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To coordinate forest conservation and rural livelihood in a Coptis-planting based community

A case study in Shizhu County, China

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Abstract:

Coptis Chinensis is a medical herb used in traditional Chinese medicine. This research features a case study at Tianwan village in Shizhu County, Chongqing, China. The case study includes three interconnected study areas: the village, the Coptis Company, the market. Participatory Rural Appraisal (PRA) is used as the main tool for data collection. The study demonstrates that the current method of Coptis planting leads to forest destruction. Even with reforestation measures, it leads to the loss of biodiversity in the forest. Coptis planting is the primary livelihood method in Tianwan village, and as for most farmers, Coptis planting provides the largest portion of cash income. The current dominant method of Coptis planting is isolated from the larger forest environment it is located in. Its planting mode is neither environmentally sustainable, nor economically sustainable, because it cannot give satisfactory economic returns, as the return is unstable and unpredictable. One alternative to the current Coptis planting mode is to incorporate Coptis planting into agroforestry system. Besides, Water shield planting also serves as a good alternative to Coptis planting itself. Improved methods of planting, management, post-harvest processing, and marketing of Coptis are also proposed and analyzed.

The intended contribution of this paper to the theoretical debate of sustainability shall be the provision of an example showing how the lack of management strategies in agricultural production affects forest conservation and forest biodiversity. It also presents redressable measures to the negative consequences. Besides, one alternative livelihood pathway for the rural community Tianwan village in my case study is suggested.

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List of Abbreviations

CBD - Convention on Biological Diversity
CIFOR - Center for International Forestry Research
CLD - Causal Loop Diagram
ECBP - EU-China Biodiversity Programme
HRS - Household Responsibility System
IDS - Institute of Development Studies
IUCN - International Union for Conservation of Nature
MEA - Millennium Ecosystem Assessment
NGOs -Non Governmental Organizations
NTFPs - Non-Timber Forest Products
PRA - Participatory Rural Appraisal
SARS - Severe Acute Respiratory Syndrome
SLA - Sustainable Livelihood Approach
SWOT - Strength, Weaknesses, Opportunities and Threats
UNDP – United Nations Development Programme
WWF - World Wildlife Fund

Currency Conversion Rates and land area unit used in the thesis

All monetary values are displayed in Chinese Yuan (CNY). Chinese Yuan to Swedish Krona (SEK):
1 CNY= 1.1 SEK as of May 15, 2010
All land areas are displayed in Km^2, except when describing specific cropland in Tianwan village, as km^2 is quite a large unit for households' cropland. Hectare (100 hectares = 1 km^2) is used instead.

Words count excluding abstract, bibliography, and appendix: 12,035

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1. Introduction

Since the "Reform and open up" in 1978, China's economy has been experiencing rapid growth. Even the recent global financial crisis has not slowed down China's GDP growth rate. In the first quarter of 2010, China's economic growth surged to 11.9 percent, while inflation stayed low at 2.2 percent[1]. The world is expecting China to overtake Japan as the second-largest economy behind the United States[2]. Comparing to China's remarkable economic achievement, China's biodiversity is under severe threat and China is already one of the most forest deficient countries by per capita (Liu and Diamond, 2005; Yu, 2010). Though China covers a vast territory, its forest resources are of poor quality and weak biological functions, due to a long time of unreasonable use, poor conservation and management (Li *et al*, 2004).

In 2002, a decision to "achieve by 2010 a significant reduction of the current rate of biodiversity loss" was adopted by parties to the Convention on Biological Diversity (SCBD, 2010, pg.9). However, a study by Xu *et al* in 2009 indicates that, there is hardly a state, which has achieved comprehensive assessment of progress towards this target, and their study on China indicates that China is progressing towards a significant reduction of biodiversity loss (Xu *et al,* 2009). This conclusion has been confirmed in the third edition of the Global Biodiversity Outlook (GBO), which was released by the Convention on Biological Diversity in May 2010. None of the 21 targets accompanying the overall target have been achieved globally (SCBD, 2010). Ahmed Djoghlaf, Executive Secretary of the CBD has said: "The conservation and sustainable use of biological diversity, and the eradication of extreme poverty are two of the main global challenges of our time. It has been recognized by the international community that these two challenges are intimately connected, and require a coordinated response" (SCBD, 2009, pg.ii). Furthermore, the Convention on Biological Diversity (CBD) points out: "70 percent of the world's poor live in rural areas and depend directly on biodiversity for their survival and well-being" (SCBD, 2009, pg.ii).

In conjunction with increasing global concern about deforestation and rural livelihood, "forests gained heightened appreciation as sources of multiple products and services, and as important sources of the livelihood for forest-based people" (MEA, 2005, pg.277). As such, forest products are the center of research on forest management, biodiversity, conservation, and poverty alleviation (Quang *et al*, 2006). Most of the more than 5,000 commercial forest products are non-timber forest products [NTFPs] (SCBD, 2009). The NTFPs definition from the Center for International Forestry Research (CIFOR) is : "Non-timber forest products (NTFPs) are any product or service other than timber that is produced in forests. They include fruits and nuts, vegetables, fish and game, medicinal plants, resins, essences and a range of barks and fibers such as bamboo, rattans, and a host of other palms and grasses".[3]

Coptis is a genus of flowering plant in the family of Ranunculaceae. The most common Coptis species is called Coptis chinensis, which yields much higher output than any other Coptis species, and it has been planted as an agricultural product for hundreds of years. Coptis chinensis is one of the most important cultivated medicinal plants in China. The rhizome of Coptis Chinensis is also called "Huang Lian" in Chinese or "Chinese gold thread" in English. Berberine, a plant alkaloid, is extracted from Huang Lian, and it has demonstrated significant antimicrobial activity against a

[1] National Bureau of Statistics of China. Online reference
[2] Kurtenbach E.(USA TODAY). Online reference
[3] CIFOR. Online reference

variety of organisms including bacteria, viruses, fungi, protozoan (Thomson, 2007). This evergreen perennial grows best in damp boggy spots in woods, preferring light, slightly acidic soils and moisture[4]. The Coptis land in China are always found to be on the edge of forests, because the current approaches to Coptis planting require cutting forest trees to provide canopies.

Another Coptis species called Coptis teeta is an endangered species itself, and its incorporation in agroforestry system benefits both conservation and economic objectives (Huang and Long, 2007). The Center for International Earth Science Information Network (CIESIN) defines agroforestry as follows: "Agroforestry is a collective name for land use systems and practices where woody perennials are deliberately integrated with crops or animals on the same land management unit".[5] Based on this definition, the planting mode of Coptis chinensis can hardly be categorized as an agroforestry, because the way Coptis chinensis being planted, is similar to most common crops. No official definitions for NTFPs or agroforestry (both in Chinese and English) can be found in a Chinese context. However, the whole industry of Coptis chinensis, especially in my study area, has been categorized under forestry instead of agriculture by the state government[6].

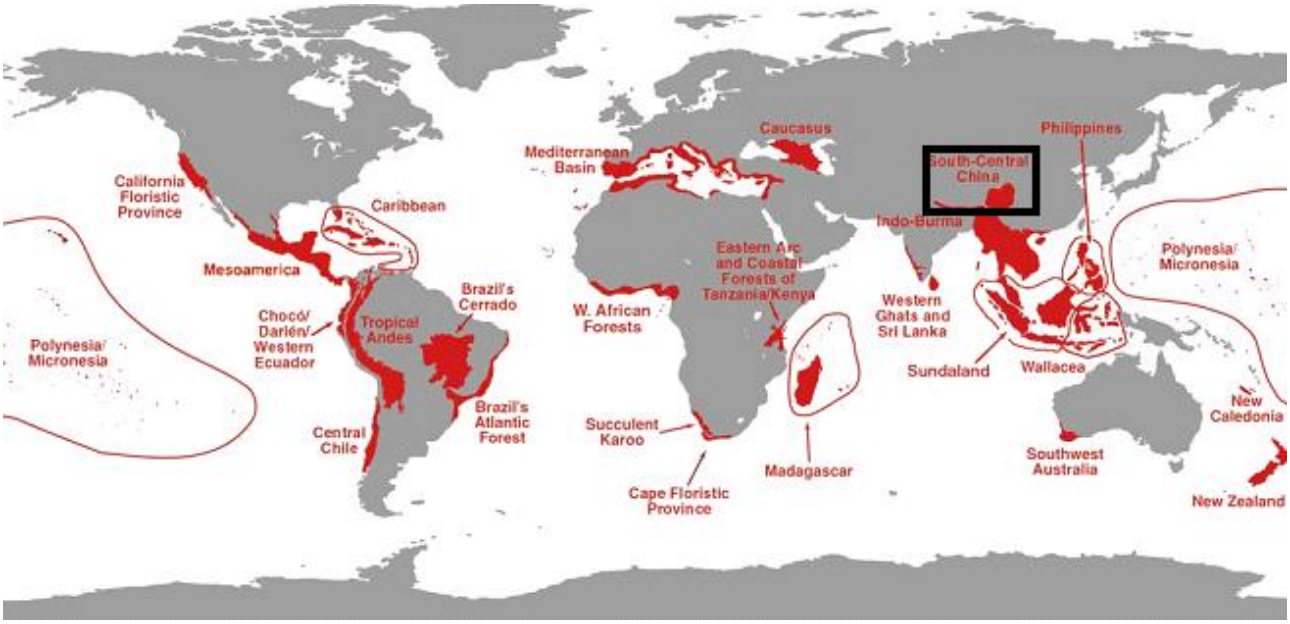
My research focuses on the relationship between the planting of Coptis chinensis and forest conservation, as well as rural livelihood in a Coptis-planting based community in Chongqing Municipality in southwestern China.

2. Background

Chongqing municipality is located in southwest China, with a population around 33 million and a land area of 82,300 square kilometers. It is one of China's four provincial-level and direct-administrated municipalities[7]. The mountains of southwest China, where Chongqing lies in, provide a wide array of habitats including the most endemic-rich temperate flora in the world, as well as protected animals like golden monkey, giant panda, etc.[8] However, the destruction of forest is one of the primary threats to biodiversity in this region - one of the 25 "Biodiversity Hotspots" in the world[9] (Myers *et al*, 2000). Geographically, Chongqing features "Southwest China Temperate Forest" and "Yangtze River"- two of 200 "Global Ecoregions" identified by WWF[10]. Figure 1 depicts the 25 biodiversity hotspots in the world (Myers *et al*, 2000). Chongqing is in the "South-Central China" region.

[4] Chinese Herbs & Co. Online reference
[5] CIESIN. Online reference
[6] China State Forestry Bureau. Online reference
[7] Chongqing Municipal Government. Online reference
[8] Conservation International. Online reference. This region is also identified by Conservation International as a biodiversity hotspot.
[9] South-Central China, refer to the square in Figure 1
[10] WWF. Online reference

Figure 1. The 25 Biodiversity hotspots (Myers *et al*, 2000)



Chongqing has a forest coverage around 20 percent. Over 6,000 species of vegetation and over 600 species of animals can be found in Chongqing. Metasequoia, a species of trees known as the "living fossils", which existed 160 million years ago, can be found in Shizhu County in east Chongqing[11]. Chongqing is also a major producer of traditional Chinese medicinal plants in China, with over 2,000 kinds of traditional Chinese medicinal plants growing in large areas in the mountainous areas in Chongqing[12].

Shizhu Tujia Autonomous County (Shizhu County hereafter) is a County-level divisions of Chongqing Municipality, and it is located in eastern Chongqing, China (Figure 2). The word "autonomous" in China, means this region has a higher population of a particular minority ethnic group. Shizhu County is populated with Tujia ethnic group. According to its official website[13], the size of Shizhu County is 3012.51 km^2. My case study site Tianwan village is in Huangshui Township; the latter is located in eastern Shizhu, and it has a size of 157.8 km^2 (Figure 3)[14].

Figure 2. Location of Shizhu County in Chongqing Municipality, China (Source: Wikipedia)

[11] Chongqing Municipal Government. Online reference
[12] Ibid
[13] Shizhu County People's Government of Chongqing (a). Online reference
[14] Huangshui Township. Online reference

Figure 3. Location of Tianwan village in Shizhu County (Source: Shizhu Government)

The Dafengbao Nature Reserve which has a size of 20,043 hectares lies in Shizhu County, and is listed in IUCN Protected Areas Category V[15]. The definition for Category V is : "Area of land where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity".[16] According to Shizhu Government[17], the whole Shizhu County has a forest coverage rate of 43.4 percent, while in the nature reserve, the forest coverage rate is 93 percent. Inside this nature reserve, there are over 2000 species of woody plants, and 46 species of national protected animal. It is one of the most biodiversified places in Chongqing[18]. Thus, it is of great importance to protect forest and biodiversity in this region. My case study site is also within this nature reserve.

Shizhu County has around 297 km^2 of dry agricultural land[19], of which, Coptis planting area amounts to 33 km^2 (11.1 percent of dry agricultural land), with annual output about 1500 tons[20]. Coptis production in Shizhu County accounts for 60 percent of China's production and 40 percent of that of the whole world[21]. However, the traditional way of planting Coptis was associated with clear-felling of forests to provide Coptis land; it also requires a large volume of timbers for establishing the canopy needed to cover the Coptis plants during its entire 5-year's life cycle. In the meantime, farmers take nutrient-rich forest humus as the main fertilizer for the Coptis. Thus, the Coptis production here has exerted great pressure on natural forests in Shizhu.

3. Analytical framework

3.1 Research aims

The intended contribution of this paper to the theoretical debate of sustainability shall be the provision of an example showing how the lack of management strategies in agricultural

[15] UNEP. Online reference
[16] IUCN (a), Online reference
[17] Shizhu Travel Bureau. Online reference
[18] Ibid
[19] Shizhu County People's Government of Chongqing (a). Online reference
[20] Shizhu County People's Government of Chongqing (b). Online reference
[21] ibid

production affects the forest conservation and the forest biodiversity. I also aim to find one alternative livelihood pathway for my case study site: a Coptis-planting based community.

3.2 Research questions

Based on my research aims, I put forward the following research questions:

- What it the connection between the current Coptis planting mode and forest conservation?
- To what extent does the Coptis planting contribute to farmers' income?
- What are the constraints of Coptis planting for a sustainable local livelihood pathway? And are there any more sustainable alternatives to Coptis planting?

3.3 Theoretical framework

Inspired by Paulo Freire, and his idea that people in poverty can and should be able to conduct their own analysis of their own reality[22]. Robert Chambers brought forward that (Chambers, 1994a; Chambers, 1994b):

- People living in poverty are creative and capable; they can and should do much of their own investigation, analysis and planning.
- Outsiders have roles as convenors, catalysts and facilitators.
- The weak and marginalized can and should be empowered.

Besides the above theoretical framework, this thesis is also based on the theme of "sustainable livelihoods", which encompass much of the broader debate about the relationships between poverty and environment (Scoones, 1998). As with the well-established term "sustainable development" (from Brundtland Report), there are often difficult compromises between different objectives embedded in the same definition (ibid). The same applies to the term "sustainable livelihoods", a normative concept made up of multiple and often contested elements (ibid).

The Institute of Development Studies gave a definition (in IDS working paper 72) as follows (Scoones, 1998, pg.5):

"A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base".

In my context, "the natural resource base" is forest-centered, and "a livelihood" is that of Coptis-planting villagers'.

[22] Readers can refer to Freire P., 2004. *Pedagogy of hope: reliving Pedagogy of the oppressed.*

3.4 Methods and data collections

This study can be characterized as a qualitative research, where a single case in Shizhu County is under comprehensive analysis. What makes a case study different from other research designs is its aim to elucidate the unique features of the case, even that its data may be unique to a time and place (Bryman, 2008). According to Yin (2003), designing my study into a case can produce both qualitative and quantitative data enabling in-depth analysis, and further illuminate a decision or set of decisions within its real-life context (Yin, 2003). The transferability to other settings is, as mentioned in my research aim, the provision of an example showing how the lack of management and development strategies of an agricultural product can affect forest conservation and rural community's livelihood.

In any analysis of sustainable livelihoods, the key questions to be asked are similar that, given a particular context, what combination of livelihood resources result in the ability to follow what combination of livelihood strategies with what outcome (Scoones, 1998). A range of livelihood resources including natural, economic, human and social capitals combined with different livelihood strategies in my case study will be discussed.

Before conducting my field study, a wide range of literature was reviewed within the following area: Forest conservation, Forest biodiversity, NTFPs developments, China's forestry policies, and community participation in natural resource exploitation and management. Both natural and social science literature were reviewed, which helped me to develop a transdisplinary approach. Part of the literature were in a Chinese context, while others were used to give a broader understanding of the concepts and theories.

Triangulation of information was used in order to increase the reliability of the acquired information (Yin, 2003).

The main tool I used in the field study is called Participatory Rural Appraisal (PRA). Chambers, a key figure in the development of PRA, explained that PRA describes a growing family of approaches and methods to enable local people to share, enhance and analyze their knowledge of life and conditions, to plan and to act (Chambers, 1994a). PRA fits my research quite well because it "has sources in activist participatory research, agroecosystem analysis, applied anthropology, field research on farming systems, and rapid rural appraisal (RRA). PRA applications include natural resources management, agriculture, poverty and social programs"(Chambers, 1994a, pg.953).

PRA emphasizes local knowledge and involve communities in the inventorying, monitoring, and planning of local forest management (AFN, 2002). PRA is a good tool for obtaining information for myself and also for providing information to the community to evaluate its own resource management practices. PRA results from questionnaires, semi-structured interviews, observations, participatory sketch mapping, and workshops are analyzed inductively and suggested measures are given in later paragraphs. Thirteen persons were interviewed on a semi-structured basis[23]; another twelve persons were interviewed during the transect walk in Tianwan village.

[23] 5 farmers from the village, 3 staffs from the Coptis Company, 2 traders and 2 farmers in the Coptis market, 1 manager from a Water shield company. See Appendix 3 for interviewee's name, occupation, and the interview date.

3.5 Limitations and boundaries

Collecting data and information through interviews generally leads to the dilemma of objectivity, which has to be acknowledged. During the field study, I presented as an individual researcher with own research questions, while I also presented as an intern in the working group of EU-China Biodiversity Programme (ECBP) Chongqing Office, the role of which is to establish a conservation fund at Tianwan village and to assess its technical cooperation with the Coptis Company. I was fully aware of my stances as part of ECBP and as an individual researcher. I tried every effort to circumvent my ECBP background during my own research. For example, I did the questionnaire survey on my own three weeks before the field trip with ECBP Chongqing Office. The questionnaire clearly indicated an academic intention, because I knew the result may be different if the respondents think the questionnaire is for official use, especially if they presumptively connect it with a possible establishment of fund for them in the near future.

With regards to system boundaries, there are several minor livelihood methods adopted by villagers at my case study site[24]. However, those methods cannot be fully taken into account as it will go beyond the scope of this thesis. Furthermore, forest biodiversity in this case study is assessed on a qualitative basis, as quantitative assessment (ecological) would require much more technical, monetary, expertise and time input, which also goes beyond the scope of this thesis.

4. The case

4.1 Tianwan village

Tianwan village is one of the 17 villages governed by Huangshui Township. The size of its land area is 2.257 km^2. A comparison of Tianwan village to Shizhu County on land area, cropland area and Coptis land area is presented in Table 1. Data of Shizhu County are from Section 2, and data of Tianwan village are from community sketch mapping in Section 4.1.5. Tianwan village has same per unit area Coptis output as to Shizhu County's average. Shizhu County has urban part, where many industries and service sectors can be found, and Shizhu is also famous for many other agricultural products - the chili, the mushroom, which are not planted in Tianwan. Together with comparison of Coptis land ratio in Table 1, Tianwan village is found to have a much higher dependence on Coptis planting, comparing to Shizhu County.

Table 1. Comparison of Shizhu County and Tianwan village in Coptis land

	Land area (km^2)	Cropland area (km^2)	Coptis land area (km^2)	Coptis land to Cropland (percent)
Shizhu County	3012.51	297	33	11
Tianwan village	2.257	0.566	0.29	51

[24] Including planting vegetables for own household consumption, working as farmer-labor in urban areas, etc.

4.1.1 Description of the site and the people

The natural reserves in China have three separate management zones: a core area, a buffer zone, and an experimental zone. In the core zone, no human activity is allowed; in the buffer zone, only scientific research and observation is allowed; in the experimental zone, educational visiting, tourism, and rearing of endangered species are allowed[25]. Protected areas provide a variety of goods and services to society at large, of which, the people living in or near the area should be the primary beneficiary (Xu *et al*, 2007). A recent report (PATF, 2004) indicates that almost all protected areas in China contain human settlement, farming and unsustainable extraction of natural resources. The same applies to my case study area-Tianwan village, despite the fact that all of Tianwan village is part of the buffering zone of Dafengbao Natural Reserve, where human settlement is prohibited by law[26].

According to Tianwan village Communist Party Secretary Mr. Bangren Zhang, Tianwan village has 98 households with 405 villagers. Tianwan village was classified as part of the Dafengbao Nature Reserve in 1990. Today although any production is prohibited within the buffer zone by laws[27], here at Tianwan village, forest trees continue be cut down to provide new land and canopies for Coptis. This village comprises crop land area of 0.566 km^2, of which, Coptis accounts for 0.29 km^2, Water shield (*Brasenia schreberi*) accounts for 0.07 km^2, followed by 0.065 km^2 of potato and 0.04 km^2 of corn. The rest 0.1 km^2 cropland is planted with other vegetables. Tianwan village is around 1450 m above sea level with steep farming land. The landscape today is a mosaic of primary and secondary forests, and cultivated land. Among the villagers' production activities, Coptis planting is the most important and oldest one. The per capita annual net income calculated on a self-report basis for year 2008 at Tianwan village is 3026 CNY, comparing to per capita 3579 CNY for Shizhu County farmers[28], per capita 4761 CNY for Chinese farmers in 2008[29]. The numbers indicate that people in Tianwan village have a comparatively lower income.

The primary reason for choosing Tianwan village as my case study area is its accessibility. Tianwan village is located at an exit of G50 Chongqing-Shanghai National Express Way and it serves as the portal to Dafengbao Nature Reserve and Huangshui Township. The second reason for selecting this site is the fact that I was affiliated with the EU-China Biodiversity Program, which was preparing an experimental Biodiversity Conservation Fund in Tianwan village.

4.1.2 Preliminary investigation and analysis

A preliminary study was performed in January which aimed to help developing research questions and better understanding of my research context. Copies of a one-page questionnaire were distributed to 30 households in Tianwan village and all copies successfully returned to me the next day. The questions[30] were Coptis-centered and had a focus on forest conservation and biodiversity. Most of the questions were made based on knowledge from other researchers' work (Belcher *et al*, 2003, Belcher *et al*, 2005; Huang *et al*, 2007).

[25] The State Council (a). Online reference
[26] This issue will be discussed in the Discussion section
[27] The State Council (a). Online reference
[28] Chongqing Municipality Agriculture Committee. Online reference
[29] Chongqing Price Information Center. Online reference
[30] See Appendix 1 for the questions and results.

The advantages of the self-completion questionnaire over structured interview are: the former is cheaper and quicker to administer, and it is more convenient for respondents without interviewer effects (Bryman, 2008). However, before compiling questions, I also thought about the disadvantage of the questionnaire method: I cannot prompt or probe my respondents. The redressable measures I took were to first explain all terms I use at the beginning of the questionnaire. Questions were in language easily understood by farmers.

Results show Coptis is the most planted agricultural product in Tianwan village. Moreover, results from Preference Ranking of 10 common local agricultural products highlighted a plant called Water shield. This result triggered my interest of further investigation on Water shield (See Appendix 1 for analysis of other results).

4.1.3 Semistructured interviews and analysis

Five semistructured interviews were held with adult farmers. The criteria for selecting respondents is their ages and if they plant Coptis: They must be adults and have Coptis land.

Interview responses were recorded in a notebook, and a tape recorder was used. All of the interviews and discussions were organized in local language: a dialect of Chinese spoken in Chongqing region. Each interview lasted around one hour during a single day. Information related to household income, land preparation, Coptis planting/management/harvesting practices, forest conservation was collected.

Results show that Coptis production has long been Tianwan village's main economic source. Because Coptis is a shade plant, here at Tianwan, villagers follow the historical planting method, which involves cutting evergreen broad-leaved forest trees to provide canopies. In the meantime, villagers take nutrient-rich forest humus as the main fertilizer to Coptis planting. There are three types of farming lands in Tianwan, namely dry land, water land, and wood land.

As for dry land, villagers also plant corn, potato, and other vegetable for their own household consumption besides planting Coptis. Villagers rarely raise pigs or poultry.

As for water land, it was previously used as paddy fields, however, due to Tianwan's high latitude and cool weather, the output of rice is very low. Tempted by the high Coptis price in past few years, villagers were expanding Coptis planting area. Owing to the negative effects of Coptis planting on forest protection, local government intervened in Coptis land expansion. As a result, some villagers resorted to Water shield planting. Water shield is a perennial plant with relatively small, floating oval to elliptical leaves with no slit. And it has a distinctive gelatinous slime on the underside of the leaves and coating the stems[31]. In China, Water shield is deemed as a delicious food. Turning from Coptis to Water shield improved these villagers' cash income, but its planting mode is also labour-intensive.

As for wood land, all forests in Tianwan are collective-owned and contracted with each household. Although felling is prohibited in nature reserve by law, villagers in Tianwan take felling trees for granted, because they think as long as they replant new trees in their contracted management zone, they will not be punished. In fact, they had never received fines from the government for cutting trees. This is where the biodiversity issues emerge: Using fast-growing, mono-type trees[32]

[31] Texas A&M University. Online reference
[32] The Japan Cedar in Tianwan's case.

to replace primary forest trees leads to a decrease in tree species richness. The vulnerability of mono-type forests will further weaken the biodiversity in forests. Caprio *et al* (2009) pointed out that bird diversity is especially influenced by tree biomass and the core area. Their result clearly showed that retention of native trees at the habitat and the landscape level is the key factor for conservation of diversity of bird species (Caprio *et al*, 2009). Tree species diversity and density of predominant tree species are also proved to be positively related to forest animal biodiversity (Tena *et al*, 2006; Mani *et al*, 2004).

Villagers were not aware of the fact that, logging - the human-induced forest change at landscape level here, has lead to the loss of natural forest habitats and forest fragmentation, and further caused loss in biodiversity (Caprio, 2009; Mani, 2004; Tabarelli, 2004).

Through interviews with villagers, I realized that they do hold an array of local knowledge, and they were also aware of forest conservation. By talking with them, I strengthened my belief in PRA's position that: The local people are creative and capable of doing their own analysis and planning. For example, farmers knew that if they shovel grass-covered humus in the up-hill forest, it will destroy grass and small trees, while if they burn the humus to make fertilizers, it will kill small animals in the soil. And shoveling itself will cause water and soil erosion in the forest and further affect trees' growth." One farmer's alternative solution is to dig a pit near his Coptis field and put the collected fallen leaves and branches inside for decomposition; he later add the decomposed matters into his Coptis field as nutrients.

4.1.4 Transect walk and analysis

Transect walk is a tool for describing and showing the location and distribution of resources, features, the landscape and main land uses along a given transect[33]. According to Zeeuw *et al* (2004), when performing a transect walk, it is best to choose a route which will cover the greatest diversity in resources, land use and geographical conditions. The transect walk is conducted by the research team and representatives of the female and male community members (Zeeuw *et al*, 2004).

The transect walk in Tianwan village took place the whole day of February 5th 2010. Four researchers including myself formed a group. During the walk, group members discussed everything encountered and noticed. Ideas were facilitated by asking questions and observation. The team members also informally interviewed any people met during the walk to get their views on land uses and resources at the corresponding spot. Audio record was taken when dialog arose. Problems and opportunities regarding land uses and resources were identified:

1. Coptis fields

Most of the Coptis fields use timbers as the supporting columns of the canopies made of branches and timbers (Figure 4)

[33] The World Bank. Online reference

Figure 4. The Coptis Field (Photo by Yike Qin)

Villagers interviewed told us: Preparing one hectare of Coptis field needs around 150 m^3 of wood. This result matched my immediate on-site calculation[34]. The 150 m^3 of wood requires clear felling of 3 hectares forest. One problem with the woody canopy is that severe nature force may sometimes destroy the canopy (e.g. a lasting heavy snow), which need to be replaced with new ones.

Some women encountered working on Coptis field told us that they need to hire laborers to prepare the canopy and ground soil due to the difficulty of this task. They pay 70 CNY per laborer/day work, which amounts to a total cost of 4000 CNY to prepare 0.1 hectare of Coptis field . They complained that Coptis prices are unstable and in the year 2009 it was very low (40 CNY/kg). 0.1 hectare of harvested Coptis produces averagely 300 kg of product, thus giving an economic return of 12,000 CNY. But after deducting the cost of laborers, fertilizers[35], the net return was quite miniscule- around 7,000 CNY for 0.1 hectare Coptis over 5 years, considering Coptis' five years' cultivation time.

When asked why they went on spending money on framing new canopy instead of switching to other livelihood methods, they said they cannot abandon the Coptis which they have planted for 4 or 5 years, and they were glad to see Coptis price in the year 2010 went up above 70 CNY/kg. Concerning switching to other livelihood methods, women said they were not adequately educated; besides planting crops, they knew nothing about other livelihood methods unless someone trains them.

I asked all Coptis farmers if they had been trained by local government on improved ways of Coptis planting. All said they had. One woman said she she underwent three trainings by Shizhu County government (carried out by Shizhu Coptis Company). She acknowledged the usefulness of those trainings, and she was expecting for more trainings which focus on specific local soil properties. By adopting improved Coptis planting and managing methods, she hoped her Coptis quality would improve in the long run, thus can bring her higher cash income, and ultimately elevate her household's livelihood standard.

[34] Suppose each column is of 0.1m*0.1m*2m dimension, and there is 2m distance between two neighboring columns. For one hectare of Coptis field, it needs: 0.1*0.1*2*50*50 (ground)+0.1*0.1*2*50*50*2 (above)=150 m^3 wood.
[35] For 0.1 hectare of Coptis, annual fertilizer input is a round 1,000 CNY

We also saw Coptis fields along the road using cement as the supporting columns for canopies. Villagers told us these cement columns were provided by local government for free. By talking with villagers we identified that the trend of cutting trees for making Coptis canopies could not be reversed in the near future, as a large number of Coptis-planting based villages in Shizhu County are still not accessible by vehicles and the inconvenience of transporting these cement columns would involve high costs.

Figure 5. Cement columns in the Coptis field (Photo by Yike Qin)

2. Water shield fields

Around one third of water land is used as Water shield fields. Group members agreed that abundant water resources, and optimal altitude are positive elements for Water shield planting. Tianwan is quite ideal for promoting Water shield planting. 0.1 hectares of water field has the ability to produce 3000 kg of Water shield, with a sale value of 2 CNY per kilogram[36]. Despite the economic returns, most villagers acknowledged that working in Water shield fields causes arthritis and females mentioned the negative effect on their reproductive system. However, they admitted that their cash income greatly increased by switching from Coptis planting to Water shield planting, not only because Water shield gives better net return, but also because the buying companies pay them up to 120 CNY subsidy for 0.1 hectare of Water shield annually.

It takes five years for planting Coptis, while Water shield gives continuous annual returns. In simple words, after harvesting, the same Coptis field will not give output for the next four years. Coptis farmers' strategy is to divide their Coptis land into 5 pieces with each planted with first year's to fifth year's Coptis respectively to guarantee continuing return from one piece of land. A visualized comparison of net return is presented in Table 2. for 0.5 hectare of Coptis and Water shield in year 2009.

[36] For 0.1 hectare of Watershield, annual fertilizer input is around 1,000 CNY

Table 2. Annual net return from 0.5 hectare of Coptis and Water shield

(Basing on year 2009's price)

	Coptis	Water shield
Net return	7000 CNY	25000 CNY

The team members agreed that Water shield planting can serve as a good alternative to Coptis planting from an economic perspective. There were potential in expanding Water shield planting area because, of all 24 hectares of water field in Tianwan village, only 7 hectares are now used for Water shield planting. However, switching from planting Coptis to planting Water shield may shift the ecological burdens from wood land to water land. It is very likely that after years' Water shield planting, the water quality will deteriorate (e.g. eutrophication) due to fertilizers input and human laboring.

Water shield fields are highly rich in biodiversity. The submerged portions provide habitats for many micro and macro invertebrates; these invertebrates in turn are used as food by fish and other wildlife species; the detritus of Water shield by provides food for many aquatic invertebrates[37]. Villagers told us that frogs, ricefield eels, loaches[38], etc can be found in Water shield field, and villagers sometimes catch and sell them in market for cash. However, converting natural water land to Water shield field may result to loss of natural habitats for the native aquatic birds. Concerning the relation between the quality of Water shield and forest conservation, a forestry expert in the group commented that, a well-kept forest uphill can filter good quality of water to the submontane water land. There is a newly built reservoir with a volume of 35 million m^3 and surface area of 6 km^2 to the east of Tianwan village. In the future, drainages can be built from the reservoir to Water shields for the need of high quality water, if necessary.

3. Metasequoia tree community

At the southeastern part of Tianwan, there is a Metasequoia tree communities comprised of 26 seed trees of Metasequoia glyptostroboides. This place is also labeled as "Seed Metasequoia tree of China" by States Forestry Bureau. Metasequoia glyptostroboides is deemed as a living fossil species which is listed in the category of "Critically Endangered" in IUCN Red List of Threatened Species[39]. This Metasequoia community is of great importance for the study of ancient plants, climate and geology. This tree community could potentially be threatened by Coptis farmers who may not be able to identify the Metasequoia saplings and may mistakenly cut them down as a result. I suggest this place should be conservatively renovated: billboards and fences should be established around seed trees and natural saplings; relevant provisions of protection and management should also be regulated.

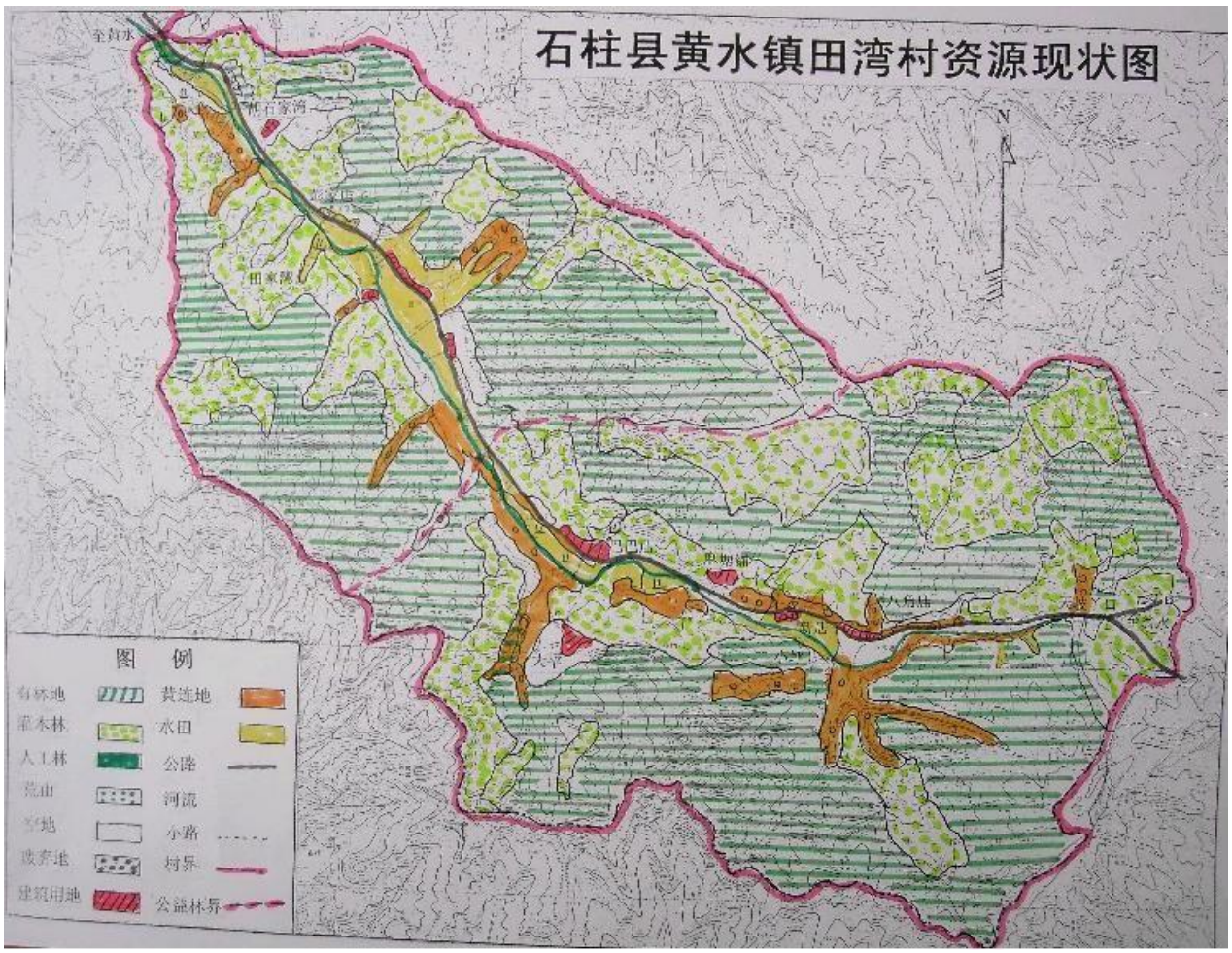
4.1.5 Community sketch mapping

Participatory mapping involves facilitating community members in developing spatial representations of their areas by creating maps on the ground or on a large piece of paper. Such maps reflect the location of villages, forests, agricultural land, water resources, as well as management issues (AFN, 2002). The process of making our map and the discussions which

[37] Texas A&M University. Online reference
[38] Oriental weatherfish
[39] IUCN (b). Online reference

occurred when making it, are important output of the PRA exercise. This map is based on secondary forest resources data and two on-site surveying and mappings taken in December 2009 and February 2010. In the sketch map (Figure 6), orange stands for Coptis land, yellow stands for water land. There is a black line representing the provincial road from the northwestern corner to eastern Tianwan village. Tianwan village serves as the portal to Dafengbao Nature Reserve and Huangshui Township. However, as for tourists, the Coptis field itself and the fragmented forest along the road may be quite unsightly. Thus, the current Coptis planting mode may have a negative effect on local tourism development. Shrubbery are represented in the map by spotted light green. Elder villagers participated in the sketch mapping mentioned that some shrubbery near Coptis field are originally primary forest. A copy of the finished map (Figure 6) was given to villagers and explained in village meetings. This map provided a rapid visual representation of the resource system that is easily understood by villagers.

Figure 6. Sketch mapping of land resources of Tianwan village



4.1.6 Village meetings and analysis

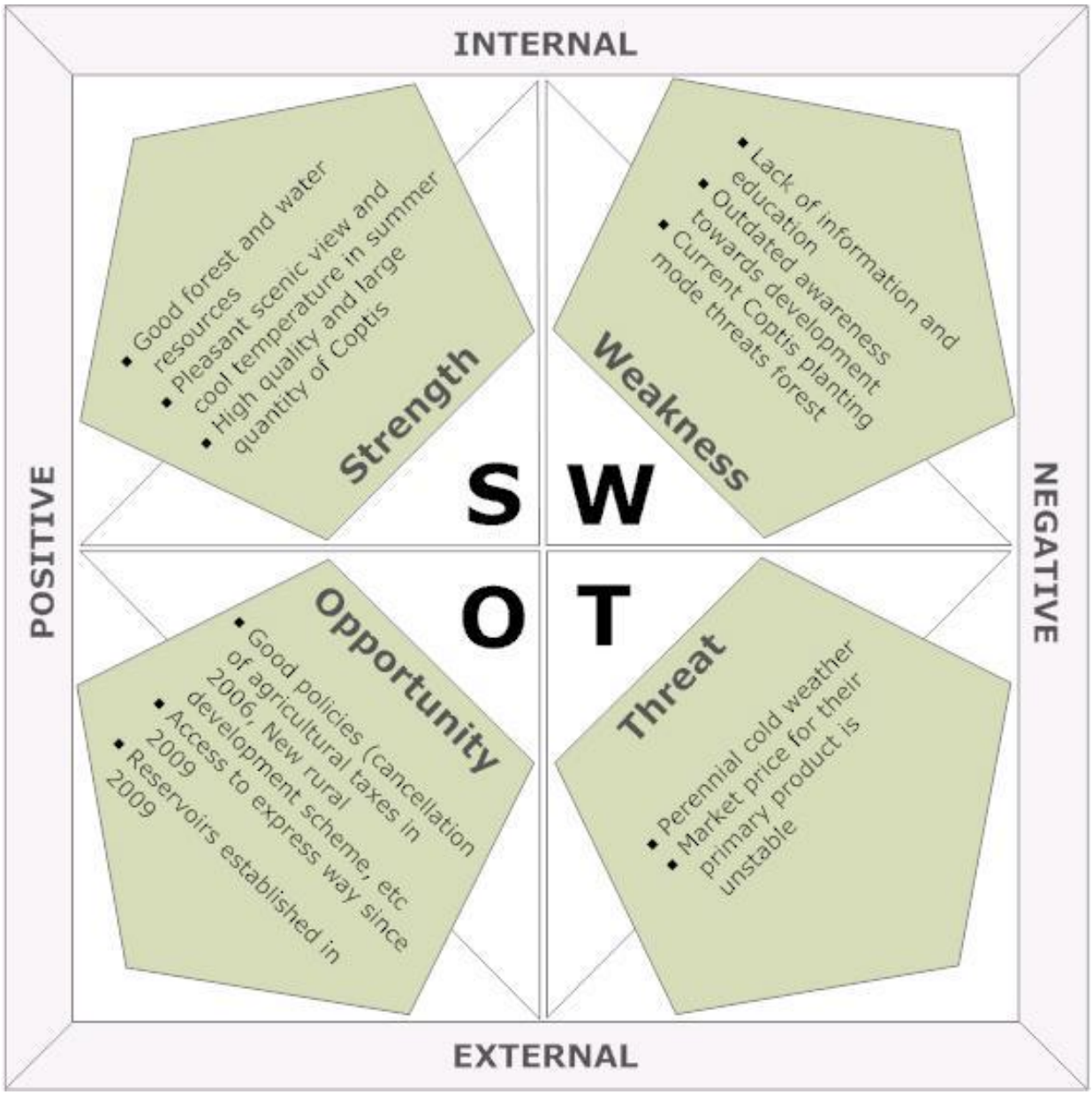
Two villagers meetings were held in evenings of February 6th and 7th by me and my colleagues from ECBP Chongqing Office. Each meeting lasted 4 hours with 40-50 adult villagers. I encouraged the villagers to conduct their own analysis of Tianwan – "What is Tianwan village's current situation?", by using the Strength, Weaknesses, Opportunities and Threats (SWOT) analysis. SWOT analysis is often used in a strategic planning process in a business environment, and it involves identifying the

internal and external factors that are either supportive or unfavourable to achieving that objective[40]. SWOT analysis can also be used in all sort of decision-making situations, and here in my case, I used SWOT analysis for a rural context. I understood that my presence as an outsider from the ECBP may have a different stance and operate under different paradigm comparing to local community members when it comes to analyze the latter's own reality.

Based on free discussions with and among villagers, I made a SWOT diagram of Tianwan village. The result is summarized in Figure 7. Among the strength, "cool temperature in summer" was discussed most. Chongqing's summers can be very hot, among the hottest in China[41]. In summers, many Chongqing urban people like to spend weekends in Huangshui Township because the latter has Dafengbao Nature Reserve and Huangshui National Forest Park nearby, and most importantly, because the weather is cool there. Villagers claimed to see much more private vehicles from Chongqing urban area after the opening of G50 Express way. Tianwan village is only 5 km away from Huangshui township. Though itself is not a tourist destination, there is a good potential of developing rural homestay here. Among the weakness, villagers identified their lack of access to information and education. Though the younger generation are entitled to full compulsory education, the elder generation can only expect trainings from local government and NGOs to acquire knowledge concerning improved livelihood methods. As opportunities and threats are external elements, there are not much to do by villagers to affect them.

[40] The Chartered Institute of Personnel and Development. Online reference
[41] The temperature can keep between 37 °C and 40 °C in August.

Figure 7. SWOT analysis of Tianwan



Following the SWOT analysis was a discussion on the forest. Villagers were asked about their general understanding of forest in their village. They thought they had very high forest coverage (around 41 percent from the sketch map). They said: trees grow quite fast here, and even felled trees can often reestablish themselves. I shared with them data showing that forest stock in Tianwan is 5856 m^3 and forest land is 94 hectares. This corresponds to 14.5 m^3 forest stock and 0.232 hectare forest land per capita, respectively. Comparing to China's per capita of 9.048 m^3 and 0.128 hectare respectively (CFS, 2003), these numbers which correspond to the village are slightly higher and seem good from villagers' point of views. However, the fact is that China's forest area per capita is only 20 percent of the world average and that forest stock per capita is only 12.6 percent of the world average (CFS, 2003). A summarized comparison of Tianwan village, China, and world average in per capita forest area/stock is presented in Table 3.

Table 3. Comparison of Tianwan village, China, and world average in per capita forest area/stock

(Source: China Forestry Society, and ECBP Chongqing)

	Tianwan village	China	World	Tianwan to World average (percent)
Per capita forest stock (m3)	14.5	9.048	71.8	20
Per capita forest area (hectare)	0.232	0.128	0.64	36

By discussing these numbers, villagers were made clear of the status quo of their forest resources, that the high forest coverage in Tianwan should not be what they are proud of. They should protect the primary forest here, instead of cutting them for Coptis planting.

Then we discussed the following question with them: "How do the current rules and regulations govern resource use?" This question allowed us to identify and resolve potential conflicts between traditional and formal resource management controls in order to development a more implementable forest management plan (AFN, 2002). At Tianwan village, systems of resource use and control do not exist. Since controls are often tied to specific forest products, it may be helpful to discuss each product in terms of community access during mediated group discussions (AFN, 2002). As for Coptis, firstly, with villagers we agreed that its planting area should not exceed the current size of 29 hectares. A suggested management procedure was summarized as: "Delimit region, limit area, cultivate scientifically, increase per unit area yield". Secondly, it was suggested that good Coptis seeds should be promoted. Thirdly, improved Coptis planting methods[42] (co-developed by ECBP Chongqing Office and Shizhu Coptis Company) will be promoted here as soon as possible. Moreover, "Tianwan villagers" regulation concerning forests" was passed and immediately went into effect. Contained within it are terms for specific rewards and penalties[43].

We finalized management and application rules of our 100,000 CNY "Tianwan community biodiversity conservation and sustainable development fund". This fund is on a "loan without interest" basis. Successful applicant for this fund should have a proposal, which show that his/her activity will at least not compromise forest biodiversity, and is environmentally sustainable. A discussion was held among villagers on what they plan to do with the money if he/she is financially supported by this fund. Common ideas included: expansion of their Water shield land and buying seeds for fruit trees. One villager mentioned he would domesticate chickens under the forest cover. He explained why his proposal should be favored, based on the fact that the fast-growing trees they planted need nutrients such as nitrogen, phosphorus and potassium to grow well, while chicken's manure can serve as good nutrient. Forest trees can provide shade for chickens, which can peck the soil pests and tree pests. Another villager added that "under-forest chicken domestication" saves cost and land area for building pheasantry. The rest of the villagers all agreed that chickens raised in this way taste good and are welcomed in the market. As for labour productivity[44], Fang's work (2009) indicates that diversification toward animal husbandry seems to be the best rural poverty reduction strategy (Fang, 2009).

I think villagers might not understand the principles of photosynthesis and the nitrogen fixation

[42] See Section 4.2
[43] See Appendix 2
[44] Measured as per labour-hour output. From the analysis in previous paragraphs, Coptis planting requires high labour input, but gives relatively low revenue.

effects, that forest can absorb carbon dioxide, and ammonia discharged by chicken, and finally enhance chicken's immunity; villagers might not know that such mode of domestication is an agroforestry by definition; but villagers do hold a wealth of indigenous knowledge.

4.2 The Shizhu Coptis Company

4.2.1 Description of the site and the people

The state-owned Shizhu Coptis Company (the Coptis Company hereafter) is located in Huangshui Township of Shizhu County, approximately 5 km away from Tianwan village. According to its manager Mr. Pingan Peng, the Coptis Company keeps 233 hectares of Coptis lands, and harvests 47 hectares, annually. The Coptis Company is operated in a "company + cropland + farmers" mode. Besides growing Coptis on its own experimental land, it also hires farmers in nearby villages to plant Coptis basing on its own GACP[45] scheme . Currently, there are 800 villagers directly attached to the Coptis Company.

In cooperation with the Coptis Company, ECBP Chongqing Office wants to use a variety of local native species to restore mixed woods on Coptis fields. This practice will not only increase biodiversity, but will also reduce the community residents' dependence on the Coptis industry for livelihoods. Under this setup, Coptis chinensis can be categorized as a NTFP and its planting can be incorporated into agroforestry, instead of only exerting negative effects on the forest. Furthermore, by demonstrating "seedling culture in bamboo forests" and "Improved drying process of Coptis", we hope that the amount of trees used for canopy wood and firewood will decrease and that threats to forest protection will be lessened.

4.2.2 Improved methods for Coptis cultivation and post-harvest drying

My research methods here at the Coptis Company are mainly on-site observations and interviews with management staffs and technicians.

The previous Coptis planting mode is isolated from forests and its planting leads to destruction of the latter. An improved way to cultivate Coptis is to incorporate it into agroforestry.

When I first met a staff from the Coptis Company, I asked, " Why don't the farmers just plant Coptis under dense natural forest instead of cutting trees to provide Coptis land and canopy?" The answer was that, "firstly, Coptis needs perennial shade, while unmanaged natural forests cannot guarantee the strict requirement on shade; Secondly, Coptis is unable to compete with the broaden leaf trees for nutrients in natural forest."

One sustainable cultivation method is called "culture of seedlings in bamboo forest". The traditional way of culturing Coptis seedlings requires wood for providing shade. After many rounds of experiments, the Coptis Company finds Chimonobambusa (a species of bamboo) forest as an ideal environment for this practice. A managed Bamboo Chimonobambusa forest can provide the perfect shady environment needed by Coptis seedlings, and it requires much less nutrients and water from the soil than mature natural forest.

Another benefit of this method is: it can diversify Coptis farmers' livelihood methods and provide

[45] GACP stands for Good Agricultural and Collection Practices. Readers can refer to WHO (2003) in the bibliography.

more cash income. According to a technician from the Coptis Company, seeding of Chimonobambusa takes place in spring, and their bamboo shoots emerge between September and October. Because of their unique morphological characteristics, delicious taste and nutritional value, these bamboo shoots are quite welcomed on the table. By the following spring, the bamboo matures to a normal height between 4-6 m. Mature bamboo can then be cut and made into handcrafts by villagers: another possible income source.

After 2-year's time of culturing Coptis seedlings, Coptis plants need transplantation. At this time, a sustainable solution is to plant Kiwi trees on Coptis field by using their leaves as natural canopy. The Coptis Company has done experiments with many species of trees, considering other issues like economic outcome, length of growing time, they concluded that the Kiwi tree was an optimal choice. According to the explanation from the manager of the Coptis Company, Kiwi is a liana, which needs the erection of durable frame immediately after being planted in order to facilitate the growth and results. If the setting of frame erection is not in time, seedlings of Kiwi trees will crawl on the ground instead of growing up straight. This will lead to branches being entangled with each other and further affect the formation of the trunk, which ultimately results in delay of the yield of fruits.

The cement columns being used as transitional substitute of woody columns in the Coptis field are ideal frames for Kiwi saplings. A Kiwi sapling can be planted near a cement column, and one year later the column can be removed. Branches and leaves of mature Kiwi trees can serve as a natural canopy for Coptis, while harvested Kiwi fruit can be sold by farmers in market for cash revenue. Removed cement columns can be transferred to other villages where cement columns are currently not in use.

The harvested rhizome of Coptis needs to be dried by farmers before bringing to market. The traditional way of drying Coptis rhizome is both very labor intensive and energy intensive. Figure 8 shows two women incessantly turning over Coptis rhizome. The oven is fueled by wood.

Figure 8. Traditional way of Coptis drying process (Photo by Yike Qin)

In 2009, the ECBP Chongqing Office together with the Coptis Company built a Coptis oven made from stone and steel and with measurements of 1m*1m*3m on the ground. There is a drum rotated by an electrical motor to blow air into the oven. This equipment is highly efficient because it only needs one person (even teenage child) to take care of the drying process and it reduces the labor time to one third of the traditional way. The cost of such equipment is 3000 CNY and it can be shared among over 10 neighboring households.

4.3 The Coptis and Water shield market

4.3.1 The Coptis market

The Shizhu Coptis Market is located in the center of Huangshui township. This market opens every Sunday except during Chinese Spring Festival (normally lasts around half month). My on-site study at the Coptis Market took place on February 7th, 2010, in the form of interviewing various stakeholders including Coptis farmers and Coptis traders.

What Coptis farmers care about most is the cash revenue from the selling of harvested Coptis. The amount of cash income from Coptis closely relates to farmers' livelihood standard. However, the market price of Coptis is quite unstable: even in the last decade, can we see large price fluctuations. Table 4 shows Coptis price trend in the last ten years.

Table 4. Coptis price trend in Shizhu County

(Source: ECBP, the Coptis Company, interviews in the Coptis market)

Year	Price (CNY/kg)	Note
2001-2003	200	Demand increase due to development of medicines using Coptis extracts
2004-2005	300	Outbreak of SARS in China lead to rising price of medicines, and Coptis has a general anti microbial effect
2006-2007	50	Increased production met normal demand
2008	50-28	Demand decreased possibly due to global financial crisis
2009	39-44	Price continuing went up
2010	70-76	Price in early February, 2010

Due to Coptis' long planting period, farmers' responses to market demands and price changes are always slow, and this situation is hard to change because most farmers, traders, or even Coptis companies do not have enough financial resources to store the product until the price increases,. Additionally, it is impossible for farmers to abandon their fourth year Coptis, even they know that next year's market price will be very low. However, there are still possibilities that farmers can get better income for selling harvested Coptis.

4.3.2 Better revenue from the Coptis

In the market, there is a positive correlation between the drying extent of Coptis and its purchasing price from traders. Traditional household's drying of Coptis can result in a product that is 90 percent dry. So, if additional drying can be promoted among farmers, the sale price should increase.

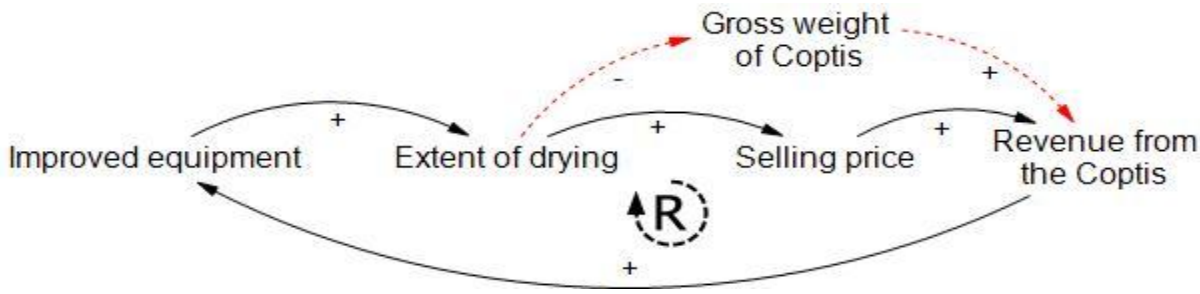
Based on an interview with farmers, I found out that: Firstly, the technology and equipment input required by higher drying levels costs a lot. Even that new drying equipments have been devised, which save labor time and fuel wood, they can only slightly improve Coptis' drying level as compared to the traditional equipment. The extra revenue brought by extra drying will take years

to offset the initial investment for such new equipment. When talking with a trader about my above idea, he said, as for him, it is unlikely that farmers will dry Coptis together by sharing improved drying equipment, because there is competition between individual farmers. The "Business As Usual" scenario for traders in the market involves meeting individual farmers with harvested Coptis in their basket back carrier, and bargaining with the farmer to make a deal on an acceptable price. After one year's labor on the Coptis field, farmers just want to sell their Coptis as soon as possible, instead of storing them. At this time, there emerges a power asymmetry: First, most farmers I talked with did not plan to go back home with their Coptis if they find the market price is too low (walking several kilometers with the harvested Coptis on their back basket). Second, none of the traders care if one specific farmer will sell his Coptis to him; while one individual farmer wants to sell his Coptis to any trader if the price is acceptable. Third, traders know well about price information at upper channel of Coptis, while individual farmer does not. A farmer has to passively bargain with an experienced trader- a process the trader calls the "Each break" strategy.

One solution to this can be establishing a "Coptis Association" at village level. The Coptis Association will be formed by Coptis farmers with external consultants from the Coptis Company, township or county level forestry/agricultural offices. The Coptis Association should serve as a platform for publicizing sustainable methods in planting, management and processing of Coptis; it should also serve as platform for exchanging market information. While individual farmers should unite and sell their Coptis together to have a greater power to negotiate with traders. An association, an affiliations, or social networks are social capital upon which people draw when coordinated actions are required in pursuing different livelihood strategies (Scoones, 1998).

Secondly, there is a conventional notion rooted in farmers' minds: "More weight, more revenue." They naturally think if their Coptis is wet, the water inside will naturally add weight to their Coptis and bring more revenue. But they are not aware of, or do not want to accept the fact that, if their Coptis is drier, the purchasing price from traders will be higher. Figure 9 presents a Causal Loop Diagram of this relation[46]. The black loop is an ideal way to improve cash income from selling Coptis, while the red lines (depicted in dashes) are farmers conceived casual relations. Here farmers miss a linkage that cash income equals Gross weight of Coptis*unit price, and the decrease of unit price brought by higher water content affects the final revenue more than the increase in Gross weight.

Figure 9. CLD concerning Coptis water content and cash income



The same applies to heavy metal content. Heavy metal content of raw medicinal materials are indicator which is highly emphasized by medical factories and international buyers. As such, buyers' purchasing price is closely correlated to this factor. A trader who claimed to have the

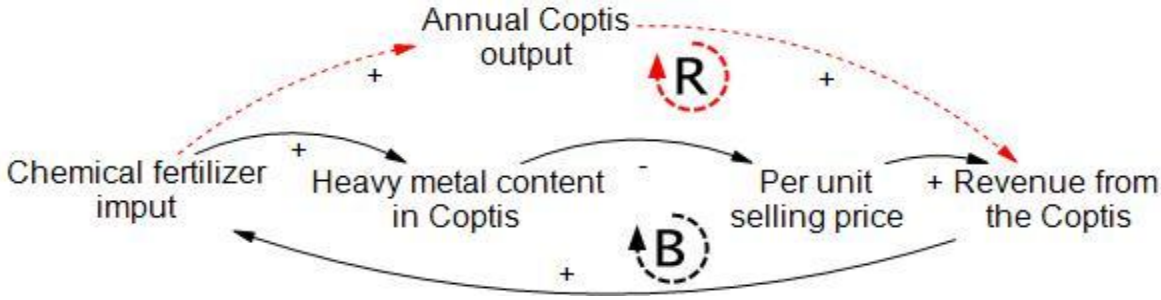
[46] Causal Loop Diagrams are often used in system analysis in order to understand the connection between multi-stakeholders and how their action affect the system.

equipment for testing Coptis' heavy metal content claimed that the standard for maximum heavy metal content is 2 mg/kg and that most traders purchase Coptis with a heavy metal content of 1.6-2.0 mg/kg. After processings by traders, Coptis is resold with a heavy metal content of 0.7-0.8 mg/kg.

According to Coptis traders interviewed, heavy metals in Coptis mainly come from the use of chemical fertilizers. This places farmers in a huge dilemma: low heavy metal content means less chemical fertilizer input, which leads to less output. Given that farmers need cash to buy fertilizers for next year's cultivation, they would rather choose to bear the slashed price quoted by buyers, instead of finding a way to reduce the heavy metal content. Figure 10 presents a Causal Loop Diagram of this relation.

Input of chemical fertilizer actually results in a balanced loop; however, red lines (depicted in dashes) show farmers' conceived causal relation between input of chemical fertilizer and their cash income. Just as the case above, the decrease in unit price due to higher heavy metal content, affects the final revenue more than the increase in annual Coptis output.

Figure 10. CLD concerning chemical fertilizer input and cash income



A possible solution is to adopt an organic Coptis planting mode, in which the selection of fertilizer is the key. In the year 2009, the Coptis Company started to use decomposed farmland manure, humus soil, and dedicated Coptis fertilizer as a substitute for chemical fertilizers. The farmland manure used is composed of manure of pigs, cattle and chickens. Together with leaves and straw, they are piled for microbial fermentation. A recent study performed by Local Coptis technicians', focuses on the dedicated Coptis fertilizer which is based upon the nutritional requirements of Coptis at different growth stages. The ultimate aim is to improve the yield and quality of Coptis.

4.3.2 The Water shield market channel

As Shizhu county is called "Hometown of China's Coptis", Huangshui township of Shizhu is also deemed as "Hometown of China's Water shield". According to my investigation, there are over ten Water shield processing enterprises in Huangshui Township, of which, three are relatively larger by annual output. Most of these enterprises are operated by farmers. During a visit to the largest Water shield processing company owned by Mr. Mo, information was collected on the current market situation. According to Mr. Mo, all processing companies have their own supply of raw materials from farmers.

Traders buy Water shield from farmers for 2 CNY/kg, and they resell it to processing companies in large quantity at a price of 2.5-3 CNY/kg. Farmers and traders perform no form of processing (not even cleaning). Mr. Mo's Water shield company performs export business with Japan and South Korea buyers, due to the demand for the product in those two countries. For example, after

cleaning and filtering, Water shield packed with ice will immediately be sent to Japan at 28 CNY/kg. Though Mr. Mo cannot speak any foreign languages, he already has some fixed east Asian buyers. Water shield for sale in the local market is packed with vinegar in hard plastic containers, and it is sold at around 10 CNY/kg at food shops in towns or cities.

Though many farmers have greatly elevated cash income as a result of planting Water shield, I find there are still factors restricting the development of this industry.

Firstly, it is conditioned by governmental policies such as taxations and factory land tenure. Though the market price of final Water shield products seems high compared to raw materials, there is high taxation from both State Tax and Local Tax, fees from Quality Check, Food Hygiene, and others.

Secondly, it is conditioned by transportation. Huangshui Township has only one way for outbound logistics, which far lags behind the time and speed requirement of the national market. Currently, the stage - "from harvesting to post processing" can be performed within 24 hours and producers are expecting to deliver their products to Japan or South Korea within another 12 hours. Previously, without the G50 Express way, this process will last more than 24 hours.[47]

Thirdly, it is conditioned by available capital: farmers who own the processing business have limited available money, and they find it hard to get loans from the state bank. Mr. Mo told me that for his factory to be certified by an Environmental Impact Assessment (EIA), it will cost him 50,000 CNY. From a technical standpoint, it won't be hard to get that certificate for his factory, but he does not have the money. The same applies to an export certificate. As a result, his exported Water shield is relabeled with another brand from a large Shanghai company who has certificates both in EIA and export. He has to pay a fee to the Shanghai company, and he feels bad that he is actually working for others. The end-consumers may never know the Water shield is from Shizhu, from his factory.

The government plays a vital role in solving these issues. Firstly, local government should support and subsidize the Water shield industry just as they have done on the "star" products like tobacco and chili in Shizhu County. Secondly, local government should invest more in road construction and linkage to express ways; Coptis and Water shield should be closely integrated into nationwide agricultural products market networks. Thirdly, local government should open green channels or give preferential policies to these farmer-owned enterprises; and lastly, local government should help solving farmers' difficulties in acquiring factory land, production permits and environmental certificates.

As for most Water shield farmers working in water land, they should unite and talk directly with processing factories, by circumventing the middle trader. Even an increase of 0.5 CNY/kg in the selling price will largely elevate their cash income..

[47] From Huangshui Township, Water shield goes through provincial road through Tianwan village to G50 Express way, then around 3.5 hours to Chongqing Airport. There is direct flight to Shanghai. From Shanghai, direct flight carries Water shield to Japan or South Korea.

5. Discussions

5.1 Answers to my research questions

Based on the findings from my case study, answers can be found for my three research questions: The current method of Coptis planting leads to forest destruction. Even with reforestation measures, it leads to loss of biodiversity in the forest. The Coptis planting is the primary livelihood method in Tianwan village, and as for most farmers, the Coptis planting provides the largest portion of cash income. The current dominant method of the Coptis planting is isolated from the larger forest environment it locates. Its planting mode is neither environmentally sustainable, nor economically sustainable, because it cannot give satisfactory economic returns, as the return is unstable and unpredictable. One alternatives to current Coptis planting mode is to incorporate Coptis planting into agroforestry system. Besides, Water shield planting can also serve as a good alternative to Coptis planting itself.

5.2 Problems with the establishment of Natural Reserves

A very special case of changes in land applications is the establishment of nature reserves. Xu *et al* found that, important criteria for the state to establish nature reserves include high biodiversity, species richness, unique ecosystems, and high endemism (Xu *et al*, 2007). They also found out that "the establishment of natural reserves has been widely associated with loss of legal access to productive resources, such as swidden land, pasture, construction timber and NTFPs" (Xu *et al*, 2004, pg.976). However, like most cases in China, the establishment of rural communities (Tianwan village in my case) came much earlier than the establishment of nature reserves. As mentioned in the introduction part, most of world's poor living in rural areas have to depend directly on biodiversity for their well-being and survival (SCBD, 2009). At community level, the population growth, together with other specific drivers, such as transformation of land for food production and procurement of construction timber have exerted great pressures on the environment (Xu *et al*, 2004). Furthermore, as mentioned in Section 4.1.1, the three management zones of a nature reserve have different roles. However, different zones are rarely marked in the field and often ignored in practice (PATF, 2004). Lastly, migration is not an ultimate practical solution to this dilemma. The Chinese government has to find a solution to coordinate the relation between nature reserves and local people.

5.3 Sustainable forest management

A report from The World Bank (2001) indicates that China's natural forests have been in a state of continuous decline for 50 years, and there are no signs that sustainable management of natural forests has even started (The World Bank, 2001). The devastating floods in the middle reaches of the Yangtze River during the summer of 1998, were caused at least in part by deforestation in the catchments of the river (Zong *et al*, 2000; Cheng, 1999; Zhong *et al*, 2002). Soil erosion induced by

deforestation in the catchment areas resulted to a large amount of sediment deposited in the reservoirs, whose capacity is largely reduced (ibid). Shizhu County is just in the upper-middle catchment areas of Yangtze River, and it is also in The reservoir area of Three Gorges (Wang *et al*, 2004; Jiang *et al*, 2006). There is only a less than 20 km linear distance from Tianwan village (Point A in Figure 11) to the Yangtze River.

Figure 11. Shizhu County's relative location to the Yangtze River

(Source: Google Map)

Immediately after the flood in 1998, the State Council took a number of decisive actions: a ban on logging in natural forests, a prohibition on opening of new lands at the expense of forests, etc. But these bans have not proved to be effective enough, mainly due to the lack of enforcement in remote rural areas like here at Tianwan village. In year 2003, the State Council implemented another policy called "Grain for Green"[48]. The core of this policy is: Farmers can convert their sloping farmland into wood land on a voluntary basis. The State will provide farmers with grain and cash subsidies for livelihoods, and subsidies for seeds and seedlings needed in the afforestation. A participatory socioeconomic survey by Ye *et al* (2003) shows that the basic living standards of farmers can be guaranteed by government subsidies (Ye *et al*, 2003). Though there were concerns about this policy's effect on food security (grain supply), studies show that the its impact on grain support at national level is very small (2-3 percent), and it has almost no impact on grain prices (Feng *et al*, 2005; Xu *et al*, 2006). At Tianwan village, although most of the Coptis fields are on flat land due to the difficulty of establishing canopies on sloping land, I can still see Coptis field on sloping land during the transect walk. This policy actually quite fits Tianwan village: Firstly, farmers here do not have to worry about the impact on local grain supply or price because they do not grow grain here. Secondly, fruit trees or bamboo forest planting can be adopted, which give farmers dual sources of benefits from both the state and the harvest. Actually, some farmers I met in the transect walk had already fully converted their Coptis fields on sloping land into young forest[49].

[48] The State Council (b). Online reference

[49] Concerning farmers' 5-year Coptis planting strategy mentioned in Section 4, the fastest farmers who responded to this new policy

Forests in China are either state-owned or collective-owned. The latter means the forest resource is owned by local communities (The World Bank, 2001). By data analysis, The World Bank found that the collectives had managed their resources much better than the state-owned sector; and as for the latter, the factors contributing to poor management of state-owned forests are similar to many other sectors in the centrally planned economy (ibid). The factors can be summarized as: a focus on production at the expense of forests destruction; the financial burden to meet social needs of employees; lack of incentives and sometimes perverse incentives for management staff (ibid).

All forests in Tianwan village are collective-owned. Like most cases in China, the collective forests are de-collectivized in the form of rural the Household Responsibility System (HRS). The HRS is an agriculture production system, which allows households to contract land and other facilities from collective organizations[50]. All collective-owned forests in Tianwan village are contracted to each household. If villagers cut trees, they have to replant new trees immediately. As discussed in Section 4, the mono-type fast growing trees villagers usually replanted, can result to forest biodiversity loss, not to mention the fact that younger forests are worse at retaining soil and water comparing to primary forests. It is suggest that, forestry staffs should give trainings to farmers concerning choosing of forest types and species for the reforestation activity.

Chhatre and Agrawal's study (2009) shows that when local users perceive insecurity in their tenure because the forest lands are owned by the central government, they extract high levels of livelihood benefits from forests, and when they have safe tenure, they conserve the biomass in such forests. They further suggests that, payments from the government to local people, for improved carbon storage in the forest, can contribute to climate change mitigation without adversely affecting the local people's livelihood (Chhatre and Agrawal, 2009).

All land in China are owned by the state. Thus, a challenge in the future is: if the state can provide secured tenure of the HRS forest, so that their custodians will make the long-term investments necessary to sustain the forest resource (The World Bank, 2001).

Another objective should be to maintain policy consistency to ensure that when policies affecting forest management do change, they will change gradually and predictably (The World Bank, 2001). Because there have many sudden forestry policy changes historically, especially in 1980s: The wide spread of uncertainty among farmers caused excessive extracting of timber, from which the forests have not yet recovered (Xu *et al*, 2004; The World Bank, 2001).

5.4 Participatory methods

Xu *et al* (2007) claim that local people are rarely included in planning, monitoring, evaluation, or management decisions. However, they did not show why local people are excluded from such activities; or it is simply because that the exclusion is the "Business As Usual" scenario in China's rural areas. Based on my own PRA research in Tianwan village, I think this more or less related to insufficient trainings of farmers on these activities, caused by the spatial distance or the low education level of farmers. In China's hierarchical governmental administration, township

has just converted their Coptis land.

[50] China Internet Information Center. Online reference

government is the lowest; and only the county government and above, have dedicated agencies for forestry, agriculture, labour and social security. In short, the agencies making such planning do not exist at village level. However, I think in the future, more rural participation should be included in forestry policy makings. Shi and Xu's work (2000) shows, in areas where there is adequate participation of farmers in planning, less deforestation has occurred (Shi and Xu, 2000).

The data and information collected in Tianwan village through the PRA tool are quite useful for my later analysis. Together with secondary data derived from official channels, literature studies, and my own observations, a triangulation of data source is really achieved. I as an outsider served as convener and catalyst, facilitated local people's active analysis and planning of their own livelihoods; enabled their participation in achieving sustainable livelihoods in the future (Chambers, 1994a).

Lastly, I need to say that some tools I used, including transect walk, preference ranking, and sketch mapping, owe much to the Agroecosystem Analysis, which was developed by Conway and his colleagues (Conway, 1985).

5.5 Sustainable livelihoods

Concerning sustainable livelihoods, there are many existing approaches and frameworks developed by UNDP, IDS, to name a few. A holistic "Sustainable Livelihood Approach" (SLA) needs much more work, and it goes beyond the scope of this thesis, since I aim to study the coordination between forest conservation and rural livelihoods. Back to IDS' framework for investigating sustainable rural livelihoods (Scoones, 1998), a tentative sustainable livelihoods pathway for Tianwan village would be:

1. A particular context (policy settings, geographic settings, socio-economic conditions).
2. A combination of following livelihood resources:

Natural capital: the natural resource stocks (soil, water, forest, genetic resources, etc) and environmental services (reservoir, etc)

Economic or financial capital: the capital base (villagers' own savings, ECBP fund, other poverty alleviation funds, improved equipments and methods for cultivation, etc)

Human capital: knowledge brought by ECBP and others, skills brought by the government and the Coptis Company, etc

Social capital: transportation networks, market networks of each agricultural product, the Coptis Association, the Water shield Union, social relations with NGOs, etc

3. A combination of the three livelihood strategies :

Diversify to a range of non-Coptis-planting income earning activities: for example, Water shield, fruit trees, and bamboo planting, or under-forest poultry domestication.

Agricultural intensification/extensification: as for Coptis, more output per unit area by planting methods improvement is welcomed, but extension of planting area is not suggested.

Migration: Tianwan villagers may move away and seek a better livelihood in cities if policies allowed. This is also a solution to the dilemma of nature reserves.

5.6 Further research

At Tianwan village, the Metasequoia tree community has great intrinsic value for biologists and conservationists. There are also great values in researching on improved Coptis planting and processing methods. Concerning climate changes, it is important to study the resilience of the Coptis, and Water shield agricultural system. There was severe drought in the southwest China in the first quarter of 2010, but it has not affected the production of Coptis and Water shield at all, at Tianwan village[51]. The result from Question 9 in my preliminary research questionnaire shows villagers in Tianwan village had a stronger ethnical based worship on forests in the past comparing to today. It will be interesting to investigate on what caused this change. I think this may result from changes in economic conditions, changes in national rural policies, or effects from market.

6. Conclusion

The contradictions between forest conservation and Coptis planting have been shown here. From this case study, I found that although villagers do have some knowledge about the importance of protecting the forest, they still cut a large amount of trees for Coptis planting, and even with intensive cultivation of Coptis, they still live in poverty. The root of this problem lies in the lack of livelihood methods: People in Tianwan village have historically followed a Coptis-centered livelihood approach. A solution to this problem is to diversify to a range of non-Coptis-planting income earning activities. This research shows that Water shield is an ideal substitute to Coptis, from both environmental and economical perspectives. As for Coptis, bamboo and fruit trees can be incorporated into its cultivation, which not only diversifies villagers' income sources and reduces the economic risk brought by unstable Coptis price, but also recovers the forest at the same time. Furthermore, improvements in Coptis fertilizers, processing technologies and equipments, together with better strategies for farmers in marketing their Coptis products, are also important factors for villagers to get better revenue from the Coptis planting.

[51] This drought affected five provinces including Chongqing, but it did not spread to Shizhu County. The last time I went back to Tianwan village for an ECBP task in early April 2010, I talked with villagers concerning this drought. They confirmed that, so far agricultural productions in Tianwan village had not been affected.

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8. Appendix

Appendix 1: The questionnaire for preliminary investigation

Questionnaire (translated from the original one written in Chinese)

For academic use

Definition of terms (if any doubt, contact Tel: 13983853688 Qin Yike)

- Harvest: All harvested cultivation measured in the market price (including their own consumption or use)
- Cash income: The portion of harvest, which gives access to cash in the market

Please tick the appropriate option. (Try to avoid easily selecting "not clear")

1. The ratio of cash income to your family's harvest?

A. greater than or equal to 50% B. less than 50% C. not clear

2. The ration your family's cash income from Coptis planting?

A. greater than or equal to 50% B. less than 50% C. not clear

3. You plant which of the following products?

A. Coptis B. fruit trees (specify___) C. bamboo D. watershed E. others (specify___)

4. Regard to Coptis planting, how many of the following terms you are familiar with?

Coptis planting with afforestation, Coptis planting with non-timber canopy, Rotational cultivation, Coptis planting on abandoned land, Organic Coptis planting, Inter-forest seedling

A. 6 B. 4-5 C. 2-3 D. 0-1

5. In the area where you live, do you think which of the following agricultural products can substitute Coptis planting from an economical income perspective?

A. Water shield B. fruit trees (Kiwi…) C. bamboo D. other type of medical plants (specify___) E. None of these above can

6. Please rank the following agricultural products in descending order of importance in terms of economic value to you, and mark numbers at the bottom of each. (1 as most important, followed by 2 as less important)

Coptis Corn Potato Bean Watershed Fruit Timber Bamboo Vegetable Mushroom

7. Your understanding of "Biodiversity"?

A. can tell the meaning B. only heard of C. never heard of

8. In terms of protection effects on forestry system, do you think artificial fast-growing forest equivalent to natural forest?

A. equivalent B. not equivalent C. I have no idea

9. As for the inhabitants in the towns and villages where you live in, do they have a common ethnical worship towards nature of forests?

A. They do worship B. They had a stronger worship in the past than today C. None/I have no idea

10. Do you think the number of forest plant and animal species, as well as their amount, has relation to local eco-tourism development?

A. the more number the more positive connection B. related, but not fundamental C. no

relations

11. Are you operating or planning to operate services or products relating to local eco-tourism? (home stay/restaurant, sell of self-cultivated agricultural products to tourists, etc)

A. operating (specify type___) B. planning to operate in the future C. do not intend to operate

Result from the questionnaire

- The first two questions ask about the economic characteristics of villagers' livelihood strategies. 80 percent of respondents indicate that they have most cash income from Coptis planting. Thus, villagers' strategies can be characterized as "specialized" and "cultivated".
- Question three's result shows that Coptis is most planted crop followed by Water shield.
- Question four measures villagers' familiarity with newly improved Coptis planting methods. Over 80 percent of respondents are familiar with more than four of six listed terms.
- In question five, I listed some local agricultural products to see which product can substitute Coptis planting from an economical revenue perspective as villagers perceive it. Around 65 percent of respondents chose Water shield.
- Question six uses Preference Ranking revised from that in Huang and Long's research. (Huang and Long, 2007) I listed 10 common agricultural products in Shizhu County, of which the most important item was assigned a value of 1, whereas the least important was assigned a value of 10. Numbers from all respondents were summed to give an overall numeric value. The crop with smaller numeric value indicates higher preference. Result indicates the top three products are: Coptis, Water shield, mushrooms.
- Question seven to ten were made to find out villagers' awareness and indigenous knowledge towards biodiversity and forest conservation. Results suggest most of the respondents have basic related knowledge, but further education is necessary.
- Question eleven asks villagers' general attitude toward operating services or products relating to local tourism in the future. All respondents showed interest.

Appendix 2: Tianwan villagers' regulation concerning forests

To protect this village's biodiversity and ecological environment, based on discussion in the villagers' meeting, the following provisions are formulated:

1. All villagers shall raise their conservation awareness, and consciously protect biodiversity and ecological environment within Tianwan village.

2. Villagers shall improve Coptis planting methods, improve Coptis quality, stabilize planting area, stop deforestation, and should not cut down trees in natural forests.

3. Using fire in the forest, catching of protected animals, and collecting of protected plants are prohibited.

4. Rewards: if villagers do the following things which favor biodiversity protection, 100 CNY is rewarded, or preference is given when applying the community fund.

1) Help fighting forest fires
2) Actively decrease Coptis planting area and reforestation
3) Report illegal deforestation or poaching of wildlife activities

5. Punishment: if the villagers have the following activities, a fine of 100 CNY will apply, and the fine goes to the community fund.

1) Help the illegal outsiders' illegal acquisition of wildlife

2) Expand Coptis field by converting forest land
3) Apply pesticides to Water shield field
4) Extract forest soil, and stones; burn forest humus to make fertilizers
5) Cut a mature tree

6. Any person violating this regulation will be abolished the qualification for community fund loan for one year.

Appendix 3: Interviewee basic information

Interviewee 1: Bangren Zhang, Tianwan village Communist Party Secretary. Interviewed on February 2, 2010.

Interviewee 2: Yongchang Pen, Headman of Tianwan village agricultural production. Interviewed on February 2, 2010.

Interviewee 3: Boxuan Zhang, villager. Interviewed on February 3, 2010.

Interviewee 4: Jinqiong Yang, villager. Interviewed on February 3, 2010.

Interviewee 5: Dirong Tan, villager. Interviewed on February 4, 2010.

Interviewee 6: Pingan Peng, Manager of Shizhu Coptis Company, Interviewed on February 5, 2010.

Interviewee 7: Mengguo Ran, Shizhu Coptis Company technician, Interviewed on February 5, 2010.

Interviewee 8: Peixuan Ma, Shizhu Coptis Company technician, Interviewed on February 5, 2010.

Interviewee 9: Hongdeng Luo, Local trader met in the Coptis market, Interviewed on February 7, 2010.

Interviewee 10: Quan Zen, Local trader met in the Coptis market ,Interviewed on February 7, 2010.

Interviewee 11: Hongsen Ma, Local Coptis farmer met in the Coptis market, Interviewed on February 7, 2010

Interviewee 12: Qide Wang, Local Coptis farmer met in the Coptis market, Interviewed on February 7, 2010

Interviewee 13: Changzhang Mo, Manager of Shanzhichun Water shield factory, Interviewed on February 8, 2010

Appendix 4: Framework questions in semi-structured interviews

For interviewee 1-5

1. How many family members in this household? Education background for each family member?

2. What is the size of your household's total cropland? What crops do you plant? Detailed land area size and annual output information?

3. What method/strategy do you use in Coptis planting?

4. What is your understanding of the term "Biodiversity"?

5. What national forestry policies do you know?

6. What is your attitude towards the "Grain for Green" policy?

7. Do you favor the establishment of a "Coptis Association"/ "Water shield Union" for the exchange of market information, and trainings on improved planting methods?

8. Do you make Coptis/Water shield fertilizers yourself or purchase commercial ones?

9. Describe what you want to practice or invest in, if your apply for 10,000 CNY loan from "Tianwan

Biodiversity Conservation Fund" is granted?

10. What do you suggest for the problem of cutting forest trees for the making of Coptis canopies?

For interviewee 6-8 (Less structured and more agricultural technique focused)

1. What is the reason for not planting Coptis under natural forest?
2. What indigenous tree species have you done experiments with the "Coptis planting with afforestation" method? What is the outcome for each species?
3. How to lower down the heavy metal content in Coptis?
4. How to prevent fungi attack on Coptis?
5. What is the criteria for quality classification of Coptis seeds?
6. How is the current research on dedicated fertilizer going?

For interviewee 9-10

1. What is the whole market channel of Coptis (with price information)?
2. What is your role as a mid-trader?
3. How you do business with Coptis farmers and upper buyers?

For interviewee 11-12

1. Do you prefer selling your Coptis immediately after harvest and drying or stocking them till the price went higher?
2. How do you bargain with traders on Coptis price? Or do you just agree with the price they set?
3. Do you think if further drying is necessary? Your reason?
4. Do you think more fertilizer input will give you more revenue? Your reason?

For interviewee 13

1. What is the current Water shield market situation at Huangshui Township and nationwide?
2. What is your Water shield market channel and how you do business with buyers?
3. What factors are restricting the development of the Water shield industry as you think?