

Community development policy to secure local energy requirement and global environment with application of mini-hydro power project at hilly and mountainous areas in Japan

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Abstract

After serious disaster of TEPCO's Fukushima No. 1 nuclear power plant, new energy policy of Japan tries to decrease the dependence on nuclear power.

The national energy policy with a law has just come into force in 1st July 2012 that requires electricity companies to buy new energy sources at feasible tariff of 20-49 Yen/kWh from the small private producers in local grid. The new national energy and environment policy supports the drastic shift of energy source from nuclear to any other optional new clean energy source including the mini-hydropower.

The aim of this study is to elaborate the new community development policy scenarios by evaluating the viability of mini-hydropower project at small community in hilly and mountainous areas including the case of Social Capital (SC) study on the Shiraito district at Fukuoka in Japan.

Key words: *Community, Social Capital (SC), Commons, Natural resources, Hydropower*

Introduction

About three-quarters of Japan's land area is mountainous or hilly and two-thirds is covered with forest. The country's forest coverage rate of 66.4% is one of the highest in the world. Average annual rainfall of Japan amounts to 1,718mm which is two times higher than the world average of 880mm. Japan has a great deal of variety in its geological and topographical features with considerable volcanic activities.

Mountain ranges that run nearly the full length of the country and rise to as high as 3,000 meters give the Pacific and Sea of Japan sides of Japan vastly different

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climatic patterns.

The theoretical hydropower potential is conceived to be high owing to mountainous topography and rich rainfall with a fear of influence from global climatic change. The amount of average annual rainfall in Japanese island has been slightly dropping in the past of 100 years. While the average annual air temperature in the western part of Japan is rising since 1980s owing to the influence of global warming on the black ocean current. The potential river flow in the small catchment tributaries had not been developed for the local community in the hilly and mountainous areas due to the vulnerability problems including the economic and financial handicaps.

Many local communities are distributed in the hilly and mountainous regions with ground elevation between 100 to 500 m above sea level. The government shall take specific actions for the fulfillment of multifunctional role in hilly and mountainous areas, by providing support to compensate disadvantages in agricultural production conditions. Mini-hydropower is conceived to support the sustainable development of vulnerable community by enhancing the local economy.

This study tries to propose the options for problem solutions of (i) regenerating the vulnerable local community and (ii) shifting to the sustainable low carbon society by introducing the micro-hydropower project in the hilly and mountainous area, simultaneously. The two concepts of “Commons” and “Social Capital (SC)” are combined to analyze the two problems. The commons is a general term for shared resources in which each stakeholder has an equal-interest. Social Capital (SC) is such as trust, norms or reciprocity, and networks of civil engagement, that can improve the efficiency of society by facilitating coordinated actions with investment.

The study area

The Shiraito community is located in the uppermost area of the Mogami river basin with catchment area of 1.55km² at elevation of 530m (Figure.1). Geology of the watershed is uniform with granitic diorite. Water fall with name of Shiraito (white strings) is a symbol of the community with 140,000 visitors per annum to enjoy the landscape with clean perennial flow from the granitic rocks. The community has 32 households to enjoy the ideal county life with beautiful nature. The disadvantage is topography for the agriculture with limited flat land.

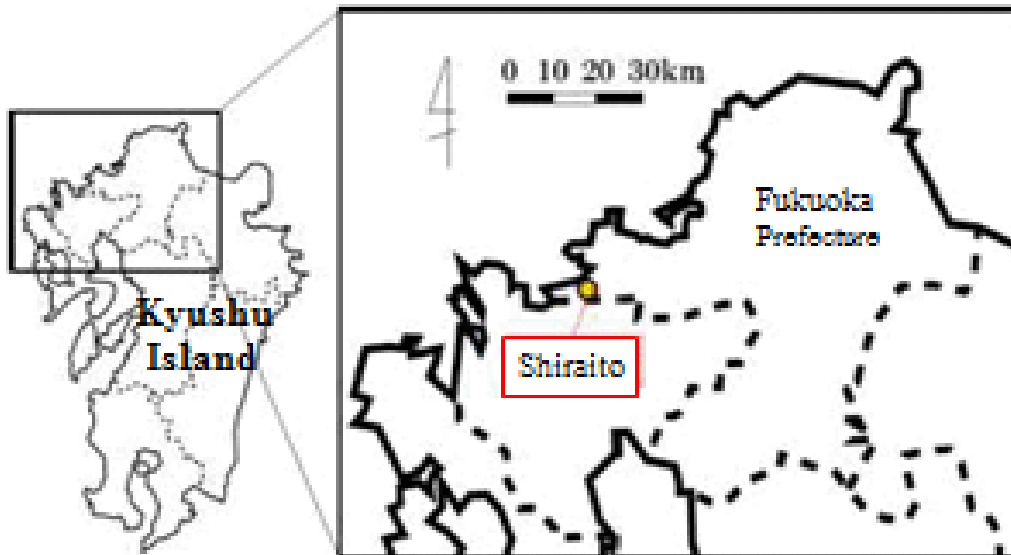


Figure 1 Location map of the study area

Mini-hydropower development

Hydropower potential is dependent on the amount of flow discharge (Q) and differential head of water (h). The base flow in the catchment is estimated to be two times as high as the average flow in Japan. The theoretical hydropower potential is 71.8kW to develop 0.08m³/s of the base flow and 133m of the differential head of water, which equivalent to 629,000kwh of electricity per annum. The hydropower could cover 189,000kwh of consumption in the community to sell 440,000kwh of the surplus power in the project.

The hydro-electricity will be sold to Kyushu Electric Power Company and provided to individual homes at feasible tariff to apply the Feed-in tariff (FIT) of renewable energy (selling at 30 Yen/kwh, buying at 20 Yen/kwh in July 1st 2012). The net benefit of the surplus electricity is estimated to be 13.2x10⁶ Yen per year, of which the surplus will be invested to maintain the system including the sustainable conservation of the deep forest in the catchment. The decision of either sharing the benefit equally or investing for the next generation is dependent on the policy of the stakeholders of Shiraito community. A series of field social survey was carried out to measure the local intentions about the sharing resources and benefits by taking into account of the next generation and nature conservation and /or restoration.

Methodology of social capital (SC) study on the local community

The Social Capital (SC) survey was carried out by two steps to confirm the local intentions of the people living in the Shiraito community. The first step is interview survey with questionnaire for the head of Shiraito district and the ex-representative of Itoshima city to confirm the commons. The city government is land owner of the Shiraito fall zone to provide the appropriation for the district. The Shiraito community is authorized to manage the touristic facilities with beneficial 140,000 visitors per annum. The second step is SC survey by direct interview with questionnaire to select 12 families in the 32 households in the community. The households were selected to take into account the sex ratio, size with children, elderly person, housemate, spouse, education level, job opportunity, income level, owned-lent house.

This study assumes the Social Capital Index (SCI) with range between 0 and 1(0=minimum, 0.5=average, 1=maximum) to quantify the efficiency of social relation capital with infrastructure investment in the local community

Evaluation of the social capital and SCI

According to the general administrative agency of the cabinet, the Social Capital (SC) of the urban is likely higher than the local to cover the indices of “education level”, “children”, “income”, and “job opportunity”. The people of Shiraito community do not feel poor even less job opportunity with lower income level. The SC in the local community in Kyushu area, where people enjoy the good climate with nature and social-human relation, has some correlations with happiness index.

The Social Capital Index (SIC) of each element is evaluated as shown below:

- 1) Sex ratio: SCI=0.7 (Men:67%, Women:33%)
- 2) Residence Period: SCI=0.62 (Year of staying in Shiraito: Men:56.5, Women:44.8)
- 3) Ratio of owned house: SCI=1.0 (100% of owned)
- 4) Spouse: SCI=0.75 (Ratio of married)
- 5) Age: SCI=0.75 (45-59 years→very few social relationship with community)
- 6) Employment: SCI=0.75 (Permanent:1.0, Part-time:0.75, Pension:0.5, Unemployed:0)
- 7) Education: SCI=0.71 (University, College, High school, Middle school, non-illiteracy)
- 8) Housemate: SCI=1.0
- 9) Income: SCI=0.83 (Enough-middle, not enough, zero)

10) Children: SCI=0.16 (Ratio of average of Japanese)

The synthesis SCI is estimated to be 0.74, which is higher than the standard average of 0.5, suggesting the opportunity of restoring the societal capacity of the local community in hilly and mountainous region in south western part of Japan (Figure.2).

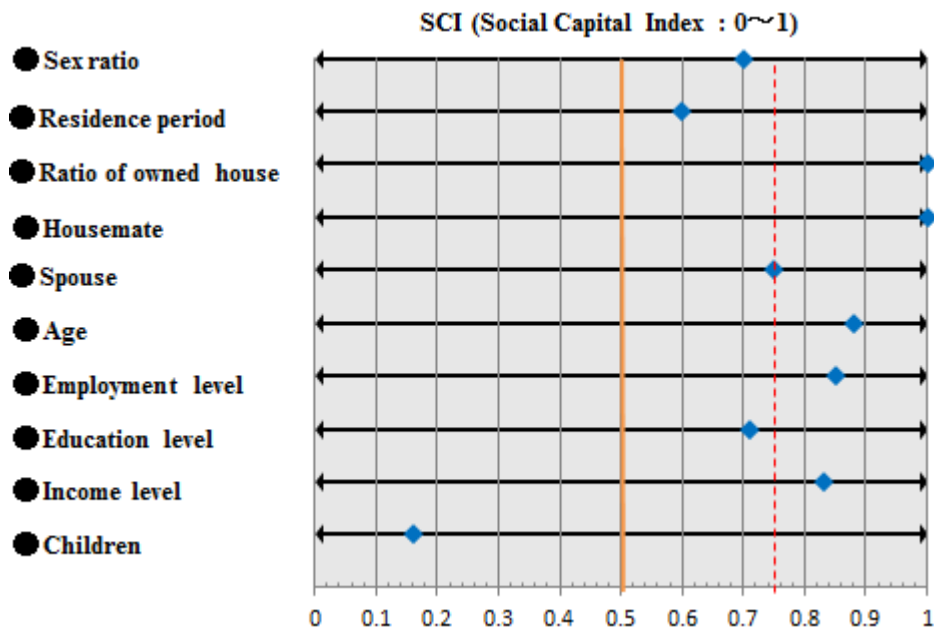


Figure 2 Evaluation of Social Capital Index (SCI) of Shiraito community

Conclusion

This study on the Social Capital (SC) evaluates the opportunity of improving the life standard in the community development to secure the human security. Quantitative SC of the Shiraito community is estimated to be high, suggesting the viability of investing mini-hydro project with high Benefit/Cost (B/C) ratio. The Shiraito is a pioneer model development project to either rehabilitate or regenerate the vulnerable local community in hilly and mountainous region in Japan. The State shall take specific measures to compensate disadvantages in agricultural production in hilly and mountainous areas in Japan, taking into account of the viability of mini-hydro development project. This SC study will be extended to the case of Kochi prefecture with highest annual rainfall of 2,700mm and 84% coverage of deep forest in Japan. It is confirmed that the commons with social tie is the most important element to collaborate the three different stake holder groups such as 1) Shiraito district, 2) Itoshima city and 3) Kyushu university.

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