Participatory Modelling: Companion Modelling in Puerto Princesa, Philippines

Paulo Campo

ABSTRACT

This paper describes the developments of an ongoing case study on the collaborative development of a Multi-Agent Systems (MAS) model for natural resource management (NRM) using the Companion Modelling (ComMod) approach involving three contiguous villages in Palawan, Philippines. In this study, the ComMod process was focused on the relationships between the institutions or rules for resource use and management, dynamics of resources in the uplands, lowlands and coastal areas and the livelihood activities of the community involving their shared natural resources. Through the modelling process, the stakeholders, which are composed of migrants and indigenous people, as well as government and non-government organizations, were immersed in collective learning activities and experiences leading to the development of role-playing games (RPGs) and computer simulation -- the articulations of a MAS model. These tools, the RPGs and simulation, were then used to initiate and facilitate discussion about natural resource management among the stakeholders. Moreover, the process revealed knowledge that was otherwise difficult to extract using traditional methods of data-gathering. With the knowledge and experiences the stakeholders have gained from the process and the tools that were used to facilitate the discussion, the stakeholders were able to lay-out initial plans for alternative livelihoods in the community together. With this said, ComMod has a high potential in facilitating multi-stakeholder processes towards attaining sustainable natural resource management.

Key words: *companion modelling, participatory modelling, sustainable resource management, multi-agent systems, role-playing games, simulations*

1 Introduction

This paper will present the results of a participatory modelling study conducted under the context of a recently concluded research and development project, Levelling the Playing Field (LPF), involving three contiguous villages sharing renewable resources within its boundaries. The study site, having a total area of about 19,000 hectares, consists of three landscapes, namely the uplands, lowlands and coastal areas and is subject to pressures of resource extraction by the locals. To control the resource extraction process, the site is also subject to various environment management schemes imposed by government units from the local to the national level and is supported by various non-government organizations (NGOs) working towards sustainable resource management. The sheer number of rules and regulations, overlap of responsibilities among the high numbers of implementers and enforcers of these rules, coupled by the lack of understanding of these rules and their effects, unleveled expectations among the stakeholders involved, ineffective coordination of efforts and unequal capacities to negotiate and decide for resource management by the stakeholders, have led to confusions, miscommunications and even conflict among the stakeholders. The LPF project aimed promote good governance, improve

livelihood opportunities of the locals and enhance the sustainability of natural resources. Some of the strategies to achieve these objectives were to improve the process of communication and coordination among the stakeholders by acting as facilitators in the process, as well as build the capacity of the stakeholders such that they can and will engage in discussions and negotiations for the development of sustainable resource management strategies and plans that are acceptable to all. To this end, Companion modelling approach ComMod) was used to complement the efforts of the project towards achieving its goals.

ComMod, a participatory modelling approach, was used in this study to develop tools for collective learning and support the discussions and negotiations among the stakeholders. More specifically, the objectives of the ComMod modelling process were to:

1) Engage the stakeholders and researchers to take part in a collective learning environment to understand the natural resource management (NRM) system by means of collectively building a model and its associated artefacts, i.e. role-playing games and simulation, and, later on to
2) Use these model and artefacts as tools or platforms to initiate and facilitate discussion and negotiation processes for NRM planning among the stakeholders involved.

ComMod is used such that the products of the process, a model and its associated artefacts, are used to support the process itself.

The main body of this paper will begin with a description of the methods used in the study, i.e. ComMod and multi-agent systems (MAS) model, and in the paper, which is the Institutional Analysis and Development (IAD) framework. The IAD framework is used in this paper as a guide in the next section, which is the description of the research setting, which will establish the focus of the ComMod approach. The next section presents the steps of the ComMod process used in Palawan, its products and its outcomes. The analysis of the ComMod process will present an exploratory use of the IAD framework to relate the outcomes of the ComMod process to the objectives of this study. We will conclude the paper by presenting the lessons learned, the advantages and limitations of the ComMod process based on the Palawan field experiences, and recommend possible steps to move forward towards improving the process and enhancing its impact to the NRM system under study.

2 Methods

Models have various uses depending on the research objectives. For the purposes of this study, wherein we would like to communicate the linkages between the dynamics of renewable resources, livelihood activities of the locals and the institutions governing the NRM system, we developed a moderate-generality and moderate-precision indicator model for consensus building (Costanza et al., 2001). ComMod approach was used to build and use a model, a multi-agent systems (MAS), wherein the stakeholders and researchers were immersed in a collective-learning process.

The Institutional Analysis and Development (IAD) framework is used in this paper to present the research setting and, later on, to guide the analysis of the ComMod process.

Companion modelling

ComMod, is a participatory approach in building models which emphasizes on the importance of quality of the modelling process with the end-users, such that the modelling process is given as much as or even more importance than that of the product itself – a model (Barreteau O et al., 2003). In this study, as in other studies using ComMod, the end-users of the model are not only the researchers but also the stakeholders themselves. Given this, ComMod has two main objectives in terms of its use (Ibid). First, ComMod is used to understand complex systems, wherein the model is knowledge-based. And rather than just a simplification of a system, a model produced in this approach seeks for the mutual recognition of everyone's (the end-users) representation of the problem under study. This is important if the outcomes from the process are to be believed and accepted by the end-users. Second, ComMod is used to support collective decision-making processes in complex situations. The focus of this objective is not to come up with optimal solutions to solve the problems found in these complex situations but, rather, it seeks to enhance the decision making process technically, e.g. providing relevant and timely information and technically sound actions or coordination, or sociologically, such as reinforcing the power of the stakeholders to make decisions. It is important to note that before the second objective can be implemented, the first objective has to be satisfied.

The approach is a cyclical process, with each cycle having a specific theme (Figure 1). The direction and end of the cycles are decided by the stakeholders involved. Each cycle begins with a survey of the problem, followed by conception of the model and then participatory simulation wherein the model articulations, e.g. role-playing games and computer simulations, are used. The double arrow between the conception of the model and participatory simulation in Fig. 1 represents an iterative process of building the model wherein the scientists and stakeholders are in constant interaction to improve or correct the model. Due to this interaction, it is not unusual that a family of models might be produced in this process. This interaction might also lead to a new model, having a totally different theme, and therefore a new cycle, or to a decision in which the modelling process is to be ended.

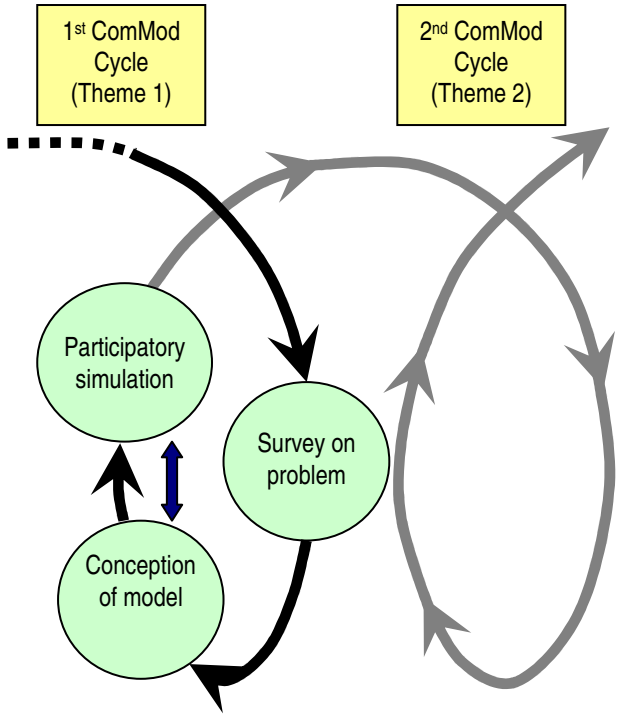


Figure 1. Companion modelling process (from the Ecole ComMod Project Website: www.ecole-commod.sc.chula.ac.th)

Multi-agent systems for natural resource management

Multi-agent systems (MAS) is used in various fields such as robotics and communications. In this study, however, we will use MAS to model the complexity of an NRM system. As in other cases of MAS for NRM cases, we give emphasis to the human aspects of natural resource management. One of the main components of MAS for NRM (Figure 2) is multiple actors or agents, which may be human and non-human, and may be an individual or a group. These agents are also able to communicate or interact with each other. Depending on the agents' goals, and how it perceives and understands the system, which may be different from one another, the agents are able to move about, decide and act on its environment. The environment itself may also have its own dynamic properties such as evolution of resources. The objective of using MAS for NRM is to be able to identify and analyze the linkages between these agents, their actions and the outcomes that are observed in the environment, while taking into consideration that some of these actions would have feedbacks.

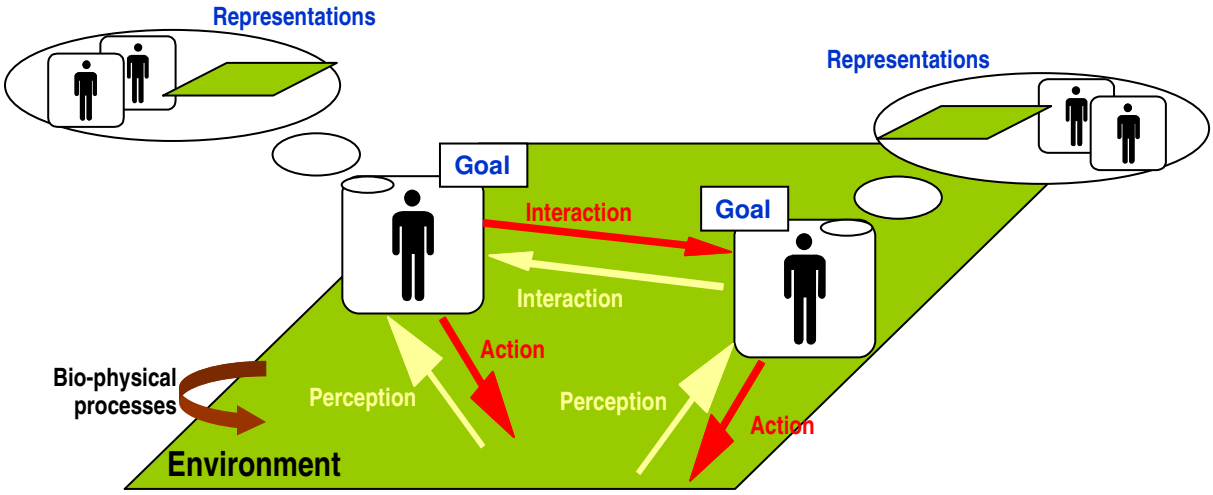


Figure 2. Multi-agent system for natural resource management (Ferber J, 1999)

The MAS model can be implemented or articulated using role-playing games (RPGs) or a computer simulation (Barreteau, 2001). An RPG is a MAS model wherein the agents are played by humans taking on the role of the agent they are playing. On the other hand, a computer simulation is a MAS model programmed into the computer and the agents behave or decide based on decision-making models, which may be range from very simple (e.g. reactionary) to complex, e.g. Belief-Desires-Intentions (BDI). Depending on the purpose of the modelling exercise, either one or both artefacts can be used to realize the MAS model.

MAS, being relatively new in the Southeast Asian region, has had some applications in the Philippines in areas such as in Isabella (Huigen 2002), Claveria (Magcale-Macandog D et al. 2003) and Bohol (Campo 2003). A compilation of case studies of MAS and ComMod applied in Southeast Asia (Bousquet et al., 2005) has been made.

Institutional analysis and development framework

The discussion in this section of the paper is based on the work of Ostrom (1994) unless stated otherwise. In general the institutional analysis and development framework is a tool for organizing concepts that could be used to guide researchers in analyzing institutions, being able to link different theories and models into a coherent structure. These concepts could be organized into different parts shown in Figure 3.

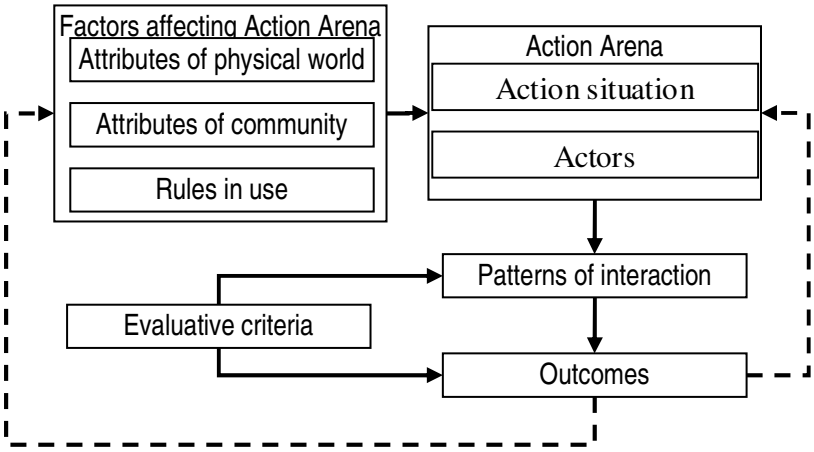


Figure 3. Institutional Analysis and Development framework (Ostrom E. et al., 1994, Ostrom E., 2006)

Action Arena

The action arena is a conceptual unit that is usually the focus of analysis, prediction and explanation of behaviors and outcomes within fixed constraints. Using the definition of Ostrom et. al. (1994), an action area is composed of the actors and the action situation. An action situation is composed of actors who have become participants in a situation. These actors are able to choose and perform a set actions based on the position they hold in the situation, the information they have about the pay-offs of their actions, knowledge about the possible implications or outcomes of their actions and the information about the costs and benefits associated to these outcomes. The elements then of the action arena are:

1) Participants – are actors who are involved in the situation
2) Positions – are place holders, in which each position has an associated set of actions limited to that position. A participant holding a certain position may only choose and perform an action from the set of actions associated to the position it is holding
3) Actions – e.g. to fish, to farm, to hunt, etc…
4) Potential outcomes – the possible implications or effects of actions in relation to outcomes
5) Transformation functions – functions that link actions to outcomes
6) Information – may have limitations or incomplete depending on the rules on how information is opened or made available in the situation
7) Pay-offs – the costs and benefits of actions as well as the outcomes

Common pool resource (CPR) situations are often composed of appropriation situations, i.e. there is extraction of resources, and provisions situations, wherein mechanisms are established to sustain the resources (Ostrom, 1990). These two faces of CPR situations are intertwined and it is often difficult to determine where one ends and the other begins. However, as prescribed by Ostrom et al. (1994) it is very important when doing institutional analysis to determine which side of the same coin the analysis would focus on.

The actors, and consequently the participants of an action situation, have preferences, a degree or level of knowledge and a certain learning capability or

technique, a set of criteria to select or make decisions and resources that they bring into the situation.

Usually, to perform an IAD analysis of CPR settings, at the minimum, these seven elements and assumptions of the attributes of the community are defined.

Factors affecting the action arena

Another aspect of the IAD framework, and is also a possible starting point of institutional analysis are the factors affecting the action arena and how changes in these factors affect the action arena. One factor affecting the action arena is the attributes of the physical world. Although this is not true for all cases, attributes of the physical world have direct impacts on the interactions and outcomes of a situation as many actions and pay-offs are directly anchored to the physical world. Another factor is the attribute of the community. Often referred to as "culture", the attributes of the community are the norms of behavior of the community, and the level of homogeneity of understanding of the action arena, of the preferences and of the distribution of resources. The most influential factor affecting the action arena is the rules-in-use as it is often the focus of development or change.

Rules, as how it is used in the IAD framework are prescriptions on what actions are required, prohibited, or permitted and sanctions should the rules are not followed. Rules can be broadly classified into seven types, each having an influence on a particular element in the structure of the action arena. Moreover, these rules may be nested into three levels, i.e. operational, collective-choice and constitutional choice. It is said that the IAD framework can be used to link and study an action arena at these three levels.

3 Research Setting

We will describe the research setting based on the prescriptions made by Ostrom et. al (1994) and that is to define the elements of the actions situation while making sure that the focus of examination is either on the appropriation side or the provisional side of the same situation. We will continue this description by identifying the factors that affect the action arena unders study. The information gathered here was complied from the country reports of the LPF project from 2005 to 2008 (Devanadera et. al, 2005, Villanueva et al, 2006, 2007, forthcoming).

Action Arena

The general interaction of the actors in the NRM system in Palawan is depicted by Figure 4. However, the focus of ComMod approach, and of this paper, is the appropriation side of the NRM system at the operational level of rules, more specifically, resource appropriation for livelihood activities.

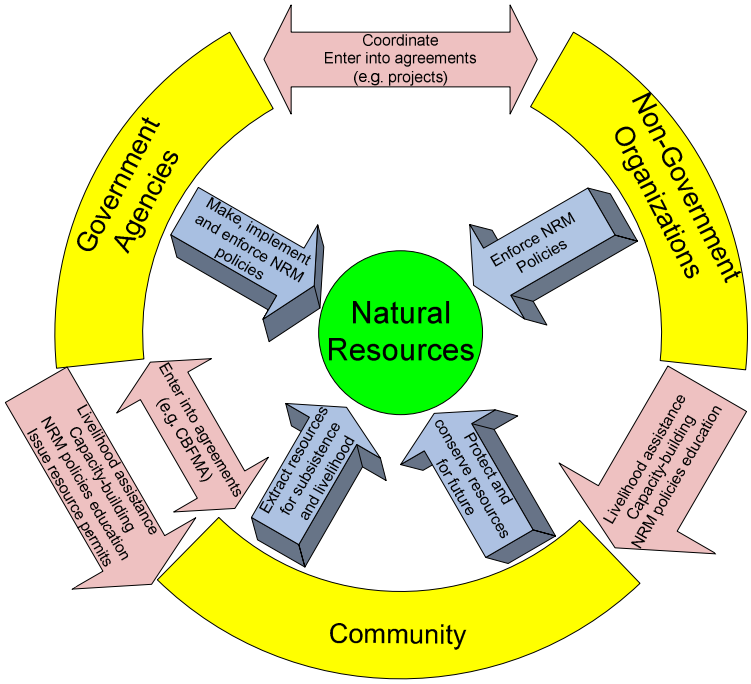


Figure 4. Actions and interactions of the actors in the action arena (Villanueva TR et al., forthcoming)

Actors

The one of the foci of development of Palawan, to which the three villages are part of, is on environmental protection. This means that there are a lot of groups, both from the private and public sectors, who are working on and with the communities to protect the natural resources, considering that Palawan is considered to be one of the last frontiers of virgin forests, as well as one of the major toursist destinations in the country. In the study site, several major stakeholders were identified (Table 1) to be involved in the appropriation game.

Table 1. Major stakeholders involved in the study site

GO	NGO	Community
Philippine Council for Sustainable Development (PCSD)	Budyong Rural Development Foundation Incorporated (BRDFI)	San Rafael, Tanabag, Concepcion Multi-Purpose Cooperative (STCMPC)
Puerto Princesa City Local Government Unit (PPC-LGU)	Environmental Legal Assistance Center (ELAC)	Nagkakaisang Batak sa Tina
Department of Natural Resources – Provincial Environmental and Natural Resources Office (DENR-PENRO)	Nagkakaisang Tribo ng Palawan (NATRIPAL)	Batak village council
Department of Natural Resources – Community Environmental and Natural Resources Office DENR-CENRO	Haribon-Palawan	farmers' organizations

DENR-Community ENRO (DENR-CENRO)		fishermen's organizations
City Environmental and Natural Resources Office (City-ENRO)		Bataks
Bureau of Fisheries and Aquatic Resources-Fisheries Resource Management Program (BFAR-FRMP)		Migrants
Bureau of Fisheries and Aquatic Resources-Regional Training Center (BFAR-RTC Region 4)		
Department of Agrarian Reform (DAR)		
National Commission on Indigenous Peoples (NCIP)		
Kilusang Sagip Kalikasan (KSK)		
Provincial Planning Division Office (PPDO)		
3 Village councils		

In the course of the LPF project, two groups were organized bridge gap between organizations, GOs and NGOs, and the community. These are the Provincial Steering Committee (PrSC) and the Community Technical Working Group (TWG). The PrSC is composed of decision makers of GOs and NGOs, and community representatives, which are the village heads and some members of the TWG. The PrSC is tasked to oversee and monitor the LPF project activities and TWG and act as a forum for communication between the organizations and the community. The TWG is composed of community members, some of which are members of their respective village councils, tasked to develop livelihood and environmental protection initiatives for the villages to address the problems of low productivity in the three landscapes as well as market access. Since then, the group has been regrouped according to three livelihood projects they have identified and chosen to put focus on for the community, namely vegetable gardening, ornamental and flower plants gardening, and cashew production and processing. These two group, in turn, also facilitated in the organizing of activities for ComMod, especially providing participants to the various activities of the modelling process.

Considering the number of actors involved in this setting, there are two main actors participating in the appropriation of resources for livelihood purposes (Table 2). Although these participants are within the same community, cultural beliefs and practices differentiate these two types of actors.

Table 2. Participants of the action situation

Participants	Preferences	Information level and	Selection Criteria	Resources

		learning capability		
Migrants	- Preferences are affected by group affiliations and social relationships, old practices, age, gender - gathering non-timber forest products (NTFPs) is the last resort. - Distance from markets, measured as an added cost, also affects their preferences.	Normally, they don't consciously remember past experiences, no records are kept as well.	Amount of income generated (and not profit margin), gender, seasonality of resources, and ease of livelihood are the criteria used for making decisions	Income, handmade equipment for conducting livelihood
Bataks	- Cultural tradition - Distance from markets, measured as an added cost, also affects their preferences.	Indigenous knowledge; although most are unable to read and write, they rely on the memory of the Batak community	Demand from the migrants, seasonality of resources, and traditional practices, - They are limited to extraction of NTFPs for livelihood due to their closeness to the resource.	Income, handmade equipment for conducting livelihood

Action Situation

The elements of the action situation are listed in Table 3.

Table 3. The elements of the action situation in Palawan

Element	Migrants	Bataks
Positions	Resource appropriators	
Actions	Farm, fish, gather NTFPs, seaweed farming, vegetable gardening, ornamental gardening, make shingles, make	Gather NTFPs, make charcoal

	copra, make charcoal, raise hogs, gather milkfish fry	
Potential outcomes	Scarcity of resources (resources are more difficult to reach), renewable resources unable to recover fast enough	
Transformation functions	Renewable resources have regrowth functions, computation of income is a functions affected by season and weather	
Information	Information about season and weather, market prices are not well known	
Pay-off	Each resource has an attached selling price that varies by season, the equipment used for livelihood have attached costs, permits and forest charges are also present	

Factors affecting the action situation

Attributes of the physical world

The study site, composed of three villages, namely, San Rafael, Tanabag and Concepcion, is situated in the city of Puerto Princesa, in the province of Palawan, Philippines (Figure 6).. IThe combined area of the three villages is about 19,000 hectares. The landscape in the three villages is composed mostly of upland or forest areas, a very small portion of lowland areas, and the rest are coastal areas (Figure 7). The seasons in the area are the wet season which is from May until October, and the dry season, which is from November to April.

Despite the number of groups tasked to support management of the natural resources in the area, it is very surprising that there is very little data available about stocks of resources in the study area, both on land and sea. Only personal accounts of the community members give an indication of the scarcity of the resources. This scarcity is a function of location and distance based on what people have been saying, i.e. they have to move further back into the sea or into the forest areas to find the resources they need, whilst considering the community-based forest management (CBFM) areas and protected areas found within the villages. Weather also affects this concept of accessibility of resources as bad weather prevents steep and high areas in the forest and fishing areas far from the coastline to be accessible.

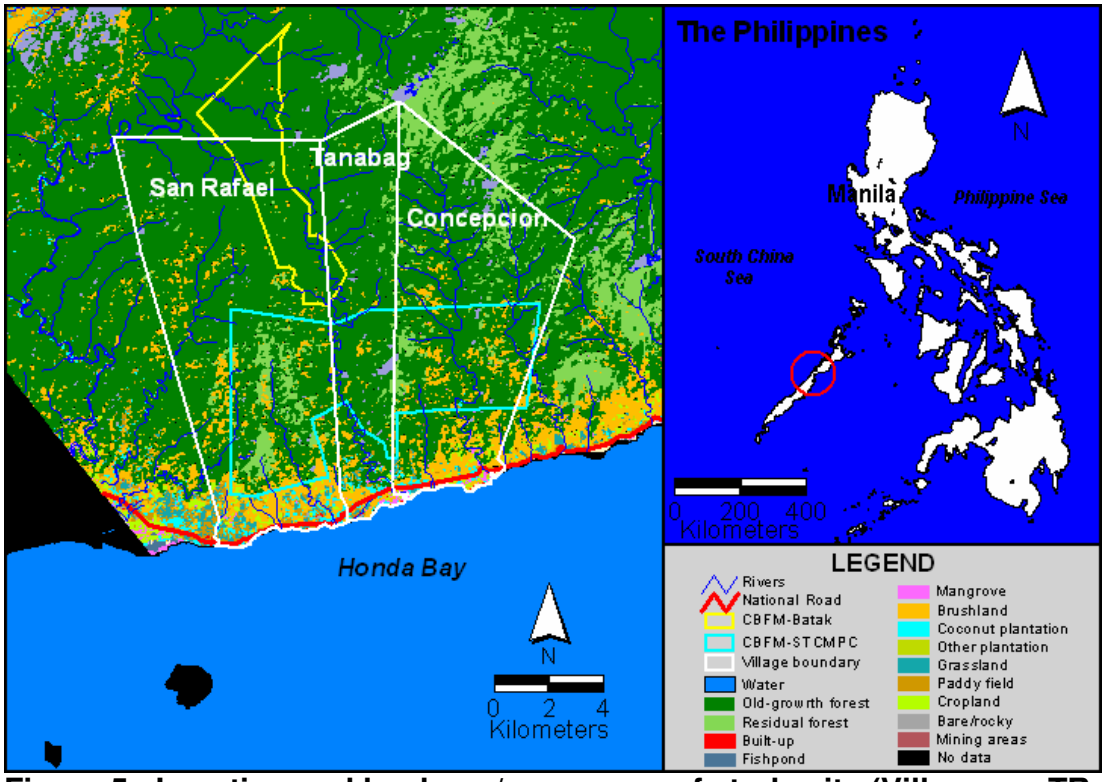


Figure 5. Location and land-use/cover map of study site (Villanueva TR et al., *forthcoming)*

Figure 6. Landscapes found in the three villages

Attributes of the community

The community is composed of the Bataks, a group of indigenous people (IPs), and migrants, or people who have come from different parts of the country and have since settled in the area. There is some evidence of mixing between these two groups. The people of the community, just like most Filipinos, do not to ask each other one's income, unless you have a close relation, e.g. a relative or friend. There still exists the concept of "Bayanihan" or the practice of providing assistance to a neighbor without monetary compensation, both practiced by the migrants and the Bataks. However, this practice is dying according to the community. A complex relationship exists between these two groups. There is an animosity between these two groups based on individual accounts from both sides. The Bataks are viewed by

the migrants as lazy and ignorant, considering that most of them are still unable to read and write. This animosity grows because, according to the migrants, despite that they have been given so much attention by outsiders (GOs, NGO's, and scientific community) they question why they still remain in the same state of being poor. The migrants, on the other hand, are viewed as people who take advantage of IPs. Despite this, there is an interdependency, albeit unfair, between the two groups. For example, the Bataks sell their goods – NTFPs – to the migrants but at very much lower-than-market value prices.

Although many still prefer selling their goods within the villages and neighboring communities, the practice of buy-and-sell is growing among the community members such that they have already identified this practice to be very important in sustaining their families. Many are becoming middle-men in addition to their set of livelihood activities.

Many from the community view external groups such as GOs and NGOs to be inaccessible, not only due to their location in relation to the community, but as well as a bit of timidity on the part of the community to interact with these groups.

Rules- in-use

Since the devolution of NRM management to the local government units (LGUs), which started in 1991, LGUs and village councils, also known as "barangays" – the smallest political unit in the Philippines – are able to establish new rules on NRM thru city and village ordinances, as well as promote community based initiatives such as CBFM. In the study area, there are two CBFM agreements (see Fig. 6) for the migrants and for the Bataks. Aside from this, in Palawan, the Republic Act No. 7611, or the "Strategic Environmental Plan (SEP) Act", established the Philippine Council for Sustainable Development tasked to oversee environmental management proceedings and to implement the Environmentally-Critical Areas Network (ECAN) zones for the entire province of Palawan. ECAN zoning systematically divides the province into protected and non-protected zones, both on land and sea. Although ECAN zoning is yet to be applied within the three villages, it will be implemented soon. The Philippine government, recognizing the significance of the IPs, signed into law Republic Act No. 8371 or the Indigenous People Rights Act (IPRA), which seeks to protect the rights of this much marginalized group. Under this law is the ability of the IP groups to identify and establish their ancestral domains and obtain a Certificate of Ancestral Domain Claim (CAD-C), a tenurial instrument to that defines the area to which the IPs are able to practice their culture. For the Bataks, being unable to get their CAD-C since their management plan was not approved; they have opted for a CBFM agreement instead.

Considering the vast numbers of laws and ordinances, as well as the traditional practices of the community applied in the study site, we opt to summarize how the resources are appropriated by the community for their livelihood activities in Table 4.

Table 4. Rules governing the appropriation of natural resources in Palawan

Types of Rules	

Position	- Anyone can participate in the action situation, even outsiders, provided that he or she has enough capital
Boundary	- Gathering of NTFPs in CBFM areas who hold permits or members of the cooperative managing the CBFM areas - Fishing is allowed only to those who have obtained permits. The location where they fish is only limited by the fishing equipment they have.
Choice	- Bataks gather a certain type of NTFP based on the agreement made by the whole community. This decision is affected by season (e.g. honey), demand (e.g. rattan) and supply (e.g. almaciga resin) - Migrants gather NTFPs when no other livelihood activity is available
Aggregation	- Democratic process of making decisions thru voting. Majority wins.
Scope	- Livelihood activities, namely gathering of honey, gathering of milkfish fry, farming, and fishing are limited by seasons
Information	- Fish stock inventory available only to members of Fishermen's organization - Information about costs involved and income generated from livelihoods is known only to those who practice it. It is an individual's choice whether or not to divulge the information to others should someone ask. - Dissemination/teaching of existing and new laws/regulations thru village assemblies - Environmental awareness are promoted thru programs/projects or thru special subjects in schools
Pay-off	- Forest charges for gathering resources in forest areas have to be paid before resources can be claimed - Permits are needed to obtain right to fish or to gather NTFPs - Penalties for breaking law involve arrest/jail term, confiscation of goods and equipment, and/or fines. - Gains of cooperatives are shared among its members. - Gains by the Bataks are equitably shared among the members of the Batak community - There is Quota or limits for selling charcoal and gathering NTFPs

Such as in many cases all over the world, despite the concept of participatory management of natural resources, implementation of laws have remained top-down, with GOs and NGOs acting as teachers to the community, telling them what and what not to do. Although these groups would say that the community has been consulted and have agreed to follow these new rules and regulations, many of the community members do not fully understand the implications of such and feel that the GOs and NGOs are often too focused on the environment, forgetting that there are humans, the community, who live and rely on the natural resources present in the environment. The community may follow them at the beginning, but, often, they go back to their old practices when they have nothing to eat. Clearly, a better environment for discussion and negotiation, and not just a consultation with the community, is needed to address the concerns of the community while being able to manage the resources sustainably. This is the aspect to which the companion modelling approach with multi-agent systems wishes to influence.

4 Companion modelling in Palawan

Initial preparations for implementing ComMod in Palawan was started in December of 2004 with a training on Companion Modelling and MAS, which included three participants coming from the Department of Environment and Natural Resources – Department of Natural Resources – Provincial Environmental and Natural Resources Office (DENR-PENRO), Philippine Council for Sustainable Development (PCSD) and City Planning Office of Puerto Princesa, Palawan. The activities for ComMod (Figure 7) were then started in March of 2005 and ended in February 2007. An evaluation of the process was conducted in February of 2008.

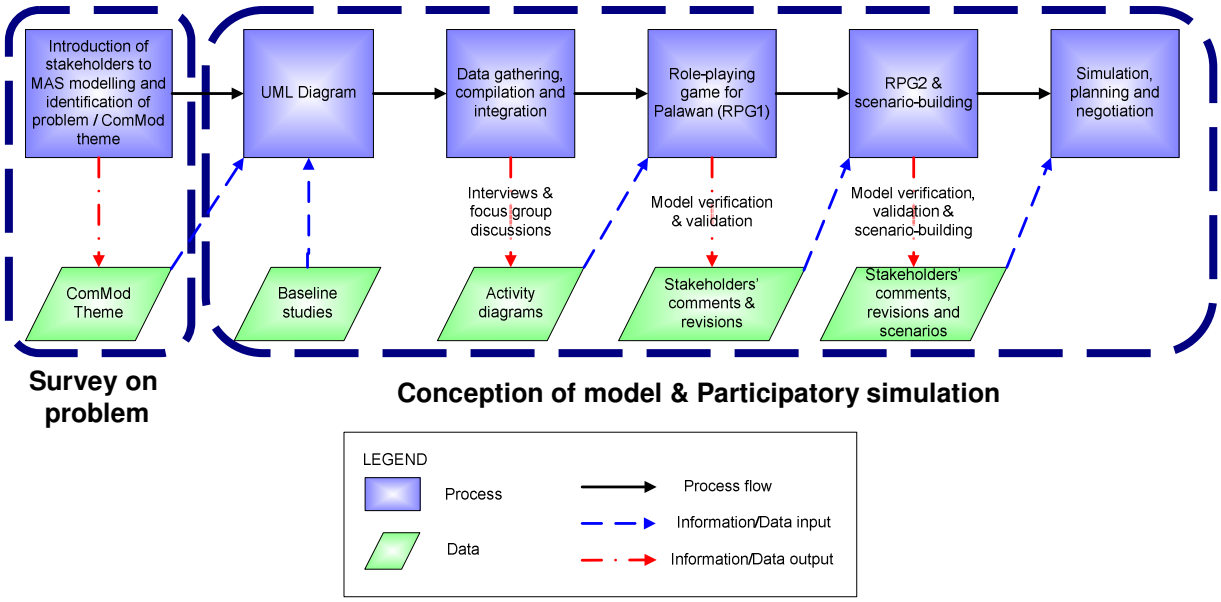


Figure 7. The steps of the first ComMod cycle in Palawan

The activities of the ComMod process in Palawan shown in Fig. 7 is divided into the 2 main categories of the general ComMod process shown in Fig. 1 which are enclosed in the broken lines. The "Concpetion of model" and "Participatory Simulation" are grouped together because of the fact the these steps go back and forth. Fig. 7 also shows the information or data that is either introduced into the process (blue broken arrows) or produced from the process (red broken arrows).

The steps of the process are described as follows:

Introduction of stakeholders to MAS modelling and identification of problem/ComMod theme

The introduction activity was divided into four sessions (Table 5) having different participants in each session. The participants were composed of representatives from GOs, NGOs and the local community. In each session, there was an overlap of representation, e.g. some members of the PrSC are also members of the local community, while others are members come from different GOs. The Bataks, however, were not represented in the other sessions due to miscommunication and they had no representatives in the other sessions.

Table 5. Participants of the Introduction to MAS activity

Session	Participants

1	Provincial Steering Committee (PrSC)
2	GOs and NGOs
3	Local community - migrants
4	Local community – IPs

This activity was with a short presentation on MAS. To fully grasp the concept of MAS, the participants were presented with an example of a MAS simulation model and an RPG called *CherIng,*. The *CherIng* game (Figure 8) is a generic RPG developed by Michelle Etienne, an agronomist and plant ecologist from the National Institute for Agronomic Research (INRA) in Avignon, France, and is about the exploitation of an abstract natural resource called *Ing*. The players have to share the resources, *Ing*, located on the environment or game board. The game is played with four different scenarios, wherein some of the rules of the game are changed. Table 6 shows the different scenarios.

Table 6. Scenarios of the *CherIng g*ame

Game session	Scenario
1	basic CherIng game wherein no one is allowed to discuss strategies or choices with other players during the game
2	- players are divided into groups - prior to the start of the game, each group is allowed and may choose to develop a strategy for extracting *Ing* - the game then proceeds like the basic CherIng game
3	- prior to the start of the game, the groups may discuss with other groups to develop group strategies for extracting *Ing.* - the game then proceeds like the basic CherIng game
4	- prior to the start of the game, a new rule is introduced to the game, i.e. quota of *Ing* extracted per round for each group - the groups may discuss with each other to develop strategies to cope with the new rule - the game then proceeds like the basic CherIng game

The results of the different game scenarios are discussed comparing the effects of the changes in rules with the game results using the visualization tools designed in the game (Figure 8). The *CherIng* game was used in this activity was used not only for the participants to experience an actual RPG, but also as a tool for learning about the linkage between resource extraction and effects of rules-in-use in the system.

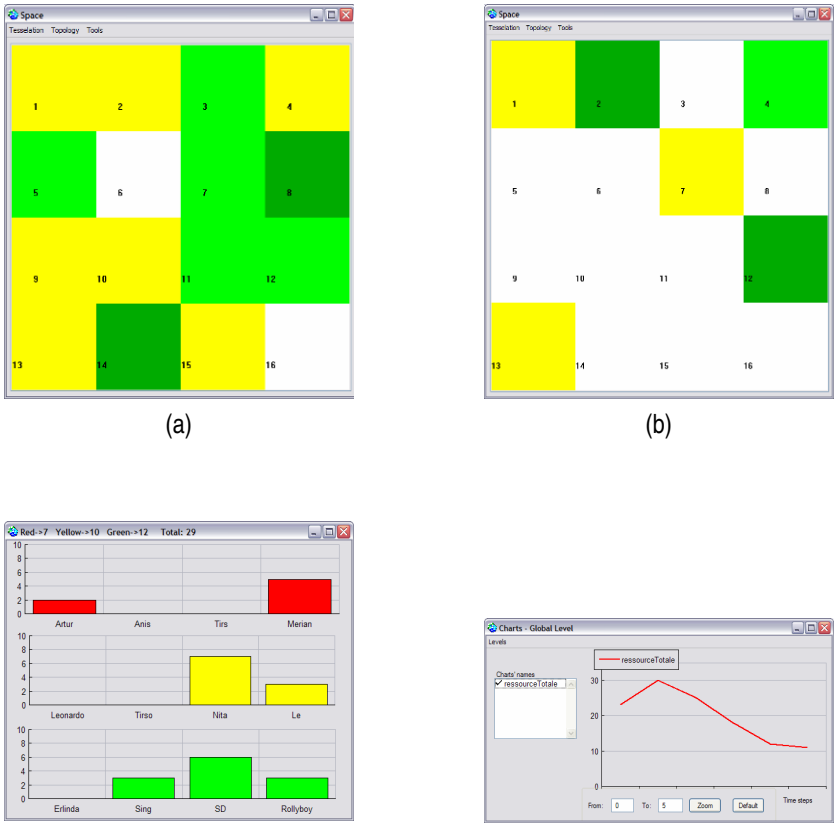


Figure 8. The *Chering* game

(a) Game board (and initial state) of CherIng game
(b) Example of game board after resource extraction
(c) Total resource *Ing* extracted by each player
(d) Total resource *Ing* remaining on the game board per round

The *Chering* game is designed to be played using a computer developed with CORMAS, a simulation platform designed specifically for MAS for NRM (CORMAS website: cormas.cirad.fr). The game board is displayed on the computer screen, or in the case of this activity, a projector. When the *CherIng game* was played with the IPs or Bataks in their village inside the forest; thus the game had to be modified such that a paper game board was used to take into account the absence of electricity in their area, as well as modifications in the other game materials to take into account that most of them don't know how to read and/or write.

Part of this activity also involved getting the approval of the stakeholders in employing the modelling process with them. After they have given their approval, the theme or the problem the model would be addressing was discussed with the stakeholders. The discussions led to the theme of the MAS model, and the first ComMod cycle, being the effects of livelihood activities, rules of access and use of resources and the dynamics of renewable resources with each other (Figure 9).

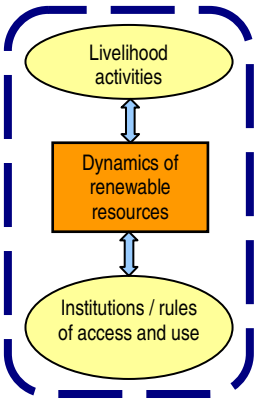


Figure 9. Theme of the first ComMod cycle (adapted from the Ecole ComMod Project Website: www.ecole-commod.sc.chula.ac.th)

UML Diagram

Having a theme for the model, a review of the baseline studies conducted for the project, which included a stakeholder analysis with socio-economic survey, institutional analysis, and vision-mission activity (Devanadera et al. 2005), led to an initial MAS concept about the structure of the system. This concept was visualized using a Unified Modelling Language (UML) class diagram (Figure 10). UML is traditionally used in object-oriented software design and programming (UML Resource Center, http://www-306.ibm.com/software/rational/uml/), but is also used in MAS modelling to describe the system and communicate the concept to others.

The class diagram (Fig. 10) shows the different classes or entities that are present and represented in the system. Each class is a template of all the instances of a particular entity in the model. Each class has a set of variables, called attributes, and a set of operations. An instance may have different values for the attributes but each instance of a class has the same set of variables and operations available for its use. For example, the "Villager" class has attributes of income, age and gender. An instance of a "Villager" class, let's say villager1, may have 10,000 Philippine pesos, 40 years old and male for its income, age and gender respectively. But all instances of the "Villager" class have attributes of income, age and gender, as well as *raiseAnimals, collectNTFP, hunt, weave, and makeCharcoal* as its available set of actions. More actions of a class are represented by simple lines or arrows with linear arrowheads connecting the classes. For example, villager1 may *farm* on an instance of a cell. Subclasses of a class are represented as arrows with triangular heads connecting two or more classes to another class. For example, "Migrant" and "IP" are subclasses of the class "Villager." Subclasses inherit or gain the properties of the main or super class but it may also have properties that the other subclasses do not. For example, aside from having actions of the class "Villager", e.g. *raiseanimals* and *collectNTFP*, the "Migrant" class has additional operations or actions such as *farmSeaweed* and *growOrnamentals*, which the "IP" subclass does not have. Aggregation or grouping of entities is also possible and is represented as arrows with diamond arrowheads connecting two classes together. For example, a "Household" is composed of entities of the "Villager" class.

This UML class diagram has to be completed with constants or equations to compute for the values of the variables, as well as the exact definition of the operations. These operations are normally represented as UML activity diagrams.

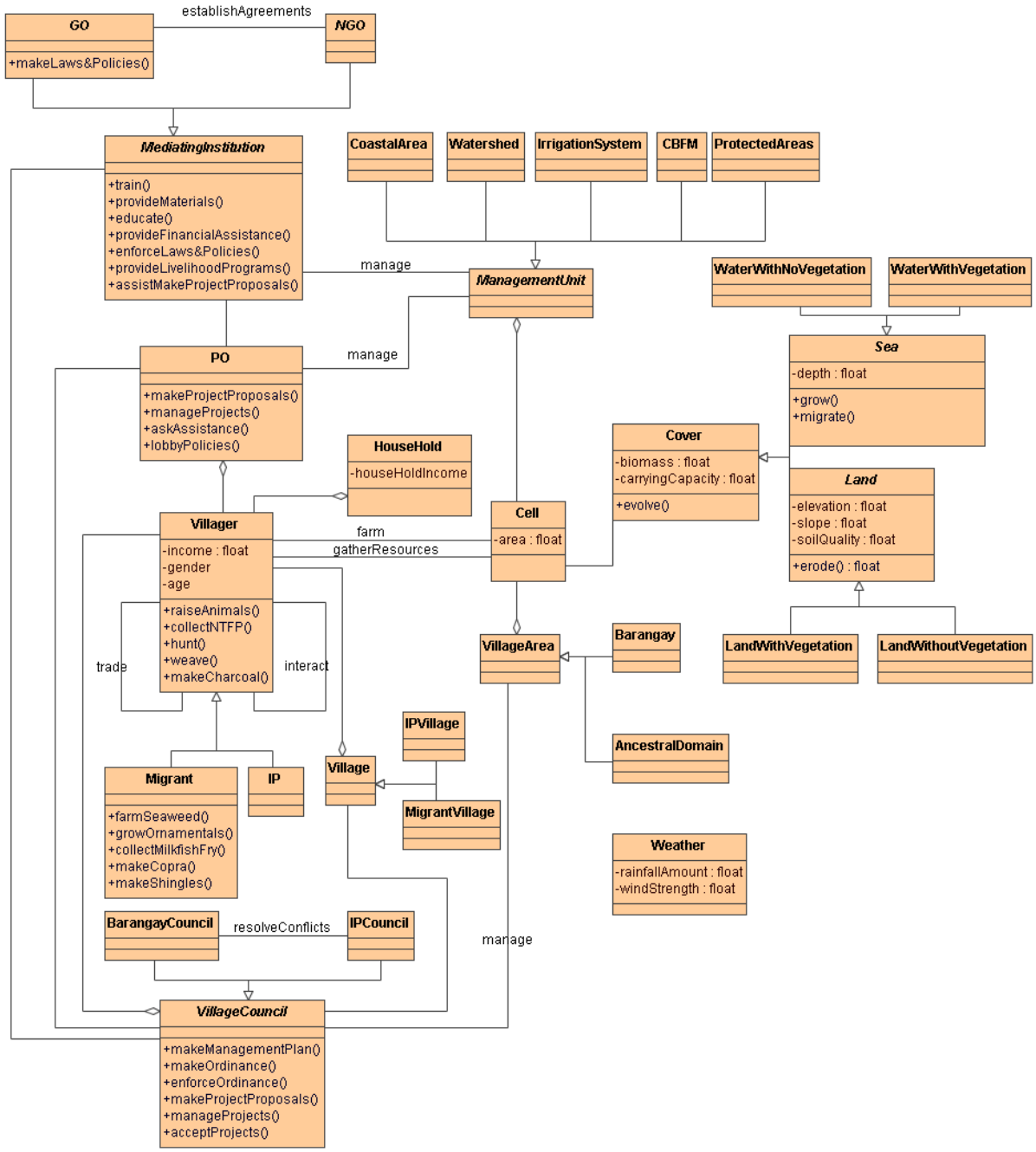


Figure 10. Class diagram of the NRM system of the study site

Data gathering, compilation and integration

Aside from the data and information found in the baseline studies, additional activities, such as individual and group interviews, and focus group discussions (FGDs) were organized to fulfill the details of the class diagram.

The interview with the local community was about their perceptions of themselves in relation to their livelihoods as well as their relationship with their natural resources. This is important to identify which resources are of particular importance to them and how these resources are used in their livelihood activities.

The FGDs were conducted with the local community, including the Bataks, to determine the "why", "when" and "where" and "how" of each major livelihood activity. The major livelihood activities of the community were also identified within the FGD activities. Initially however, the participants of the FGDs were identified based on the stakeholder analysis of the project (Devanadera et. al., 2005). The results of the FGDs were then used to make the activity diagrams for the operations of the classes. An example of an activity diagram is shown in Figure 11. A similar activity was done with the GOs and NGOs but these were done by interviews.

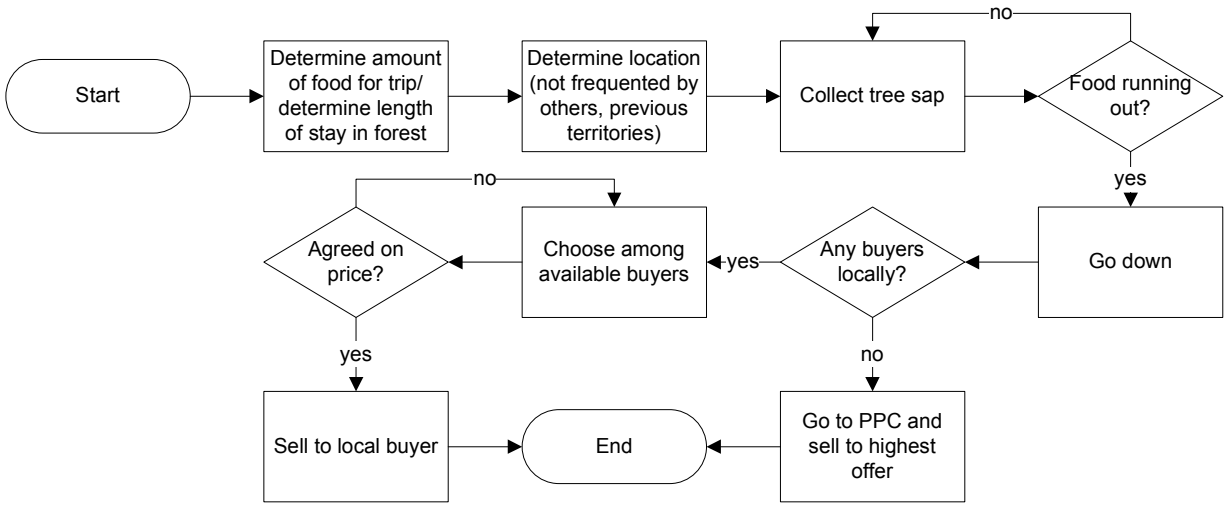


Figure 11. Sample of a UML activity diagram: the flow of actions for the Almaciga resin collection operation of the "Villager" class

The data and information gathered from this activity were then integrated into an RPG which was then played with the local community.

Role-playing game for Palawan

The main objective of the RPG for Palawan activity, or RPG1, was to verify and validate the MAS model. Considering that the entire MAS model would be very difficult to translate into a simple RPG, the RPG was designed to concentrate on a particular aspect of the MAS model (shown in Figure 12). The participants of the RPG1 activity were all coming from the community, with one session per village, plus a separate session for the Bataks. The participants The RPG1 included some participants from the Introduction to MAS activity, the interviews and FGDs. It was difficult to get the same participants from the previous activities because of their schedules. There were also new participants to play the game so broaden the audience that will verify and validate the model. The RPG1 was designed after the *CherIng* game introduced at the beginning of the ComMod process so that some of the participants would already be familiar with the game process and would be

comfortable to play it. In general, the game elements of the *CherIng* game were retained and some details were added. In a sense, it is a adaptation of the *CherIng* and fit to the local situation. This involved the extraction of a diversified set of resources and livelihood activities, with pay-offs measured in terms of the local currency. The livelihood activities represented in RPG1 are the following:

1) Lowland farming
2) Coastal fishing
3) Almaciga resin collection, also known as almaciga tapping
4) Honey gathering
5) Rattan collection
6) Milfkfish fry gathering
7) Hog raising
8) Ornamental plants/flower gardening
9) Charcoal making
10) Coconut shingles making
11) Seaweed farming
12) Copra making

For the RPG1 played with the Bataks, only livelihoods involving forest resources, namely gathering of NTFPs, were included in the game since these are the only activities they are involved in.

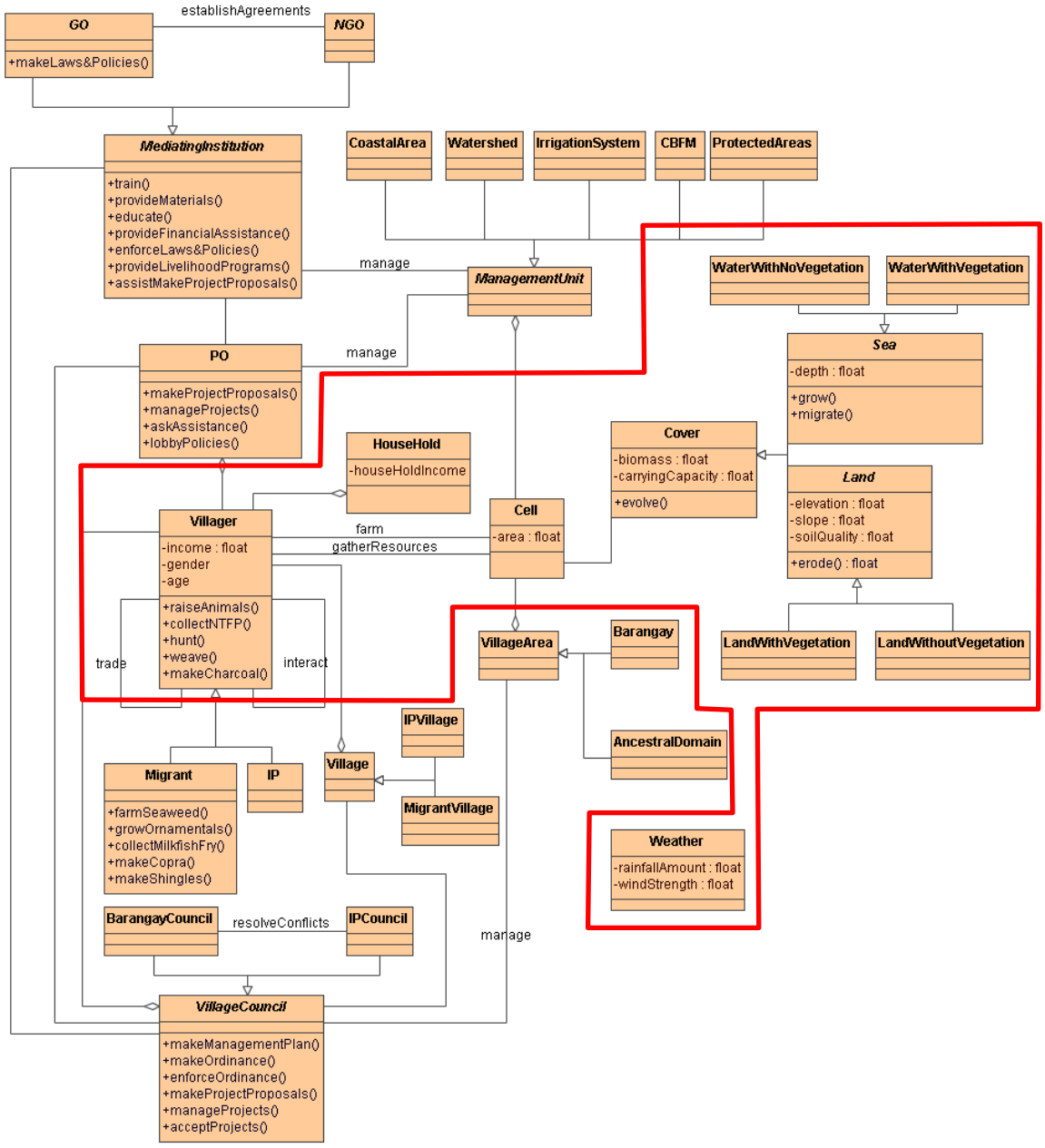
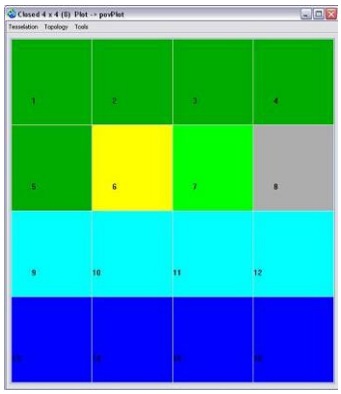


Figure 12. Class diagram of the RPG (enclosed in red box)

The game is limited to a maximum of 12 players and each player represents a household consisting of about 6 members. There is also a game master controlling the sequence of the game and computing the pay-offs for each player and some game assistants to facilitate the game, such as collect the materials and assist players in writing. There are twelve rounds in a game representing the months of the year, starting with January. The game materials used in RPG1 are shown in Figure 13. Similar to the *CherIng* game there is a game board (Fig. 13a) representing the three landscapes of the study site, i.e. coastal, lowland and upland/forest areas. The same paper game board is also available in the computer (Fig. 13b) to be used later on to display the choices of the players anonymously and as well as display the effects of their decisions. An income card (Fig. 13c) is distributed to each player which is put inside a folder after making a choice. This is done for the purpose of organization as well as secrecy. A livelihood card (Fig. 13d) is also made available

for each of the twelve livelihoods represented in the game and each card contains information about the costs of doing that livelihood. This also serves as a reminder that the player already has paid the costs for the equipment for doing a livelihood activity and no longer needs to pay the same costs should the player choose to do the same activity later in the game. The computer program devised using CORMAS, was then used to display the results of the games (visualization tools) (Fig 13e) as well as to compute the income each player receives from doing a particular livelihood. A sample picture of the stakeholders playing RPG1 is shown in Fig. 13f)



Legend
Forest / upland
Coconut farm
Agricultural farm
Coastal area
Deep water

(a)

Legend
Forest / upland
Coconut farm
Agricultural farm
Coastal area
Deep water

(b)

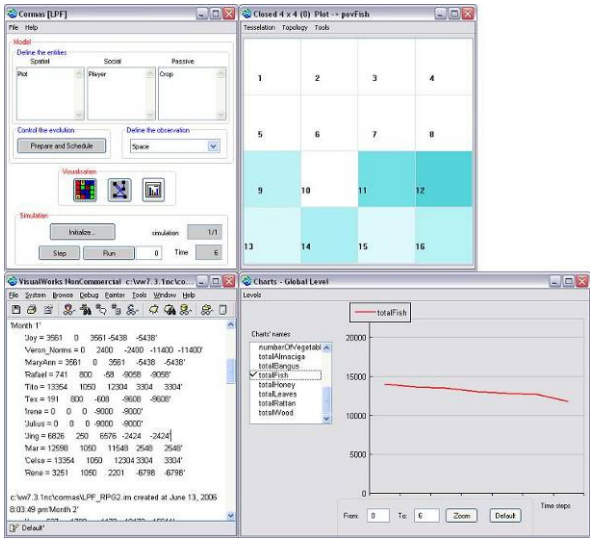
Pangalan:			Barangay/Organisasyon:		
Buwan	Gawain/Lugar	Kita	Gastos	Kabuuan	Menos buwanang gastos
Enero					
Pebrero					
Marso					
Abril					
Mayo					
Hunyo					
Hulyo					
Agosto					
Setyembre					
Oktubre					
Nobyembre					
Disyembre					

(c)

Almaciga Tapping

Paunang capital: P 535.00
Karagdagang gastos: P 800.00

(d)



(e)

(f)

Figure 13. RPG1 game materials

RPG1 is played with the following sequence:
Step 1: In round one, each player chooses a livelihood activity and gets the corresponding livelihood card. In round 1 it is assumed that the player already has the necessary equipment to perform the activity he or she has chosen such that he or she no longer pays for the capital costs. However, in the succeeding rounds, if a player chooses to do a new livelihood activity in the round, that player has to get the livelihood card of his choice and pay for the equipment costs. If a player does not change livelihood in the next round, or is going back to a livelihood activity he or she has already chosen before, need not get a livelihood card nor pay the equipment costs. A player may is only allowed one livelihood activity per round but is allowed to change livelihood activity for every round.
Step 2: Each player chooses a space in the game board (identified using numbers) where he or she is to perform the livelihood activity. The player then writes this information plus the livelihood activity he or she has chosen on the income card. The income card is then placed in the folder and is collected by the game assistants. The folders are then given to the game master.
Step 3: The game master, with the assistance of the game assistants, records the choices made by each player then displays them on the computer screen/projector to display the places the players have chosen. The choices are unidentifiable in terms of who made the choice.
Step 4: The game master runs the program to compute the pay-offs, wherein the costs of the equipment and operation costs are deducted from the income as well as the monthly cost of living for a household of 6. The net income is then written on the income card for each player and is then returned to the player.
Step 5: Steps 1 to 4 are repeated until the 12 rounds or 1 year is completed.
Step 6: The results of the game are discussed using the visualization tools showing each players total net income in the game and the remaining resources in the game board compared with the initial amounts at the start of the game.

After the discussion, it was found out that the seaweed farming activity has to be replaced with vegetable gardening and the costs of some of the other livelihood activities have to be corrected. In between the period of the FGD and the RPG1,

seaweed farming is no longer being done and that vegetable gardening has been growing in popularity among the locals. These changes were implemented and the modified version of RPG1 is now called RPG2.

Part of this activity also involved an evaluation of the day's activity with the participants, wherein a set of questions were asked to the participants to determine the usefulness of the activity, i.e. did they learn anything and were these lessons meaningful, how well the activity was organized, and determine possible areas of improvement in the activity.

RPG2 and scenario-building

After the proposed changes were made to RPG1, the game, now called RPG2, was then played with the stakeholders, but this time, the activity was divided into sessions per type of participant. A session was organized each for the PrSC, GOs, NGOs, the migrants and the Bataks for a total of 5 sessions done in 5 days. Again, the objective for this activity was to verify and validate the model. However, an additional activity was done, which is the scenario-building activity. To introduce the scenario-building activity, RPG2 was played twice having only 6 rounds per session (January to June). The first game represented the base situation and the second game represents a scenario where a new rule, "no-access" rule, is imposed in their area. This is relevant to their situation since a new rule, the ECAN zoning, was to be implemented in their area soon.

In the scenario-building exercise, participants formulated "What if…?" questions to determine what interests them in their future in terms of their livelihood and natural resources. An example of a "What if…?" question is , "What if we continue to do same practices in our livelihood?" They were also asked how would they assess the result of their question, i.e. what are the indicators would they look into to analyze the situation. Examples of these indicators are the amount of resources remaining, the total net income of the community, and the number of villagers doing a certain livelihood, These scenarios were intended to be used in the computer simulation such that the simulation would try to answer these questions or scenarios, using the indicators they identified to collectively analyze the outcomes of the scenarios.

It is also during this activity that they approved the model. Since the participants are not the people responsible for laying out resource management plans for the community, the group responsible for which is the *Barangay* Development Council (BDC, *barangay* means village) and has yet to be formed, they have officially endorsed the use of the MAS model in the future activities of the BDC for developing management plans as they see it as a vehicle to transmit their views to this group.

Simulation, planning and negotiation

Due to logistical constraints of the LPF project, the activity initially planned to present the scenarios identified in the previous activity and a water resource management planning activity were combined into a 2-day workshop with representatives coming from GOs, NGOs, migrants and the Bataks. The objectives of the workshop were to present the computer simulation to the stakeholders and relate it to the need for a water resource management plan for the communities. At the end of the workshop,

the participants were expected to have come up with a strategy and plan to address the water resource distribution issue.

The computer simulation made for the Palawan site is an extension of the RPG which contains more details that were not included in the RPG but are included in the original MAS design. The visualization tools used to collectively analyze the scenarios presented in the simulation (Figure 14) are similar to those used in the RPGs for Palawan as well as that of the *CherIng* game. Again, the simulation was programmed using CORMAS. In Figure 14a, the space visualization tool showed the land and sea cover of the study site which has been simplified to match the categories used in the RPGs. Each cell or square represents an area of 4 hectares. The stakeholders represented as agents in the simulation were the Bataks, shown as blue dots in Figure 14b and 14c, and the migrants, shown as red dots in the same figures. The initial and final states of a scenario were compared using the space visualization tool wherein the amount of a resource, stored in a layer of information, is represented as shades of a color. For example, Fig.14b shows a snapshot of the fish stock, or cells in shades of blue, at the beginning of the simulation and Fig. 14c shows the same resource at the end of the simulation. Another visualization tool, a chart, is used to display the variation of an amount over time. For example, the chart in Figure 14d shows the variation of the number of almaciga resin collectors over the period of 10 years.

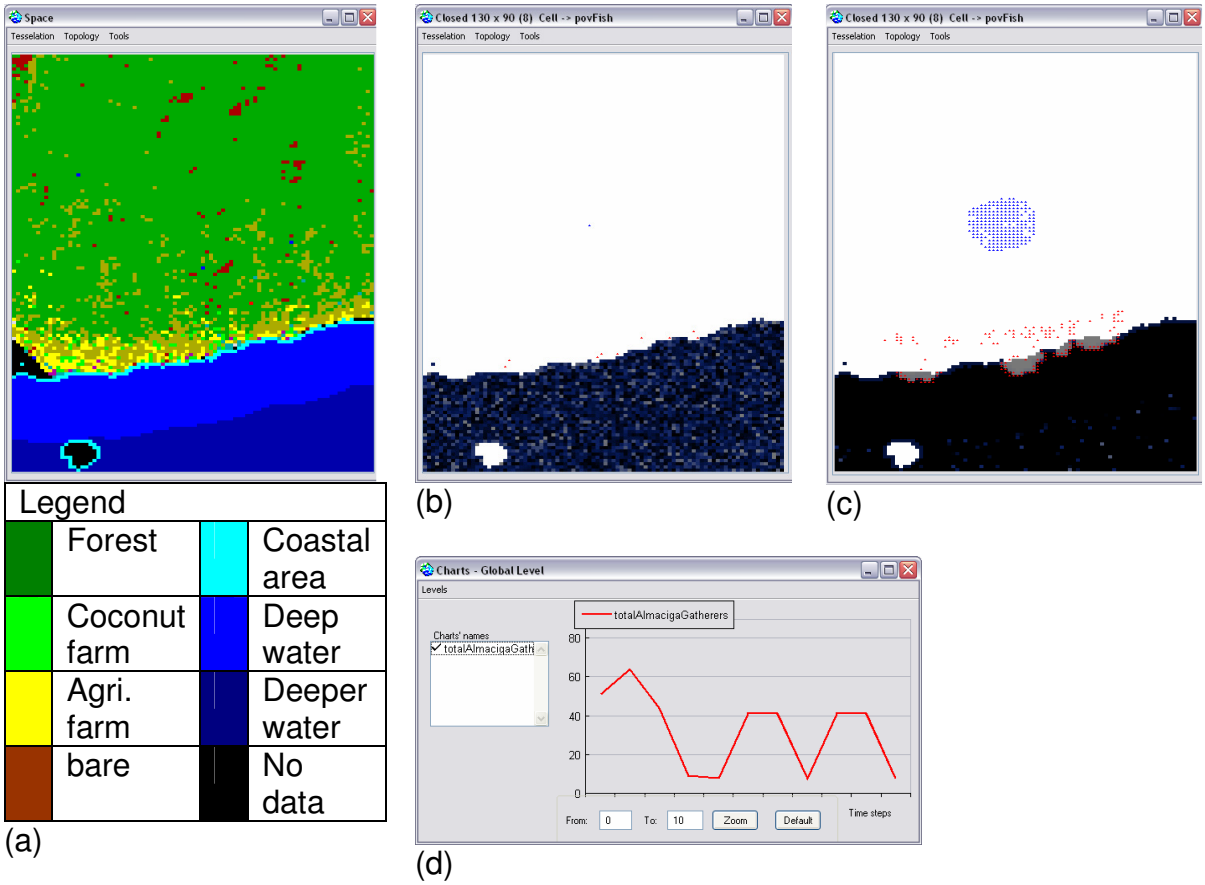


Figure 14. Simulation visualization tools

The scenarios presented in the workshop covers a 10-year period. Two factors were changed in the simulation, the presence (or absence of the ECAN zones) and the

ability (or non-ability) of the agents to change livelihoods. Combinations of these 2 factors give 4 different scenarios, with no change in livelihoods and no ECAN zones present being the base scenario. Note that the initial states of each scenario were all the same.

The results of the scenarios were then linked to the livelihood projects already being implemented by the local community, i.e. ornamental and vegetable gardening. Since these activities are water-intensive, there is an urgency to establish a water distribution system for the villages to sustain these activities. The stakeholders then were given a short training on how to make plans and, at the end of the workshop, they were able to make and present these plans to the workshop participants, as well as make verbal agreements among the people with responsibilities in their plans to carry out their tasks. These management plans contained the strategy to address the issue, a plan to implement this strategy, the timetable for implementing the steps of the plan, and the person or people responsible for carrying out the steps. Currently, two villages, namely San Rafael and Concepcion, have started implementing their plans in villages.

ComMod evaluation

Although this step is not included in the ComMod process shown in Fig. 7, this is an important step in completing the cycle to determine the strengths and weaknesses of the ComMod process as how it was conducted in the study site, and determine if the objectives were obtained. The period for evaluation covered the entire ComMod process and was done approximately nine months after the last activity, i.e. in February 2008. The evaluation was done using the ComMod Evaluation protocol which is being developed and tested by more than twenty scientists around the world who are involved in the use of the ComMod approach (source?). The evaluation protocol is designed to evaluate the ComMod process from the point of view of the implementer of the ComMod process and from the point of view of the stakeholders who participated in the process. It is important in this evaluation protocol to determine the changes in the system, including changes in the stakeholders, if there were any, and to associate these changes to the steps of the process. Considering that the evaluation was done only recently, the final report of the evaluation is yet to be published.

5 Results and discussions

In order to influence the communication process among the stakeholders involved in this NRM setting, the ComMod approach tapped into the presence of the PrSC and the TWG as forums for discussion and negotiation for sustainable resource management. Implementing ComMod with representatives of the community, GOs and NGOs, as well as the PrSC and TWG, the participants of the Commod process, including the researchers, were able to learn and formulate plans of actions that would help the attain each other's objectives. According to the accounts of the stakeholders and on our observations of the stakeholders, we could see that the new actions they have made were on the operational level:

1) The Bataks have become more selective when cutting trees.

2) Many participants were made aware of the seasonality of the livelihood acitivites such that they have improved their timing according to seasons.
3) The migrants have become more enthusiastic in adopting new livelihood activities, more notably vegetable gardening. They even requested the data about the costs involved for conducting livelihood activities which were compiled from the FGDs, and then used in their livelihood planning activities. Currently, they are implementing the vegetable and ornamental gardening projects within the community.
4) The stakeholders were able to collectively formulate water resource management plans for each village. Two villages have begun implementing these plans.
5) The interest to protect and care for the environment has increased and the community has started some programs for this purpose. For example, the community did a riverbanks rehabilitation program by planting vertiber grass on the riverbanks. They themselves made a request for assistance from the appropriate government offices. Their request was approved and they implemented the said program.
6) The local community is now more vocal in expressing their views and sentiments.

We now examine how these outcomes were brought about by the ComMod process. Going back to the IAD framework, we see that these actions were brought about due to changes in the attributes of the community:

Behavior

In terms of behavior, the ComMod process complemented the efforts of the LPF project of exposing the participants to different types of stakeholders. By their own accounts, the local people who used to be uncomfortable in interacting with "higher" people, i.e. high ranking officials in the local government have become used to the idea of being around them. Now they feel less threatened by the presence of these government officials and are able to discuss with them.

Another important aspect that the ComMod approach was able to address was the process of interaction among the stakeholders. With the RPG, the stakeholders were entertained while learning and discussing matters about NRM. The stakeholders commented that they never thought that they would be able to discuss important issues such as NRM planning, normally regarded as a process done under very formal conditions, in a light and entertaining manner. For them, seeing that there is a way for them to participate in such processes that it changed their minds and gained confidence to participate in NRM planning processes.

Knowledge and common understanding of the action arena

In the Palawan case study, the ComMod process was able to:
1) expose some local knowledge, which already existed but are only known by few, to a broader audience
2) introduce new knowledge about to the participants
3) reinforce the knowledge people already knew but were unsure about

With the new and reinforced knowledge the local people now possessed, they have gained more confidence in interacting and discussing with people who they view to be "higher" in terms of position in the society, and therefore, knowledge. And because they know that the model produced in the ComMod process was made with the shared knowledge and approval of the stakeholders involved, they see it as a good basis to which they can anchor their views and ideas. This also encouraged the local community to pursue other livelihood activities because of what they have learned in their interaction with the model and with other stakeholders. This knowledge was reinforced when they have started to reap the gains of their new actions, which in turn encouraged others to follow suit. These meetings with different types of stakeholders also became venues for the stakeholders to be familiarized with the appropriate people or agencies who could assist them with their plans and initiatives. Prior to that, they usually didn't know who to approach when they need to address problems in their communities, which aggravated their lack of confidence to pursue their plans.

On the side of the researchers, the lessons learned from the process were used to guide or direct the future actions not only of the ComMod project, but as well as those of the other development and capacity-building efforts initiated or supported by the LPF project. The process also validated some of the ideas collected throughout the project life cycle and debunked some of the assumptions made.

What exactly were the lessons learned? From the side of the stakeholders, they learned that:

1) In the FGDs, the villagers have gained a more complete understanding of the livelihood activities in the villages, such as the costs involved in doing these livelihood activities. Before, the information about livelihood activities is localized to the people who practice them. Those who were unaware of this information were reluctant to adapt such livelihood.
2) From the RPGs, they were able to keep track the net benefits they receive from livelihood activities and are made aware of the effects of seasons in the livelihood activities such that they were able to strategize their actions to gain the most benefits. Prior to this, they are not aware if they are losing money from their livelihood activities because they basically don't keep track of it and they are used to making a living on a day-to-day basis.
3) The simulation drove home the point that there is a need to reduce the pressure exerted on forest and fishery resources and adapt alternative livelihood activities such as vegetable and flower gardening. This, however, brings out the issue of water resource, its proper distribution and management. The stakeholders now know that they need to carefully plan for this together with other stakeholders if they want to successfully implement initiatives.
4) Also from the RPGs and simulation, the local community learned that the profit margin for collecting NTFPs is extremely low, such that, for those who depend on NTFPs for a living, most especially the Bataks, will always never make enough income to sustain them.
5) The stakeholders also agreed that they all need to address the lack of available alternative livelihoods for the Bataks.

From the side of the researchers, they learned that:

1) During the interviews, the community perceived themselves as resource users without any specific major livelihood activity. So much so that they say that their major livelihood is the combination of smaller, seasonal livelihoods, or more colloquially referred to as “sidelines.”
2) Also from the interviews, it was gathered that many livelihood programs, such as milkfish culture, were initiated by the community but most end up failing because of mismanagement. This meant that the capacity-building and skills training of the LPF project need to address the area of project planning and management.
3) From the RPGs, there were distinct variations in the intensity of livelihood activities practiced by the community depending on the village they come from. Initially, it was assumed that all people from the villages shared the same resources within the three villages. For example, it was seen from the RPG that people from Tanabag were more interested in livelihood activities related to forest resources than the other two villages.
4) Also from the RPGs, the researchers realized the importance of buy-and-sell activities of the locals, not only for the local resources, but also resources coming from outside the village. The intensity of this practice may have significant effects on resource stocks within and outside the village. The market chain for this practice should be given more attention in the future.
5) From the RPGs, the researchers learned that the Bataks will all perform the same livelihood activity. For example, if one collects almaciga resin, everyone will do the same. Also, they only collect rattan if there is a demand for it coming from the lowland because if there are no buyers, then the rattan would just rot and would go to waste.
6) From the water resource management planning activity, it was learned that it is technically impossible to formulate a unified water resource management plan for the three villages because they do not share the same watershed for their water. Furthermore, the three villages have different levels of water distribution structures, with Concepcion being the most advanced and the others practically don’t have any structures at all. Lastly, there seems to be a hidden conflict existing between San Rafael and Tanabag, wherein there seems to be occurrences of theft of pipes for the water distribution network in the past. This conflict was not resolved, and there seems to be an unwritten agreement not to talk about it. This conflict was only uncovered when one of the participants in the planning activity joked about it and the others reacted.
7) Throughout the process, the researchers learned the stark and negative perceptions of the stakeholders about each other and this had to be continually addressed in the designs of the activities not only of ComMod, but also of the LPF project.

In general, the ComMod process’ influence on the system under study is on the attributes of the community, which is needed to initiate changes in the rules-in-use, which would hopefully change the outcomes of the action arema. What is interesting about this finding is that it shows that the factors that affect the action arena may have strong influence on each other, such that a change in one factor may influence change in another.

Looking back at the actions taken by the stakeholders as a result of the ComMod process, we could see that these actions addressed the NRM problem from the

appropriation side, e.g. reduced extraction of resources, following seasonal changes for livelihood activities, as well as the provisional side of the situation, e.g. organizing and adopting alternative livelihood activities and development of a water resource management to support their alternative livelihood activities. At this point, it is too early to tell if these actions are optimal or even effective in the long run. But what is important is that they learned and planned for their future collectively and that they have started to apply what they have learned.

6 Conclusions

MAS modelling using the Companion modelling approach allows the stakeholders and scientists learn from each other while being entertained. This is important to ignite and maintain the interest of the stakeholders to participate in the process.

The constant exposure of the stakeholders with each other in such environments lets them become more comfortable to interact with each other. Combined with the new or reinforced knowledge they gain from the process which they learned together, and having a common basis from which they are able to create ideas, i.e. the collectively-built model, raises their confidence and become more willing to express their views and ideas.

The stakeholders, especially those who feel that they are not hear, appreciate the ComMod process because they feel that the process allows them to communicate their ideas and sentiments to the people who need to hear them.

Because of the interactions designed in the ComMod process, the scientists are able to observe the stakeholders in simulated reality situations, which would have been difficult and time-costly to do in real situations. This provides an opportunity for the scientists to immediately formulate the interesting questions on behaviors and patterns of interactions they observe and be able to adjust the process to take into account the observations they have made.

This approach is not without its challenges, however. For example, the scope of the stakeholders involved in this study was very diverse, such that the planning for each activity is very difficult. The stakeholders were located in different areas, i.e. the GOs and NGOs located in the city proper, which is about 1 hour away from the study site, and the Bataks located within the forest area. Moreover, there is no electricity in the Batak settlement making it more difficult to conduct activities using equipment that relied on electricity. Some of the activities with the Bataks had to be done in the village proper.

Aside from the location of the stakeholders, their availability also posed a big problem. The stakeholders have varying degrees of availability depending on the season, month, week, day and even time of day, including holidays for fiestas. It is difficult to organize activities which required different types of stakeholders to be together. In such situations, we have to divide an activity to several sessions to accommodate the stakeholders in the process.

The level of education and perceptions of the stakeholders about each other were very diverse and very challenging to address.

However, we also view these challenges as opportunities for innovation and creativity that could lead to better tools for communication and improvement of the process. For example, the RPG developed for Palawan was designed such that the game can be played with people who don't know how to read by using pictures and colors as symbols. In terms of writing, we compensated by having game assistants who can assist the players. In the future, the RPG will be translated to a game that has very little or no dependency for computation machines and electricity and can easily be transported from one area to another. Being able to deal with the ever-changing local situations demonstrates the strengths of the ComMod approach.

Towards the end of 2004, landslides occurred in the province of Aurora in the Philippines during a typhoon. They attributed the landslide to excessive logging in the area. In response, the Philippine government issued a total log ban across the nation, which included the CBFM areas. A bill for a 25-year log ban is also in the pipelines. It is hoped that the ComMod process can be brought to this level of decision-making so that we could influence the decision-making process and avoid sweeping decisions which could have adverse effects, especially to those whose lives depend on natural resources.

In this paper, we used the IAD framework to map the data, information and ideas generated in the ComMod process into a formal structure, thus guiding how we view and analyze the situation. What would be interesting is to use the IAD framework in the actual design of the ComMod process, starting at the definition of the problem. Using the IAD at the problem definition stage might be able to facilitate process in terms of identifying the relevant variables which are of interest to the participants. The IAD framework may also be interesting to use in the ComMod process for a structured participatory institutional analysis of the system that may enhance the quality of knowledge produced.

Comparing the IAD framework and the UML diagrams for MAS, we can see that the same elements of the IAD framework are also found in the MAS model. In a sense, this is another representation of the action arena using a MAS framework. So then, it would be interesting to conceptualize the system using MAS modelling framework using the IAD framework as a guide in identifying the elements of the MAS model.

In closing, the Companion Modelling approach has a high potential in promoting sustainable resource management by creating an atmosphere conducive for multi-stakeholder planning and negotiation, brought about by a change of attitude or behavior and by having tools that facilitate discussions among the stakeholders.

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