arise if a community pond and irrigation canal were both available for use in reality. It was understood that the villagers may fight over the water and consequently divide themselves into two groups: one group with an irrigation canal running right through their land, and the other without such an advantage. They also observed other possible problems. First, access to a community pond might mean that villagers would attempt to do the RLR transplanting at the same time, possibly causing some conflict surrounding the equitable use of water among the more active and less active villagers. Second, the irrigation canal scenario also stimulated thinking about how the particulars of irrigation canal construction need to be negotiated between the village landowners and the canal constructors before any contractual commitments are made.

From the players' differing points of view, the ComMod activities has indeed motivated them to think of paying more attention to sharing ideas and talking about the future use of water and other resources so as to avoid conflicts. The ComMod activities facilitated an environment where the players were encouraged to think about future situations that could cause

conflict; most importantly, it brought the villagers together, allowing them time and space to discuss the use of community resources.

6.1.3 Simulation of variable rainfall distribution stimulated participants to adapt RLR management

The ComMod research team varied the distribution of rainfall per day, week, and month into the simulation to observe how the players made their decisions.

During the interviews, a farm type A representative said that previously he had always focused on rainfall and drought patterns, trying to find the best solution each year and preparing ways to solve farming problems. The ComMod activities helped the participant to think about how to better manage the rice transplanting and to pay attention to variable distributions of rainfall. Another farm type A representative said that the variable rainfall distribution scenarios helped him understand how the period for and steps of RLR transplanting are both related to rainfall. Consequently, the participant has realised that he must better prepare for the steps of RLR transplanting. Moreover, the participant got creative ideas about RLR management, such as when to establish rice nurseries. Farm type C representatives commented that the ABM stimulated the sharing of RLR management information because the players were able to see the simplicity of the RLR transplanting process of other players and to pick up good techniques to improve their own farming.

From the players' point of view, the variable rainfall scenarios could trigger the local farmers to think of common situations on the farm and to be careful of situations affecting RLR production; the scenarios have stimulated them to improve their RLR and water management which is usefulness for improving local farmers' livelihood.

6.1.4 The farm pond scenario stimulated water use the participants

From one interview with a farm type A representative stated that the community pond scenario triggered the idea that if a big pond is available for use, similar to the one presented in the ABM simulation, then the management of water from the pond could be very effective. The participant suggested that water could be pumped into areas when and where needed that there would be enough water for use in the field as well.

The ComMod scenarios could stimulate the participants' awareness of possible future situations. That is, the participants could say what they would do if they faced with situations

similar to the ones in the ComMod scenarios and what principles they would apply to solve community problems. The farm pond scenario not only stimulated the players' awareness of its usefulness, but also its helpfulness in improving farmers' RLR transplanting techniques.

6.2 Knowledge acquisition about the issue being examined

The ComMod activities were implemented to increase the players' knowledge about the issue at stake through the collaborative modelling scenario exploration activities. Gradually, the successive sessions increasingly presented knowledge on agro-ecological systems; agricultural practices; economic and social sub-systems.

6.2.1 Learning about the agro-ecological system

In this case study, the ComMod research team tested water and land use as a sub-system of an agro-ecological system to observe the participants' opinions. What knowledge the farmers acquired about the agro-ecological system is detailed below.

6.2.1.1 Better understanding of differences in RLR production conditions across farm types

In spite of the fact that all the participants came from Ban Mak Mai, they had never reflected and tried to understand each other's patterns and techniques used for RLR production. The game board demonstrated the prevailing conditions of each participant's farming area, for example: lower or upper farm land and the rice area size.

Data from interviews indicated that all farm types agreed that the ComMod activities helped them better understand other villagers' farm management. One farm type A representative said that each participant's farm size could be seen on the game board and on the computer screen, helping the participant to better understand the differences in the location of each participant's farm land. The participant also learned how to manage water on high and low paddy land. One farm type A representative said that upon seeing the farm location of Mak Mai villagers, he thought that it was impossible to build irrigation canals in Ban Mak Mai village because most of the farms were located on the high land. Other farm type A voices commented that they could understand the situations in the village because they could see all the physical aspects of other villagers' farming areas, but could not understand other villagers' ideas because many villagers did not participate in the activities with them. Farm type C representatives could

see how other players, who had similar farms to them, made their decisions and finished their farming activities at different times.

The claim can be made that the ComMod activities increased the players' knowledge of different rice patterns as well as farm locations. Moreover, it helped them to better understand the other players' farming decisions, which in return enabled them to improve their farm management as well.

6.2.1.2 Participants better understand the impact of water availability on RLR production

The ComMod research team simulated different rainfall distribution patterns, examining the effects on local farmers.

From the interview data, one farm type A representative said that the relationship of rice product and rain distribution in the simulations could genuinely reflect reality on the farms; as rainfall decreases, so does rice production as well. The representative added that while such understanding of water availability was very general for scientists, it was new for local farmers. This was because local farmers had never thoroughly discussed rainfall distribution before, as one farm type B representative suggested. Farm type C representatives thought similarly to type B farmers, indicating that they now better understand what to do when faced with good rainfall and drought periods.

6.2.1.2 Participants better understand the relationship between water in farm ponds and paddy fields

In the workshop held on 10-11 October, 2006, the gaming sessions simulated different water levels in the farm ponds and paddy fields. Normally, the water levels are very difficult to explain so that the participants can understand. For the purposes of this research, the qualitative definition of water level was interpreted into quantitative (height of water level in metric unit) definitions to make it easier for the players to understand.

After participating in the field workshop, farm type B representatives said that the relationship between water levels in the pond and paddy field scenarios helped them to realize when water could be pumped and how much could be saved for later use. They also came to understand the adequate paddy field water levels needed to start RLR production. One

female farm type A representative stated that the water levels in the farm pond and paddy fields helped her understand how levels of water in the field and in the pond were related.

From the examples presented above, it is clear that the scenario about the water dynamics helped the players understand the relationship of water levels in the farm pond and paddy field more easily. This new knowledge motivated them to get new ideas for the management of their water use in their fields.

6.2.1.3 The two paddy field plots scenario stimulated participants to explore ways to solve problems between lower and upper paddies

This effect emerged from farm types A and B. After the ComMod research team conducted the ABM simulation, they better understood the differences in farming activities between the paddy field having access to a farm pond, and the paddy field without a farm pond. Farm type B representatives could see the differences in rice transplanting patterns. The paddy with a farm pond could start producing rice seedling earlier. A farm type A representative whose paddy field was located in a lower area said that when he saw the ABM simulation, he better understood why farmers who had farms located in upper paddies started growing early maturing rice varieties before late maturing rice varieties. The representative got new knowledge because he exchanged information with the players who had upper paddies as well. One farm type A representative (who let other farmers rent his land) said that the ABM presented a situation where a farmer with 20 rai of land was able to completely transplant rice over the whole area, motivating her husband to work on his farm with more energy.

When taking such effects into consideration, one can assume that the design of the ABM simulation closely reflected the actual circumstances of farming production, thus helping the local farmers to gain new knowledge directly by having discussions with each other and facilitated by the scenario simulations.

6.2.2 Learning about agricultural practices

The participants had all previously practiced varied forms of agricultural production namely because of differences in the size of their land and traditional knowledge. The ComMod process facilitated opportunities for the sharing of knowledge. Consequently, some players learned new agricultural practices.

6.2.2.1 New ideas and knowledge on how to operate a community pond

Currently, Ban Mak Mai village has a big community pond located on public land, but the villagers cannot utilize water from it for use in farming activities or consumption because it is located very far away from the village. The villagers have not had any discussions about the use of this community pond before.

After the ComMod activities, a farm type A representative (the TAO representative) said that he learned about the benefits gained from use of the community pond, getting the idea that if the villagers wanted to use water from such a pond, they would have to set up a water supply system in the village. A farm type B representative confirmed that if the villagers were really using the benefits from a community pond, villagers would talk with each other before using the water. New ideas stimulated them to agree that the community pond, or other public water sources, would need to be discussed among the villagers before any investments were made as water resources were always constructed on land whose owners do not like to do agriculture or is located very far away from the village. Agreement among those inside and outside the village on the use of public resources may solve future water related conflicts.

6.2.2.2 The irrigation canal and community pond scenario could generate sufficient income and more integrated farming

Ban Mak Mai village does not have an irrigation canal yet and integrated farming is not popular, even though it has been promoted since 1992. To motivate and observe the players' decision making under such circumstances, irrigation canal and community pond scenarios were simulated.

During the interviews, representatives from all farm types said they wanted to have an irrigation canal system in the village and if it was available they planned to change their farm activities. For example, an elderly man from farm type A thought that if an irrigation canal was built in his village, 50 % of the villagers would call their relatives to come home back and help out on the farm chores. There would be a change in their agricultural practices, with a move to integrated farming systems to save money and people would stay on the farm and migrate less. A farm type A representative, whose family member migrated to work abroad, said that if an irrigation canal were to be built, he would have enough water to use and could make enough income, so he would not let his kids and relatives work anywhere else. Two

farm type B households (with no history of family migration) said that if there was enough water supply, they could increase their agricultural output with the use of integrated farming to increase their incomes and enjoy doing so. A Farm type C representative said that he would pump water from an irrigation canal into the paddy field to grow vegetables and help in transplanting RLR.

The interview results suggest that if water was abundant, the labour migration households would call for their family members to come back home, while the non-labour migration households would also practice more integrated farming systems. Moreover, all players have the same opinion that the irrigation canal and community pond scenarios stimulated their desire to have private water resources on their farms. This is because in the case of an irrigation canal, they know that the use of the irrigation canal could not be possible for all farmers because the farms have varied locations. Mak Mai village is located very far away from the river, and an irrigation canal would require a large area of land, which is not suitable for small farmers. So, it is impossible to have an irrigation canal, but a private pond is possible.

6.2.2.3 Preparing RLR seedling in May could be a good technique to allow a longer period at transplanting

Usually, RLR seedling production depends on rainfall conditions. Local farmers always wait until the rain comes to start their nurseries.

After the ComMod activities, one farm type A representative saw how one large farm started a rice nursery in May. In the interview, she believed that it was a good strategy because it allowed more time for rice transplanting later on. However, she concluded that such practice requires a farm pond to store water for maintaining the RLR nursery. This new knowledge encouraged her to change her strategy for rice seedling production in the 2008 crop year.

6.2.2.4 Transplanting 20 day old RLR seedlings is now perceived as a good practice

In the past, a type B farmer started transplanting 30 day old seedlings. In the interviews, she understood the different ideas employed by other participants on how to run a farm, and who made similar decisions to her in regards to rice transplanting. She came to better understand why farm type C and type A (elder farmers) who lacked labour made their decision to transplant rice early; they needed more time to practice the job. Consequently, the farm type B

representative acquired a new technique, changing her RLR transplanting practice for the 2008 crop year.

It is implied that during the ComMod process the older farmers from farm types A and C transferred their traditional farming knowledge to younger farmers through discussions of their ideas. This process proved very useful for farm type B farmers, who were generally younger. Without their joint active participation in the ComMod activities, the older and younger farmers would have never had the chance to talk about their farming production with each other, especially those who live very far away from other farmers. The facilitation of knowledge sharing among the older and younger generations of farmers proved to be one of ComMod's useful outcomes.

6.2.2.5 ComMod activities increased theoretical knowledge about water use

Interview data showed that the participants concurred that the ComMod activities were designed for farmers to play and work together on agricultural issues, especially those pertaining to water use from different sources. One farm type A representative highlighted that if the players were not farmers, or the players had very little experience dealing with issues of agriculture, then they would not be able to discuss any of the ComMod activities. She added that the players essentially acquired more knowledge by asking questions throughout the ComMod implementation. A farm type B representative agreed that the ComMod activities helped the players to learn, search for academic resources on agriculture, and find out what the best solution to problems were by themselves. The activities encouraged a practical application of what had learned. For example, they were able to understand the relationship between water in pond and paddy fields by observing the water levels on the water board and the record sheet. One farm type A representative stated that while participating in the gaming session held on 20-21 April, 2006, he liked how solutions to problems were 'pointed to' and 'opened up', helping to stimulate the farmers to start thinking more creatively. The participant added that such a technique could obviously be used in everyday life. Thus, the artefacts used in the ComMod activities supported the players understanding of theoretical knowledge, allowing the players to participate more comfortably in the activities. They could think and decide things for themselves and did not need the help of research assistants.

It appears that the theoretical knowledge taught was not that difficult for the local farmers, who were able to learn by doing and participating in the ComMod process as everything was about their own farming life. The activities helped them to more easily understand the everyday problems the participants face on the farm; in the process, the activities trained the participants to learn by doing. However, some non-participants thought that ComMod research team were not farmers, so they did not want to participate in the ComMod process. Non-participants believed the design of the RPG and ABM was purely based on an understanding grounded in academic theories and books, rather than knowledge grounded in the everyday practicalities of rice farming. They believed that the research team stood to benefit from the local farmers, rather than the farmers benefitting from the research team.

6.2.2.6 Participants acquired new knowledge on direct seeding of rice in dry years

During the gaming sessions, some players made the decision to adopt direct seeding of RLR when they faced a dry year. This decision provided new knowledge for local farmers who had never observed or heard of such a technique. One farm type A representative stated that during discussions about drought years, other players advised the participant to practice direct seeding in drought years because it was cheaper than other kinds of RLR establishment techniques. So, direct sowing is used to ensure that they will have enough rice for home consumption.

6.2.3 Learning on the economic sub-system

The economic sub-system at the family level was also discussed by the participants throughout the ComMod process. Four core effects on the participants were observed.

6.2.3.1 Participants learned how to compare incomes arising from both labour migration and on-farm employment

The information gathered from the interviewees show that the ABM simulation about labour management, particularly in the dry season, showed that the players made decisions differently on whether to allow family members to migrate or not. Some players decided to grow different kinds of plants on the farm. These decisions stimulated a farm type A representative (who always allowed his son to migrate) to compare the advantages and disadvantages of their decisions. The representative stated that when he had got new ideas, he

thought more intensely about whether or not he would allow his son to migrate. He added that he would have to compare the benefits arising from both labour migration and on-farm work because "farming in the dry season can bring more income" said farm type A. However, this idea only emerged from one participant with experience in higher education and a plan to practice integrated farming.

6.2.3.2 Participants better understand how to take good care of their farm

As previously mentioned, a couple of farm type B representatives are from the new generation of farmers. They usually practice agricultural production by using traditional knowledge, and they just accept outcomes without too much critical thinking.

After participating in the ComMod activities, one of them said that in the past, he did not pay any attention to the seasons, simply working steadily on his farm. He did not realize how much rice he could gain until comparing his yield to other farms. Previously, he had only known whether or not other villagers had rice paddies. ComMod activities helped him to realize that he needed to begin to take good care of the farm. He added that his neighbour, while owning less farmland than he owns, took very good care of his farm, and so produced more output and got a higher income. This realization is usually common knowledge among some farmers, but for farm type B farmers in this case, it is very useful in encouraging them to improve their farm management.

6.2.3.3 Participants learned how to assess income from rice

A female farm type B representative was interested in the calculation of farm income because she had never thought about the farm's income. She had never calculated whether she was making a benefit or loss; she did not estimate any of her farming investments, nor calculate labour expended on the farm. During the last round of interviews, she said that when the ComMod research team asked her about her techniques for RLR transplanting, RLR investment, and yield. It stimulated her to start thinking about recording farm expenses so that she could accurately calculate farm income. She believed that this information would help and guide her plans to reduce expenses. Although the necessity of basic accounting is common knowledge among local farmers who have consistently participated in meetings and training programs, it is a new concept for farm type B farmers, who have tended not to participate in any meetings.

6.2.4 Learning on the social sub-system

Ban Mak Mai is a large village in Klang sub-district and the villagers do not really understand the social sub-system of which Mak Mai villagers are a part. The ComMod process helped the participants to understand their interconnectedness with others in the village.

6.2.4.1 They understand some villagers would still migrate as the irrigation canal would not provide enough water for all

The ComMod participants suggested that the reason for why the Mak Mai villagers migrated to work in the cities was because they do not have the opportunity to work on the farm all year round, especially in the dry season. There simply is not enough water to use for farming activity. With this reasoning in mind, the research team assumed that the irrigation canal scenario might have been able to help understand some of the decision-making surrounding labour migration. Accordingly, they designed the irrigation canal scenario into the simulation.

The results suggested that Mak Mai villagers would still migrate, but less. An older, female farm type A representative believed that labour migration could not be reduced through the construction of an irrigation canal because the irrigation canal could not provide enough water for farmers to work on their farms all year round particularly in upper land. Today the Mak Mai villagers still migrate domestically and abroad for work, even though community pond and individual farm pond projects have been supported and promoted by the government. A farm type B representative stated that presently some farmers have ponds on their farms, but they have not done any agriculture in the dry season because doing so requires a lot of time. She also said that she did not pump water from the recently built community pond because it was on public land and the water was much too muddy.

As results mentioned above, it seems that the improvement of water infrastructure alone cannot solve the problems arising from the labour migration situation.

6.2.4.2 Participants realized that most villagers were children and elders

All Mak Mai villagers think that labour migration is a very usual situation and something they have never really discussed. The ComMod activities helped the migrant from farm type A to give new information about the labour migration situation and made him understand the reality of the village's situation. He told the interviewer that this scenario stimulated the players to understand that many of the Mak Mai villagers have not been able to help

on the farms namely because they are children and elders. The migrant believed that if Mak Mai villagers did not migrate to the city, they could work on their farms, stay at home with their family, and make more produce on their farms. However, this greater idea of the labour migration situation has not entirely influenced him to stop migrating; in his family, the decision to migrate has always depended on family consensus.

6.3 Effects on changes in own perceptions of the issue at stake

The interaction between land / water and labour management was the issue examined during the implementation of the ComMod process at the study site. The ComMod effects on the players' changes in their perception of the issue, their aspirations and opportunities are presented below.

6.3.1 Aspirations: participants want to practice integrated farming and improve water supply

Simulated scenarios where water was in abundant supply, like the irrigation canal and community pond scenarios led to a better understanding of the usefulness of each water resource. They thought the ComMod activities seemed to motivate to them what to do and how to do it. Practicing integrated farming and improving water supply were important topics among local farmers who did not have a farm pond. One male farm type A representative stated that if he were to have enough water to use all year, he would plan to do agriculture all year and make more income for his family. Another representative of the same farm type said that he wanted to use the basic accounting principles like the ones presented in the gaming sessions to record and assess his sundry expenses. He would account for his farming material investments, marketing, and labour hiring costs in order to save money. The players have changed their ideas because they acquired new knowledge from the questions that were asked by the research team and the computer that showed all the various aspects of the other players' situations.

In abundant water scenarios, players who had farm ponds and made decisions to cultivate different kinds of vegetables in the dry season helped other players better understand what might be possible when water is available.

6.3.2 Opportunities: the gaming sessions suggested new sources of income that farmers could tap

Most of the local farmers did not have ideas for agricultural production in the dry season, after rice harvesting. One farm type A representative stated that when the research team came to the village, they facilitate discussions on agricultural production in the dry season through the use of the RPG. The gaming sessions highlighted the period of free time when farmers usually take a recess from work on the farm, and showed the participants possible new sources of income that farmers could make from January to May. It stimulated the players to think about working in different jobs instead of working only on the farm. As one farm type A representative stated, new ideas were generated automatically because the farmers could imagine what was going to happen. However, it must be stated that this effect was predominant only among local farmers who had previously done very little after rice production.

6.4 Effects on other players' perceptions of the issue

The ComMod process encouraged the formation of new aspirations among the participants, and gave them opportunities to acquire new knowledge. At the same time, they increased the participants' understanding of each other's situations and opinions.

6.4.1 On their respective situations

Participating in the ComMod activities helped them understand the other villagers' situations because it facilitated the exchange of ideas and discussions among the group on diverse topics such as the rearing of cattle, RLR and vegetable production, water resource use, and labour migration.

6.4.1.1 Participants better understand other players decisions

The first sessions using both the first and second RPGs encouraged all players to make decisions to grow rice and manage their land in the dry season. In the final session of the second workshop, the research team presented the participants' decisions on a screen. It helped all the players to see the other players' decisions, which they had not seen before.

One farm type A representative said he understood how to make decisions when sharing farmland, using underground water and working on integrated farms of the

other players. He added that understanding the other players' situations was very useful because they were also able to understand the motives behind other players' ideas. Understanding the other participants' could prove helpful for community development and increasing local empowerment. Moreover, the participants came to a better understanding of how the other participants with similar farms made their decisions. This understanding emerged from farm type C participants who thought that most of the activities in the RPG were similar to the farm activities undertaken on their actual farms. They were not interested because they were already familiar with some of the activities before participating in the RPG. However, after participating in the second RPG, one farm type C participant stated that the RPG helped him better understand other players' situations. He better understood who performs the activities and how, who hires and pays for the labour, and who benefitted and loses money from investments in RLR production. He also knows how other players who had similar farms to him made their decisions. Finally, a farm type C participant recommended that participating in the gaming and simulation sessions was similar to a training, but it required that players think about it again upon returning back to their farms so that they would be able to have new ideas.

6.4.1.2 Why youngsters and young adults work in the city after rice harvesting and come back in the rainy season

Two households from farm type B have not had any experience with labour migration. In this case, the research team's simulation facilitated the players' understanding of each other's labour migration situation. They said that after participating in the ComMod activities, they realised that other families allowed their members to work outside the village. Most of the migrants work in big cities, and they come back to work in their field in the rainy season. The migration households stated that they allowed the family members to work in the cities because they needed more income to support their family.

6.4.2 On their opinions

Normally, the ComMod players saw other villagers making decisions in their daily lives, but they did not have the time to ask about the reasons for and causes of these decisions. The ComMod activities helped them to understand the other players' opinions on various issues.

6.4.2.1 Participants got a better understanding of why farm types A and C transplant rice early

The small group activities helped farm type B better understand the other players' decisions, particularly the decisions made by farm types A and C. The research team presented the decisions made by farm types A and C on the screen, motivating her to ask questions. Later on, she better understood why a farm type A and a farm type C villagers made their decisions to transplant rice early; they needed more time for the transplanting, and to take good care of the rice which the best way to achieve good yields.

The ComMod process not only increased the participants' knowledge, but also gave them opportunities to discuss and clarify their respective decisions.

6.4.2.2 Participants better understood the research team objectives

The participants also understood why the research team used the ComMod approach to gather data from local villagers. They point out that the research team wanted to learn about the local farmers' activities and the true situation of rice production strategies employed in Ban Mak Mai in order to share this knowledge to other people.

6.5 Effects on own behaviour

ComMod's effects on the participants' knowledge acquisition, perceptions and opinions, both their own and that of the other participants, were examined. In this part, ComMod's effects on the participants' behaviour are explored.

6.5.1 Farm type A participant decided to spend more time working on the farm

Before ComMod, this participant had let his farm out over for the last three years. The change was influenced by the questions the research team asked and the players' answers; they enabled him to acquire a more creative outlook, which will be more useful in the future, and acquire more knowledge about agricultural production. Previous to the ComMod process, he had not paid much attention to thinking about farm production and did not care what other people said.

In contrast, the gaming sessions motivated him to think intensively and to practice his farming according to both the decisions he had made and what he had learned while participating in the field workshops. The participant stated that he had to work for a living because

not doing so meant not having anything to eat. His idea changed from one of standing still to one of being more active, wanting to do something creative rather than not doing anything. He concluded that the gaming and simulation sessions triggered the ideas to start being more decisive on the farm, to practice a farming similar to what he did in the workshops, to stay home, and to work instead of wasting time. He added that because the research team implemented the field workshop very frequently, it effected a behavioural change as well. If the field workshop was implemented only one time, the participants would not think too much about it and would probably forget what had been learned.

6.5.2 Farm type A and B better understood the rice cultivation cycle and became more decisive quick thinker, speaking with more confidence.

The step by step rice production that was simulated in the gaming sessions allowed the players to acquire a more in-depth understanding of rice production.

One female farm type A participant who had never even learned the names of the Thai months stated that participating in the RPG gave her an understanding of the actual farming months. Previously, she had just understood that rice transplanting commenced after Songkran Day (Thai New Year), which she called the fourth or the fifth month. She never knew what month she started or finished her farming. The new knowledge assisted her to answer other peoples' questions clearly and with more confidence because she was now able to reply to questions about the rice transplanting steps, and point out the dates and times for the rice transplanting period to other villagers. Furthermore, she has become a quick thinker because a variety of things in the activities kept evolving continuously, pushing her to keep up with what was happening, her mind ticking all day. She added that the ABM moved very quickly, so she too had to think quickly. This was confirmed by the fact that that she could answer the researchers' questions immediately.

One farm type B participant said that the gaming sessions were similar to studying in elementary school. It was similar to the first, second and third grades because she could understand the last RPG more quickly than the previous one. She was able to spend less time thinking, able to find quicker solutions. A variety of farm type B opinions suggested that the ComMod activities increased the players' knowledge, communication skills, and critical thinking abilities, all leading to behavioural change.

6.5.3 Farm type A participant even adjusted his general way of life

This behavioural change was unexpected. One month after the last field workshop was implemented, the man of farm type A representative was interviewed. He stated that after the first field workshop, he started to think about a plan for his future. The ComMod activities, particularly the abstract ABM scenario, stimulated thinking on the possibilities of what he can and cannot do about his situation in reality. He was able to understand both the purely imaginative and the practical aspects of the simulation. This helped him realise that some things he was doing were wrong; he had to stop and start thinking about a better action. Finally, he has changed to become more of an active farmer. He now avoids gambling on the legal lottery, and he wants to do something more for his family. Nowadays, he has a feeling that he is a 'careful' man. Other participants have indeed confirmed that he has become a new farmer.

6.5.4 Some participants have become more experimental in their approach to farming

This behaviour change has been observed with two women from farm type B households. The abstract 'what if' scenarios stimulated the players to think of unusual situations. They tried to find the causes and reasons of situations by themselves, sharing ideas with each other. After, the final field workshop they stated that through a comparison of reality and 'the abstract', they would now apply the new knowledge and principles gained from that comparison to reality on the farm. They believed that they would retain the 'thinking processes' learned during the simulations and be able to apply those thinking processes in their daily lives.

6.6 Effects on communication and networking

The ComMod participants were given the opportunity to participate in an innovative, collective approach that focused on the sharing of ideas, knowledge, and perceptions between scientists and local farmers. The interview data suggested that the effects of ComMod on communication among the participants could be divided into two distinct categories: the effects on participants and the effects on non-participants.

6.6.1 Communication among participants

6.6.1.1 Better communication in the community like in the ComMod activities may help solve problems

Normally, the villagers do not share ideas among each other as they tend to be busy working for their livelihoods. This fact, which the research team found from the individual interviews, was a catalyst in the decision to employ the ComMod process at the Ban Mak Mai study site.

They assumed that the ComMod activities would provide the players with the opportunity on the community situation. The community pond and irrigation canal scenarios were designed to stimulate collective discussion. During the interviews, the participants said that collective discussions, similar to the ones that took place during the ComMod activities, were the best way to solve village problems. They reasoned that the ComMod activities helped their communication skills and they were able to share and discuss their ideas together. Participants highlighted the fact that prior to the ComMod activities it was hard to get together with others to talk out ideas collectively. Brainstorming was an integral technique used to stimulate collective discussion during the activities. Types A and C farmers commented that if the villagers faced problems, they should participate in the ComMod activities because they would get to learn from and understand other villagers' ideas.

One participant from farm type A commented that an understanding of other players' ideas could be achieved because the ComMod activities displayed the immediate results of the players' decisions. The participant added that during the community pond scenario players consulted with each other about who should farm first and last, what month the transplanting of the RLR seedlings would be done, how much and on how many day water would be used, and who else might want to use the water. The participant concluded that collective solutions to problems could be found. While the participant from the government agency (ARD) echoed such sentiment stating that the strategies used in the RPG were appropriate for solving community problems rather than individual problems. Moreover, all participants thought that discussing the issues at hand and sharing knowledge together were more important than using their own knowledge solely. The ComMod process proved very useful for the villagers; they felt

more positive about tackling their everyday problems on the land, they acquired modern knowledge, and they learned from the diverse skills of other players.

However, doubt remains as to whether or not the villagers or the group experiencing conflict fully participated in the activities, particularly those who do not have access to water in the first place. Those participants tend not to like the RPG, as they do not see the possible usefulness of such activities. Clearly the ComMod activities have their limitations and are not able to simply solve all kinds of community conflicts and problems.

6.6.1.2 Better understanding of the usefulness of communication process

One farm type A representative stated that communicating and sharing knowledge is important because it provides powerful techniques and ideas for farming activities. The more questions were asked by the research team mean, the more knowledge the players will earn. One farm type A representative also agreed that the ComMod activities helped him to understand how to solve and plan for real problems, such as drought. One female from farm type A stated that this round of RPG was usefulness for communication and it was suitable for people who were not good at speaking because they did not have to talk; they could just listen and answer the questions.

6.6.1.3 ComMod activities also strengthened relationships and unity

ComMod was limited in the sense that a large number of people were not able to participate. One male farm type A representative stated that a limitation on the number of participants involved caused limitations on the communicative network. Therefore, the ComMod activities needed a greater diversity of players so that a broader base of ideas on community situations could be shared, as one female farm type A said.

6.6.2 Communication with non-participants: they communicated their experience at different times and opportunities

After participating in the ComMod field workshop, some participants did not have time to communicate the ComMod events to non-participants because they were always busy. However, some participants communicated such activities to family members and neighbours.

Most of the non-participants did not want to participate in the ComMod activities because they felt it was a waste of their time, while neighbours of farm type B said that

participating in the game was good for acquiring more knowledge. Otherwise, relatives of farm type C said that players participated in the ComMod activities because they were able to acquire new knowledge and earn an allowance also. One younger returned migrant stated that he communicated some of what he had learned in the workshop to his friends. While some of his friends wanted to participate in the events, some felt the game was suitable only for children. Nevertheless, the migrant thought that the RPG sessions was similar to a review of who he was and what he did**.** So, he wanted to invite other youths to join because they would acquire knowledge about agriculture, time management, and future planning.

Because ComMod activities tend to consist of many objects, participants were interviewed on how they might have impeded the participants' communication with non-participants. Two older farm type A representatives stated that they could not explain the activities to non-participants because they did not have pictures to show them while they were verbally explaining ComMod events. Moreover, there was too much detail. Nevertheless, the younger players did not get confused like their elders, and they were able to communicate the details of ComMod activities with non-participants.

6.7 Effects on decision-making, actions, and practices

The change in the ComMod participants' perceptions and behaviours might be unconvincing for people who did not participate in such activities. To provide a more in-depth understanding of ComMod effects, the changes in decision making, actions, and practices of local farmers are examined below.

6.7.1 One farm type A rent land and apply a more scheduled approach to cultivate

He has changed his decision making because the first and second gaming workshops motivated him to follow and practice the activities that he had learned while participating in these events, particularly the dry season activities. In the dry season, he now understands that he should grow plants for family consumption and he cultivated cassava in the 2008 crop year.

6.7.2 Decision making for farm activities in dry years motivated some participants to change their agricultural practices

One farm type A representative has decided to divide his farm land to grow RD6 and KDML 105 rice varieties. He said that if he will face a drought year, he would plant more RD6 than KDML 105 since his family members normally eat RD6. In drought conditions, he has come to understand that less RD6 can be produced, which would mean a shortage for family consumption.

6.7.3 One farm type A participant improves his farm pond and invest in an artesian well

This change was brought about by his participation in the final field workshop. He is also planning to practice integrated farming so that his daughter can get involved in farming. His neighbour has confirmed that he has changed to become more of an active farmer who wants to do something more for his family. Another woman from farm type A has also improved her farm pond by re-building it so that it is bigger. She claimed that the sessions increased her understanding that she could not do much in the dry season if she did not build a farm pond. While one male farm type A representative told that he improved his farm pond after participating in the ABM simulations, he realized that a big pond can store an abundance of water for use, and the big field plot can store water in his field plot as well. Thus, a big farm pond is better than a small one, but it is hard to build it on a small farm because the farmers will lose rice land.

6.7.4 A farm type B participant has started using a new rice variety

In the RPG sessions, a farm type B asked a farm type C participant various questions about the rice varieties he grows, when their rice will be harvested, and how they earn their incomes. This communication increased her understanding of seedling, rice transplanting techniques, and she has learned that different rice varieties have different uses and harvesting times. She feels that because different players had different ideas. She was able to start using a new rice variety in 2007/2008 crop year thanks to her collaboration with a farm type C participant.

6.7.5 Changes are made in different ways

A farm type A women said that if the labour allowance was high, she would allow other villagers to rent her land because she would benefit more from such an arrangement. However, she visualized the concept of hiring labour for the transplanting and harvesting of rice in her mind only. One woman from farm type B also changed her mind about migrating in the dry season. This effect was observed with another woman from farm type A. She gained new knowledge about the benefits of labour migration by asking the labour migration family members some questions and actively participating in the simulated labour migration scenarios with the ABM. She better understood that labour migration in the dry season is one way for making money outside of the family concern.

Figure 6.1 presents a comparison of the changes effected on the participants' farming actions, and practices.

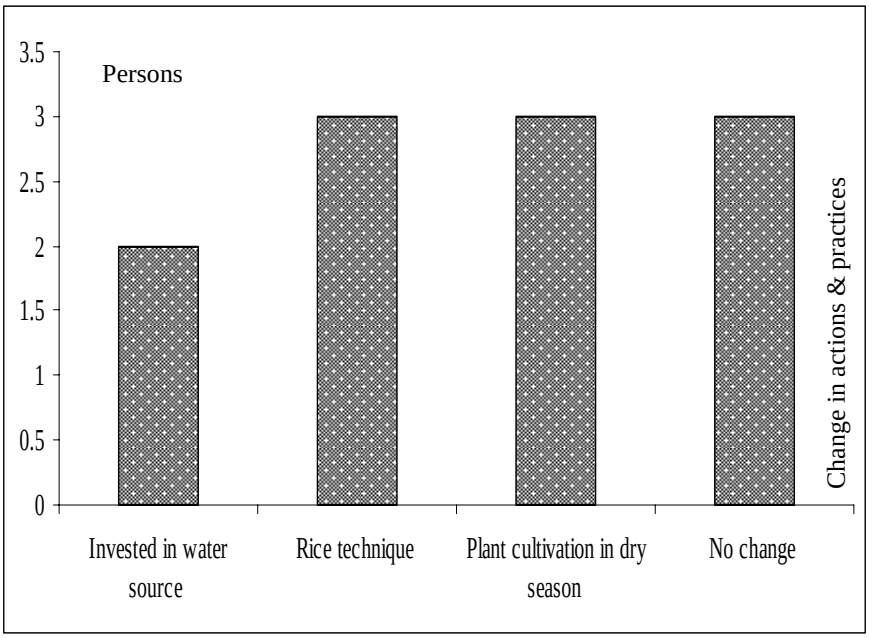


Figure 6.1 Comparison of the changes effected on the participants' farming practices after completion of the ComMod activities

The two farm type A participants who have made no changes have done so because they lack labour resource; the farm type C participant who made no change has done so because

all knowledge from the ComMod activities was common, traditional knowledge, of which he had already understood.

6.8 Capacity building effects

6.8.1 Towards collective decision-making

The irrigation canal and community pond scenarios encouraged the players to think of how they could solve their water problems together. As mentioned before, the ComMod activities allowed the Mak Mai villagers to have more time for collective discussions on the use of common resources. The process allowed each of them to speak their minds in an environment valuing the equal opportunity for all participants to talk. Some farm type A participants said that the sharing of ideas was better than each participant thinking alone. In the future, holding discussions and taking an active part in the problems of the community will empower the local villagers to solve their own problems. Participatory activities similar to ComMod are indeed one way to solve the community's conflicts as well.

6.8.2 Effects on non-farmer participants

6.8.2.1 The TAO officer learned a new methodology for collective discussion and decision-making useful for TAO planning

The ComMod activities, particularly the ABM simulations, gave to all participants the opportunity to share and discuss their ideas comfortably. The ABM simulations could also be used as a media to facilitate the exchange of ideas among TAO representatives. They could see each other's projects and be able to compare each other's ideas. They could then share ideas about the respective benefits of each project and their effects on villagers. She concluded that this approach might prove very useful for a community's collective development as well.

6.8.2.2 An ARD officer learned about organizing a ComMod workshop for collective sharing of ideas with villagers

ComMod offered a new participatory approach for her to learn the steps of the thinking process and to analyze the community situations with villagers. She received the new ideas and view in organizing villagers' meeting and training as well. Additionally, she commented that the preparing procedures were very difficult for an organizer who did not have previous experience with computer simulations.

6.9 Specific effects of the main ComMod tools

In the participatory modelling approach used in the Lam Dome Yai watershed case study, the RPG and ABM were the main tools used with the various stakeholders. The specific effects of these tools on local farmers are examined below.

6.9.1 Role-playing game (RPG)

RPG were built and used to "open the back box" of the complex system of interactions to be examined and to help the participants to understand the subsequent ABM and to contribute to its construction with their own knowledge.

6.9.1.1 RPG and respondents' actual circumstances: the relation with reality

The successive RPGs were created based on local farmers' actual realities. Farm types A and B stated in the interviews that the RPG was similar to local farmers' realities in that the RPG was used to discuss the facts of the typical farmers' reality on the farm. This was particularly true of the RPG held on 10-11 October 2006; that RPG provided a very detailed account of RLR transplanting situations, even showing the players' farm locations. Consequently, the players made their decisions according to what they had always done on the farm; some players made decisions to transplant rice late because their farm was located in higher land areas. Later on, one man from farm type A stated that the RPG seemed to practice, or put into action, theoretical knowledge. Furthermore, the RPG motivated the players to ask questions, present their ideas, and answer questions because it the RPG's design was heavily influenced by the typical Mak Mai farmer's reality. Thus, the participants were able to exchange ideas and knowledge without confusion because they had all relevant experience.

A farm type C participant had a very different perception. He was unable to suspend his beliefs for the purposes of the gaming sessions because the fact was that the participants would never be able to spend as much money on the hiring of labour in reality as they could in the simulated RPG because labour wages depended on shifting agreements among employees and employers each year.

6.9.1.2 RPG and knowledge acquisition

Even though the ComMod approach was designed to facilitate a sharing of knowledge, all participants said that the first workshop was very difficult to understand because they could not imagine what they would do. In the second field workshop, the research team used a computer replaying the RPG session. All participants concluded that the computer presentations in plenary helped them to understand the RPG better; it was easy to generate point at issues, and they could repeat their answers several times. The RPG helped the players to learn about and engage with academic agriculture with their own experience. It was a "learning by doing" tool, stimulating thinking the same way as studying in intensive courses with a teacher might. This effect stimulated a farm type B participant to get the idea that she would invite both her husband and father to participate in the RPG sessions because they would acquire new knowledge from other players, and it would be easier for her to change their perceptions on doing farm work.

6.9.1.3 RPG and communication to facilitate collective discussion

The effects on facilitating communication for farm type A: the use of a RPG is one of the best methods that made us transfer our knowledge to other players, makes the players understand the unusual problems easily, and RPG sessions are better remembered than ABM simulations. "It is the communication tool between local farmers and researchers as well" farm type B said. When comparing the RPG with other participatory tools, the players confirmed that because they took part in all steps of the RPG sessions, they learned new knowledge from their experience by themselves, can play, watch, listen, communicate, and understand farming situation immediately while general practice they had listened only. It is also spend less time method, but could help players to get new ideas. Thus, the first RPG session and the ABM simulations about hiring out-villager labour were very less interesting for participants because the players looked at the situations at hand and decided to do the farm activities by themselves only, and there was a lack of communication.

6.9.1.4 RPG sessions were too fussy, confusing, and hard to understand

One old woman from farm type A said that RPG sessions were too fussy, confusing, and hard to understand. So, it was more suitable for younger people rather than elders because they could better remember and understand the RPG's rules. Another stated that

they could not explain the RPG sessions with non-participants because they could not remember all the steps, but they did remember the important outcomes. Finally, one farm type C representative stated that the RPG was easy to play and easy to forget because he could not refresh his memory about his decision-making when participating in the RPG session. In contrast, the ABM simulation recorded his decision-making into the computer, allowing him to refresh his memory whenever he wanted.

6.9.2 Agent-based model (ABM)

The ABM was built under the CORMAS (Common-Pool Resource Multi-Agent System) simulation platform, which is a Multi-Agent Systems programming environment using the Smalltalk object-oriented language dedicated to the representation of the management and dynamics of renewable resources (Warong Naivinit, 2008). In the Ban Mak Mai case study, the "Ban Mak Mai model (BMM model)" was gradually constructed with the farmers and used to facilitate the sharing of knowledge about land / water and labour management.

6.9.2.1 ABM and respondents' actual circumstances: the relation with reality

One man from farm type A stated that the ABM's features seemed to be based on theories found in books. He was easily able to compare and identify similarities or differences with reality because when he saw the ABM running simulations on a projector screen, it enabled him to understand what decisions he made for both his rice production process, his land and labour management. Some players from farm types A and B commented that some scenarios were very close to actual circumstances. For example, the fourth plot of paddy field land was 40 rai with 4 labourers, and this farm did not need to hire labour; a 20 rai farm transplanted the early maturing rice before the late maturing rice; and the rainfall stopped in the rice transplanting season. Finally, the most of ComMod participants like the ABM because the ABM simulations more easily facilitated collective discussion process than the RPG sessions, the players would be eager to participate in new ABM simulations sessions to examine other agricultural issues in the future, such as local markets, bio-fertilizer production, integrated farming, etc.

In contrast, all players stated that the simulated scenario about the hiring of foreign labour was less similar to reality because the local farmers generally hired labourers from their own village, wanting only to pay their fellow villagers. Another reason for why the

ABM was perceived to be less similar to reality was because it seemed to take short cuts in the learning process, and it did not follow the various steps of farming activities. Moreover, one woman from farm type A said that if some unusual situations were created by the ABM design, it would most probably cause misunderstandings among the players. For example, she would not want the hiring of alien labour to be simulated by the ABM because some people could get the wrong idea about Thai traditions; most farmers do not hire alien labour.

6.9.2.2 ABM and knowledge acquisition

The ABM stimulated thinking and learning by the presentation of agents such as the decision-making of the players on the hiring of labour, and farm pond use. The use of water from farm ponds helped the players understand their decisions without too much confusion because they could see all the participants' decisions on the projected screen. A farm type B participant confirmed that the ABM increased her knowledge because in the final ABM simulation session she could answer the researchers' questions immediately without assistance. If the ABM model simulated other situations than farming ones, elderly players would not participate because they have little experience and will not be able to apply the new knowledge to practical farming.

The players agreed that the ABM simulations were suitable for younger players because they have experience with and knowledge about computers. The TAO representative stated that the ABM was suitable for adults as well because they can synthesize the ABM symbols. So, they can understand the simulation faster than older people. A woman from farm type A said that for more intellectually inclined people it was easy for them to acquire new knowledge by reading or writing, while a 'learning by doing' method, similar to one employed in the ComMod approach, was the best way to gain knowledge and apply it to reality for non-intellectuals. Another woman from farm type A confirmed that the lessons from the gaming and simulation sessions were useful to get new ideas to do things differently.

6.9.2.3 ABM and communication to facilitate collective discussion

Farm type A and B representatives said that the ABM was the best tool to stimulate exchanges knowledge among the players because each of them could observe the other players' decisions by watching their decision-making on a projector screen. This made it easy for the players to compare and identify similarities or differences with reality. One woman from farm type A said that the ABM stimulated collective sharing of knowledge and ideas because

it was easy for the participants to use their imaginations and the participants were able to reverse previous decisions anytime they wanted. The last comment was that the ABM features on the visual interface displayed on the screen are similar to a map, enabling the participants to understand faster because exact farm locations are shown and they can see the simple images on screen, including: farm ponds, KDML 105 and RD6 transplanted areas, farm labour, and family member migrations etc. A farm type C representative stated that the ABM features allowed for ease of play and enabled the participants to remember what they had done during the simulations. In contrast, another farm type C and farm type A representatives said that while the use of ABM facilitated collective discussions easily, and was able to generate ideas, they did not like the abstract ABM because they considered it not realistic.

One woman from farm type A gave a different opinion. She stated that an ABM that was too easy would not be so good because non-intellectual people might not be able to understand real farming activities. However, the players agreed that even if the ABM simulations were easy to understand, new players would still need to start playing with the RPG before to look at the ABM running simulations because they would need to know where the information in the ABM comes from and how it is processing it.

6.10 Comparison of RPG and ABM by the participants

Table 6.1 presents the similarities and differences of participants' perceptions between RPG sessions and ABM computer simulations.

Table 6.1 Present RPG sessions and ABM simulations according to the participants' perceptions

Topic	RPG	ABM
Facility to memorize	Cannot refresh	Can easily repeat scenarios several times
Reminiscence on memory	Easy to remember because based on learning by doing	Easy to remember because it stays in mind, easy to forget because based on learning by watching
Participation	By playing doing things individually	Participating by collective watching
Appropriate number of participants	10 - 15 with different ages, education, and experience	20-25 with people who like thinking
Process	Slow and need to wait for other players	Continuous and without break
Time used	Need more time	Need less time
Tools' features	First RPG was too fuzzy, confusing, hard to understand,	Easy to understand and to identify features
Rice production	More detail and complete on rice production steps	Takes short cut and does not follow all steps
Generation of future scenarios	Integrated farming, trade & marketing of farm products	Marketing farm products, vegetable cultivation in the dry season, migration of family members

6.11 Different effects on ComMod participants

Tables 6.2 to 6.4 present the different effects on ComMod participants among local and non-local farmers.

Table 6.2 Different effects on farm type A participants

Difference effects	Farm type A
Awareness of the issue being examined	• Labour shortage may occur because of labour migration • Variable rainfall distribution scenario stimulated to pay attention
Knowledge acquisitions	• **Agro-ecological system:** differences in RLR production conditions across farm types, levels of water in filed and pond were related • **Agricultural practices:** have to set up a water supply to operate community pond, RLR seedling in May could be a good technique, direct seedling of rice in dry year • **Economic sub-system:** though to compare advantage and disadvantage of labour migration and growing some kinds of plant • **Social sub-system:** irrigation canal could not provide enough water: villagers still migrate, most villagers were children and elders
Changes on own perceptions	• **Aspiration**: want to practice integrated farming • **Opportunity:** possible new source of income in dry season
Effects on other players' perceptions	• **On their opinions:** ComMod approach was used to learn about local farmers' activities and situations
Effects on own behaviour	• Changed to start being quick thinker, speaking with more confidence
On communication and networking	• **With participants**: communication provides powerful techniques and ideas for farming activities, and strengthened unity and relationships
On decision-making, actions, and practices	• Rent land and apply a more scheduled approach to cultivate • In drought year, grow more RD6 than KDML 105 • Improve farm pond and invest in artesian well
Role-playing game	• Made us transfer our knowledge to other players • Too fussy, confusing, and hard to understand for older
Agent-based model	• 20 rai farm transplanted early maturing before late maturing rice was very close to actual circumstance • Some unusual scenario would probably cause misunderstanding • Easy to generate ideas

Table 6.3 Different effects on farm type B participants

Difference effects	Farm type B
Awareness of the issue being examined	• Irrigation canal and community pond scenarios guided to think possibly conflicts and problems
Knowledge acquisitions	• **Agro-ecological system:** when water in pond could be pumped and how much could be saved for later use, paddy with farm pond could start producing rice seedling earlier • **Agricultural practices: t**ransplanting 20 day old RLR seedling is a good practice • **Economic sub-system: t**ake good care of farm produced more output and got higher income, recording farm expenses could accurately calculate farm income
Effects on other players' perceptions	• **On their respective situations:** family member migration because needed more income • **On their opinions: f**arm type A and C made their decisions to transplant rice early because need more time to take care of rice, ComMod research team used ComMod approach to learn about local farmers' activities and situations
Effects on own behaviour	• Become more experimental in ComMod approach to farming
On communication and networking	• **With non-participants**: neighbours said that participating in ComMod field workshops were good for acquiring knowledge
On decision-making, actions, and practices	• Has started using a new rice variety
Role-playing game	• Learning by doing too
Agent-based model	• Increased knowledge and no need assistance

Table 6.4 Different effects on farm type C and non-farmer participants

Difference effects	Farm type C	Non-farmer participants
Awareness of the issue being examined	• No change on awareness about labour migration because had enough family labour	
Knowledge acquisitions	• **Agro-ecological system:** - understand other players who had similar farm to them made their decisions	• **TAO representative:** New idea to facilitate sharing of TAO' idea and community collective development • **ARD officer:** new participatory approach for organizing villagers' meeting
On communication and networking	• **With non-participants**: relative said that participating ComMod activities were able to acquire new knowledge	
Role-playing game	• Easy to play and easy to forget	
Agent-based model		• **TAO**: suitable for adults

Based on the assessment of the various effects of the ComMod activities on the participants in the process, a discussion of how to improve further the ComMod approach and the monitoring and evaluation methodology employed is presented in the next chapter.

CHAPTER 7

DISCUSSION ON THE MONITORING AND EVALUATION METHODOLOGY USED IN THIS RESEARCH AND ITS IMPROVEMENT

In the first section of this chapter the researcher served as the evaluator of this study will present about the monitoring and evaluation methodology used. The applicability of the ComMod is presented in the second section, and suggestions for improvement of the ComMod approach is presented in the last section. Discussion of the M&E methodology is carried out to improve the project's management throughout. This chapter presented based on the evaluator's experience during three years to monitor and evaluate the ComMod effects.

7.1 Evaluation of methodology

The purpose of the discussion is to present the advantages, disadvantages and obstacles of the methodology used and the process that was implemented.

7.1.1 Monitoring and evaluation process

The monitoring and evaluation (M&E) process was widely implemented to gather information on the ComMod process to improve future ones and their management.

7.1.1.1 Evaluator who had experience of ComMod activities and the M&E process was needed

Presently, for Thailand field work, ComMod is a new and very complicated participatory approach which needs more in-depth understanding of its principles and process of implementation. Under the ComMod characteristics, evaluator who had experience of the ComMod approach and M&E process is needed to ensure the information gathering is relevant and complete. The evaluator's experience also saves time in the information gathering process.

7.1.1.2 Collective design of the M&E indicators is an important first step of the M&E methodology

Indicators are evidence and agreements of the evaluator which are used as guides to evaluate inputs, processes, and outputs of the ComMod in the Lam Dome Yai watershed site study project. These indicators are then used to demonstrate M&E results and take corrective action to improve ComMod project delivery. So, participation of key stakeholders (including local farmers) in defining indicators in the first session of such a process is important. However, the ComMod approach is an iterative process, therefore the M&E indicators need to be improved, refined, or modified throughout the process implementation.

7.1.1.3 Transcription, data presentation and coding processes heave to start immediately after data gathering is completed

Because the ComMod process is an iterative and evolving one, analysis of the information gathered needs to be undertaken immediately after its collection for an evaluator to avoid to find herself in front of a large amount of information and have problems to make sense of it or to analyse it under M&E key themes and evaluator's intuitive understanding (J. Shapiro, 2001). Undertaking this step at once is also very useful for identifying new useful questions to design the individual interview's guidelines to be used subsequently.

7.1.2 Evaluation tools

7.1.2.1 Participatory observation

1) Participatory observation helps to compare participants' reactions happened inside each field workshop

Collecting evaluation data by directly observing ComMod activities and informally interacting with participants throughout the process is a good way to get a rich dataset. It is a tool that helps to confirm whether the evaluator's understanding and information gathering by other tools is correct, or not. The evaluator can see the reaction of participants and use the results to cross-check with the results of the interviewing process.

2) Specifying the participant who the evaluator needs more in-depth information from

The first observation process provides the evaluator with a general overview of ComMod activities, and helps to visualize particular participants' actions and behaviour when the ComMod activities are carried out. A second observation of the participants is needed to better understand their reactions, along with the ComMod activities, to observe the key participants who will be good interviewees, and specify the participants who can help the evaluator get ideas for formulating questions that can be included in the guideline for individual interviews. The special participants are also the key informants of the interviewing process. Because the local famers came to participate in the ComMod field workshops in pair, so specifying the participant helps evaluator get in-dept information.

3) Having no guidelines for observation is not good for inexperienced evaluator

Observation guidelines are like a map for an inexperienced evaluator to use in the participatory observation process. If there are no guidelines, the junior evaluator may observe all things during the activities that are implemented. Some things may not be useful for the evaluation process and the evaluator will lose time as well. The observation guidelines might be designed under the field workshop's objectives of the ComMod team and the interviewing's results. Check lists are also commonly used in the observation process.

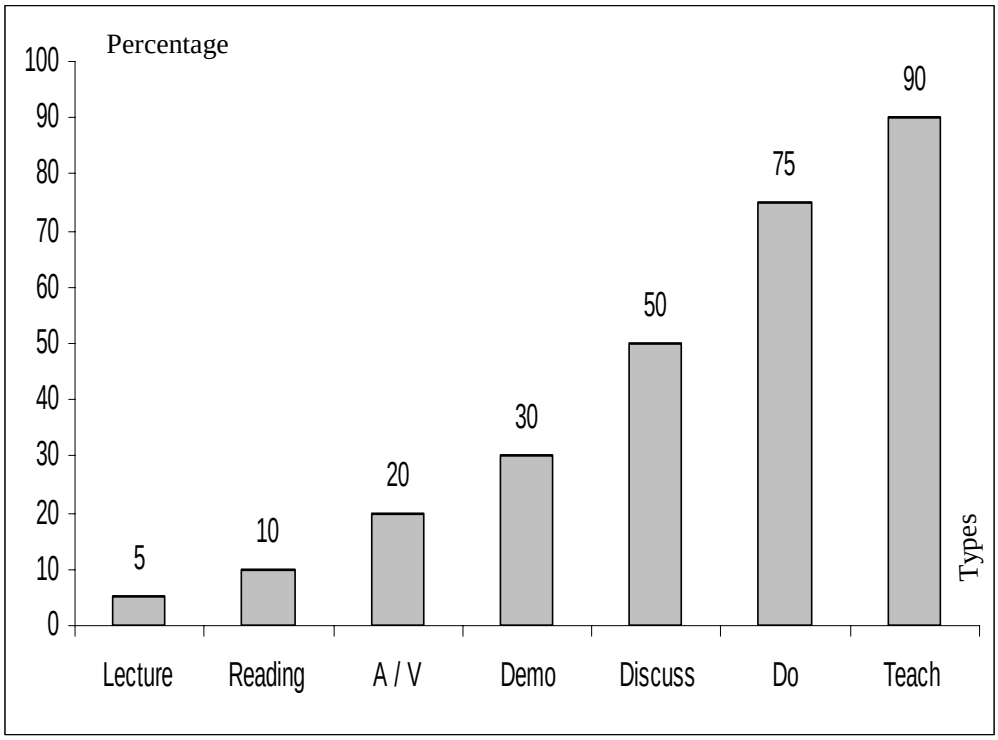
7.1.2.2 Individual interviews

1) Guidelines for interview provide precise information on what the evaluator needs to know

Precise guidelines help to ensure and cross-check that the information was collected along participatory observation. It also gives in-depth and detailed information on the evaluator's needs. Precise guidelines are also useful in organizing the following steps of data presentation and analysis of the M&E results.

2) Interviews one month after the workshop is not good, one week after would be better

The ComMod activities were implemented with large details and in multiple sessions. So, some participants could not remember the main ideas and events that occurred during the workshop because of different brains' retention. According to Pornpilai Leartvicha et al. (2005), the brain's retention after 24 hours of the learning process at different levels, so remember' ability of participants depends on type of participation's techniques (figure 7.1).



Remark* A/V = Audio / Visual, Demo = Demonstration

Figure 7.1 Presented the different levels of brain's retention 24 hours of participants after participation in different communication tools

From the figure, lecture, reading, audio/visual, demonstration, discussion, doing, and experienced teaching are the generally main kinds of the method used for learning. ComMod tested at this site consisted of audio and visual, demonstration, discussion, and

doing things. The agent-based model (ABM) mainly consists of audio and visual where the brain can retain 20 % only. If the interview process is carried out more than one week later, the players will not remember the ABM sessions and principles particularly elder participants. Therefore, one week after is the best period to get pertinent effective information because the ComMod participants remember better.

3) Specifying the key informant for each interview process

Finding knowledgeable informants is the first step of the interviewing process. The participants in the ComMod process came in pairs: husband and wife; father and son; father and daughter; mother and mother-in law. Specifying the key informant saves the evaluator's time and makes it easy for the evaluator to formulate the guidelines for interview because the evaluator knows who will be able to give pertinent information. Nevertheless, the key informant depends on the type of information the evaluator seeks and with whom he/she wants to compare. The evaluator may interview one or many different informants (W.K. Kellogg Foundation, 1998).

4) The Designer Questionnaire (DQ) used for evaluator interview the ComMod designer is to be used after the last workshop

DQ is one of the raw ComMod information sources of all sequences. The evaluator used DQ to interview and fill out the information about all ComMod activities with the ComMod user after second and third field workshops. Carrying out the DQ process after the last field workshop is better because it is easier for the ComMod leader and evaluator to generate ideas and the evaluator can originate precise questions during the interviewing process. However, the evaluator needs other ComMod research source to overview the process at first such as logbook, and ComMod field workshop reports.

7.1.2.3 Story telling

1) It is a friendly and open-ended tool for a storyteller to tell about a ComMod experience

Story telling consists of two or three questions, main principles, and does not have guidelines. Storytelling gets inside the minds of the individuals who collectively make up an organization and affects how they think about themselves. It is an easy tool for the

evaluator to support and motivate the storytellers to tell the stories concerned with significant changes with no time limitation.

2) It is difficult and time consuming to analyze and synthesize the effects of ComMod activities

Some storytellers tell very long stories and some details are not concerned with the effects of ComMod field workshops. Therefore, during the synthesizing step, it is very difficult to find useful information. However, the evaluator should make a decision on what the story is about and write the final evaluation report (Kanika Sukkasam and Suchart Prasitrattasin, 2004).

3) Choosing a good storyteller who has experience of telling stories is important

Storytelling is the traditional activity of local people to tell about the history of their village, their culture, and so on. A good storyteller who has a rich oral or folk-story background is able to give an important perception of ComMod effects and she / he may give interesting recommendations as well. The evaluator may find a good storyteller useful during the implementation of the interview and observation processes.

4) Writing and recording important things

Writing and recording important things while the storyteller is speaking makes it easier for the evaluator to remember when analyzing, synthesizing, and making the evaluation report. Taking short notes also saves the evaluator's time. Tape recording can be helpful to verify that the information is correct. It also is evidence for discussion about the evaluation report. Although, it is commonly believed that people with an oral culture have excellent memories.

5) Using this tool with the same participant before the ComMod process, at mid-way and at the end would be good

Using the story telling tool three times with the same participant is easy and useful to monitor the participants' changes of perception, behaviour, action, and so on. The evaluator's understanding of the story should be gradually improved each time as well, and the information would be useful for improving the project during its implementation.

7.2 General applicability of ComMod in lower northeast Thailand

7.2.1 Suitable issue

The most suitable issue for the participant's occupations or situations should be chosen. In lower northeast Thailand, farming is the main occupation of local people. This is followed by employee, trader, and government officer respectively. If the ComMod objective is used as a platform to improve their livelihood, an issue concerning agriculture is most suitable for them, such as integrated farming. The issue may focus on sharing knowledge on advantages and disadvantages of monoculture and integrated farming. Then integrated farming is offered as an alternative agricultural practice. The issue examines things such as the comparison of family incomes between integrated farming and monoculture farming, varieties of agricultural marketing, affects of monoculture farming and integrated farming on the environment, and so on are also offered.

7.2.2 Stakeholders' arena

ComMod is one of the alternative approaches to facilitate communication because it motivates and engages all kinds of people to participate collectively. A greater variety of players involved in the ComMod activities should be good. 10 -12 households for RPG sessions (come in pair) and 20-25 people for the ABM simulations are suitable numbers because participating in the RPG and ABM activities requires deep thought, and concentration to take part. If the ComMod is to examine monoculture and integrated farming under RPG, the 10 -12 households for the RPG participation should consist of monoculture households; young and elder households, integrated farming households; young and elder households, government agencies, TAO representatives, village chief, local NGO, and local scientist at least 3-4 person per group of participants. For the ABM, the relation of participants is similar to the RPG, but an increased number of participants are involved, particularly the ratio of farmers and government agencies because they are the main group of people who influence on agricultural improvement and movement.

7.2.3 Tools used

In The ComMod process implemented in the Lam Dome Yai watershed, the RPG and ABM were the main tools used to facilitate collective discussion about community and local farmer situations. As a result, the RPG engages the participants to discuss about resource

management, land/water and labour, situations because it consists entirely of details and steps of agricultural practices that stimulate the farmers to think of the reality of their situations. Adaptive management of integration farming practices needs to change farmers' perceptions and paradigm, so the step by step process of the RPG is a fitting tool. The RPG is also an appropriate supporting tool among both young and elder farmers' sharing about their farming experience. Lastly, the RPG is a low cost, easy to design supporting tools, and it is learning by doing tool. Nonetheless, it is better if the ComMod user can offer the ABM because it will be able to present the decision-making of all the RPG's players. It helps the players understand other players' perceptions clearly.

7.2.4 Model of applicable ComMod process

One interesting issue is RLR production with or without chemical inputs. After collective sharing of ideas with villagers, the ComMod user may propose the RPG about investment among chemical and non-chemical use in agricultural production, sharing knowledge about the effects on the environment and health. Key decision-makers or farm workers from the same village, and public organizations in the sub- district and district are responsible people who should be invited to participate in the collective sharing of knowledge. The students who study agriculture in the local university may also be invited because the ComMod approach provides a chance for them to better understand on agricultural practice, which may change their behaviours, and actions in the future. In this case, the ABM and the RPG will be used together because the issue of rice production with or without chemical inputs use may consist of qualitative and quantitative components. So, using the RPG and ABM throughout the ComMod process helps the participants better understand. Finally, a reporting of stakeholders' actions and plans should be present for all participant groups and other people to increase their understanding on agricultural practice and local people perceptions.

7.3 Suggestions for improvements

7.3.1 On the process management

1) All stakeholders to participate in the model designing, improvement, and the selection of subject

One objective of all participatory approaches take into account the existing local village situations to stimulate local villagers' awareness about their realities. People from outside the village offer alternative approaches for villagers to learn new things by using new innovative methods: the ComMod approach. Collective development needs stakeholders to take action with new innovation so, they can apply these approaches and use a simple simulation to facilitate, negotiation and discussion in the future by themselves. The selection of subjects also needs more stakeholders' participation because local villagers understand their actual circumstances the best. Therefore, formulating the ComMod process in the stakeholders' interest is better to get more ideas. However, it is impossible to involve all participants in designing the model, so the ComMod team may select the participants' representative who will be able to be a key man in village development.

2) Explain and share ideas of the whole ComMod process before implementation

Three ComMod participants said that they did not understand why the ComMod research team invited them to join in the field work activities. It is importance to say that understanding the whole ComMod process and objectives is an important step which influences whether the stakeholders participate in the process or not. Understanding the ComMod process may engage them to participate in the ComMod activities more. If they participate in the ComMod process just because they are invited, it is not useful.

3) Do not simulate about the same subject for a long time

To give local farmers a clear understanding of decision-making, the ComMod research team showed simulations about the same subject for a long time. Sometimes, the participants may get bored because they think it is not important, too general, and not useful. For example, an elderly man and woman of farm type A told me after they participated in the 24th April 2007 field workshop that "I feel that participating in this field workshop was similar to the last three workshops, it becomes repetitive and I did not learn new things". The ComMod process

increased local farmers' knowledge, learning management and living situations. Learning new things means they gain new ideas, so the ComMod team should create new subjects for local villagers' to learn.

4) The researchers should add more precise problem conditions into the simulation sessions

ComMod participants considered that the process resolved the village's problems. Adding significant problem conditions, particularly community problems, might affect their way of life and help them to find a way to resolve villagers' problems. The evaluation results can say that Mak Mai villagers did not consider the labour migration situation and the effect on their perception was minimal. Because they are farmers, the problems such as rice marketing, rice investment, selling rice and so on are the issues they proposed. One man of farm type A said "the research team do not add problems in the rice transplanting activities, so other people may think that rice transplanting is easy." However, designing of problem conditions depends on the type of stakeholders involved as well.

5) Present outputs or results for participants and other villager at the end of the project

This process is like a conclusion session to generate all stages of the field work activities and provide the participants with an opportunity to ask questions about imprecise sessions. It helps them to see their knowledge's improvement, point out to them how to improve their lives, and it also motivates them to think of any future activity they will be able do. Present outputs can increase other villagers to understand village members' perceptions and ideas.

6) The migrants should have been interviewed to see if his answers were the same as their parents or not

The ComMod approach was used in this case to better understand the farm labour management. Representatives of family members answered the questions on the migrants' ideas on the migration situation instead of the migrants themselves. It would be better if the interviewer interviewed the migrants in person. This would have helped the evaluator to get more precise information about decision-making regarding labour migration.

7.3.2 On its main tools

7.3.2.1 Role playing game

1) The ComMod process is also appropriate for solving communities' problems

The design of the RPG in the Lam Dome Yai watershed case study was done under individual decision-making in both decision-making on individual and public water sources. The results showed that the ComMod process is also appropriate for solving community problems because it provides simple guides for villagers to create collective discussion and agreements. It helps them to see the other villagers' perceptions, behaviours, and actions easily.

2) The simulated RPG should be carried out at a fast pace

The RPG progresses in stages, for each step of rice production. It helps if the participants understand such a process clearly, but long time use is a limitation of the RPG. If the RPG user can moderate the RPG and move from stage to stage faster, it will be better because the participants will not get bored and their interest will increase. However, it depends on the type of players and the issue proposed: it is impossible to move fast if some of participants are elderly.

7.3.2.2 Agent-based model

1) New participants need to experience the RPG two times to know about the ABM operation and symbols' meaning

Understanding the RPG's features is the first thing for a new participant to learn on how to use the ABM and how it works. If the ABM simulation is seen by someone who has never played it before, maybe, he /she has to spend a lot of time to try to understand it. Elderly participants who participated in this case study agreed that they were able to understand the ABM after they participated in the RPG two times. They could understand the ABM symbols' meaning, and that the information in the ABM model was similar to the information in the RPG: the older of farm type A said "the ABM copied the players' decision information from the RPG". However, younger players immediately understood the ABM because they have experience in rice transplanting, computer features, and received better formal education as well.

2) Changing symbols and colour in the ABM model

Symbols in the ABM model influence the players' understanding: white indicates that no rice has been transplanted; yellow indicates the rice harvesting period; blue indicates a canal; people in different colours indicates they live in different households; somebody staying home means that they are not working on the farm. Most of the ComMod participants are elders, so changing the ABM's symbols so that they are bigger would be good. The colours are also changed, such as the colour of the water in the farm pond should change to blue, growing rice should be painted green while mature rice should be yellow.

3) ComMod players do not want the researcher to run simulations with wrong Thai traditions and abstract model because it is not useful

All ComMod participants have the same opinion that the ABM is very close to their actual circumstances and influences their perceptions change and have new ideas to do. However, the abstract ABM simulations of different local people's realities are less useful because other villagers may misunderstand their realities and they cannot apply new abstract knowledge to their realities, particularly in farming.

The ComMod approach was implemented with local farmers at Ban Mak Mai village by using the RPG and ABM tools which provided new ways of collective sharing of ideas and knowledge, especially about land / water and labour management. It also helped the villagers understand each other. In the next chapter, the author will present the conclusion of the ComMod process by dividing it into two topics: the conclusion of the ComMod approach to improve the use of such an approach; and propositions to promote integrated resource management.

CHAPTER 8

CONCLUSION

This research was done to: 1) test the proposed monitoring and evaluation (M&E) methodology; 2) monitor and evaluate the different types of effects of the companion modelling (ComMod) approach on participants; and 3) make recommendations to improve the proposed M&E methodology. The researcher used qualitative research methodology; participatory observation, individual interviews, and story telling were the main tools used for data gathering in the rainfed lowland rice ecosystem of the Lam Dom Yai watershed, Ubon Ratchathani province. The respondents were 11 were made up of representatives from local farming households at Ban Mak Mai Village, Klang Sub-district, Det Udom District, Ubon Ratchathani province, a local NGO, a government agency, and the lecturers. The data were analysed using data coding technique. In this chapter, research conclusions are drawn and suggestions made for future research on monitoring and evaluation.

8.1 The different types of effects of the ComMod approach on participant

The results showed that the ComMod activities could facilitate collective sharing of knowledge about RLR production, labour migration, and water management experiences. Various ComMod effects were observed.

8.1.1 Local farmers became more aware of labour migration issues, the causes and effects of their rainfed lowland rice (RLR) production and water use decisions, and adaptive RLR management practices.

8.1.2 Farmers became more knowledgeable about water issues fundamental to RLR production, the different RLR conditions across the farm types, income management, and the interaction between labour migration and irrigation.

8.1.3 Changes in farmer perceptions towards farming were observed, with farmers aspiring to practice integrated farming and improve water supply so as to tap into new sources of income.

8.1.4 The farmers came to a better understanding of other players' decisions, migration issues, causes and effects of early RLR transplanting, and the research team's objectives.

8.1.5 They had become quicker, more decisive, and more experimental in their thinking, and that they had gained more communicative confidence.

8.1.6 They better understand the usefulness of how the communication process can improve formal and informal relationships and unity.

8.1.7 Changes in the farmers' decision-making, actions, and practices have been observed among farm A and B type farmers: type A farmers intend to plant more RD6 than KDML 105, while type B farmers understand labour migration to be another viable way of making money.

8.1.8 Farmers have a stronger belief in collective decision-making, believing the active exchange and discussion of ideas is better than farmers thinking alone and that this can empower villagers to solve their own problems. Non-farmer participants also realized the potential benefits of collective discussion and decision-making in their administrative and developmental domains.

8.2 Test the proposed M&E methodology

8.2.1 Participatory observation helps to compare participants' reactions happened inside each field workshop. Specifying the participant and having guideline are good for M&E process.

8.2.2 Individual interview by using guidelines provide precise information on what the evaluator needs to know. Interviews one week after would be better and need to specifying the key informant for each interview process.

8.2.3 Story telling is a friendly and open-ended tool. However, it is difficult and time consuming to analyze and synthesize the effects. Choosing a good storyteller, writing and recording important things while the storyteller is speaking would be better. Using this tool three

times with the same participant is useful to monitor and evaluate the participants' changes of perceptions, behaviours, and actions.

8.3 Propositions to improve the use of the ComMod approach in the context of lower Northeast Thailand

8.3.1 Design and simulate situations closest to participants' actual circumstances

RPG and ABM tools designed to simulate situations that closely reflect the participants' actual circumstances is the ideal, allowing the participants to concentrate on issues that will undoubtedly affect them in the future. However, changes need to be made, particularly in regards to the issues examined, the RPG's features, and participation. The simulation technique has become an interesting tool in operational research because of limitations of conventional model formulation using linear programming methodologies and tools. So, various alternative approaches to deal with dynamic complexity of resource management system including MAS simulations are being widely developed, and applied for the purpose of facilitate collective discussion and collective solving real problems; natural resource management (J. Hagmann et al., 2002, Kanchanasunthon, 2007). However, Lam Dom Yai field experience showed that if the gaming and simulation tools are very close to actual circumstances, the participants stick to their routine ways of doing things, to their own real setting, and do not become more creative and imaginative such as some RLR production techniques. In this way is not the ComMod objective. The ComMod approach' objective is to make participants more creative and to explore new ways of doing new things.

8.3.2 Cooperation and collaboration among the stakeholders would increase more if they took part in problem analysis sessions and in preparing supporting tools

The impact on local people will increase when they work intensively with researchers over the period of time research is implemented (N. Johnson et al., 2003). Cooperation can enhance the stakeholders' sense of empowerment and ownership of the process. Outsiders can be most effective if they have a truly facilitating role in a social learning process among the actors and stakeholders (J. Hagmann et al., 2002). The goal of the ComMod approach is to increase human capacity to adapt to changing resource management conditions. For that to be effective, the stakeholders' cooperation is needed particularly in RPG tool.

8.3.3 The time needed to implement ComMod activities should be reduced: do not repeat and implement the same topic several times

At this study site, the ComMod process was implemented over four years. If the time to implement ComMod activities could be reduced, it would benefit the participants by saving them time and, crucially, keeping them interested. However, a simple reduction of time would not be easy; it would depend on the issues, stakeholders, and workshop objectives. But an already trained research team, with leaders who are not engages in degree training, would be able to design ComMod tools and implement field activities in a more time and cost efficient way. At other sites, one ComMod sequence could be implemented in 3-4 months, and not around one year like in our case study.

8.4 Propositions to promote more integrated resource management

8.4.1 Participatory modelling combining computer model engage collective learning on integration resource-use management

The innovative ComMod approach is a co-constructed learning process facilitated by specific tools used by both insiders and outsiders. Computer models have been included as a supporting tool in participatory procedures. The use of computer models leads to a streamlining of cognitive frames, to uniform knowledge, and to develop a deeper understanding of complex and multi-dimensional problems of the interactions between natural and social systems (B. Siebenhüner and V. Barth, 2004). The better suited computer models used are generally simplified so that they can be understood more easily; the models should not dominate the stakeholders in order to facilitate the mutual exchange and the direct communication between scientists and non-scientists (Dahinded et al., 2003 cited in B. Siebenhüner and V. Barth, 2004). The process of collective sharing of knowledge and ideas has been geared toward enhancing the adaptive integrated management of the stakeholders' resource-use at the local level.

8.4.2 It is a bottom-up process that could be used for collective policy setting

In this case, the ComMod process has various tools to encourage the collective sharing of ideas between different stakeholder levels, which provides crucial input for political decision-making. A bottom-up process promotes the people's participation to increase adaptation and efficiency, and is more likely to gain broader support when used to discuss and design new

projects or services. Participation is one of the critical components that aims to initiate a mobilization for the collective action of stakeholders, ownership of policies and projects, increased empowerment of the poor and disadvantaged, strengthened capacity of people to learn and act, and institution building (J. Pretty, 1995).

8.4.3 It is both a self-study and collective process to examine the dynamics of their resource system and the possible ways for finding solutions to problems

The ComMod process provides the stakeholders with opportunities to learn from experience and daily situations grounded in reality. Usually, local villagers learn something from their own existing perceptions and constructions of reality, not on externally perceived realities. ComMod is a good facilitative process for sharing knowledge and ideas through the use of the external researchers' constructed model and inputs from people' realities. As a result, stakeholders are able to gain new learning experiences and engage themselves in discussions based on their experience of land / water and labour management, driven by their goals and needs.

8.4.4 It is a new way to find out what really happens, exposing what was previously unknown and what could happen next

It is commonly known that some local people no time to communicate experience and some people do not want to talk with other people (except in family discussions), particularly about the community activities, resource management situations, opinions and decision-making on resource use; and their land / water and labour management themselves. A farm type A representative commented that "the ComMod activities motivated me to realise that what thing I did and what thing will do in the future". Simulations of possible future scenarios with the modelling tools also allow the participants to explore new situations that they may have to deal with and to understand what consequences they may have on them and the community common resources. In doing this, it is importance to say that the ComMod designer and leader of the process is only a facilitator, because the scenarios and the indicators to assess their effects should be selected by the participants.

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APPENDICES

APPENDIX A

DESIGNER QUESTIONAIRES

Designers Questionnaire (DQ)	
Project Name:	
Location:	
Project Team Members and Roles (such as project designer, team leader):	
Evaluation Date:	
Evaluator:	

Instructions

Save an original version of the Designers Questionnaire (DQ) as a template that you can copy and paste to complete the evaluation. The designers' questionnaire is to be filled out by the project designer (or another member of the project team). The framework consists of four tables:

1) **Initial Context Table**: captures the designers' initial perceptions of the context around which the project was designed.

2) **Method Table:** each method used in the project requires a Method Table to be completed. This highlights the importance of ensuring that you save a clean version of the framework as a template as this table (and the Artifact Table) will need to be copied and pasted for each method used. You work through the methods used in your project in chronological order, assigning a unique number to each Method Table (beginning at 1 for the first method). For each method that uses an artifact, the Artifact Table is to be completed.

3) **Artifact Table:** is linked to the Method Table and captures how you perceive a specific artifact to impact on the participatory and learning process. This table will also need to be cut and pasted for every artifact used in your project.

4) **Contextual Change Table**: records how the context changed over the life of the project. This table is to be used in conjunction with the Method Table to prompt you to reflect on how specific methods impacted on the context.

It is important to read the instructions for each table to ensure they are filled in correctly. After reviewing what is needed for each table, you can complete the Designers Questionnaire as follows:

1. Initial Context Table
2. Method Table
    1) Did this method use an artifact:
    - Yes – Complete the Artifact Table for each artifact used and then go to step 3.
    - No – Go to Step 3.
3. Record in the Contextual Change Table how the method impacted on the context (if necessary). Repeat step 2 for the next method used.

In addition to filling in the Designers Questionnaire, the project team should ensure that the completed Task 2 document – Canvas de Montfavet – and all relevant project documents are sent to the evaluator (prior to their first meeting) so that he/she can gain an understanding of the project. Once the Designer Questionnaire has been filled in and reviewed by the evaluator, a storyboard will be constructed by the project team and evaluator together. The storyboard will include a timeline of the project, methods implemented (including those intended but not implemented), artifacts used, stakeholders involved and what interactions took place between them. This will provide a graphical representation of the project process and will also act as a quality control mechanism in terms of how the process was presented in the Designers Questionnaire. The project team will then communicate to the evaluator where and why a 'loop' (or cycle) begins and ends (also to be represented on the storyboard). The project team's explanation of loops as they occur in their particular project can then be explored further if necessary. The next step involves working with the Participant Evaluation Framework (PEF) to gain an understanding of the participants' experiences of the project.

Initial Context

Fill in the 'Initial Context Table' below to describe your initial perceptions of the context around which the project was designed. The Contextual Change Table (found later in this document) will encapsulate how the context actually changed and how your perceptions of the context changed over the life of the project.

<table>
<tr><th colspan="4">Initial Context Table</th></tr>
<tr><td>Contextual Aspect</td><td colspan="3">Initial perceptions of the context around which the project was designed</td></tr>
<tr><td>Physical System</td><td colspan="3"></td></tr>
<tr><td>C1. At the beginning, what were considered to be the resource(s) at stake (specify)?</td><td colspan="3">[ ] Forest: [ ] Livestock:
[ ] Land/soil: [ ] Wildlife:
[ ] Water: [ ] Health:
[ ] Crop: [ ] Other:</td></tr>
<tr><td>C2. At the beginning what was the scale of focus of the project?</td><td colspan="3">[ ] Local [ ] International
[ ] Regional [ ] Other, explain:
[ ] National</td></tr>
<tr><td>Socio-Political Setting</td><td colspan="3"></td></tr>
<tr><td rowspan="4">C3. Who are the stakeholders involved? Why and how did they become involved in the project?
Continue…</td><td>Who? Select from the Appendix – Stakeholder list</td><td>Why were they selected?</td><td>How were they identified?</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>C4. At the beginning of the project, were</td><td colspan="3"></td></tr>
</table>

there any stakeholders who you knew should have participated but didn't?	
C5. At the beginning, what relations between stakeholders could be identified? (such as alliances, conflicts, coalitions) Explain.	
C6. At the beginning, who was considered formally responsible for the issue (or resource) at stake?	
C7.Formalized/legal context: What were the main public policies and legal standards regulating the issues at stake? Explain their effectiveness.	
C8. Why was the project initiated?	
Objectives	
C9. At the beginning, what were your project objectives?	

<table>
<tr><td>C10. At the beginning, who participated in the design of the project?</td><td colspan="2"></td></tr>
<tr><td>C11. What influenced your selection of methods to be implemented in the project?</td><td colspan="2"></td></tr>
<tr><td rowspan="3">C12. A priori, what was the added value of using the approach (es) implemented? Explain</td><td>Approach used</td><td>What is the added value? Explain</td></tr>
<tr><td>[ ] ComMod Approach</td><td></td></tr>
<tr><td>[ ] Other (specify):</td><td></td></tr>
</table>

Process

1) In chronological order outline each method you used in your project. From the Activity list following, specify which activity this method corresponds to. This is to be achieved by filling in the 'Method Table' which requires you to allocate a number to each method used; beginning at 1 for the first method. It is anticipated that each method will fall into one activity type. If, however, a particular method overlaps activity types highlight (using bold or underline) what the more dominant 'focus' of the method is.

2) For methods that use an artifact, complete the 'Artifact Table' for each artifact used.

3) Every time a 'Field Action' (Activity FA) is carried out in your project, include a brief description of what the action is and the steps involved. The Method Table does not need to be completed for this activity (unless you think appropriate). Ensure that you indicate where Field Actions chronologically occur in the project.

4) Each time you finish filling in a Method Table for a specific method, update the 'Contextual Change Table' found later in this document, then continue on to the next method implemented in your project.

Activity List

These activities are based on the functions of an Integrated Environmental Assessment (IEA). The two defining features of an IEA are: (i) that it seeks to provide information of use to significant decision-makers and (ii) it brings together a broader set of areas, methods, styles of study, or degrees of uncertainty then a single research discipline. Methods used in the ComMod process will overlap these activities, however, it is anticipated that the main focus of a method will fall into one activity.

Activity 0 (zero): Establish Procedures (this is not part of an IEA). This involves establishing how the project process is going to be carried out. It may include communicating and discussing with stakeholders what the ComMod approach is, what tools and method will be used, how interactions are to take place. This includes receiving an agreement (or refusal) to proceed with the process. It may also involve establishing partnerships.

Activity IP: Identification of Problem (Sorting out the character, underlying causes and implication of the issues). This is about working out what the problem is: the nature, causes and implications. It involves learning about the current situation.

Activity AO: Analysis of Options (Identifying and evaluating management options). This is concerned with exploring options and strategies to manage the resource. It involves experiential learning as participants assess impacts of different solutions. Models (and role playing games), for example, provide information about effectiveness, efficiency and equity of management options (Hischemoller 2001).

Activity IS: Identification of Strategies (Establishing objectives and strategies). This activity identifies strategies to manage the resource and involves a choice, or ranking, of values. It involves negotiations which may take place through meetings. A model may also be used in this activity, for example: “given a clear set of preferences, models are useful in assessing complex tradeoffs between conflicting interests” (Hischemoller et al 2001: 61). This activity differs from

'Analysis of Options' in that a focus is on ranking strategies (through comparison perhaps) rather then exploring possibilities.

Activity CR: Communication of Results. Communicate the results. For example, if the process has led to a management plan (which may involve one or more potential strategies) these results need to be communicated to others not involved in the process. This may be through a business plan (in report form) or through the use of a model shown to higher level institutions or scientists.

Activity FA: Field Action (this is not part of an IEA). Implementation of an action that is an outcome of the project (such as setting up an institution to manage a resource).

Reference

Hischemoller, R., Tol, R., Vellinga, P. (2001) 'The Relevance of Participatory Approaches in Integrated Environmental Assessment', *Integrated Assessment* 2: 57 –72.
Found at: www.uni-hamburg.de/Wiss/FB/15/Sustainability/iapia.pdf.

This table is to be completed for each method used.

Method Table		
What Activity does this method correspond to? (If the method overlaps activities highlight the dominant activity type.)	[ ] Activity 0: Establishing Procedures [ ] Activity IP: Identification of Problem [ ] Activity AO: Analysis of Options	[ ] Activity IS: Identification of Strategies [ ] Activity CR: Communication of Results [ ] Activity FA: Field Action
Identify the Method		
Assign a number to this method (begin at 1 for the first method you use)	Method Number [ ]	
1. What is the method? (select from the Appendix – Method list)		
2. Purpose		
3. Period of implementation (approximately)	**Start date:**	**Finish date:**
***Why* this Method was used**		
4. Was this method intended in the original design of the project?	[ ] Yes [ ] No. Briefly describe what method you did intend to use and why you didn't use it:	
5. What outcomes did you expect in terms of:	**Type of outcome** (Select from the Appendix – Context list)	**Brief description of expected outcome**
• Learning		
• New relations		

• New practices within the group		
• New practices outside the group		
***How* this method was implemented**		
6. Briefly describe the method		
7. What are the underlying theoretical assumptions of the method, or how does this method fit into your overall approach?		
8. Who participated in the selection of the method?		
9. Who participated in the implementation of the method? Why?		
10. Who are the participants?	**Who?** (Select from the Appendix – Stakeholder list)	**How many?**
11. Of the stakeholders identified in the context, who is not participating and why?		

12. What 'type' of participation are the participants expected to engage in? (you can choose more then one response)	[ ] Cognitive: create distance between the participant and the problem at hand (such as through a RPG) so that information can be considered and new alternatives can be explored creatively. Debate and argumentation is restricted. [ ] Argumentative: participate through debate and dialogue; explore the problem through identification, confrontation and integration of divergent viewpoints. [ ] Relational: to enhance communication (as used in icebreaker activities) [ ] Non-specific [ ] Other, briefly describe:	
13. If a facilitator was used, how did he/she interact with the team members and/or participants? What general attitude (posture or approach) did he/she adopt?		
***Results* of the Method**		
14. Referring back to question 5, how do the results of the method compare with what was expected:	**Type of outcome achieved** (Select from the Appendix – Context list)	**What were the results of the method?**
● Learning		
● New relations		
● New practices within the group		
● New practices outside the group		

15. How do the outcomes compare with the underlying assumptions stated above?	**What went right?**	**What went wrong?**	**How could you improve the method?**
16. How did the outcomes of the method impact on the context? (Including relations between stakeholders)			
17. What artifacts were used in the method and why? List them and complete the Artifact Table following.	**Name of Artifact** Select from the Appendix –Artifact list		
18. Did this method conclude a sequence?	**[ ] No. Update the Context Change Table (if necessary) and begin the next method.** **[ ] Yes. Update the Context Change Table (if necessary) and continue to the next question (18).**		
19. If this method concludes a sequence, what are the overall outcomes of the sequence and how do they compare with the project objectives?	**What went right?**	**What went wrong?**	**What could have been done differently?**
20. Do the series of sequences conclude here?	[ ] No. Begin describing the next method of the next sequence. [ ] Yes. Explain why (then continue to question 20):		
21. If the series of sequences conclude here:	**What are the next steps?**	**What are the challenges?**	**What are the opportunities ?**
22. What are the most visible effects of the project? (social, environmental etc)			

This table is to be completed for each Artifact used.

Artifact Table	
What method number does this artifact correspond to?	Method Number [ ]
1. What is the artifact? Select from the Appendix – Artifact list	
2. Why was it used?	
3. Was it accepted by participants	[ ] Not presented [ ] Yes [ ] No. Explain:
4. Influence of the artifact on improved sharing of information among participants (project team included):	[ ] Equality: participants equally shared informational resources associated with the artifact. [ ] Credibility: the artifact and associated informational resources were credible to the participants. [ ] Formal/informal agreements emerged between participants concerning the sharing of resources associated with the artifact as an indicator of social learning. [ ] Other, explain: **Comments:**
5. Influence of the artifact on improved relationships between participants (project team included):	[ ] Improve communication [ ] Increase ability of participants to understand each other [ ] Facilitate acknowledgement of expert and local knowledge. [ ] Other, explain **Comments:**
6. Influence of the artifact on the outcomes of the participatory process:	[ ] Improve the amount of knowledge [ ] Improve the quality of knowledge [ ] Explore broader range of alternatives [ ] Test more alternatives [ ] Effective integration of different components of the system [ ] Other, explain: **Comments:**

7. In your opinion, what is the degree of 'usability' of the artifact in terms of the following criteria:	**Criteria**	**Scale**				
	▪ **User Friendly**: simplicity of the artifact and easiness to interact with	Low Usability 1	2	Neutral 3	4	High Usability 5
	▪ **Effectiveness**: capacity of participants to complete the task	1	2	3	4	5
	▪ **Efficiency**: resources consumed to complete task	1	2	3	4	5
	▪ **Satisfaction**: users reactions – comfort, attitude	1	2	3	4	5

APPENDIX B

PARTICIPANTS EVALUATION FRAMEWORK

Participants Evaluation Framework (PEF)

The Participant Evaluation Framework mirrors questions from the Designers Questionnaire (DQ) to assess how the participants' experiences correspond to the project team's perception of how the project was carried out. The left column – 'Designer Questions' – are the original questions selected from the Designer Questionnaire that are relevant to conducting this comparable assessment (the numbering system matches the designers questionnaire and therefore is not consecutive in this framework). The 'Corresponding Participant Questionnaire Guide' stipulates what information needs to be collected from participants. **This line of questioning must be rephrased by the project team and local translator (if necessary), with assistance from the evaluator, to tailor the questions to the local project context. It should be used as a guide only.** A large degree of freedom is left to the project team to structure the questionnaire as appropriately as possible for their specific project context.

The result of this tailoring process will be a questionnaire to be taken to the field to interview participants. The project team will select between 1 to 3 methods – including the model and RPG - to interview the participants about. The questionnaire will consist of:

1. Questions relating to the 'Initial Context Table'.
2. Questions relating to the 'Method Table'; which in this document encompasses the 'Artifact Table'. This is based on the idea that in the minds of the participants, methods and artifacts are not separated; they exist as a single event. Questions relating to the method may be repeated a number of times for one participant if they are being interviewed about more then one method: the interview may focus on one method and then progress to the next. For example, after all questions relating to the model have been answered, the same questions are then asked about the RPG. Alternatively, questions can be posed simultaneously for the model and RPG, depending on the project team's preference. It is recommended that photographs be used to assist the interviewee in refreshing their memory and reflecting on what the method was about.

3. Questions concerning the participant's general reflections on the project (or part of the project which involved the ComMod approach if the participants are involved in a larger project). General reflection questions do not mirror the Designers Questionnaire.

The order of questions is flexible and will need to be rearranged by the project team and evaluator to ensure the interview flows as effectively as possible. Additional probing questions should be included in the questionnaire where necessary in case a question fails to elicit a response from the participant. **Ensure that the questionnaire devised by the project team indicates what number each question corresponds to in the Participant Evaluation Framework to assist with analysis.** Also confirm that all bullet points are accounted for in the questionnaire.

An important point for the interviewer to consider when conducting the interviews is that there are four ideas or concepts that are of particular interest to the ComMod evaluation project. The interviewer should listen out for these ideas and attempt to explore these concepts further with the interviewee:

(i) **Perception of the issue**: what is the interviewee's individual perception of the issue (which the project focuses on) and what does he/she consider the collective perception of the issue to be? How did this change throughout the project or, more specifically, the ComMod process?

(ii) **Learning**: what did the participant learn individually and what was learnt collectively (socially, environmentally, economically, politically, cognitively etc)?

(iii) **Relations**: what relations did the interviewee have with other stakeholders (including non-participants) and how did these relations change throughout the project (particularly the ComMod process)? How did the interviewee interact with other stakeholders (including non-participants) and how did the interviewee perceive others to interact. Were there alliances, conflict etc? How did these interactions change?

(iv) **Practices**: did the interviewee develop or change any of his/her practices or actions, such as the way they live their daily life or through the real-life application of new or alternate strategies.

The interviewer should follow these steps in conducting the interview:

1. Work through the questionnaire designed by the project team, local translators (if necessary) and evaluator.
2. If any of the four concepts listed above ('perception of the issue', 'learning', 'relations' or 'practices') emerge through the interviewee's response, try to explore them further.
3. It is possible to ignore questions in the questionnaire if they have already been adequately covered through the interviewer probing the interviewee's responses.
4. Probing questions should be included in the questionnaire and should be asked when the main questions fail to elicit a response which may be easier for the interviewee to answer.

The table below should be filled out for each interview conducted and a copy of the interview questionnaire should be submitted to the evaluator. It would also be helpful to make a note of which questions in the questionnaire proved difficult to answer.

Participants Evaluation Framework	
Project Name:	
Location:	
Project Team Members and Roles (such as project designer, team leader):	
Interviewer:	
Interviewee (representing what stakeholder group):	
Length of Interview:	
Date of Interview:	
Evaluator:	

Initial Context Table	
Designer Questions	**Corresponding Participant Questionnaire Guide**
Physical System	
C1. Resource(s) at stake (specify)	• At the beginning of the project what did the participants regard the issue(s) or resource(s) at stake to be?
Socio-Political Setting	
C3. Who are the stakeholders involved? Why and how were they selected?	• Why is the stakeholder participating in the project? What is their motivation to be involved? • Who else can he/she recall that is participating (in terms of social groups not personally). • Why are they participating?
C4. Are there any stakeholders who should be participating in the project but are not? Explain	• Is there anyone you else the participant thinks should be involved in the project but is not. • Why should they be involved/why aren't they participating.
C6. At the beginning, who was considered formally responsible for the issue (resource) at stake?	• Who does the participant consider to be responsible for managing the issue or resource (mentioned in question 1).
Objectives	
C9. What are your project objectives?	• What does the participant consider the project to be about (generally speaking).

Method Table	
Designer Questions	**Corresponding Participant Questionnaire Guide**
Identify the Method	
2. Purpose	• What type of interaction did the participant have with the project, what aspect(s) of the project was he/she involved in. *This can be answered by the project team.*
3. Period of implementation (approximately)	• When did the participant have this interaction. *This can be answered by the project team.*
***Why* did you use this Method**	
5. What outcomes did you expect in terms of: • Learning	• Was the method useful to the participant in any way. How was it useful to them. Did the participant **apply** this to their daily life. (This relates to **practices**). • How did the participant **interact** with the other participants. Did this change through the method (for example through using the model or RPG). (This relates to **relations**). • Did the participant **learn** anything through the method (i.e. through using the model or the RPG). Did the participant learn from the other participants.
• New relations	
• New practices within the group	
• New practices outside the group	
***How* was this method implemented?**	
6. Briefly describe the method	• What are the participant's impressions and thoughts on what happened through interacting with the method (i.e. when the model or RPG was used).
11. Of the stakeholders identified in the context, who is not participating and why?	• Who does the participant think should have participated but didn't, or should have been involved but wasn't.

13. If a facilitator was used, how did he/she interact with the team members and/or participants? What general attitude (posture or approach) did he/she adopt?	• What did the participant like about the way the method was facilitated. • What did the participant dislike about the way the method was facilitated.
***Results* of the Method**	
15. How do the outcomes compare with the underlying assumptions stated above?	• What did the participant like about it. • What did the participant dislike about it. • How does the participant think the method could have been done differently to improve it.

General Reflection Questions
These questions do not respond to the Designers Questionnaire
R1. A question should be posed relating to the project team's definition of where a loop finishes and a new loop begins to ascertain how the project team's perceptions of what happened in the project corresponds to the participants' experiences. For example: "How did the way you think about the issue change from when you used the model to when you used the RPG? Did anything else change, such as the way you interacted with the other participants, the way you learnt, or did you change your actions in daily life?"
R2. What does the participant know about what is happening next in terms of the project. Where is the project at now?
R3. Did the participant feel that his/her contribution to the project was valued. For example, did he/she feel their personal opinions were taken into consideration by the other participants? Did he/she think their level of involvement/participation had an effect on the way the project developed? In the interview it is important to check that it is known what the interviewee means when they talk about their contribution.

APPENDIX C

GUIDELINES FOR INDIVIDUAL INTERVIEW

Guidelines for interviews in Ban Mak May 20-30 May 2006

Evaluation of the effects of the 2rd field workshop

1. **General evaluation of stakeholder interest in the field workshop**
    a. What did you find the most interesting in playing the game (1st day)? Why this/these topics?
    b. What did you find the most interesting in the computer model playing the game (2nd day)? Why?
    c. During this workshop, we discussed many different things: what subject of the discussion did you find the most interesting in? Why?
    d. Do you think such a game can be useful for the village in the future? If yes, specify about what subject?

2. **General evaluation of effects on individual participants**
    a. Did you continue to think about the game, the model & the discussion during this workshop after the research team went back to Ubon? If yes, please specify on what subject?
    b. Did the game, the model, or the discussion provide you with new knowledge to be used in your real life? If yes, please specify what kind of knowledge?
    c. Did the game, the model, or the discussion give you new ideas to be used / useful in your real life?
    d. What kind of problem do you better understand now thanks to / because of the game & the model (in general)?
    e. In particular regarding land/water use and labour migrations, what do you understand better now thanks to the game?
    f. Did the game and/or the model help /allow you to better understand the other villagers' situation? If yes, please specify and give an example?
    g. Did the game and/or the model change your way of thinking regarding the relationship between land/water use and labour migrations? If yes, please specify how?

h. Did the game and/or the model change your way of thinking about the future of your farm?

i. Was it important to play the game & discuss the model? If yes, please specify why?

3. Evaluation of collective effects

a. After the game, did you continue to discuss about the game and/or the model with other people? If yes, did you discuss with players or non-players?

b. What did you discuss about with other players and with non-players (different topics?)? Could you precise the content of the discussions (who thought what? Who agreed or disagreed with whom?)?

c. What were the reactions of the non-players?

4. Evaluation of the effects of the irrigation scenario tested in the 1st afternoon

a. In the game, in the afternoon, a new feature in the game was suggested to solve the problem of lack of water for farming, and this idea was tested in the game: do you remember what was this idea?

b. The idea was to introduce irrigation canals, do you remember who proposed this change?

c. Did you agree with this idea? Why?

d. Do you have another idea to solve the problem of lack of water for farming?

e. Did you continue to discuss about the possibility to irrigate the land after the game? If yes, with other players or non-players? What was their reactions?

f. Do you think that it is feasible? What would be the main obstacles?

g. If there is a better access to water for farming, do you think that this will change the labour migration in your family? Please specify why?

h. If there is a better access to water for farming, do you think that this will change the labour migration in your village community? Please specify why?

5. Evaluation of the potential of the field workshop to facilitate cooperation

a. A collective irrigation system would force the villagers to cooperate in its management. Do you think that villagers would agree to cooperate? What would be the difficulties of this cooperation?

b. Do you think the game and/or the model could facilitate this cooperation? Why?

c. Do you think the last game and/or the model made EVERY player more ready to cooperate? If not everybody, why?

d. Was it easier to discuss about the problems of water scarcity and labour migrations in the game and with the model than in reality? If yes, why?

6. Evaluation of the interest to join in participatory simulations

a. On the second day in the morning, the computer model playing the game was presented and the players discussed what the computer was doing: did you find this interesting? Why?

b. Would you be interested to play again with the computer model after rice transplanting is completed? What for?

c. Would you like to play a gaming session again before the computer simulations? Why?

d. Would you like to use the model alone, at home, or with other people? Why? With whom?

e. What scenario would be interesting to play with the computer model?

7. Other comments?

Guidelines for individual interviews with players in participatory modeling workshop at Ban Mak Mai, Klang sub-district, Det Udom district, Ubon Ratchathani Province on 10-11 October 2006

1. What do you think about the participatory **modelling workshop**? (this is too general you could say: "Players opinions about the workshop"
    a) Did you remember the workshop? Which parts of the workshop do you remember the best? And Why?
    b) Was this participatory modelling workshop different from the last two workshops? (if they remember them! So need to check this out first, if they do not remember them, then no need to ask this question.
    c) In the second day, what did you do, and why did you do that? (Specify in more details regarding what activities in the 2nd day?)
    d) Comparing between the first, second and third rounds in the game of the first day, in which round did you understand how to play the game?
    e) Was the participatory simulation activity different on the first and second day? Why?
    f) Was the proposed new community pond useful for you?
    g) After workshop, did you tell anyone about the workshop? How did that person respond?

2. Analysis of the effects of the workshop

    a) What was the new information that you got from this workshop?
    b) From whom did you get new knowledge: researchers, participants or family members, and why?
    c) What do you think about the elderly participation in the game?
    d) Was this workshop easier to understand and participate in than the two previous workshops? Why?
    e) Do you think the workshop is useful for your community? In which way?
    f) Why will you be interested in having an agricultural market in the next games?

g) How to motivate young players to participate in the games?

h) What does it mean “playing RPG builds imagination”?(farm type A1 said): to be asked to him only for clarification of his opinion?

i) What influenced you to participate in the workshop (per diem, fun, knowledge, participant etc?)

j) What does it mean “playing the game of community pound scenario unites the community”, farm type B said? : to be asked to her only for clarification?

j) Why did you participate in the workshop all day?

k) Will you participate in the next workshop? And why?

l) What are you suggestions to improve the game?

Guidelines for individual interview the effects of the 4th field workshop (after 1 month) Ban Mak Mai on April 24, 2007

1. **General evaluation of stakeholder interest in the field workshop**
    a. Did you remember the last workshop on April 24, 2007?
    b. What was the feature did you best understand? why

2. **General evaluation of effects on individual participants**
    a. Did you continue to think about the model & the discussion during this workshop after the research team went back to Ubon? If yes, please specify on what subject?
    b. According to the last workshop, what changed in your daily life behavior? Why?

3. **Evaluation of collective effects**
    a. After the model, did you continue to discuss about the model with other people? If yes, did you discuss with players or non-players?
    b. After finish the workshop, did you tell anyone about the workshop?
    c. How did that person reflect (players and non-players)?

4. **Evaluation of the effects of the MAS simulation and RPG**
    a. What do you think about MAS simulation?
    b. Among Role playing game and MAS simulation, what kind of tools did you better understand about land, water use and labor migration? Why?

5. **Evaluation of the potential of the field workshop to facilitate cooperation**
    a. Do you think the model could facilitate this cooperation? Why?

6. **Evaluation of the interest to join in participatory simulations**
    a. Would you like to play a gaming session again before the computer simulations? Why?

b. Would you like to use the model alone, at home, or with other people? Why? With whom?

c. What scenario would be interesting to play with the computer model?

d. Do you think who was the most important in the workshop? Why?

e. If the next workshop does not pay per diem, will you participate in the workshop? Why?

7. Other comments?

a. In the first workshop (9-10 July, 2005), 8 original participants could not participatory in the workshop, what is criteria to selected the new participants? (specific question for Mrs.Jaengkom who is the key informant to selected the new participants)

b. What are activities in real life similar playing in game or model? Why?

Guidelines for individual interviews after the final ComMod workshop held on 13-14 May, 2008 at Ban Mak Mai Village, Det Udom District, Ubon Ratchathani Province

Objectives

- To assess the effects ComMod activities
- To know their opinions about ComMod activities,
- Especially the use of participatory simulations and an agent-based model (ABM) recently introduced with this group of villagers (compared to what they said about the role-playing game tool in previous interviews)

1. General process assessment

- Up to the present, do you know why the ComMod team is monitoring and evaluating the effects of ComMod activities? (This could be your introductory question at the beginning of the interview)
- What are encouraging you to continue to participate actively in the ComMod process?
- In your opinion, what benefit do you get from participating in ComMod activities? Why is it important? (Try to rank them from the most to the least important according to their opinion, and compare the results between participants later on)
- If the ComMod activities do not provide a daily per diem, would you be interested to participate? Why?
- What do you think is the best way / method for you to get more knowledge or information?
- Where is the most suitable place to hold such activities? Why?
- If ComMod activities are used again on the same topic in the future, who do you think should be invited to participate? Why?
- On what other topics would you be interested to apply the ComMod approach in the future?

2. **Comparison between RPG and ABM tools**
    - RPG and ABM: which one does you prefer, have most interesting and why?
    - RPG and ABM: which one is easy to play and understand, why?
    - Among the successive RPG and ABM sessions you participate in, which one did you find most / less interesting? (Try to rank them from the most to the least interesting according to their opinion, and compare the results between participants later on: why did they like them or not?)
    - RPG and ABM: which tool is best to stimulate the collective sharing of information and ideas among stakeholders? Why? And how should it be used to maximize this benefit?
    - RPG and ABM: which tool allowed you to get more knowledge? On what is issue of particular interest to you?
    - If you have the choice to participate either in a RPG or an ABM session, which one do you prefer to participate in? Why?
3. **Comparison between RPG and reality**
    - Do you think the RPG is similar to reality? Why?
    - What do you want to adapt in the RPG or which part do you want to change to improve it further?
    - Which RPG session did you find closest to your actual circumstances? Do you like this and why?
    - What do you think about a game that will be more abstract but still on the same topic?
    - Does the RPG stimulate your imagination? What kind of game is best for that? Give examples.

4. **Comparison between ABM and reality**
    - Do you think the ABM is similar to reality? Why?
    - What do you want to adapt in the ABM or which part do you want to change to improve it further?
    - Which ABM session did you find closest to your actual circumstances? Do you like this and why?

- What do you think about a more abstract ABM still about the same topic?
- Does the ABM stimulate your imagination? What kind of ABM is best for that? Give examples.

5. Change in perception of own situation?

(regarding their farm and their village farming environment)

6. Change in perception of other farmers / villagers?

(how the ComMod process influenced the way they look at other people and interact with them?)

7. Change in decision-making?

(regarding their own farming activities – rice production, labour management - or more general?)

8. Change of behaviour?

(regarding their own farming activities - rice production, labour management - or more general behaviour?)

9. Any new actions & practices?

(regarding rice production, labour management, others?)

10. If you get opportunity to uses the simulation model in the future, what do you want to use for (e.g. conduct own experiment (about what), present own perception (farm activities) to other, use for idea sharing among villagers).

APPENDIX D

SAMPLE OF STORYTELLING

Farm type A 15' s Story

Farm type A 15 lives in Mak Mai village with his wife, his son and two nieces from his daughter. His daughter works in Bangkok and returns home once a year to visit her daughter. She often sends money back home. His son works at the 7-11 shop in Amphur Det Udom, doing the morning to evening shift. Thongdee is the main source of labour on the family farm, with his wife unable to work on the farm because of her ill-health and her responsibilities of looking after her two nieces. Both of them are at pre-school. Farm type A 15 supplements his income after rice season with a job as a freelance tree cutter.

Farm type A 15's farm is 15 rai, which is a farm type 'A': a small farm that predominantly serves to self-sustain the family. He also supplements his income on construction sites. He receives support from his children. Farm type A 15 has played RPG twice. The first time he played was owing to an invitation from Ms.Jiang Kum. He 'had to' play with her as his wife was not well at the time. Ms. Jiang Kum is Farm type A 15's wife's niece. The second time he played was with his wife. One month after his second time playing RPG, he remembers a little from the RPG.

Farm type A 15 started that the RPG gave him a knowledge base and he disseminated some of that knowledge to those close to him. "…I learned about farm planning and management: how many days to farm, how many days to harvest…" Farm type A 15 considered the RPG as a reminder to guide his actions, including the sale of his rice and how to farm during periods of drought. The RPG provided advice. However, Farm type A 15 said that the RPG couldn't be applied to his real situation for he lacks enough water, including a well, and a full in farmpond. And if he followed the RPG's direction, he would have to plant things that could be consumed rather quickly, such as chilies and watermelons. "…the RPG makes you think of what and how you can plant during periods of drought…vegetables, peanuts, and how many rai you can farm…" Farm type A 15 added that after finishing the RPG, he could see what other players had planted and how much they had planted. Colour codes of red and green guided him. The RPG also let him know who had gone to Bangkok, and who had stayed home.

Farm type A 15 also added "…I came to understand how to divide my time in matters of work. I must do this, I must do that. In the past, I couldn't really think about these issues."

However, in times when Farm type A 15 had little to do, he was able to sit down and seriously consider what to do. After this he would share his knowledge with relatives so they too could follow. " …previously, when I thought about going to the farm but friends popped around to invite me to have a drink, I would take off and not work the farm. Right now, I have something to motivate me. Sometimes I can't sleep because of thinking about the issues in the RPG. When I go out, I sort of think 'hey, hang on a minute, I said I was going to do this or that, didn't I?'…" In regards to playing the RPG at the school, farm type A 15 preferred staying at home, where he could do whatever he wanted on the farm so he could have enough to eat on a daily basis. In fact, this year Farm type A 15 didn't want to do any farming, but because of the RPG's lessons, he realized that he wouldn't be able to survive.

Farm type A 15 said that the time when he played the most was during heavy rain periods or periods of drought. When it rained, it made him search for ways to "…farm well this year…" When farm type A 15 caught up with friends, he would constantly ask them whether or not they had done things in the RPG. Previously, farm type A 15 had thought about doing this and that, but he wasn't too interested in thinking. "…there was the thinking, but playing made me really interested in the RPG. It's like learning at school and learning from a lecturer, and similar to going to a training session or meeting. Before ever playing the RPG, whatever anyone said I wasn't interested…" However, this year Farm type A 15 has thought a lot, because the lecturer has come often. In the past, the team came once a year. But now they come more often. For farm type A 15, it's quite inspiring. The more they come, the more he is inspired to think. If they only come once a year, farm type A 15 won't think that much and would probably forget things. This means that the people in the village switch-off because they lose that connection with the lecturer. When the team comes into town, all the people are interested and excited; but when the team leaves, everyone loses their interest.

But playing the RPG according to farm type A 15 means that " ..when the team comes into town, the people start to think, and they believe that it is an opportunity to learn and discuss with each other what they have learned in order to produce benefits from their farming in the future…it constantly changes our ways of thinking…" When the new generation comes through, the people are able to tell them what the lecturers taught them regarding how to farm and what to do in cases of drought. When the people get together, they are able to share ideas on what they

should do in the current year. People can take their shared ideas back to their home villages and spread the information. Normally, formal training is quite static, but the RPG encourages people to actually go and do something.

Farm type A 15 said that the RPG "…are a very good way to promote knowledge. If the lecturer asks us questions, we answer, and both the lecturer and all of us increase our knowledge. When we get together and ask and answer each other's questions, things become a lot clearer…" The group can exchange opinions and ideas in a way that is not too difficult or too easy. Understanding takes place. He thinks that playing RPG is similar to studying and when the lecturer asks questions, it raises certain learning points. Farm type A 15believes that the things he has gained the most knowledge about are farming and the planting of various species of trees.

Farm type A 15 concludes that the RPG allows participants to consult with each other on RPG issues including what to do, where the kids have gone to work, and whether or not the kids have come back from their farming duties. It is like an informal meeting of close friends. For example, if one of the gaming participants can't hire labour for their farms, they can find where to hire people within the group. When the kids go off the Bangkok to work in the RPG, the RPGrs need to pay for labour, which probably comes from their children's pockets. This is very similar to reality. Talking is asking questions, which is like sharing ideas that can help everyone think for themselves.

APPENDIX E

SAMPLE OF CODES, FAMILIES OF CODES, RELATED CODES, AND TOPICS

Data coding, families of code, related codes, and topics designed in M&E ComMod process

Name of interviewee : Farm type A 15, after 2nd workshops on 20-21 April, 2006		
Topics	**Families of codes**	**Related Codes**
2. Learning about the issue being examine	F1 The RPG's questions increased knowledge	• The simple question guided players to get ideas what they should do if they cannot hire labour and what it will happen in the future • The questions of the RPG enable me to learn and get more knowledge about agriculture
	F2 The RPG would be useful in the future	• The player could learn new ideas and teach them to transfer to next generation • The RPG provided more creative knowledge and it will be more useful in the future
	F3 I gained new knowledge	• The best knowledge that I gained about plant and vegetable cultivations • I learnt that I have to work for a living, if I do not work, I will not have anything to eat
3. Learning about other peoples' situation and opinions	F4 RPG helped to discuss together	• I leant and got knowledge from discussion the other players and the lecturer • I could share and exchange knowledge from each other • I discussed on planning in farm activities and in their children e.g. where and what they did, when they returned home, how to manage the labour, and when they hired labour. • Participation in the RPG was like the family discussion

Data coding, families of code, related codes, and topics designed in M&E ComMod process (continued)

Name of interviewee : Farm type A 15, after 2nd workshops on 20-21 April, 2006		
Topics	**Families of codes**	**Related Codes**
3. Learning about other peoples' situation and opinions	F5 I understood other players situations	• I learnt about labour migration e.g. who has gone to work in the city in dry season and who came home on rice transplanting season • The computer shown the final decision of each player about how to plant the rice and how to solve the problems of hiring labour
5. Specific effects of the various main ComMod method /tools applied: RPG and computer RPG	F6 Strengths of the RPG	• The RPG was one of the best methods that made us transfer our knowledge to others • The RPG was similar to "a lecturer" who introduced new practices and allowed the players to use their own decisions getting from natural practice
	F7 This is easily RPG	• This RPG was easy to understand
6. Capacity building	F8 The RPG helped him to intensive thinking	• I have been thought by myself, but I did not focus on what I thought and I am always confused • I did not pay much attention in solving problems • Most of the time I always focused on whether the rainfall or drought season and I tried to fine the best solution in each year and prepared the way to solve problems

Data coding, families of code, related codes, and topics designed in M&E ComMod process (continued)

Name of interviewee : Farm type A 15, after 2nd workshops on 20-21 April, 2006		
Topics	**Families of codes**	**Related Codes**
6. Capacity building	F9 Participations in the RPG are similar to study carefully	• The RPG helped me to think about how I manage the time • Playing in the RPG was the same as studying in intensive courses • Playing the RPG was like a teaching instrument • I felt like studying in the class with a teacher
	F10 The RPG changed my thinking	• The RPG trigged my ideas to think about the decision and motivated me want to practice the same as the lessons in the RPG • My idea was changed from "staying still" to be more active wanting to do something
	F11 The RPG repeated it is better	• This year I thought more seriously because the researchers came to visit me more often • They coming more often stimulated me to pay more attention in solving problems • If the researchers visited and discussed only one time, the players will not thought, forgot and not continue the activities because they believed that the researcher did not monitor them • When many villagers came to meeting, some of them paid attention but some did not. When the meeting and discussing ended, the villagers often lost the topic

Data coding, families of code, related codes, and topics designed in M&E ComMod process (continued)

Name of interviewee : Farm type A 15, after 2nd workshops on 20-21 April, 2006		
Topics	**Families of codes**	**Related Codes**
7. Anchoring of the local decision-making process in the context: networking to get recognition and resources for implementation	F12 Telling the RPG with other people	• I could bring the best way of agriculture knowledge to teach my family members and my relatives • I told my friends and gave them recommendation how to do agriculture successfully • When I met other RPG players, I always asked that whether I practiced the RPG or not
8. Action / new practices	F13 The RPG motivated me to practice	• The RPG stimulated and motivated me to follow and to practice the activities that I had leant during playing RPG e.g. in dry season, I should grow entire plants • During playing the RPG, I have to promise that I have to practice what I have learnt in the RPG
	F14 My behaviour is changed after playing the RPG	• When I think about playing the RPG, I want to spend most of the time to work on the farm and I want to stay home and do some work instead of wasting time • In the past, I did not care what other people said, but now I do

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