Title: Socio-economic development of local community through SHP development: A case study of Oohito 50kW SHP in Hinokage town, Miyazaki prefecture (Japan)

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Abstract:

The paper aimed to discuss with the socio-economic development of local community by utilizing local resources to develop small hydropower (SHP). In a case of introducing SHP development, the paper intended to the community solution which local people concerns things, for example maintenance the water channel, depopulated and aging community, migration of young population and so on. In this case study, the local resident became an owner of their SHP, it creates jobs, allow young people to stay at the village. The paper has described a socio-economic case study of an Oohito 50 kW hydropower plant installed in the Miyazaki prefecture, Japan. This plant was installed via crowdfunding in local community. After the installation of the plant, the local community became the owner and they do all the maintenance required. Installation of this kind of project not only benefit the local community but also it is supports to the local government to achieve the sustainable development goals.

Keywords: Community development, SHP, crowdfunding, FIT, Japan

Introduction:

In Japan, SHP is considered a reliable and sustainable source of electricity, which resulted in its development and adoption whenever there is an adequate quantity of unused flowing water at the local level. Moreover, in recent years the Japanese Government has simplified the water rights application system, whilst also setting targets to initiate thousands of SHP projects across the country.

Overall, Japan has an abundance of small streams particularly in mountainous regions and in the past many small channels have being created for irrigation purposes. Some of these irrigation channels continue to be used today. Others, though in good condition, remain unused. Increasingly these channels have been utilized to produce SHP electricity to promote community development. This is particularly important for rural Japan, which has suffered from rapid depopulation due to a combination of an aging population and urban migration[1].

On the same concept, a 50 kW Oohito micro hydro power plant in Hinokage town, Miyazaki prefecture of Japan was built on an existing irrigation channel. The water of this channel is used for irrigation purpose especially for rice field and extra water is used to produce electricity. The plant started running in November 2017 and in the present time it produces 49 kW without any major hurdle[4].

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Community development through SHP installation:

There are a number of municipalities / villages becoming depopulated villages due to the migration of young people. By installing small hydroelectric power plants, Local residents will become business owners, it creates own jobs independently, and allow young people to remain at home. It is not a thing called small hydropower generation that is proposed, but it is a process with an eye on regenerating depopulated communities.

The installation of this kind of projects intend solution of local problems by utilization of local resources. It aims to build a better relationship between urban consumers and energy production areas[5].

In Japan, the concept of community development by SHP installation is new, but it is in trend. Many prefectures of Japan have already installed many micro hydro projects for the local community to reduce migration and to protect the old rich culture of the respective communities[2]. The part of total investment cost comes via crowd funding by the local resident and rest is given by bank or financial cooperation agency on cheaper interest rates.

After payback period of the loan, the money received by selling electricity is utilized to support the local culture, festival, education purposes and other useful work.

A Case study of 50 kW Oohito SHP:

This plant is located at Iwaikawa Pond, Hinokage town, Miyazaki prefecture of Japan. The water for hydroelectric generation is diverted from an existing irrigation channel by making a small weir in the middle length of the channel as shown in figure1. Diverted water first stored in Forebay tank then it is carried out to the powerhouse through penstock pipe. After passing the turbine the water mixes to nearby Iwaikawa pond.

Table 1: Technical Details of the 50 kW Oohito SHP project

Site condition and other parameters of the SHP:
Effective head – 85 m
Design discharge – 0.12 m^3/sec
Turbine – Cross-flow T15 (D300, B100) from Asosiasi Hidro Bandung (Indonesia)
Efficiency of turbine – 76%
Type of generator – IPM generator from Yasukawa Electronics (Fukuoka, Japan)
Generator spec – 1,150 rpm, 55 kW
Generator + GD + DC efficiency = ~94/95/95%
Mechanical & electrical design concept (Fig. 1) – Nakayama Iron Works Co. Ltd (Japan)
Civil Engineering, consultant and owner – Local company (Japan)

Table2: Oohito MHPP energy generation and income

Items	Values	Remarks
Turbine output	60 kW	T-15 Cross-flow
Total output	49.9 kW	
Electricity generation per year	320 MWh	Estimated
Total investment	JPY 95 million (US$ 880,000)	Approximate
FIT	34 JPY/kWh (US$ 0.34/kWh)	1JPY=0.1USD
Expected income per year	JPY 7.3 million (US$ 67,500)	Roughly
Present output	48 kW	

Figure 1: Irrigation channel/Intake/Forebay tank

Figure1 show the irrigation channel from where the water has been diverted. The total length of this channel is 10 km. At the middle of this channel (approx. 5km). A small desilting tank with a Tyrolean type intake weir has been made. The water first stored in forebay tank as shown in figure1 by blue arrow. Since the first priority is given to irrigation. The rest water is utilized to produce electricity and so, the amount of discharge changes throughout the season according to water requirements for the crops.

Figure 2 show the powerhouse. The pipe in black is a penstock pipe which is used to carry water from the intake to the power house. On the right side of the power house a turbine, generator and control panel have been shown which is installed in the power house. The generated electricity is sell to the grid line infront of the power house.

Figure 2: Power house

Economic analysis of a small hydropower plant with reference to Oohito SHP:

The inflow of the money:

The total direct investment of Oohito hydropower plant was 880,000 USD and running cost was estimated 3,700 USD per year for a period of 20 years which is the standard lifespan of a micro hydro project in Japan.

Total cost = 880,000 + 3,700 *20 years = 954,000 USD

The inflow of the money during construction was as follows:

55 household of the Oohto village contributed 37 USD each, 80 % of the money was financial cooperation agency as loan on 0.001 % interest rate, 1 % was the incentive from the government and rest were the loan from a local bank on 26% loan interest.

The outflow of the money:

Tariff: 34 cent/ kWh approximately

Table3: Cash outflow & annual energy generation

Month	Period		no. of days	kWh	Amount received (USD)
February	2018/02/06	2018/03/05	28	32,291	10,210
March	2018/03/06	2018/04/04	30	34,361	10,865
April	2018/04/05	2018/05/07	33	37,502	11,858
May	2018/05/08	2018/06/05	32	21,313	6,739
June	2018/06/06	2018/07/04	31	24,768	7,832
July	2018/07/05	2018/08/05	32	36,564	11,562
August	2018/08/06	2018/09/05	31	30,587	9,672
September	2018/09/06	2018/10/04	29	30,972	9,793
October	2018/10/05	2018/11/05	32	37,648	11,904
November	2019/11/06	2019/12/05	30	35,265	11,151
December	2019/12/06	2019/01/08	34	40,033	12,658
January	2019/01/09	2019/02/05	28	30,832	9,749
Total			370	392,136	123,993 USD

- The table shows kWh data recorded from February 2018 to February 2019.

As can be seen in a period of one year, the total energy generated is 370 MWh and the amount received by selling this electricity is 124,000 USD approx. If the same value continues in future the payback can be achieved within 7 years which is earlier than expected during installation.

The sole target of this kind of project is to provide job to the local people, stop migration, support government policy about renewable energy, and support the local people to get better life. The Oohito SHP, all the civil works were done locally by the local civil company. Installing this kind of project, local company get employment for a specific period during construction.

CONCLUSION/ LESSON LEARNT:

It is concluded that SHP can play a vital role in community development. In rural community, people do not have work and so they are migrating. MSHP makes network, it integrates the local community to the urban stakeholders. It creates job for the local community which help to engage the local youth to be at home. Installing this kind of project will benefit both the local community and the country. The main driving force is the government FIT policy, water & forest clearance, and cheap land availability. The obstacle to implement this kind of project is to search for the electro mechanical machines and total investment cost. It is hard to find the turbine maker in Japan with cheap price and unique technology. But, choosing overseas made turbine and improving it in-house can solve this problem. Therefore, for the future business it is important to make a good network globally. It will reduce the dependency on local expensive equipment and will reduce the total installation cost of MSHP. It will help to install more and more such kinds of project in the future.

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