INTERDISCIPLINARY TRAINING COURSE ON MULTI-AGENT SYSTEMS, SOCIAL SCIENCES, AND INTEGRATED NATURAL RESOURCE MANAGEMENT IN THAILAND: LESSONS FROM AN INTER-UNIVERSITY PROJECT1

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Abstract
In this new century, there is an urgent need to integrate and organize knowledge into suitable frameworks to examine essential problems with the people involved in solving them. Recent advances in computer science, particularly distributed artificial intelligence and multi-agent systems (MAS), are creating a strong interest in using this new knowledge and technologies for various applications to better deal with the increasing complexity of our fast-changing world, particularly for studying interactions between societies and their environment. By emphasizing the importance of interactions and points of view, the MAS way of thinking can facilitate high-level interdisciplinary training and collaborative research among scientists working in ecology and social sciences to examine complex problems in the field of integrated natural resource management (INRM).

This paper describes how an ongoing project based on a series of short courses in the field of MAS, social sciences, and INRM at three different universities in Thailand is transferring European expertise and research results to an Asian audience of graduate and post-graduate students and young researchers interested in innovative and action-research–oriented interdisciplinary approaches. The course structure and organization, and its contents, are described and assessed. The course participants are characterized and their opinions are used to evaluate the strengths and weaknesses of this training program. The first sustainable outputs and key preliminary lessons learned from this innovative collective learning experience are presented. In conclusion, we suggest ways to support the emergence of a regional network of “MAS for INRM” practitioners in Southeast Asia to build on the dynamics begun by this project and serve the need for such interdisciplinary training across Southeast Asia.

Introduction
In this new century, knowledge management faces two major challenges. The first one deals with the adequacy between globalization and fragmented knowledge among disciplines on the one hand and multidimensional realities requiring transdisciplinary approaches on the other hand. The second challenge is the continuous and accelerated improvement of knowledge in many fields, which is making knowledge organization more and more difficult to achieve but also more and more crucial for students and educators. There is therefore an urgent need to integrate knowledge across scientific disciplines, as well as with other sources of information, into suitable frameworks to examine essential problems with the people involved in solving them. Nowadays, it is necessary to give equal importance to stakeholders’ opinions, traditional representations, and science-based information. Principles to organize knowledge to face the challenge of complexity, uncertainty, and fast changes are required. Edgar Morin (1999), who spent many years studying complexity issues, considers that training students to establish linkages among


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knowledge from different disciplines and sources is of paramount importance for the next generations.

In the field of renewable natural resource management, adaptive management is required to deal with complex and unpredictable situations (Holing 1978, Lynam et al. 2002). The functional integrity of the ecosystem can increase in parallel with the adaptive capacity of resource managers. Particularly, this can be achieved through a better coordination among these managers and a greater collective ability to recognize and agree upon points of intervention to improve the sustainability of resource management (Ostrom et al. 1994).

At the same time, modeling is a more and more suitable approach for examining complex resource management problems. In this field, it is now widely accepted that modeling should proceed iteratively, by successive approximations, usually from simple to more complex representations of the system dynamics. Far from being the work of scientists in ivory towers, these iterative, applied, and action-research–oriented modeling activities should be implemented in close interaction with field work and stakeholders looking for solutions to the real-world problem under study. Stakeholders should play an important role in the validation of such models. Later on, they should be able to use them with scientists to explore the effects of different options and scenarios of resource use to negotiate and reach a compromise on suitable rules and action plans to be implemented collectively. We call the “companion modeling” approach (Bousquet et al. 1999) such a collective learning process for integrated natural resource management (INRM). While it is usually easier to find scientists in the broad fields of agro-ecology and biology to analyze a specific resource management problem from their point of view, there is still a need for capacity building in the “softer” field of social sciences to examine such problems with “hard” scientists, and for training both types to collaborate in a truly interdisciplinary way (Roling 1999).

Recent advances in computer science, particularly in the fields of distributed artificial intelligence (DAI), agent-based modeling (ABM), and multi-agent systems (MAS), have created a strong interest in using such innovative technologies to examine complex issues and better deal with the increasing complexity of the real world. MAS are computational systems relying on the technology of cellular automata, in which various autonomous agents interact in a given environment (Figure 1). They are based on the principles of distribution, interaction, and control (Ferber 1999). Recently, significant progress has been made in simulating societies in interaction with their environment (Gilbert and Troitzsch 1999) and innovative approaches such as MAS can create artificial societies (Weiss 1999).

Figure 1. General representation of a multi-agent system. After Ferber 1999.
MAS simulations are being increasingly used to deal with ecological and socioeconomic issues arising from the management of scarce resources by multiple users. When this approach is applied to INRM problems, such as when modeling situations of conflict among stakeholders, the effects on the resource dynamics of the interactions among different agent behaviors and the associated feedback effects can be simulated and tested. Modelers use these methods to create computer representations of dynamics observed in the field.

The MAS way of thinking emphasizes interactions and diversity of points of view for analyzing interactions between societies and their environment. It could facilitate the design of high-level interdisciplinary training and research among ecologists and social scientists working in renewable natural resource management and on INRM problems. Case studies examining concrete resource management problems have recently begun in Thailand (Trébuil et al. 2002).

Today, these problems at the interface between the environment and society are frequent in Thailand, particularly in situations where limited, or even shrinking, natural resources are exploited for multiple uses by competing users. Many examples in forest, water, and biodiversity management, etc., are regularly making the headlines of local newspapers. At the same time, there is a trend toward the decentralization of natural resource management, particularly under the new charter approved in 1997 and with Tambon (sub-district) Administrative Offices (TAO) being installed across the country. It is therefore urgent to train a new generation of natural resource managers equipped with approaches, concepts, methods, and tools to face the increasing complexity and uncertainties of situations and to be able to organize and interconnect knowledge from various sources to rapidly manage changing ecological and socioeconomic environments.

To contribute toward such a goal and as MAS for resource management are still little known in Thailand and Southeast Asia, since October 2001, the authors have been implementing a training project composed of a series of short courses on MAS, social sciences, and INRM which, are organized in rotation at three public universities in Thailand: Chulalongkorn, Chiang Mai, and Khon Kaen universities. It is financially supported by a grant from the Asia IT&C initiative of the European Commission, the French Cooperation, the International Rice Research Institute (IRRI), and the Centre de cooperation internationale en recherche agronomique pour le developpement (Cirad).

Objectives
This paper describes how this interdisciplinary training project was designed and is being implemented to transfer European expertise and research results in the field of MAS, social sciences, and INRM to an Asian audience composed of mainly graduate and post-graduate students or young researchers interested in interdisciplinary approaches to research in the field of renewable natural resource management.

Following a presentation of the course structure, organization, and contents, the way the project is improving knowledge and technology cross-flow and the management of interdisciplinarity are assessed. An analysis of the participants and collaborative institutions is made. Their inputs helped to evaluate the strengths and weaknesses of the program design and mode of implementation. Its effects on the extent of partnerships in this fast-developing scientific field are also described. The presentation of the first sustainable outputs of this project and useful lessons learned to facilitate the implementation of similar training activities in Southeast Asia in the future are also dealt with. Finally, several perspectives and prospects for reinforcing the momentum created by these training activities are suggested.
Materials and methods

Sources of information
The information analyzed in this article comes from various sources and materials. The initial project document (Bousquet 2001) was used to present the design and organization of the course. A series of successive training reports produced after each successive short course was used to analyze the participation and to monitor trainees’ progress. The project database on trainees and their institutions provided information to prepare several figures illustrating this paper. The series of course evaluations by the participants carried out upon completing each of the eight training sessions held from October 2001 to April 2003 was the main source of information to analyze trainees’ needs, the relevance of the concepts and topics presented by the instructors, and the strengths and weaknesses of these short courses. Individual interviews with six core trainees who attended five to eight courses were also conducted during the preparation of this article. The topics discussed during these interviews were as follows: efficiency of the transfer of knowledge and know-how, assessment of the organization and management of the courses and suggestions for improvements, management of interdisciplinarity, emergence of sustainable outputs and impact of these courses, and new partnership mechanisms emerging from the project activities.

The following indicators were monitored to assess the transfer of knowledge and know-how during the training process: evolution of the participation (number and educational background of trainees and collaborative institutions), number of trainees’ applications being developed, number of trainees’ M.Sc. theses integrating the MAS approach, number of complementary MAS training taken overseas, number of MAS-based proposals for doctoral studies, and number of university courses, including presentations of MAS for the INRM approach.

Course structure and organization
Figure 2 displays the general structure of this interdisciplinary training process which is taking advantage of the respective expertise available at the three collaborating public universities to organize each of the successive short courses.

Figure 2. General structure of the interdisciplinary training course on multi-agent systems, social sciences, and integrated natural resource management in Thailand.
Apart from the 2-week introductory course on MAS for social sciences and INRM, all the following ones are 1-week training sessions. A different instructor leads each course. These instructors are specialized in diverse but complementary fields and are all recognized as leaders in their respective scientific areas. Almost all of them are members of a European community of scientists working on social simulations. Table 1 shows the scheduling, location, main themes, and key concepts introduced during the 12 successive short courses offered under this project.

Table 1. Contents of the Asia IT&C initiative training program on multi-agent systems, social sciences, and integrated natural resource management, Thailand, October 2001-spring 2004.

<table>
<thead>
<tr>
<th>Step no.</th>
<th>Month/year</th>
<th>Location/univ.</th>
<th>Main theme</th>
<th>Main instructor/institution</th>
<th>Key concepts introduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oct. 2001</td>
<td>KKU</td>
<td>Introduction to MAS for INRM</td>
<td>Dr. F. Bousquet IRRI-Cirad, Thailand</td>
<td>Overview of the main concepts</td>
</tr>
<tr>
<td>2</td>
<td>Feb. 2002</td>
<td>CMU</td>
<td>MAS &amp; social simulation</td>
<td>Prof. N. Gilbert University of Surrey, UK</td>
<td>Simulation in social sciences, emergence</td>
</tr>
<tr>
<td>3</td>
<td>Apr. 2002</td>
<td>KKU</td>
<td>MAS &amp; ecological economics</td>
<td>Dr. M. Janssen Vrije Universiteit, NL</td>
<td>Resilience, models in ecology &amp; economics</td>
</tr>
<tr>
<td>4</td>
<td>Apr. 2002</td>
<td>CU</td>
<td>MAS &amp; computer sciences</td>
<td>Prof. A. Drogoul Paris VI University, FR</td>
<td>Agents in computer science, distribution</td>
</tr>
<tr>
<td>5</td>
<td>Oct. 2002</td>
<td>CMU</td>
<td>MAS &amp; geographic information systems (GIS)</td>
<td>Dr. S.P. Kam, IRRI, PHIL Dr. C. Le Page, Cirad, FR</td>
<td>Spatial dynamics, scaling issues</td>
</tr>
<tr>
<td>6</td>
<td>Oct. 2002</td>
<td>CMU</td>
<td>MAS &amp; integrated watershed management</td>
<td>Dr. O. Barreteau Cemagref, Montpellier, FR</td>
<td>Integrated modeling, companion modeling</td>
</tr>
<tr>
<td>7</td>
<td>Mar. 2003</td>
<td>CU</td>
<td>MAS &amp; the environment: methodological issues</td>
<td>Prof. Scott Moss Manchester Metro. Un., UK</td>
<td>Validation of models, abstraction</td>
</tr>
<tr>
<td>8</td>
<td>Apr. 2003</td>
<td>KKU</td>
<td>MAS &amp; social psychology</td>
<td>Dr. Wander Jager University of Groningen, NL</td>
<td>Social psychology, decision-making processes of agents</td>
</tr>
<tr>
<td>9</td>
<td>Oct. 2003</td>
<td>CMU</td>
<td>MAS &amp; knowledge management</td>
<td>Prof. Niels Roling Wageningen University, NL</td>
<td>Tools for participatory decision-making, soft science</td>
</tr>
</tbody>
</table>
Different combinations of teaching methods and tools are used during each course. Generally, on each day, two 90-minute lectures alternate with presentations of case studies, group exercises, hands-on exercises, or personal work. A large quantity of visuals is used as most of the sessions rely on video projections. At the beginning of each course, all the slides used by the instructors, a series of key reference papers for further reading, a CD with these files, and the software used during the course as well as the computer exercises are provided to the trainees.

Networking, exchanges, and group dynamics are sustained by the subscription of each trainee to a global electronic discussion list (with a Q&A service) linked to a Web site specifically designed for MAS users in INRM (http://cormas.cirad.fr). On this site, trainees can find more information (reference papers and tutorials, completed case studies, new versions of software, opportunities for further training, etc.) and particularly a library of already developed MAS models providing more inspiration.

Contents
Following the main introductory course, the successive course instructors present different disciplinary points of view, key concepts, and experiences on the use of MAS in social sciences and INRM (Table 1). Because several new concepts are introduced during each course and all the sessions are conducted in English, the contents are rather difficult to follow for some participants. The use of MAS simulations by all instructors establishes a linkage between sessions. After ten courses presenting different and sometimes conflicting viewpoints, the final course will aim at reconstructing the whole picture.

The teaching and use of the CORMAS (Common-pool Resources and Multi-Agent Systems) simulation platform in most of the courses is another important linkage. Provided free to all participants, this simulation platform is the key reference computerized tool used in this program (Bousquet et al. 1998). Vensim, NetLogo, and SDML (Strictly Declarative Modelling Language) are other software packages also introduced during these training sessions.

As soon as this project began, the participants were encouraged to design and gradually build a personal application on a concrete problem related to their academic interest or professional activity. In the middle of the week, time is made available to work on these personal projects through interactions with other trainees and the instructors. Usually, the last morning of each training session is allocated for the presentation of several trainees’ applications, each one being followed by a collective discussion and comments from the instructors. This is very useful because the quasi-absence of completed case studies in Southeast Asia at the beginning of this program limited the illustration of lectures by examples dealing with local problems and contexts.

Participants and their institutions
Most of the trainees are graduate and post-graduate students, young or more senior university researchers, and officers from development-oriented government agencies (DOA-MOAC, DOAE-MOAC, LDD-MOAC, etc.) who are interested in interdisciplinary and applied approaches to research in the field of participatory resource management. Figures 3 and 4 show that these trainees come from 11 countries and many more institutions. Of the current total of 72 participants, Thailand (38), the Philippines (11), and Vietnam (7) are the main contributors. The presence of a small minority of European trainees in several
courses has a mainly positive effect on the group dynamics through the sharing of different viewpoints and the establishment of new professional contacts.

Trainees apply electronically to attend a particular course, but many new ones are colleagues of former participants. No special advertising for these courses is done as the target size of the audience is limited to 16–20 full trainees plus several observers. This limited group size guarantees the quality of the support provided by the trainers, particularly during computerized hands-on exercises on new software or the design and construction of a personal application.

Figure 3. Number and country of origin of the trainees who took part in the first eight short courses of the interdisciplinary training program.

Figure 4. Number of collaborating institutions by country in the first eight short courses of the interdisciplinary training program.
The heterogeneity among the trainees, in terms of background knowledge about MAS, social sciences, and INRM, is important and tends to increase over time. Figure 5 displays the initial field of specialization of the trainees. This diversity of educational background among the trainees responds to the similar diversity observed among the main instructors.

Figure 5. Academic background of the trainees who took part in the first eight short courses of the interdisciplinary training program.

At this stage of the training process, three types of participants can be distinguished:
- A core group of regular participants who attend most of the short courses and who are also
developing personal applications based on their new knowledge.

- Less regular participants who join only the short courses dealing with themes of their interest; most of them are not involved in building their own applications.
- Observers who just want to familiarize themselves with MAS and attend one or several courses depending on their main themes.

Table 2 shows the changing sizes of these subgroups over the first eight short courses held since October 2001.

Table 2. Composition of the audience during the first eight short courses of the interdisciplinary training program.

<table>
<thead>
<tr>
<th>Location and date</th>
<th>KKU10/02</th>
<th>CMU02/02</th>
<th>KKU03/02</th>
<th>CU04/02</th>
<th>CMU10/02ab</th>
<th>CU03/03</th>
<th>KKU04/03</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of core trainees</td>
<td>10</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>No. of new trainees</td>
<td>12</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>No. of observers</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

The management of such heterogeneous groups is a challenge for the trainers, particularly as the size of the subgroup of core trainees decreased during the recent courses while the number of newcomers increased. This situation should improve in the next courses with the planned return of several core participants and the admission of fewer newcomers.

Results and discussion

Strengths and weaknesses of the training process

The following analysis is based on a review of the course evaluations by the participants. We found that the overall course effectiveness assessed by the trainees was very satisfactory, as indicated in Table 3.

Table 3. Average scores and standard deviation of the overall course effectiveness for the first eight training sessions of the interdisciplinary training program according to the trainees.

Rating scale: 1 = poor, 2 = fair, 3 = average, 4 = good, 5 = excellent.

<table>
<thead>
<tr>
<th>Location and date</th>
<th>KKU10/02</th>
<th>CMU02/02</th>
<th>KKU03/02</th>
<th>CU04/02</th>
<th>CMU10/02ab</th>
<th>CU03/03</th>
<th>KKU04/03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average score</td>
<td>4.36</td>
<td>4.50</td>
<td>4.10</td>
<td>4.50</td>
<td>4.67</td>
<td>4.21</td>
<td>4.33</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.03</td>
<td>0.50</td>
<td>0.29</td>
<td>0.50</td>
<td>0.47</td>
<td>0.41</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Organization and structure

Strengths

The diversity of disciplinary backgrounds among the different course instructors, all having the MAS approach and tools in common, is seen as a “unique opportunity” (as one core trainee put it) to become familiar with MAS and their use in various fields. The organized interactions between trainers and trainees having a chance to interact with specialists about their own personal projects are also receiving high marks. The choice of presenting a whole research approach and process during a 5-day course is also appreciated. Participants have time to discuss difficult topics and to integrate relevant new knowledge into personal applications that are gradually built between successive courses.

The timing (courses are held between university semesters) and duration (5 days) of the courses are convenient to most of the trainees, who like this research-oriented training on a university campus providing a suitable atmosphere for the transfer of new knowledge. The networking of many institutions
of higher education in the region along the way is also a plus according to many core trainees, and some of them find that the number of partner organizations and participants is still too limited.

Weaknesses
In theory, a better chronological order among the instructors and their respective disciplines could be imagined to avoid too much “jumping” from one view to the next. Under an externally funded project mode of operation, many logistical constraints interfere and limit the possibility to plan a smoother succession of the themes and topics to be covered during the whole training process. But some trainees are looking for ways to engage trainers further in the collaborative process.

The management of heterogeneous groups of trainees needs further improvement as few specific activities are available for newcomers who do not plan to build personal applications. During group exercises, techniques like the so-called “snowball” discussions (two trainees analyze a question, then they pool their findings with those of another couple of trainees, and so on, to produce a unified view and answer) are emphasized to help them catch up with the core group.

This short-course model is not very adapted to the construction of a full case study from A to Z to describe the problem, identify the relevant theory and concepts, make methodological choices, and continue with detailed stepwise procedures for model development. Such a process is still being requested by several core trainees and could be implemented during the final course. This format does not allow enough time for computer exercises. Other trainees find that more real-world activities are desirable, such as the role-playing game (another tool associated with MAS models in companion modeling) organized with villagers in Khon Kaen Province during the April 2003 course.

Contents

Strengths
Because these courses cover diverse themes and issues in MAS for INRM, from various disciplinary points of view, and are led by instructors who are leaders in their fields are seen as key strengths of the project. Core trainees also found a suitable balance between theoretical/abstract and applied/practical contents to understand the subject matter and to be able to apply this new knowledge. The construction of a collection of models providing numerous examples and case studies (“I always need an example”) is also assessed as an appropriate choice. Core trainees also like the possibility to combine different tools in the development of their applications. Attempts at bridging the gap between computer scientists and other specialists by using simple tools to stimulate the collective construction of new models are also well received. The usefulness of the diagrammatic representations (class, activity, and sequential diagrams) of the Universal Modeling Language (UML) for such a purpose is confirmed.

Weaknesses
Because there are several weak articulations between the themes of successive courses, the self-updating of the global picture by the trainees themselves is not an easy exercise. In the future, more support and time for critical discussions on the contents of the course will be provided to help the trainees achieve such a continuous reconstruction by integrating the new knowledge acquired over the last course in the whole picture. Efforts will also be made to better manage the language barrier by clarifying all key concepts and specific terminologies in layman language. With time, we also expect that more Asian applications will be available for an easier understanding of case studies by the participants. But some of the most advanced trainees are already requesting the introduction in the coming courses of other ways to represent and formalize knowledge in MAS.

Knowledge transfer: assessment of trainees’ cumulative improvements
When asked if they observe cumulative improvements in their knowledge and skills related to these interdisciplinary courses, the core trainees say “yes,” “absolutely yes,” “of course,” or “yes, very effectively, more or less linear!” If some of them find that these improvements are following a linear pattern, others say that a given course (usually the joint courses held at CMU in October 2002) has accelerated this process by providing them with a clearer view of several key concepts and a more global view of the training process in which they are taking part. They also agree that such progress is facilitated by the chosen structure of the training process itself.

The fact that, altogether, ten applications are currently being developed across five countries (five in Thailand, two in the Philippines, and one each in Vietnam, Indonesia, and Bhutan) to examine concrete INRM issues is also a relevant indicator of the progress made by core trainees. The development of such personal projects seems to be necessary to guarantee continuity in the effort to improve the trainees’ skills in using the approach, methods, and modeling tools introduced to them during the short courses.

Two core trainees have already taken several weeks of complementary training in France on MAS modeling using CORMAS and two more will do the same during the coming months. The MAS approach has also been integrated into the Master of Sciences theses defended by four project trainees. Three of them have prepared proposals for doctoral studies in this field and have been accepted at universities in France, Japan, and Canada. They are going to invest in this field to deepen the transfer of knowledge and know-how on MAS for INRM as much time is needed to assimilate innovative approaches, methodologies, and tools for sustainable impact.

Several participants have already used MAS and shown their first applications in conference presentations. Other core trainees are already teaching or are planning to teach MAS at their respective universities. Trainees are becoming trainers as the contents of these courses are being introduced in graduate study programs at several universities: two short courses and workshops for M.Sc. students were held in 2002 at the University of the Philippines-Diliman campus, a new course on “Simulation with the MAS Approach” will be offered next year at Ubon Ratchathani University, and this approach is also being introduced in the new Post-Graduate Training Program in Systems Agriculture of the Faculty of Agriculture of Khon Kaen University.

Management of interdisciplinarity
Interdisciplinary exchanges are occurring permanently between instructors and trainees, but also among trainees. They are sustained by the diverse academic profiles and professional experience (lecturers, researchers) of the European instructors and the selection of the Asian participants. Figure 5 shows that a high level of interdisciplinarity among trainees has been maintained during the first eight short courses of the training process. But the level of representation of the different disciplines has varied over time. Although many trainees coming from the social and economic sciences participated in the first four courses, their number decreased when the themes of the subsequent courses covered the use of GIS and watershed management; then, a partial recovery in their participation occurred during the last two courses focusing on economics and social psychology. While several agricultural scientists have been attending almost every course, more trainees coming from ecology and biology have been joining them recently. Figure 5 shows that, so far, the most stable group of participants has an academic background in land-use studies and GIS.

In this project, the interdisciplinary exchanges are guided by the existence of a broad common approach to the use of MAS among the trainers. This approach was explained to the trainees at the beginning of the process, but, with many newcomers attending the recent courses, it could be wise to recall and re-explain
it with more details. Several core trainees are also requesting to discuss explicitly the different points of view and possible conflicts between some instructors.

At this stage, it remains difficult to establish strong linkages among computer scientists, ecologists, and social scientists for them to work on common applications as interdisciplinary teams in their institutions. But the fact that several computer scientists joined in the last two courses is encouraging. It is interesting to see that it is not among the partner institutions that are well known for their early work on systems thinking in agriculture and resource management that we observe the emergence of interdisciplinary teams in MAS for INRM. The difficulty of establishing collaboration among staff from different faculties could partly explain this unexpected situation.

The use of simple modeling tools, such as UML diagrams, proved to be effective in stimulating interdisciplinary exchanges of views when conceiving a new model, and before its implementation and coding in a computer language by a specialist. The “snowball” discussion technique also created greater participation and interactions among trainees having different disciplinary backgrounds to produce ideas and come up with a unified view on the subject matter. The organization of the successive courses in different settings, taking advantage of the strong expertise of each institution (GIS at CMU, role-playing games at KKU, ecology and social sciences at CU), also helped to sustain interdisciplinary exchanges. We see trainees becoming more and more interdisciplinary-minded, but we have yet to assess changes in their professional practices at their respective institutions. Nevertheless, some participants would like to see a suitable pathway along which trainees could monitor gradual improvements toward mastering interdisciplinary research.

Extended partnerships

At this stage
We observe the emergence of a regional network of core MAS for INRM practitioners, linked by a strong bond and common interest (and friendship), who are sustaining the effort thanks to regular “get-together” events during the short courses. If this young network still needs external support at this stage, several core participants are already realizing that external funding is also a weakness of the current process. Fifteen institutions, particularly from Thailand, Vietnam, and the Philippines, are involved in sharing knowledge and experiences in modeling and simulation, but also differences in their respective social and cultural systems and environments. Their network of contacts, especially in Europe through the course instructors’ teams, is already extensive. But it could easily be much broader if the trainees were more active exchanging messages on the global CORMAS electronic discussion list.

By the end of this project
Core trainees say that more people and institutions will become involved in the undertaking before the completion of this training project. By then, a first set of MAS-based applications will be completed and jointly published. They also expect to initiate follow-up MAS-based applications projects among former participants in this project. They also want to see a stronger Asian network of practitioners disseminating MAS-based modeling approaches applied to INRM and social dynamics.

Beyond mid-2004
Some trainees think that they will have the capacity to influence scientists and experts in mission-oriented research and interdisciplinary practices, particularly computer scientists. They think that they will be in positions to influence policy design through MAS simulations. They also want to move toward setting up an Asian Club for Social Simulation and organizing a conference on MAS for INRM in Asia to share and discuss experiences among project participants. Such activities could help widen the influence by inviting other Asian country representatives, such as from Japan, China, etc. The trainees also wish to organize
official exchange programs for both students and lecturers among participating universities and see more opportunities for further research collaboration in this field—in their country, the region, and globally.

Conclusions: Preliminary sustainable outputs and perspectives
On the basis of this first series of courses and case studies being developed across the region, these project activities are delivering promising collective learning methods and tools to enhance stakeholders’ participation in resource management. Participants are discovering a new way of thinking and an innovative approach to interpret their environment and real-world phenomena. They say that they are broadening their knowledge and vision. They understand a new research paradigm for INRM, which is more applied and “useful” and more action-oriented. This “different way to look at things” is also characterized by an increased awareness of the need to take into account agents’ behavior and diversity of viewpoints when designing applications.

We are now witnessing the emergence of a regional network of MAS for INRM practitioners in Southeast Asia who are selecting this field for their masters and doctoral studies, who are disseminating the message in their respective institutions, are developing practical applications on local real-world issues, and are already engaged in the joint publication of their results. They are also discussing ways to structure and reinforce their small regional network.

Such innovative ways of looking at resource management problems and of thinking about how to alleviate them collectively need to be further introduced in existing graduate study programs at various institutions. It is also desirable to study how more young scientists could be exposed to these ideas and methods early in their professional career. On this basis, we are studying the possibility of establishing a specific graduate study program in this field at a public university in Thailand to build on the dynamics begun during the last 18 months and serve the future needs for similar training across Southeast Asia. To avoid some of the weaknesses of the current project, such a new program would have to be more connected to local research support programs and less dependent on external funding. Beyond training activities, it should also have a strong research component to continue the development of local case studies examining concrete problems by using state-of-the-art methods and tools in this fast-developing field of MAS for INRM.

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