Grafting Knowledge - A Conceptual Model to Facilitate Local Development*

Monica MacKinnon

The paper describes the exchange of scientific and indigenous knowledge between a botanical garden and two local villages in the context of two assistance projects in Southwest China. Differences in the nature of these two knowledge systems are described and some practical examples of success and failure in knowledge transfer presented. Whilst from an academic point of view the documentation and field testing of new techniques contribute to an increase in higher level scientific knowledge, what happens on the ground during a development program is limited to the knowledge that can be placed in the hands of local farmers. This remains mostly indigenous knowledge with only some rudimentary new lessons learned from science. The findings are placed in a conceptual framework and an analogy is drawn with the technique of fruit tree grafting such that indigenous knowledge can be viewed as the native root stock and the scientific knowledge as the introduced superior scion.

INTRODUCTION

In recent years, the recognition of indigenous knowledge (IK) and its possible contribution in facilitating sustainable development has been gaining increasing attention (Roling and Engel 1989; Warren 1991; Rajasekaran, Martin, and Warren 1993; Colchester 1994; World Bank 1995; Liu, Xu, and Xu 2000). The value of the knowledge and experience of the local and indigenous communities in the use of the medicinal, agricultural and other useful properties of endemic flora and fauna has been gaining growing appreciation (Nijar 1996). In addition, there has been a growing interest in integrating IK into development planning and resources management systems (Roling and Engel 1989, Sharland 1993, Campilan 1995, Subedi 1997, Grenier 1998, Xu et al. 2000).

IK is important; nevertheless it is not the only key. The development of these areas that are marked by unprecedented population density, loss of natural resources, or political change may require adaptation for which past local experience provides little guidance. It is a fact that poverty and hunger are no strangers in many areas where traditional agricultural practices still prevail. Therefore, in the development of the indigenous communities, particularly those

* Paper based on doctoral dissertation (Extension Education), U.P. Los Bańos, 2004

located in places where livelihood and economic improvement of the local people depend on ever-decreasing natural resources, knowledge, both scientific and indigenous, is needed to cope with the ever-changing conditions of human dynamics and unstable environment.

Research into the knowledge systems has not only recognized the wide gap between science-based and indigenous knowledge (see Table 1) and the big challenge that intertwine them (Campilan 1994), but also sparked calls to search for a common ground for the productive engagement of farmers, scientists and extensionists (Scoones and Thompson 1993), and to establish suitable communication channels among stakeholders (Poffenberger 1997).

This paper explores the fusing of research knowledge with indigenous forms of cultural and environmental knowledge and innovations in order to develop a better alternative to environmental degradation and poverty, and steer toward integrating local development and achieve social sustainability in the conservation of the ever-decreasing natural resources. It is hoped that, by way of an alternative framework —grafting research knowledge on the base of the IK, the researcher is engaging development theorists and practitioners alike to rethink ways we had in the past and have now, and more or so, the possible ways of a transformed future. The researcher makes her case, based on a study of a practice of knowledge exchange in Xishuangbanna, Yunnan, China.

Table 1. Important Differences between Indigenous and Scientific Knowledge

Indigenous Knowledge	Scientific Knowledge
Transferred by word of mouth and personal experience	Transferred by documentation and publication, more second hand
Knowledge often closed (trade secrets)	Knowledge openly shared in journals
Imprecise	Precise
Tradition and superstition are strong elements, religion relevant	Tradition, superstition and religious elements absent
Low level of innovation	High level of innovation
More subjective	More objective
Founded on long-term but narrow experience with local plants and conditions	Founded on knowledge base of biology, ecology, agriculture over wide range of species and conditions
Poor knowledge of external markets, laws, policies and trends	Good knowledge of external factors

Development in Man'e and Manmo Village

From 1992 to 1998, Xishuangbanna Tropical Botanical Garden (XTBG) researchers, with the financial assistance from the MacArthur Foundation, implemented a project titled "Integrating Conservation and Sustainable Development Systems" (Project 1) to develop and demonstrate integrated development systems among communities in the tropical forest of south Yunnan. Two ethnic communities, Man'e (Dai) and Manmo (Hani), were selected as pioneer villages to develop and demonstrate the integrated development systems. Both villages are situated near XTBG and border the Menglun block of the Xishuangbanna Nature reserve (XNR). The project had three components: agroforestry, cash-crop development and eco-tourism.

A second project "Recovering Dai Ethnic Traditional Plant Culture: Holy Hills and Plants in Temple Garden" (Project 2), funded by the Ford Foundation started in 1993. Man'e Village was chosen again as one of the demonstration villages due to its holy hill and ancient Buddhist temple. The same group of researchers from XTBG who were involved in the project 1 implemented project 2. Project 2 was further extended from 1997 to 2000 with further financial assistance from the Ford Foundation.

The two projects have the same main principle – working towards sustainability of natural resources and rural economic development. This is due to the recognition by the XTBG scientists, of the failure of the so-called "island effect theory" in conservation of natural resources. To conserve natural resources in a region, specifically in Xishuangbanna, one must see to it that the cycle of poverty and environmental degradation is broken.

As a result of the two projects, the two communities have greatly benefited economically and local people have gained much knowledge. The History of XTBG (Xu et al. 2000) recorded an increase of farmers' earnings by 52 percent in Man'e and 83 percent in Manmo. At the same time farmer's level of science and technology has improved, 1500 people having attended training. This provides a solid base for further economic development.

LOCALE OF STUDY

The entities involved include XTBG and two surrounding communities, Man'e Dai Village and Manmo Hani Village.

Xishuangbanna Prefecture has a total area of 19,220 km^2. Lowest altitude is 430 meters above sea level (m.a.s.l.) where the broad Lancang (Mekong) river leaves China and rises through a series of hills to the highest peak of over 2300m.

Much (94%) of the region consists of mountains and hilly terrain; river valleys make up the remaining area. Xishuangbanna lies mainly in both subtropical and tropical climate zones. Biological resources are plentiful due to the unique landforms and climate

conditions, this area is known as "the kingdom of wild floral and fauna" (Xu et al. 2000).

XTBG is situated in Menglun town at lat.21°41' N, long 101°25' E, and 570m altitude, with annual mean temperature of 24.4 °C, annual precipitation of 1556.8 mm and mean relative humidity of 83%.

Man'e Dai village is located on the plains of Mengkuang River, a branch of Lancang River. Geographic characteristics are similar to that of Menglun town, being only two kilometres away.

Hani people are by tradition a hill-dwelling group. Manmo Hani village is located attitudinally slightly higher than Man'e village, between 680-1000 m.a.s.l. It is only 7 km by road from Man'e.

METHODOLOGY

Two trips to China were made for the purpose of data collection. First trip was made in January 2003 and a second trip between October and November 2003. The following are some of the informants interviewed: local farmers, village leaders, monks in Man'e village, former director, deputy director and key researchers of XTBG, officials of Xishuangbanna Nature Reserve, tourism managers, prefectural tourism officials, tourists in botanic gardens and other sites.

The following methods were used in gathering both quantitative and qualitative data: in-depth interviews, key informant interviews, participant observation, and review of secondary data.

RESULTS AND DISCUSSION

Regional context for development

Xishuangbanna Dai Autonomous Prefecture is located in the southern region of Yunnan province and shares borders with Laos and Myanmar. With unique geographic formations and climatic conditions, this region is blessed with rich flora and fauna of the tropical rainforest. To conserve the diversity of wildlife, Xishuangbanna Nature Reserve (XNR) was established in 1958 to protect the unique fauna and flora from further logging, hunting or farming. Adjacent to the nature reserve and surrounded by it, XTBG was established in 1959 to collect, study, and conserve the rich plant species. With more than forty years history, XTBG has become the biggest botanical garden in China and Southeast of Asia in terms of land area and richness of plant species. At the time of this research, XTBG has been an independent research institute directly managed by the Chinese Academy of Sciences.

Xishuangbanna is also home to many minority ethnic groups, including Dai, Hani, Lahu, Bulang, Jino, Bai, Yao, Miao, Hui, Zhuang, Wa and Yi communities. Dai constitutes the largest group (35%). These groups have strong cultural identities and maintain traditional beliefs and customs. For millennia, these groups have evolved careful ways of producing from the land while caring

for its integrity and thus sustaining production (Borrini-Feyerabend G. ed. 1997).

However, recent changes in Xishuangbanna in technology, population dynamics and the widespread shift from subsistence to market-oriented production have strained many of those relationships. In particular, during the Mao era all Chinese were dictated to adopt "the same nationally-determined, State-imposed culture" (S. J. Nepal 2000). Ethnic groups and communities were forced to abandon their beliefs and practices.

It was not until the overall reform entering into 1980s, that these ethnic groups slowly started to regain their rights over their traditional cultures and practices. With further political and economic reform, the diverse resources of flora and fauna together with the distinct ethnic cultures and practices, are finding huge potential in development. Within this context, integrated development with assistance from external agencies such as XTBG, started and thrived among these ethnic groups.

Environmental context of Xishuangbanna

An environmental context manifests the relationship between human beings and their surroundings within a period of time. Thus, an environmental context outlines not only the objective natural surroundings of a location, but also the human activities, the impact of such activities on the natural surroundings. It also points out possible ways of ameliorating any conflict between human survival and the ecological sustainability of the location.

In Xishuangbanna, the environmental degradation has been unprecedented. For example, in 1950, about 70 percent of Xishuangbanna was covered with forest. Today the figure is only half of that. The speedy and continuous deforestation contributed to the environmental degradation of the region. The present environmental context can be attributed to both natural and anthropogenic causes. It is marked by the following aspects:

1. Shifting cultivation. Xishuangbanna has traditionally been farmed by slash and burn practices. As population has increased and forest area has shrunk, there is now insufficient space for the sustainable continuation of such shifting agriculture.
2. Population growth. Although population density in Xishuangbanna is well below the national average, the rate of increase is alarmingly high and this has already put great pressure on limited agricultural land. Population is high because the ethnic minority people are not limited by the "one child one family" policy applied to Han majority. In addition the region has been subjected to high levels of immigration from other parts of Yunnan and Sichuan, partly to develop the rubber industry but also to take advantage of the comparatively dynamic growth of the local economy.

3. Rubber industry. Since the 1960's Xishuangbanna was opened up for the development of Brazilian rubber. At first rubber could only be grown below 800m and much excellent forest was cleared to make way for the new crop. Since then Chinese scientists (centred largely at XTBG) have found improved management techniques including introducing second crops such as tea between rows of rubber. As a result of these researches, rubber survives the cool winters better, can grow up to higher elevations and can have better yields than in the first trials. Rubber has been promoted to small farmers as a way to stabilize shifting cultivation. Today, almost one quarter of the entire prefecture is under rubber cultivation.

Government response: Biodiversity conservation

The value and importance of the prefecture's rich biodiversity has long been recognized. Government has set up nature reserves in 1958 to protect the rich fauna and flora resources of this region with varying degrees of success. Also in response to the importance of local biodiversity a total ban on hunting with guns has been imposed on the prefecture.

XTBG involvement

In recent years, researchers realized, although XTBG has the biggest land area in China, a botanic garden is at its best, a fragmented ecosystem whose sustainability depends on a larger ecosystem. On its own it cannot protect most species from danger and/or extinction in the long term. An improved regional environment is key for its biodiversity conservation. XTBG scientists have taken the view that conserving the richness of natural resources in Xishuangbanna region depends in large part on good economic prospects for the communities within the region. Therefore much of XTBG efforts and resources have been put into the research on methods and techniques of the integration of local economic development and biodiversity conservation specifically on knowledge exchange. Only this can lead to sustainability of the natural resources and resolve the vicious cycle of "poverty and environment degradation".

Comparison of characteristics of the two communities

Man'e and Manmo communities are situated in the same geographical location, and yet their different cultural background and traditions and their specific situation, give rise to differences in attitude and aptitude and have effects upon the knowledge construction and exchange process. (Table 2)

THE KNOWLEDGE EXCHANGE PROCESS

1. Funding and planning

In the case of the projects implemented in Man'e and Manmo village by XTBG, funding sources include international funding agencies, government agencies, and contribution

Table 2. Comparison of Main Features of Two Villages

	MAN'E DAI	MANMO HANI
History	900 years	40 years
Biophysical setting	River basin	Hillside
Agro-systems	Holy hill (burial ground and holy forest)- Buddhist temple - village - fuel - wood plantation - paddy rice fields	Forest (for water source and burial ground) - village - shifting cultivation (for dry rice and maize)
Religion and belief	Hinayana Buddhism with traces of earlier polytheistic beliefs	polytheistic beliefs and ancestor worship
Sources of income	Rubber 70-90% Other cash crops – Chinese cardamom and winter vegetables, irrigated paddy rice sufficient for home consumption and surplus for market; Ecotourism – little income	Rubber: 90% Others cash crops – Chinese cardamom, rice just enough to feed the community Ecotourism – little income
Relationship w/ outsiders	Long amicable relationship with XTBG, MNR, and other government agencies	Related to XTBG only during projects, normalized relationship with MNR, little contact with government agencies.
Women status	Women are respected and share equal rights with men, have independence in income, own properties and can make decisions	Women have no names, no rights over income or no place in family genealogy, no say in family or village affairs.
Education	Long history of written Dai language and temple school education for boys. Now with state schools (for boys and girls), and temple monastery school for boys to learn old Dai language and Buddhist canons.	Traditionally no Hani schools, no Hani written language nor literature. First school in Manmo village was established in 1995. Today, Manmo Hani people are very keen to see their children get educated in state schools.
Traditional knowledge	On plants and their taxonomy Astronomical knowledge Arts and Literature Knowledge on Architecture	On useful wild plants and animals
Knowledge transfer modality	Generation to generation within family, village or wider Dai society. Temple school and state school	Generation to generation within family, villagers and from village elders. School (new)
Form	Folk stories and legends, books, literature, manuals, and temple school lessons, state school lessons	Oral stories and legends, school lessons

from villagers. The funding sources and contributions include:

- MacArthur Foundation (project 1)
- Ford Foundation (project 2 and its extension).
- Man'e Dai villagers' donation to the restoration of village temple.
- Manmo Hani villagers' contribution to Manmo electricity facility.
- Local government contribution to Manmo electricity facility

The author considers the inclusion of some contribution from the villages themselves as an important component for success and commitment.

Prior to the implementation of the project, XTBG set a precondition for Manmo village — an agreement for the villagers not to cut trees from neighboring nature reserve or other village land, without conflict with other villages and Manmo will get the outside assistance, mainly from XTBG to prosper by themselves. This measure is planned, based on the XTBG scientists' awareness of worsening relationship between Manmo and its neighbouring nature reserve and neighbouring village, caused by the diminishing Manmo village forest.

2. Selection of technologies

The technologies, as summarized by the XTBG scientists, were: agroforestry, cash crop and ecotourism development. The rationale behind the selection of technologies was to increase the income sources by diversifying the farmers' cropping system, and establish sustainable agricultural development, thus to achieve conservation of the regional biodiversity.

Selection of the technologies was done by the XTBG scientists. It was based on the analysis of the communities in terms of social, economical conditions as well as their dependence on natural resources; extensive review of available literature on the region; and assessment on XTBG's own research and available technologies.

At a time when participation of the local people in decision-making seems to be paramount in the change process, one can easily criticize the seemingly top-down approach used in the technology selection. However, special situation would need special solutions. In the course of technology selection, participation is embedded in the interviews and field observation done by the XTBG researchers. Another point is that even Roling (1990) points out that the typical issue in natural resources management requires decision making at a system higher than the conventional farm level. At this higher level, networks (including XTBG, local communities, local government agencies and foreign funding agencies) and processes (interviewing local people, reviewing literature, access XTBG's own research, and soliciting other agencies) were required for generating locality-specific responses to diversity and complexity, taking into account the multiple perspectives and objectives of the actors involved.

The different features of the two communities, their respective indigenous knowledge systems were the bases for selection of technologies and approaches to disseminate them by XTBG. The selection was made by scientists well versed in local ways and preferences and any suggestion put forward by the scientists would anyway have to run the gauntlet of acceptance or rejection by the farmers at field trial level.

3. Experimentation and trials

Living among the rich natural resources of the Xishuangbanna forest, the people in Man'e and Manmo had never planted vegetables or fruits before, because they knew how to survive on the food from the forest (IK). However, as the forest shrinks and food resources decline, the IK in surviving on the land would not sustain them anymore and newer ways toward natural resource management would have to be found. This is where the research knowledge can come in to build on the base of the IK.

Among the selected technologies, some were readily available within XTBG (some agroforestry inter-cropping systems such as rubber with tea, Chinese cardamom and coffee etc.), and some were new. New technologies (cash crop varieties such as vegetables, fruits and medicinal plants) were first developed and tried on the experimentation plot in XTBG.

When the newly developed technologies became ready on XTBG's experimentation field, trials in the communities started. Man'e leaders agreed to rent a piece of village land to XTBG as a field trial and demonstration plot. Farmers from both Man'e and Manmo were taken to see the experimental plots in XTBG and later in Man'e, and Menglun market to compare the prices and savour the taste of different varieties.

The experimentation, trial and demonstration of planting vegetables, fruits and medicinal plants on Man'e village land had immense effect on the farmers. Farmers from both communities witnessed and marvelled with their own eyes the whole cycle of the plants growth and production. A farmer from Man'e village, Mr. Bo, agreed to convert part of his home garden as a trial and demonstration plot for Man'e and Manmo farmers. Seedlings of vegetables, fruits and other cash crops were propagated in his home garden. Scientists and experts on vegetables and fruits came to train farmers and demonstrate new techniques in his garden. Mr. Bo and his wife, along with a few other progressive farmers had become unofficial proxy teachers in these techniques.

4. Facilitation of the technologies

The facilitation can be categorized as: interactive, participatory and mutually beneficial. Different approaches were used to facilitate the technologies in the two communities. Again these approaches had deep roots in the understanding of IK and indigenous people.

Having had long involvement with XTBG, Man'e Dai village farmers had trust in the XTBG scientists and the

initiation was easy. Manmo Hani village had little previous contact with XTBG, therefore, getting the trust of the farmers at this phase was the hardest among all other activities of the project, according to XTBG scientists.

A. Agroforestry and cash crops

Although Man'e people had for a long time maintained home gardens, the production from home gardens was mostly for home consumption. They had great potential to bring in more economic benefit if new varieties and newer technologies were introduced and selection of species improved. On the basis of traditional home gardens, XTBG scientists introduced to the farmers ways of grafting fruit trees and the use of the shaded space under larger plants to propagate seedlings. Introducing a new variety of pomelo was a big success.

Apart from the long-term fruit tree crops, XTBG scientists also introduced some short-term crops to generate faster income for farmers whilst waiting for the benefit from the fruit trees, which may take several years. The short-term crops included winter vegetables such as chillies on the resting rice fields. Consideration was also given to rationally use the space underneath the fruit trees, where other economic crop varieties, such as vanilla, were introduced to intercrop with the fruit trees.

Based on their analysis, XTBG scientists planned the improvement of the Manmo, similar to that of Man'e, to increase diversity of useful plant species through improved agroforestry and introducing cash crops. Accordingly, the priority task for XTBG scientists was to make sure the Manmo farmers had enough food. To achieve this, they collaborated with Manmo farmers to improve the paddy field irrigation, opened more paddy rice fields, converted some original dry rice land into paddy rice fields, and introduced a higher yielding hybrid rice variety. In a period of two years, the grain production in Manmo increased and was able to meet the population needs.

However, rubber trees took at least 6-7 years to mature and to generate economic returns. Help was provided by XTBG to intercrop the trees with rice, pineapples, etc. which is an interim measure while the rubber trees were young. Meanwhile cultivation of Chinese cardamom under existing forest cover was further promoted.

Tropical fruits were introduced and old fruit trees were improved by grafting. Grafting Menglun pomelo on the existing old stem of pomelo trees was faster than planting other fruit trees, so this became the main task in the first phase of the agroforestry and cash crop introduction. Other cash crops and fruit trees were also introduced for the long-term economic and environmental benefits. A nursery was also set up with the assistance of XTBG scientists to produce seedlings of fruit trees. As a complementary measure to mitigate the firewood shortage during implementation of the projects, XTBG researchers had come up with the

training of the village people to build energy saving stoves as in Man'e Dai village. In addition, *Cassia* planting techniques were introduced to the Manmo people, so that firewood shortage will not be a long-term problem.

B. Ecotourism development

In Man'e Dai Village, ecotourism was a main part of planned economic development of both projects. On the basis of the village temple, holy hill, the traditional Dai style of life, and easy access to Menglun town, XTBG scientists planned the eco-tourism development in Man'e to manifest the traditional Dai village with its culture, religion, holy hill forest and paddy fields.

In Manmo Hani village, the remaining rainforests and the poorly known Hani culture formed the basis for ecotourism development. With the assistance of XTBG, an area of 60 hectares of tropical rain forest just north of the village residential area was transformed into an ecotourism area.

Despite the potential interests and the favourable location of the two villages beside a good road that serves as a major artery for visitors to the prefecture, the development of community level ecotourism has not been successful in either village.

The success of any type of tourism, particularly ecotourism depends on an intricate balance of many factors of the destination site and its wider context. These include social, cultural, economic, political, environmental and psychological factors.

The capacity or necessary knowledge on the part of the managers, operators and the destination site as a whole has not been given enough attention. This may well be part of the reason for the failure in the ecotourism development in these two communities — a lack of knowledge on the part of the farmer operator to continue to run the destination without the researchers' assistance.

CHANGES AS RESULTS OF THE PROJECTS

In the villages

Changes in attitudes are clear in the two communities as well as the XTBG researchers. In both Man'e and Manmo, the farmers now respect the XTBG researchers and their knowledge ever more than before. Man'e and Manmo people have become friends.Great self-esteem has been fostered among many farmers during the projects.

Building on the culture and religions of the local people, renovating the village temple and restoring the village holy hill in Man'e not only steered the renewed respect towards Buddhism, to the holy hill and ancestors, and to the community, but also added farmers knowledge on their culture, religion, and the significance of plants in their way of life.

Farmers now realize the important role temple garden plants and holy hill forest can play on the conservation of tropical vegetation, plant diversity and

local environment as well as an important part of the Dai traditional agro-ecosystem. Their traditional knowledge on plants has been further broadened to include knowledge on cultivated vegetables and fruits, such as chillies, passion fruits and raising seedlings and grafting. Due to the increase of knowledge and enhancement of the traditional knowledge, knowledge on their cultivated land has been improved and so did knowledge on the broader environment.

Agricultural practices in both communities have now shifted from earlier hunting gathering with some farming activities, to more diversified practices including vegetable and fruit planting. Changed practices also enable Manmo people to give up shifting-cultivation while now having more than sufficient food resources and cash income. This also enables men to reduce hunting – another positive change for the environment. Planting fuelwood and installing energy-saving stoves make fuelwood supply and need balanced thus conflicts with the nature reserve was mitigated. Tree cover increase and tree crops on former shifting cultivation areas have improved water flow and soil conservation.

In XTBG

The XTBG scientists have gained much knowledge from the local people both from the project communities and beyond. This rich knowledge has resulted in many beneficial outcomes, namely, (1) the knowledge they gained has contributed to their own botanical research work in XTBG, (2) publishing reports and books benefit XTBG and the individual researchers for academic standings and promotion, which can help in application for new projects and research grants, (3) the knowledge the XTBG researchers gained from projects can bring economic benefits to the botanical garden and individual researchers.

The knowledge gained by the researchers from the local people has been widely used in the tourism development of XTBG. Although it is not easy to identify which knowledge shown in XTBG is used to attract tourists, in totality, XTBG's tourism development has been an on-going process of improving the learning of and showing of the diverse plants, the local knowledge, local culture and people, relationship between local people and their environment. Almost half a million visitors a year pay to enter the gardens. The attraction of XTBG has been increasingly dependent on learning from the local knowledge. The scenic beauty of the garden is built on the ethnic groups, particularly the Dai style. That such a plant collection from this region is available in XTBG is due in part to the ethnic groups' accumulated knowledge on plants and their protection. Special displays and facilities are all based on the ethnic styles, not to mention the ethnic minority people as the tourist guides, explaining ethnic ways of life in relation to plants; hotels and restaurants serve ethnic foods based on local knowledge on plants, and even the keeping of the green peacocks is a display of Dai ideology and symbolism.

In particular, the opening of the Ethnic Forest Culture Museum within XTBG is a direct resulting benefit from the two projects. Many of the cultural artifacts on display in the museum are from the people in these two communities. This suggests that the development of tourism in XTBG has benefited much from the local knowledge and local culture as well as the participation by local peoples.

CONCLUSION

Man'e Dai village, having settled in its present location for about 900 years, having distinct agro-ecosystems (paddy rice fields - home gardens - village centre - Buddhist temple - holy hill forest), having written language and both state school and temple school education, longer and better relationship with XTBG and other outside agencies, with wider range of indigenous knowledge, the learning of the XTBG scientific knowledge had been easier for the Man'e farmers and results were better sustained. In Man'e Dai Village, agroforestry practices such as intercropping rubber with other crops, maintaining the holy hill forest and temple garden plants are well sustained. Cash crops planting such as raising winter vegetables and high value fruits are also practiced.

In comparison, Manmo village with short (40 years) history in its present location, with distinct agro-ecosystems (forest - village residence - shifting cultivation), with no written language, having had limited contact with XTBG and outside agencies, with its indigenous knowledge more focused (and perhaps understudied) on the forest and surviving in the forest, the persuasion for people to change had been more challenging. And the result of the learning from the scientific knowledge relatively less well sustained.

In both villages, ecotourism development has largely failed. External influences such as government taxation scheme, proximity to better run competing tourist facilities (including XTBG), and internal factors such as lack of management skills on the part of the villagers are responsible for the failure.

It is clear that the local farmers possess a great amount of valuable local indigenous knowledge. Much of their knowledge has evolved from the availability of natural resources, natural environment and their varied ways of coping with the nature and its changes. The local indigenous knowledge has provided strong base both for the livelihood betterment of the region and the scientific research of XTBG.

At the same time, the scientific research as carried out by XTBG is also fundamental in the local development in Xishuangbanna region where the environmental degradation has become severe. XTBG's scientific research into botany, ethnobotany, plant conservation and their contribution in conservation of both local plant diversity and local economic development are timely and necessary. However, yet without a strong base of local knowledge, including local cultures, local beliefs and locally

specific practices, the insertion of the scientific knowledge into the local development process would not stand much of a chance to succeed.

This case study demonstrates that development of the local villages depends upon an exchange of local indigenous knowledge and scientific knowledge. In the knowledge exchange process, the local indigenous knowledge has been transformed into scientific knowledge and scientific knowledge into local indigenous knowledge. New knowledge has been constructed during the course of exchange.

For both the local people and XTBG scientists alike, this is a process of continuous learning and knowing, trying to emulate what occurs in nature, trying to understand and construct necessary knowledge, needed for the right fit of human, culture and landscape. Thus knowledge, both indigenous and scientific, is embedded in a complex system of social, cultural, physical, temporal and other elements.

Facilitation of the local knowledge process by external intervening agents has been recognised as a potential key strategy for sustainable development (Roling and Brouwers, as cited by Campilan 1995). In the development of the two villages, XTBG's research provided higher-level solutions than the farm level or village level in the pursuance of the integration of wider environment conservation and local economic development. At this higher level, XTBG's research has been generating locality-specific knowledge to cope with local and regional diversity and complexity, taking into account the multiple perspectives and objectives of the actors involved.

This process of knowledge exchange is similar to the process of fruit tree grafting. Scientific knowledge can be seen as the scion and local indigenous knowledge the understock. The purpose of inserting scientific knowledge into the bases of the local indigenous knowledge is to propel local development through a knowledge exchange process. In the fruit tree grafting, cambium is the essence for the growth of newer branches, which will bear fruits. In exchange of scientific and indigenous knowledge, a knowledge cambium is the quintessence for successful exchange and construction of new knowledge.

A knowledge cambium would need a good fit of knowledge and situation. Similar to the elements to be considered in fruit tree grafting, the dynamics (including who, what, where, when and how, not just knowledge per se) of knowledge cambium are very diverse and localized. A reliable formula, if it exists at all, needs painstakingly detailed study on the local indigenous knowledge, available scientific knowledge and the compatibility of the two.

Drawing from the grafting analogy, the author emphasizes the importance of the IK as the base for local development and recognition of the resulting mutual benefit. Thus, IK should serve as the foundation for the common ground (Scoones and Thompson 1993) and the new higher

ground (Chambers 1997). Only development founded on the strong base of IK will yield desired results and be sustained.

In realizing whose reality counts, Chambers (1997) calls for 'putting the first last', therefore, altruism and generosity on the part of the uppers. Here the author proposes the uppers, the outside intervening agencies, to take a step further, to foot development efforts on the base of IK and the IK bearers. This implies not only putting the first last, but last first; not only altruism and generosity, but also consistency and persistence, in our efforts to change.

It is also hoped that with a firm footing on the IK, implications can be drawn on such contentious issues as who participates with whom, what stage and how to participate in the development process, access and rights to resources (including knowledge and information, both indigenous and scientific), etc.

REFERENCES

Borrini-Feyerabend, G. (ed.)

1997 "Beyond Fences: Seeking Social Sustainability in Conservation." http://www.bsponline.org/publications/asia/beyond_fences/bf_section1_2.html

Campilan, D.

1994 "Enhancing the User-oriented Diagnostic Framework through Knowledge Systems' Thinking." In *Taking Root*. Proceedings of the Third UPWARD Annual Conference. Los Bańos, Laguna, Philippines: CIP-UPWARD.

1995 "Learning to Change, Change to Learn: Managing Natural Resources for Sustainable Agriculture in the Philippine Uplands." Ph.D. dissertation, Wageningen University and Research System.

Chambers, R.

1997 *Whose Reality Counts? Putting the First Last.* London, UK: International Technology Publications.

Colchester, M.

1994 The Social Impacts of Wilderness Preservation. *The Politics of Parks, Society, and Biodiversity. Salvaging Nature: Indigenous Peoples, Protected Areas and Biodiversity Conservation*. Discussion paper 55. United Nations Research Institute for Social Development. Geneva.

Grenier, L.

1998 *Working with Indigenous Knowledge. A Guide for Researchers.* Ottawa, Ontario, Canada: International Development Research Centre.

Liu, H. M., Z. F. Xu, and Y. K. Xu

2000 "The Role of the Traditional Beliefs in Conserving Plant Diversity: A Case Study in Xishuangbanna, Southwest China." In: J. C. Xu (ed.) *Links Between Cultures and Biodiversity.* Proceedings of the Cultures and Biodiversity Congress 2000. 20-30 July, Yunnan, PRO China. Yunnan Science and Technology Press.

Nepal, S. J.

2000 "Case Study 9: Xishuangbanna Nature Reserve, China." In J. Beltran (ed.) *Indigenous and Traditional Peoples and Protected Areas: Principles, Guidelines and Case Studies.* IUCN, Gland, Switzerland and Cambridge, United Kingdom and WWF International, Gland, Switzerland.

Nijar, G. S.

1996 *In Defence of Local Community Knowledge and Biodiversity – A Conceptual Framework and the Essential Elements of a Rights Regime.* Third World Network Paper 1.

Poffenberger, M. C.

1997 Local Knowledge in Conservation. In G. Borrini-Feyerabend (ed.) *Beyond Fences: Seeking Social Sustainability in Conservation.* http://www.bsponline.org/publications/asia/beyond_fences/bf_section1_2.html

Rajasekaran, M. and D. M. Warren

1993 "A Framework for Incorporating Indigenous Knowledge Systems into Agricultural Extension." *Indigenous Knowledge & Development Monitory* 1(3).

Roling, N. and P. Engel

1989 IKS and Knowledge Management: Utilising Indigenous Knowledge in Institutional Knowledge Systems. In D. M. Warren, L. J. Slikkerveer, and S. O. Titilola (eds.) *Indigenous Knowledge Systems: Implications for Agriculture and International Development.* Iowa State University Research Foundation, pp. 101-115.

Scoones, I. and J. Thompson

1993 *Challenging the Populist Perspective: Rural People's Knowledge, Agricultural Research and Extension Practice.* Discussion Paper 332. Institute of Development Studies.

Sharland, R.

1993 "Fusing Tradition and Science to Design a Better Granary." *LEISA Newsletter for Low External Input and Sustainable Agriculture* 9 (3), March.

Subedi

1997 "Farmer's Local Knowledge Agrees with Formal Experimental Results." *LEISA Newsletter for Low External Input and Sustainable Agriculture*13 (3), October.

Warren. D. M.

1991 *Using Indigenous Knowledge in Agricultural Development.* Discussion Paper No. 127. World Bank.

The World Bank

1995 "The World Bank Operational Manual, Operational Directive (OD) 4.20: Indigenous Peoples." In S. H. Davis and K. Ebbe (eds.) *Traditional Knowledge and Sustainable Development.* Proceedings of a conference held at The World Bank, Washington, D. C. September 27-28, 1993. Environmentally Sustainable Development Proceedings Series No. 4, pp. 52-57.

Xishuangbanna Tropical Botanical Gardens. Chinese Academy of Sciences. Tropical Plant Research. Collected papers (selected issues).

Xu, Z. F. et al. (eds.)

2000 *History of Xishuangbanna Tropical Botanical Gardens (1959 - 1999).* Unpublished monograph.