Key Impediments to Biodiversity Conservation in the Greater Mekong Subregion: Human Context

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Abstract— *The conservation of global and regional biodiversity increasingly relies on the network of international cooperative protected areas. In this article we examine human demographics, land cover and land use, and agricultural suitability as main human context impediments that may influence the smooth work of biodiversity conservation in the GMS area. Moreover, through comparison, contrast, explanation, and argumentation, this thesis analyzes the ethical and economic problems and contradictions that may occur in the process of realizing biodiversity conservation and sustainable development in the subregion, and the article also provides clews for future protecting and research work performance.*

Keywords— biodiversity conservation, human context, impediments, sustainable development

1. INTRODUCTION: HUMAN DEVELOPMENT AND BIODIVERSITY CONSERVATION

The Millennium Ecosystem Assessment (2005) identified continued biodiversity loss as an important aspect to the decline of key ecosystem services that humans and other species rely upon. It is estimated that people may have increased the rate of global extinctions by as much as 1,000 times the natural rate typical of Earth's long-term history. Some 12% of birds, 25% of mammals, and at least 32% of amphibians are threatened with extinction over the next century [1]. Human activities have taken the planet to the edge of a massive wave of species extinctions, which further threatening our own safeties.

Human-induced habitats loss and fragmentations have been regarded as major threats to biodiversity conservation. By the end of the 20th century, human beings have used about 40% of the earth's territory and had changed one-third of the land area to urban using and agricultural fields [2]. Cultivating forests and wetlands into croplands, using rivers to generate power, and hunting wild animals for various benefits may not end all kinds of natural processes, but it will change our landscapes and disarrange all the natural processes.

Modern conservation of global and regional biodiversity increasingly relies on the network of international and regional cooperative protected areas. In the year of 2005, the Greater Mekong Subregion countries China, Lao PDR, Myanmar, Cambodia, Thailand, and Vietnam have promoted the plan of the Greater Mekong Subregion Biodiversity Conservation Corridors (GMS BCC) together. According to the plan, all the six GMS countries will cooperate with each other in doing scientific expeditions and assessments, building natural resources networks, and protecting rare species to realize biodiversity conservation and sustainable development in the Greater Mekong Subregion.

In this plan, the first proposed ten years GMS Biodiversity Conservation Corridor Initiative (GMS BCI) is to support the broad-based agenda of sustainable development identified by the GMS countries. According to the agenda, the GMS BCI will undertake activities in five pilot sites Xishuangbanna, Ngoc Linh – Xe Sap, Xe Pian, Dong Hua Sao, Dong Ampham, Tenasserim: Western Forest, Kaeng Krachan, and Cardamom Mountains [3] in the priority areas of GMS to conserve habitats for wildlife, to enhance ecological services, such as water supply and flood protection, and to improve local community welfare through poverty alleviation measures and sustainable use of natural resources. By the year of 2015, the GMS countries will have established basic biodiversity conservation landscapes and corridors for protecting and maintaining ecosystems, realizing sustainable and rational use of shared natural resources, and improving the livelihoods of people in the subregion. Therefore, this article further examines main human context impediments, such as human demographics, land cover, and agricultural suitability, so as to provide clews for future protecting and research work performance in biodiversity conservation in the subregion.

2. ASSESSING FEASIBILITY OF BIODIVERSITY CONSERVATION IN HUMAN CONTEXT

Human Demographics

Calculating human population in the Greater Mekong Subregion shows how many people in this area would direct affect and provide potential threat to the new Biodiversity Conservation Corridors. With a total area of 2.33 million sq. km, the Greater Mekong Subregion has a population of 246 million by the year of 2000 [4]. Over the past 30 years, the population of the Lower Mekong Basin has doubled. It is estimated that by 2025 the population in this area will increase another 30% to 50%.

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Although at the beginning of this article we mentioned that human activities, which may influence the earth environment directly or indirectly through various ways, is one of the ultimate reasons for biodiversity loss, and human activities reflect more accurately the adverse impacts towards environment, researchers and experts consider the population size of human settlements nearby or within wildlife habitats or core zones of reserves as the most potent source of threats to biodiversity conservation [5]. Human settlements may cause damage of forests, loss of habitats, increase in livestock densities, rapid development of commercial agriculture, and systematic and large-scale construction of urbanization.

In Yunnan Province of China, Lancang-Mekong River has a drainage area of about 88,700 sq. km where the population density is of 69.6 people per sq. km [6]. In other GMS countries, by 2004, Lao PDR has a population density of 24 people per sq. km, Myanmar has a population density of 74 people per sq. km, and Thailand has the density number of 124 people per sq. km. This number in Cambodia is 72 people per sq. km, and the population distribution in Vietnam is 246 people per sq. km which is the highest country population density in the whole world [7].

Although there is great variability in population densities associated with different areas in different countries of the subregion, research shows that once the distribution of population reaches to 10 or more people per sq. km, the adverse impacts toward the environment and biodiversity conservation occur [8]. Moreover, satellite images provide that even in the areas of some of the new conservation reserves in the subregion, population densities are high as well. Take the Lao PDR which has the lowest population density in the subregion for example, across the GMS BCI pilot site Xe Pian – Dong Hua Sao – Dong Amphan, within the Xe Pian National Biodiversity Conservation Area in the Lao PDR, the population is estimated at 50,000. Fourteen of the 80 villages in the 3 districts covered by Xe Pian are located inside the national biodiversity conservation area, and seven ethnic groups reside in and around the area. The total population of Dong Houa Sao is 28,800 and of the 82 villages contained in the 3 districts that it covers, two are inside the national biodiversity conservation area, and other seven ethnic groups reside within its boundary [9]. In addition, according to the demographic census, in some coastal and lowland zones in the subregion, the population density reaches to more than 750 people per sq. km [10].

In the Northern Annamites Rain Forests across the border between Lao PDR and Vietnam, in the Northern Plains Dry Forest areas in north Cambodia, in Xishuangbanna of southwest China, and in other vast tract of protected reserves, human settlements and population densities are considered to be significant threat to biodiversity conservation.

Land Cover

Land cover in the Greater Mekong Subregion indicates the capacity of biodiversity conservation in the newly established corridors. In the past years, land cover conditions in the Subregion has been changed by deforestation, agricultural cultivation, dams construction, urbanization, hydrologic response, water quality, topsoil erosion, biogeochemical cycles, land surface atmosphere interactions, and climate change.

With very few forested areas remaining; lowlands of the subregion are clearly dominated by rice paddies and croplands. Among these areas, the relationship between land cover and human settlements is clearly reflected in the central and northeastern agricultural area of Thailand, the Tonle Sap Lake and Inundation Zone of Cambodia, and the southern areas of Vietnam. In contrast, portions of mountain areas such as the Cardamom Mountains in Cambodia, parts of Xishuangbanna in China, and forest areas in Lao PDR are covered by fragmented forests and mixed agro-forestry landscapes.

Research on land-use change in Thailand in 1998 reveals conversion of forest, logging of natural forest, and farming in the forest areas are three major components of deforestation and land use transformation in this country. In 1960, 54% of lands at national level were covered by natural forest, 20% areas were covered by farmland, and 26% national lands are used for non-forest land development. However, in the year of 1998, new collected data shows that forest cover at national level in Thailand reduced to only 25.3%, simultaneously, farmland cover increased to 41.5% and other non-forest land-use took 33.2% of national land. Three major aspects of overall land-use change since 1960 in Thailand are: changes in proportions of land under forest, agriculture, and other uses; levels of each type of area per capita as the population has grown; and the proportion of the population officially located in metropolitan areas [11]. Resorts and golf courses convert land directly from forests and habitats. Urbanization, industry, housing, agriculture, and other constructions are rapidly devouring landscapes of natural biodiversity.

Agricultural suitability and agricultural economy

As a globally leading cause of habitat conversion, agriculture remains an enormous threat to conservation, a threat which is expected to increase markedly with anticipated growth in demand for food in coming decades [12]. As the Greater Mekong Subregion has such a huge population, among which the majority are smallholder and poor farmer population who live in rural areas where they lead subsistence or semi-subsistence agricultural lifestyles, agricultural suitability is a non-negligible factor when assessing feasibility of biodiversity conservation in this area.

There are two types of agriculture: subsistence and commercial. In most of the GMS countries, rice and other subsistence food crops have continued to be the mainstay and principal commodity of the economy. People grow crops both through sedentary agricultural practices and shifting-cultivation methods. Although research shows that growing crops in most mountainous reserves and gap locations would most likely fail to meet high human food demands and lead to subsequent agricultural expansion in order to generate desirable yields, and thus could result in the further loss of species

[13], in many poor areas in the subregion, subsistence farmers still commonly use the slash and burn or swidden agricultural method by which a portion of land is cleared and burned to provide at least one and up to three years of good crops grown. Once the land can no longer be utilized, a new patch of ground is slashed and burnt for another round of crops. This shifting-cultivation method has been considered to be one of the major causes of deforestation.

Another problem left over by history has been the illegal commercial cultivation of the opium poppy. Although the general trend of opium poppy cultivation is toward a decrease, today it is still grown and processed in the uplands of Myanmar and Lao PDR, and in some small pockets of Northern Thailand. This problem not only causes a series of other social problems but also provides potential threats to the biodiversity conservation because most of the growers have chosen deep mountains and remote areas nearby or within the natural habitats and reserves to plant the opium poppy, and governments' programs to curb production have had limited success because of the profitability of opium production and the inaccessibility of growing areas.

Broadly speaking, other widely applied practices relating closely to agricultural economy in the subregion include animal husbandry, fishery, agroforestry, and economic forest regeneration. Widespread conversion of the habitats into croplands and food supply cultivation areas and regenerating of natural growth forests for economic forests such as rubber plants, eucalypts, palm trees, tea gardens, and fruit trees, is an outstanding threat towards regional biodiversity conservation. Natural forests which are regarded as one of the most important elements for ecosystem biodiversity conservation in the GMS have been gradually transformed into ranges of "agricultural" species. With the reduction of natural rainforests and monsoon forests, in many places, natural biodiversity has been changed to human-induced agrobiodiversity.

Forest Inventory data collected in Vietnam shows that the natural forest cover in this state in 1943 was 14,325,000 hectares, while this figure declined to 9,444,198 hectares till 2000. In 1943, there was no planted forest in Vietnam; however, till 2000, the area covered by planted forest has been increased to 1,471,394 hectares. Forest cover decreased from 43.7% in 1943 to 33.2% in 2000, and by 1990 this number used to decrease to 28% [14]. With population's increasing settlements to forest areas, land needed for cultivation have been extended. People regenerate natural forest diverse species for high-yield and monoculture agricultural crop. As chain effects of population settlements and land cultivation, forest habitats are cleared, trees are logged down, plants species are lost, and animals are hunted for food and trading. In other places, such as the Tonle Sap Lake Zone of Cambodia, increasing use of fertilizers has caused significant adverse impacts on fish species in the Great Lake and population health around this zone.

Recent research shows that the greatest opportunities for expanding the current global and regional network of protected areas to fill priority gaps in biodiversity conservation tend to occur in the tropics on larger landmasses and in mountain zones [15]. The Greater Mekong Subregion, fixing both of these factors, is the appropriate setting for creating and managing protected areas for biodiversity conservation. However, because of high human population density, and because most areas in the subregion are fit and valuable for cultivation and farming, it takes both financial and social costs to restrict agriculture and create conservation corridors.

3. BIODIVERSITY CONSERVATION: GAINS AND LOSSES

A Case Study of Xishuangbanna, Yunnan Province, China

Located in Yunnan province of China, Xishuangbanna has been chosen as one of the five GMS BCI pilot sites. By the end of 2005, 193 nature reserves had been established with a total area of 3.74 million ha in Yunnan Province, which cover 8.8% of the provincial territory [16]. Among these reserves, Xishuangbanna National Nature Reserve was established in 1958 which is one of the earliest established nature reserves in Yunnan. It lies in the counties of Jinghong, Mengla, Menghai, south of Yunnan, and covers a total area of 241,776 hectares among which forests cover an area of 197,800 hectares and accounts for 81.8% of the total land of the reserve. However, only 7000 hectares in the 197,800 hectares forest area is natural virgin forests which has never been destroyed by human beings and human activities and accounts for just 2.9% of the total land of the reserve [17]. In 1993, Xishuangbanna was accepted by UNESCO as a member of the International Man and Biosphere Reserve Network. With the promotion of GMS Biodiversity Conservation Corridors Initiative, Xishuangbanna National Nature Reserve, including Menyang, Mangao, Menglun, Mengla, and Shangyong - which are fragmented due to the development of large-scale rubber plantations, has been selected to create a united and unique formation of tropical and subtropical forest extending from Yunnan Province down to the border of Lao PDR through a series of corridors [18].

The main GMS BCI targets for environmental protection in Xishuangbanna is the tropical forest ecosystem, including marvelous virgin forests, tropical rainforests and monsoon rainforests, as well as precious flora and fauna. Although Xishuangbanna covers only 0.2% of the territory of China, the abundant flora there comprises more than 3890 identified species of higher plants and seed plants. Among these plants, 57 species are rare and endangered plant species. In addition, there are over 800 species of medicinal plants and other plants with special use. The reserve is also a home of 429 species of birds, 37 species of amphibians, 68 species of reptiles and 100 species of fish, among which 114 species are rare and endangered animal species.

Xishuangbanna's total population is 840000, and there are 13 ethnic minorities live in this area. Pursuant to the Regulations of the People's Republic of China on Natural Reserves, people are not allowed to inhabit, log, hunt, fish, travel, clear land, mine, or quarry in the core zone of nature reserve. Limited livestock grazing and

non-timber products collection such as medicine collection are allowed in buffer zone. Therefore, local people living in and near the nature reserves are not supposed to get means of livelihoods directly from the reserves. Nevertheless, because of poverty and lack of education, people still commit illegal hunting for food and trading, unlawfully felling, and irrational land clearing for farming and cultivating. As a result, the nature reserves have still been gradually destroyed; people who have been caught of ruining nature reserve may be fined or penalized, and these punishments may cause the poverty situation even worse. What's more, because the nature reserves usually have been created after people's settlement in relevant areas, it is not easy to find a proper strategy of management both realizing the final and complete purpose of establishing nature reserves and improving local people's life quality. One of the commonly used modern strategies in biodiversity conservation management is to migrate and resettle people from protected areas. However this strategy may bring about new ethical problems and economic pressures.

With the human society's development, conflicts have arisen in nature reserve and biodiversity conservation management between wildlife and adjacent communities. One of the conflicts is damage to crops, housing, and even people's lives done by wild animals particularly elephants, bears, and monkeys. According to results with statistics gathered by the Forestry Administration of Xishuangbanna, in 2005 there were 578 villages and 12037 households' crops, sugarcanes, banana plants, and non-timber trees have been eaten or destroyed by wild animals, which has caused direct economic losses of 21,740,000 Yuan. Moreover, twenty people were attacked by wild animals and three of them died. The Law of the People's Republic of China on the Protection of Wildlife provides that local government shall compensate people for the damage done to crops by wild animals. Basing on this provision, the provincial government of Yunnan issued Compensation Rules for the Damage to People and Their Property by Protected Terrestrial Wild Animals in 1998. According to the Compensation Rules, provincial government of Yunnan will provide half of the compensation funds and prefecture and county governments are supposed to finance the other half funds. However, because prefecture and county governments have difficulties in providing money for compensation funds and because of various other reasons, the actual compensation for damage caused by wild animals to sufferers is very low. In 2004, for one kilogram corns, people living adjoining to the reserves could be compensated 0.05-0.08 Yuan while the market price was 1.2-1.4 Yuan per kg; the average compensation fee for a farm cattle was only 70 Yuan; and there would be no compensation for personal injury [19]. This situation has not been ameliorated in recent years, and in other places adjacent to nature reserves in Yunnan Province along the Lancang-Mekong River Basin, the exact compensation fee is the same as Xishuangbanna or even lower.

Benefits-Duties Approaches to Biodiversity Conservation

As discussed, to simply migrate people from nature reserves; forbid them to adversely impact protected areas by punishments; or compensate them once damage done by animals happen could not fully accomplish the ultimate purpose of biodiversity conservation in the subregion and may cause ethical, social, and economic problems. Therefore, we need to find new strategies to help community members change their behaviors from negatively impacting the biodiversity conservation to conserving it. One possibility for this is to establish a benefits-duties model for community members.

To build such a benefits-duties model, emphasis should be placed on both providing benefits that local people may gain from participating in biodiversity conservation and notifying people of their duties and responsibilities to environmental protection and natural resources management. One of the major concerns for this model is whether there is a stable and long-term management system for relevant local people and local communities to create and gain moderate benefits that they may appreciate and as a result solid support from the communities may be given to the government on biodiversity conservation. Here, benefits refer to not only economic incentives but also other forms of profits such as employing local people; creating and providing steady jobs relating to biodiversity conservation; supplying people with better strain crop seeds while teaching them scientific planting methods to raise production; and helping people to install energy saving facilities such as solar energy water heaters to control natural resources consumption. Economic incentives can have an impact when income is relatively high and where income accrues directly to local residents at household level. However, where the financial benefits are small, income generating jobs are relatively few and little opportunity exists to exert any influence over the use of wildlife resources, people continue to consume and trade wildlife illegally [20].

When we create a benefit-sharing model for relevant local people and local communities, we shall also establish a link between the benefit transfers and the biodiversity conservation objectives. Without such linkages, people may fail to understand and realize the purpose of biodiversity conservation behind the benefits they achieve [21]. Thus, the local people should be informed of their responsibilities, duties, and obligations to nature reserves and biodiversity conservation. As people are social actors of biodiversity conservation, differentiation needs to be made with regards to what role each community involved should play in effecting nature reserves and participating in conservation. Consequently, the roles of all stakeholders involved should clearly define duties and responsibilities. On the one hand, local people and local communities are supposed to be part of biodiversity conservation programs, and to manage and be responsible for biodiversity conservation affairs according to their different knowledge towards relevant nature reserves. On the other hand, systematic and consistent legitimacy of

national statutes and legislations as well as local regulations and commands should be constructed both to ordain sanctions and prescribe rights of local people.

4. CONCLUSION

Increasingly, global and regional biodiversity conservation relies on a network of nature reserves and international protected areas which provide basic and essential living conditions necessary for the species' survival. In the human context, the analysis of feasibility of conserving biodiversity and assessment of impediments and threats to biodiversity conservation in the Greater Mekong Subregion help to find strategies to achieve the final targets of the ten year plan of GMS Biodiversity Conservation Corridor Initiative and other natural resources management programs.

It is not an easy task to conserve biological diversity and restore habitats within limited time and areas. With the rapid growth of world's human population and speedy consumption of natural resources, biological diversity will continue to decline and species will continue to be extinct if there is no effective and rational management and reserving structure that considers both conservation purpose and relevant human environment. In the Greater Mekong Subregion, as most people are smallholder population and as the annual income of many local communities are still below poverty line, more intensive research both nationally and internationally should be done to study systematical measures and techniques to realize protection of rare species and sustainable development.

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