A survey on the local community willingness to participate in the cooperative management of nature reserve: A case of Snake Island-Laotie Mountain National Nature Reserve, China

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Abstract. This paper investigated local resident and enterprise participation willingness in the management of Snake Island-Laotie Mountain National Nature Reserve (SILMNNR). The questionnaire is designed through examining local resident needs, and their behaviour, and knowledge of SILMNNR, and the willingness to participate (WTP) in the nature reserve management and its influencing factors. It is concluded that: a) the level of local community’s knowledge on SILMNNR is lower; b) increase of social progress and local resident income leads to plenty of environmental price, then, economic development becomes one of the factors effecting ecological deterioration; c) local residents would not be involved in the reserve management until their needs of ‘‘health’’, ‘‘safety’’, ‘‘housing’’ and ‘‘food and clothing’’ are satisfied; d) local resident and enterprise administrators’ attitude on ecological conservation are positive, but currently their level of environmental behaviour and the participation willingness is still low; e) main factors of influencing local groups’ WTP in the cooperative management are resident education, age, sex, and enterprise annual net income. Therefore, through understanding their needs and factors affecting their WTP, local community’s capability and level of participating in nature reserve cooperative management could be improved.

1. Introduction

Chinese policies strictly restrict exploiting and utilizing natural resources in nature reserves, therefore they neglected local community’s development needs for a long time [1] from China’s first nature reserve establishing in 1956. Nevertheless, most Chinese nature reserves locate in rural villages, where local resident income is lower [2], and their daily lives depend on the reserve natural resources to a large extent. When local community or individual explored or utilized natural resources excessively, there would be some increasing pressures to ecosystem service function in nature reserve. Hence, the relationship between nature reserve and local community became intense, and conflicts arose among them continuously along with it.

Researchers focused on protecting natural resources through changing law enforcement into cooperative policies [3], and specifically implementing community-based management to satisfy local resident needs for relieving the conflicts between protection and development [4-5]. Venter A. K. argued that nature reserves should establish forum framework and management institution for reserve planning, implementing and project assessment [3]. Tracey Morin Dalton provided the framework of
natural resource management being composed of factors that influence the success of participatory processes [6]. Mason Douglas concluded the best working conditions of co-administration [7]. Young Juliette C.’s findings emphasize the need to evaluate multi-level conservation efforts in terms of processes, social outcomes and biodiversity outcomes [8]. Moorman Michelle C. found that stakeholders believed an adaptive co-management model could improve conservation efforts [9]. Zhuge et al [10] and Zhang et al [11] also realized co-management can be hard to proceed if local government do not participate or oppose it with any reason.

However, there are many problems on local community participating in the cooperative management of nature reserve in China, which can hardly make a substantial progress. Ren Zhuge et al considered community-based management in China is passive, and lack of an incentive mechanism for guiding the public to be involved in the co-management consciously [10], Yang Su argued that the weak capacity of co-management organizations, and lack of investment, both limit their effectiveness [12]. Liu found the Chinese recent community-based management is centralized, and community and residents cannot acquire equal rights, and non-governmental organization and community participation capacity do not get enough attentions as well [13]. Zhang [14] and Shen et al [15] thought unsuitable management institutions, and unclear ownership of natural resources, and unreasonable fund sources and lack of sharing cost and benefit mechanism also contribute to limit the effectiveness of co-management in practice.

Because nature reserve management and community-based management are both influenced by local groups’ attitude, behaviour and interests [16-18], it’s necessary to understand groups that affect government decisions and actions, and affected by them [19]. Recent studies indicated that the level of resident participating in nature reserve management is low [20-21], Yan Zhang believed that the most important variable of influencing community involving in the management is participation chance [20]. Meng considered the main factors affecting the level of community-based management are family income, economic loss resulted by wild animals and birds, and whether gaining compensation from it or not [21]. Another investigation revealed that the effect of nature reserve co-management presented a decreased tendency from national to provincial, and to municipal, and to county scale [22]. Natural and socioeconomic status in different countries and areas are not the same, neither are the states, problems, and reasons of participating in management concluded by research. Then, experiences from one community-based management would be hard to be applied to others. Consequently, researchers should seek and understand the specific factors that affect local community participating in nature reserve management.

This survey investigated local community’s WTP in SILMNNR’s management and its influencing factors, which would be good for knowing and relieving the conflicts between local socioeconomic development and the reserve management. Satisfying local community basic needs and strengthening SILMNNR’s co-management capability are of great importance to the reserve sustainability as well.

2. Methodology

2.1. Study site

SILMNNR was established in 1980, locating in the west of Lvhunkou district in Dalian City, Liaoning Province. It composes Snake Island and Laotie Mountain with the total area of about 9.1×10⁷ km². Snake Island is the only habitat of Gloyysiu Shedaoensis Zhao (GSZ, 1979 [23]) in the world, which is a type of viper with the population quantity of 2×10⁴ at present (figure 1). While Laotie Mountain is the main migration passage for wild birds in northeast Asia, it had recorded 340 wild bird species in SILMNNR till 2014, including 9 species of first-class national protected birds, and 49 species of second-class national protected birds. Besides, vegetation coverage rate is over 70% in Snake Island, and about 35% in Laotie Mountain. Thus, SILMNNR provides important function in the natural resource management and ecosystem protection. However, its total area and functional zones were modified three times in 2003, 2005, and 2010 respectively for satisfying local community’s utilization. In addition, some residents’ illegal hunting seriously threatens the population of the
migratory birds.

![The map of SILMNNR](image)

**Figure 1.** Location of SILMNNR, Liaoning, China.

This article investigated local groups’ behaviour and participation willingness in SILMNNR, included local resident needs, local resident and enterprises’ behaviour and their influencing factors, and knowledge about SILMNNR, and participation willingness and its influencing factors so that it can conclude the level of local community participating in the reserve management.

### 2.2. Study design

The survey was conducted to investigate residents in three villages in the reserve at random, including Zhangjia village and Chenjia village which are both in Tieshan Street, and Shantou village in Shuangdao Bay Street. Moreover, all the enterprises in the reserve were interviewed and questioned from March to April in 2011. Pre-survey was made to talk to selected residents, and then some questions and answers were modified based on the specific feedbacks before issuing the formal questionnaires. Besides, most respondent residents and enterprise administrators answering the questionnaires live or locate in the buffer zones and the experimental zones, while few in the core zone of the reserve. Hence, the total number of valid samples that received is 105, included 83 resident respondents, and 22 of all enterprise respondents.

### 3. Results

#### 3.1. Local resident cognition of natural resource change
Local resident cognition was investigated on the change of immigrtatory birds’ population, state of vegetation cover, sea water quality, soil quality, air quality and living conditions during the past ten years (figure 2). 37.3% of respondents accounting for the valid resident samples believed the immigrtatory birds’ population decreased, which was consistent with the real situation. Whereas 22.9% of respondents believed the immigrtatory birds’ population increased, which indicated part of the residents did not know its change. 64% and 59% of respondents believed sea water quality and soil quality became worse respectively, while 62.7% of respondents chose the answer of vegetation cover becoming better, which did not accord with the land exploited increasingly and the reserve land deceased in practice. That may be related with the respondent vague cognition on the reserve’s boundary. Besides, 63.9% of respondents chose the answer of living quality becoming better, which was the same with the real status.

**Figure 2.** Local resident cognition of natural resources change.

**Figure 3.** Comparison of the commonly used energy between local residents and enterprises.

3.2. Local community’s environmental behaviour

This survey investigated local community’s environmental behaviour mainly on the types of energy use and waste disposal. The types of energy that local resident commonly use in daily life are wood, coal, electricity, gas and petroleum products, and the most used energy are coal and wood, which are both high polluted and low efficient energy, respectively accounting for 24.7% and 32.9% of the valid samples. Respondent residents who use high efficient and low polluted energy, such as electricity, gas and petroleum products account for small percent. However, the energy that local enterprises mainly use is electricity, which accounts for 72.7%, but some enterprises usually use coal and wood (figure 3).

As for the waste disposal, 73% of respondents (including residents and enterprises) deal with the waste by themselves. 91.3% of respondents’ toilets are pit privy, including 50% of it without flushing and 41.3% of it with flushing. While 88.8% of respondents fermented their toilet waste into biogas for energy, which recycled much of the waste, but storing it in a traditional way could be a hidden danger to rural people’s health and their residences’ safety.

3.3. Local resident needs

It designed eight needs of “health”, “environmental protection (EP)”, “education”, “safety”, “food and clothing”, “housing”, “tourism”, “transportation” to understand the importance level of resident need items, and defined the grade from 1 to 5 levels. The mean values of the needs show the highest one is “health”, which equals to 4.72, and the fifth one is “EP”, which equals to 4.33, and the last one is tourism, which equals to 3.43 (figure 4). These results indicate the precondition of the residents participating in nature reserve management is to satisfy the needs of “health”, “safety”, “housing” and “food and clothing”.

![Figure 2. Local resident cognition of natural resources change.](image1)

![Figure 3. Comparison of the commonly used energy between local residents and enterprises.](image2)
3.4. Knowledge on SILMNNR

To investigate the knowledge of local community on SILMNNR, five questions were designed and then scores were analysed. The results show that 14.3% of respondents haven’t heard of SILMNNR, while 61.9% of respondents know protected species clearly. 56.7% of respondents know Snake Island is the only habitat of GSZ in the world, but 47.6% of respondents don’t know the types of immigratory birds completely and only 9% of respondents know more than one species of immigratory birds. As for different groups’ mean score, even though enterprise administrators’ is 3.16, higher than the residents’, which is 3.07, but it still indicates both two groups’ knowledge on SILMNNR is lower.

3.5. Level of local community participating in SILMNNR’s management

To investigate local group relationships with SILMNNR, present participation behaviour and WTP in the management of SILMNNR in the future are considered. For the first aspect, 77.5% of respondents started to live or opened their enterprises in the reserve before 1980, the year SILMNNR established, while the respondents chose the option of coming in to the reserve after 1980 are all enterprise’s administrators. Moreover, 18.2% enterprise respondents run their enterprises before 1980, and 50% of them opened their enterprises from 2001 to 2010. These indicate that most respondent residents live in SILMNNR before 1980, and new enterprises were involved in the reserve with the socioeconomic development. More importantly, they produce farm and industrial products, and provide service depending on the reserve resources, so they have a strong relationship with SILMNNR. However, 36.5% of respondents do not know they are in the reserve, and only 24.3% respondents clearly know the functional zone that they are in, which manifest that local community’s acknowledgement of SILMNNR’s boundary and functional zones is vague.

Besides, investigation is made on the attitude toward birds hunting and times of participating in the management to understand local community’s participation behaviour. 70.7% of respondents do not support hunting wild birds firmly, which show most respondents’ attitude on protecting wild birds is positive. 87.3% of respondents express that there were wildlife protection actions occasionally and usually in their villages, but 80.2% of respondents did not participate in them. These indicate the level of local community’s participant behaviour is lower, and it may be because the environmental protection activities are unattractive.

With respect to the last and the most important aspect, 16.9% of respondents are not willing to participate in the management, and 14.9% respondents think it has nothing to do with them; while 40.6% respondents express they are willing to do it in mind but will not do it in reality because of limited time. 40.6% of respondents are willing to do it depending on how much they can get from it, and 18.8% respondents are willing to participate in it without any compensation.

4. Factors influencing the WTP in the cooperative management

For further discussing factors influencing local communities’ WTP in the cooperative management, correlation analysis and regression analysis are done by using resident need of “EP” and community

![Figure 4. Mean value of local resident needs.](image-url)
WTP in the cooperative management with respondent characteristics.

4.1. Factors influencing resident WTP

For the first time, correlation analysis is done through using resident education level and “EP” need, and Pearson Correlation Coefficient is 0.323” at 0.01 significant level, which indicates resident education level is positively correlated with “EP” need. That is the higher level of resident education is, the more they concerned with “EP” need. Therefore, upgrading the level of resident education can heighten their concern with “EP”, and elevate their level of participation in the management.

Next, correlation analysis is conducted through using age groups and their mean value of “EP” need, and Pearson Correlation Coefficient is -0.913** at 0.01 significant level. Then, regression analysis is made by using respondent age as independent variable with their mean value of “EP” need, and the goodness-of-fit is 0.834, and F value is 15.096 at 0.03 significant level. Regression equation is showed as figure 5, which displays when resident age reduces 1%, the mean value of “EP” need would increase 0.171. Then, the mean level for “EP” need for older residents is lower.

![Figure 5. Regression analysis on age groups and their mean value of “EP” need.](image)

In addition, the mean value of female’s “EP” need and mean value of WTP in the cooperative management are both 3.52, furthermore, are both higher than male’s values. These results manifest females would pay more attention to and participate in “EP” actions.

4.2. Factor influencing enterprise administrators’ WTP

Correlation analysis is made through using enterprise annual net income and their WTP in the cooperative management. Pearson Correlation Coefficient is 0.428” at 0.05 significant level, which shows enterprise annual net income is positively correlated with their WTP in the cooperative management. That is enterprises with higher annual net income would be more willing to participate in and support the reserve co-management.

After the third time modification, Liaoning SILMNNR Authority (LSILMNNRA) have prohibited opening new enterprises and closed heavy polluters. However, the ownership of the reserve land belongs to the community, so former enterprises are still opened. Hence, cooperating higher income enterprises in the reserve management can decrease their destruction on natural resources.

5. Discussion

The main respondent residents of investigating local community’s WTP in SILMNNR’s cooperative management are 50-60 aged, education level of middle school farmer with annual net income below 10 × 10^4 RMB (≈1.5 × 10^4 USD). While the main respondent enterprise administrators are local investors from Lvshunkou district working on mechanical processing industry with annual net income below 50 × 10^4 RMB (≈7.6 × 10^4 USD). These were mainly because a great many of rural residents
leaving their home for large cities to find more job opportunities with higher income. Consequently, the remaining of the residents largely are older with low level of education and income farmers. In addition, although some established enterprises are hard to be removed to outside the reserve, opening new enterprises are prohibited completely. Therefore, main enterprises in SILMNNR are located from 1981 to 2000 with lower income.

While most respondents know about SILMNNR’s protected species, but their knowledge is vague and some of them do not know at all. On one hand, this reflects most respondents do not care about wildlife, and LSILMNNRA should strengthen their work to let more people understand wildlife protection. On the other, lacking boundary monument also confused local community’s knowledge.

Recently, local community’s living and producing in SILMNNR have led to great social changes and more income, which largely based on natural resources’ deterioration, because most respondents in total valid samples believe the population of migratory birds, and water and soil quality decreased, and their life quality became better. Besides, the types of local resident common used energy are wood and coal, which are cheap, high polluted and low efficient, but easy to get. Local enterprises use electricity the most, but small scaled and less competitive enterprises also usually use wood and coal in production. Nevertheless, both these two groups’ levels of environmental behaviour are lower.

Economic condition is one of the main factors resulting to ecosystem deterioration in local community utilizing natural resources. For example, the wood they use are easily obtainable around the villages without purchasing. Coal is a lower price energy too. Therefore, using low efficient and high polluted energy is dictated by economic condition. Meanwhile, local community’s way of recycling waste also embodied considering for saving their costs off. Hence, improving their environmental behaviour should be in the premise of enhancing their economic capability.

Local resident most important need is “health”, followed by “safety”, “housing” and “food and clothing”. The fifth one is “EP”, and “education” and “transportation” afterwards, and the last one is “tourism”. The rank of these needs showed their level of importance. That is the toper needs are more important ones, or they have not satisfied yet. Then, nature reserve’s cooperative management should build on the basis of meeting or not degrading their needs of “health”, “safety”, “housing” and “food and clothing”.

Most respondents’ attitude on protecting wild lives is positive, but their present participation behaviour and the level of WTP are lower. Major respondents are opposed to butting birds firmly and know it’s illegal, but their level of WTP for free are lower. That can be explained through the reason that the needs of “health”, “safety”, “housing” and “food and clothing” still have not be satisfied. As a result, taking the advantages of local community’s knowledge and involving some of the residents and enterprises to profitable cooperative management will increase their income gradually, and satisfy their basic needs so that it can heighten the capability and effect of the co-management project.

The factors influencing community participation in the reserve management are resident education level, age, sex, and enterprises’ annual net income. They are that residents with higher education level would be more concerned with “EP”, and younger residents are also paying more attention to “EP”. Moreover, female’s attitude to environmental importance and WTP are better than male’s, and enterprises’ WTP with higher annual net income are better. Thus, higher educational young female would be easy to understand new ideas and comprehend the significance of ecological protection, and then participate in the reserve management first. In addition, encouraging enterprises to provide environmental friendly services and products would also make the cooperative management a great deal of progress.

6. Conclusion
This article investigated local community’s level of WTP in the cooperative management in SILMNNR. It concludes that the main groups of local residents are older, and lower educated and family income farmers, and lower income and small size enterprises; residents and administrators of
enterprises know not much about SILMNNR’s protected birds and snake; social progress and economic development paid the environmental price during the past ten years; weak economic capability is one of the reasons resulting to ecosystem deterioration; the premise of participating in the reserve cooperative management is to ensure resident “health”, “safety”, “housing” and “food and clothing” needs; resident and enterprise administrators’ attitude on wildlife protection is positive, but their present and future level of participant behaviour is lower; main factors of influencing community level of WTP in the cooperative management are education level, age, gender, and enterprises’ annual net income. Therefore, enhancing local resident and enterprises’ knowledge on nature reserve, and improving their income, and satisfying resident needs, and fully considering their WTP’s influencing factors can all heighten the level of WTP. These findings also can help to establish the reserve cooperative management forum based on decision-making between participant negotiation, which should define their responsibility and functions, and benefit sharing. Conversely, utilizing this forum can provide local resident and enterprise administrators’ knowledge and technology training on agricultural production, and ecological protection, and enterprise cleaner production and pollution control. It also can help local communities to set up rational awareness of using and protecting natural resources, and reduce dependency on them, and can partly resolve the problem of inadequate staff of the authority. Consequently, understanding local community’s level of WTP and its influencing factors is good for relieving the conflicts between socioeconomic development and natural resource protection, and improving the mechanism of local community participating in the reserve cooperative management, and finally achieving sustainable development of nature reserve.

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