

**“Project Formulation Survey” under the  
Governmental Commission on the Projects for  
ODA Overseas Economic Cooperation  
in FY 2013**

**Summary Report**

**Myanmar**

**Project Formulation Survey on  
Micro Hydropower Generation**

**March 2014**

**Joint Venture of**

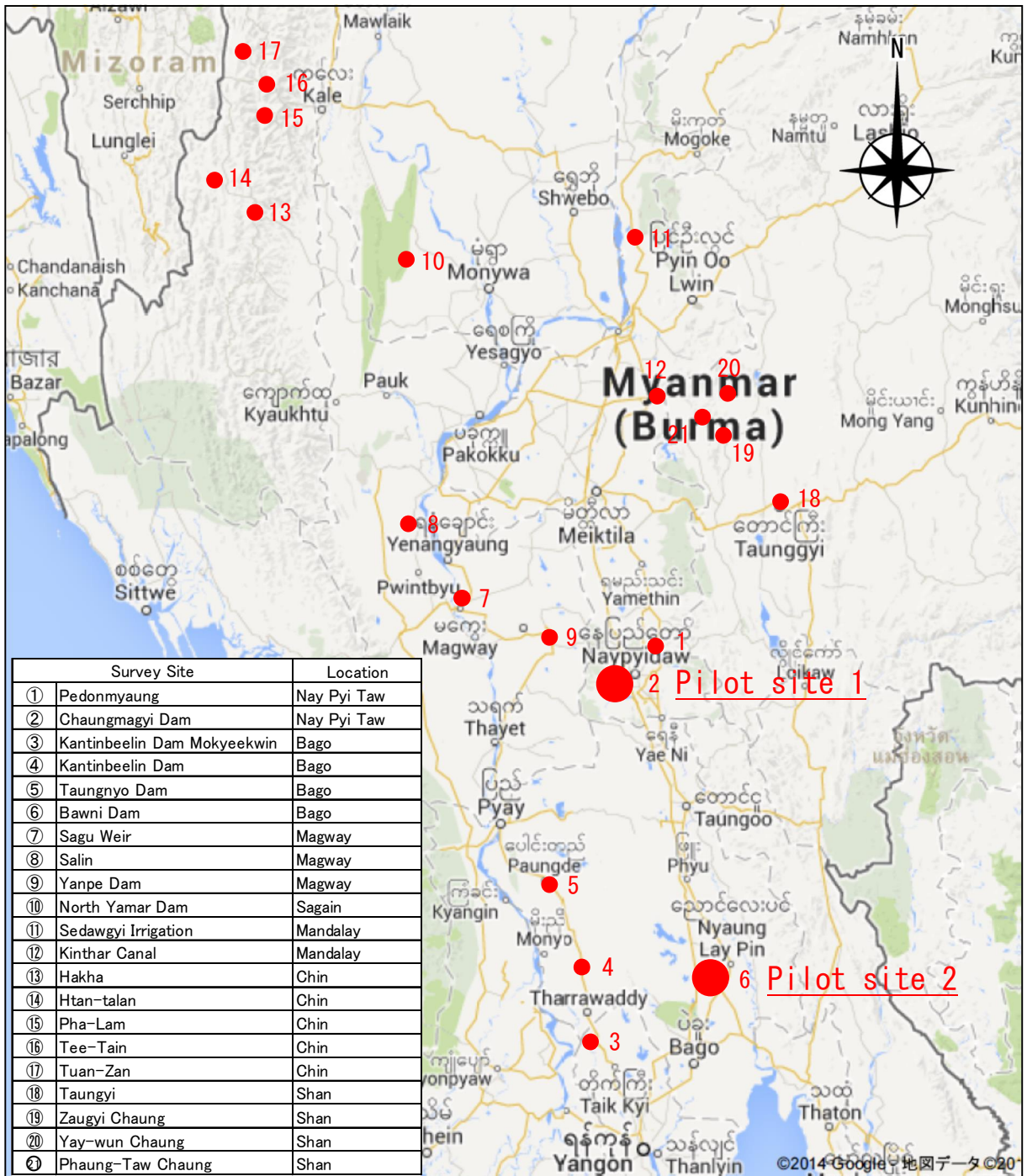


**Hokuriku Seiki Co., Ltd., and**



**Infrastructure Development Institute, Japan**

The content of this report is a summary of the project formulation survey, which was commissioned by the Ministry of Foreign Affairs of Japan in the FY 2013 and is carried out by the consortium of Hokuriku Seiki Co., Ltd. and Infrastructure Development Institute, Japan. It does not represent the official view of the Ministry of Foreign Affairs.



Location Map of Surveyed Sites and Selected Pilot Sites

## Preface

### 0.1 Objective

This is the Project Formulation Survey on the demonstration and dissemination project. The project is intended to increase the electrification rate of villages in Myanmar that are currently un-electrified, in which encouragement is made for tryout and introduction of the superior Micro Hydropower Generation of Hokuriku Seiki Co., Ltd., a small and medium-sized enterprise (SME), in Myanmar's government agencies through product and technology utilization and technical guidance, with the prospect of achieving the business development of this technology.

### 0.2 Outline

This survey was carried out during the period from October, 2013 to the end of January, 2014, with the counterpart -- the Irrigation Department of Ministry of Agriculture and Irrigation (ID), including two site surveys, in October and December of 2013. The survey was implemented as a joint venture of Hokuriku Seiki Co.,Ltd. and Infrastructure Development Institute, Japan. Survey outline is as follows.

- Subject survey areas : 4 districts of Bago, Mandalay, Magway and Sagaing, and 2 states of Chin and Shan
- Survey on current situation and development needs related to the micro hydropower generation in Myanmar
- Adaptability and possible application of the products and technologies of the SME to development issues
- Expected development impact in Myanmar
- Effect on business development of the proposing SME
- Pilot site selection and implementation structure based on assumption of the demonstration and dissemination project
- Overall setup of the equipment type, generation capacity, costs, etc.
- Negotiation with Myanmar local partner corporation for future business development

## 1. Description of the Current Situation and Development Needs of the Concerned Development Issues in Myanmar

### 1.1 Current status of development issues

The household electrification rate of Myanmar was about 26% in 2012 (An Energy efficiency conference 2012). With regards to development of the electric power infrastructure, electrification of the local rural areas -- 70% of the total population -- is extremely delayed, in addition to chronic power shortages.

In the field of micro hydropower generation -- the development issue -- the Irrigation Department (ID) is developing micro hydropower generation using the irrigation canals from the dams under its direct control, as a part of the measure to deal with non-electrification of rural villages under the special assignment of the President. As of 2013, about 100 units are in

operation. The power generated is supplied free of charge to the villages while restricting its use to electric lights. In this way, micro hydropower generators are produced or assembled and installed, though small in size, in order to eliminate un-electrified villages by ID and private corporations. However, this may seem to be far from increasing the electrification rate and just the first step toward achievement of the goal.

### 1.2 Needs for micro hydropower generation (100 kW or less)

Reservoir dams under the control of ID spread throughout the country, the total number is 239 as of 2013. The field survey covered more than 40 locations including irrigation channels, mountain streams, etc., all of which have un-electrified villages in the surrounding. The ID staff who acted as a guide reported that all of these villages are expecting supply of electric power. Considering the challenge of eliminating the non-electrification state of villages, the needs for power supply through micro hydropower generation is extremely high for the purpose of improvement of life environment (particularly to enable children to study during nighttime), increase in the agricultural productivity, and poverty reduction.

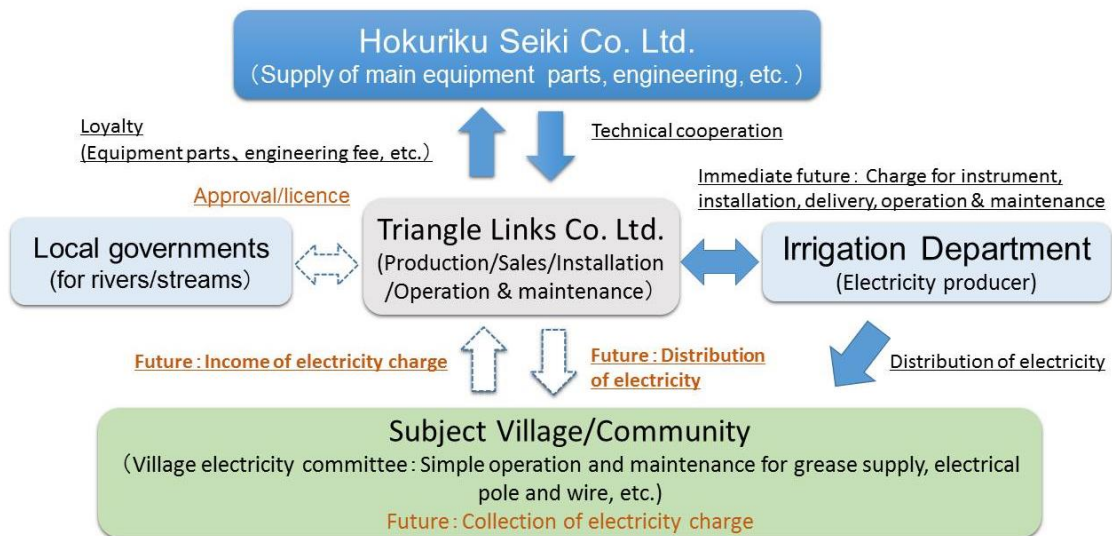
## 2. Possible Application of the Proposing SMEs Products and Technologies and Prospects for Future Business Development

### 2.1 Possible application and adaptability of the proposing SMEs products and technologies

This product will be a core in the next-generation energy system for supply of the clean renewable energy by means of water, and has various features; òvertical axial flow waterwheel requiring small-scale work for installation,ò òhigh generation efficiency,ò òmaintenance free,ò òstable operation for 20 years or more.ò Specifically, the use of a drop structure of irrigation channel from the dam ensuring stable flow enables òhighly-efficient stable power generation with small flow and low drop at low cost.ò

### 2.2 Prospect for the future business development

The business models covering the local manufacturing, retail, installation, and maintenance of equipment as well as training of engineers is assumed on the basis of technical tie-up with local partner corporation. By actually implementing manufacturing of the equipment locally, the study will be made on the feasibility of the òhigher efficiency,ò òlonger life,ò and òlower cost,ò hydropower generation equipment of Myanmar and on the òestablishment of the maintenance system,ò to achieve these requirements. In this context, great prospect of business development for dissemination of the hydropower generation equipment exists toward elimination of un-electrified villages scattered all over the country. Japan, on her part, can also contribute greatly toward elimination of un-electrified villages of Myanmar through utilization of these superior technologies. As of present, the business model and development system with future potential is shown below.



### Business Model and Development Framework in Phase 3

The partner on the Myanmar side at present has manufactured and retailed its own equipment, though small in scale, by utilizing its own empirical method. The partner welcomes the technical tie-up while strongly expecting raising of its technical level and improvement of the efficiency of power generation with the equipment. Moreover, Hokuriku Seiki is negotiating acceptance of the trainees from the partner by taking the future business development into account. Clients currently considered for business development include Irrigation Department (ID), local governments, and villages.

## 3. Introduction of SMEs Products and Technologies and Verification of Its Adaptability to the Country

### 3.1 Product presented by the proposing SME (vertical axial flow waterwheel)

Hokuriku Seiki Co., Ltd. was founded in 1959 and has been engaged in region-based manufacturing. It started off as maker of machinery components, and the corporation is now developing a comprehensive business, including manufacturing, installation, and maintenance of equipment and machinery, generating equipment, etc. In addition, the "New Toyama Science and Technology Plan" (2007 - 2015) is under way at present in Toyama Prefecture where the corporation is located, contributing to promotion of science and technology by combining dynamics of academic, industrial and government sectors. The corporation has also conducted joint development with Toyama Prefectural University and Ishikawa Prefectural University.

The product proposed this time is a vertical axial flow waterwheel, which is outlined below.

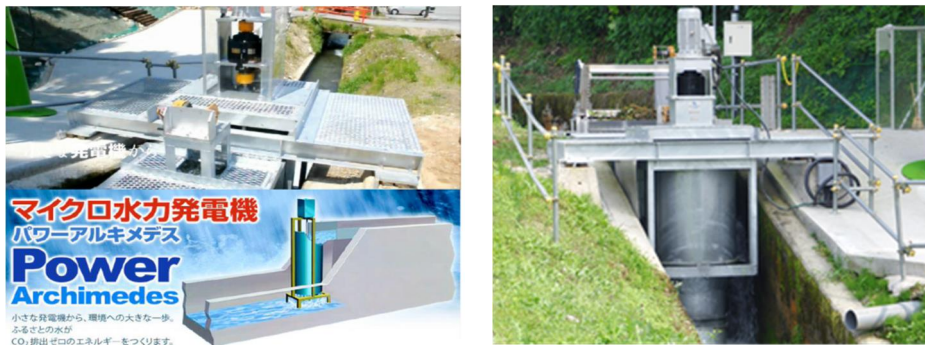


Image of Vertical Axial Flow Type Waterwheel

### 3.2 Verification of adaptability

The demonstration and dissemination project involves verification of the local adaptability of the products and technologies introduced in 3.1. Principal factors to be verified in the second year after installation of generator are the state of operation and distribution, efficiency of power generation, stability, applicability to other areas, cost reduction measures, maintenance approach and system, etc.

### 3.3 Study on profitability

The proposed product (vertical axial flow waterwheel) has features in its long life (20 years and longer), high generation efficiency, stable power generation, etc. This product will surely meet the demand on quality electric power, which is expected in the course of future economic development of Myanmar.

At present, the power cost of Japan is one million yen/1 kW. For the business development, the required electricity quality (used for electric lights temporarily) and reduction of the investment cost for such development down to about 500,000 yen/1 kW are considered possible by structuring the local manufacturing system through tie-up with Triangle Link Co., Ltd. Cost reduction depends greatly on the labor costs, employment of local parts without adverse effects on the performance, machining costs, etc.

On the other hand, the costs on the side of Myanmar is estimated to be about 200,000 yen to 400,000 yen. The price will be higher than the cost when considering the shorter life and low generation efficiency. In consequence, business development is considered possible. Issues as above described are confirmed in this demonstration and dissemination project.

## 4. Expected development Impact and Effect on Business Development of the Proposing SMEs in the Surveyed Countries through Proposed ODA Projects

### 4.1 Expected development impact in Myanmar

As the result of discussions during the field survey, the counterpart agency of the demonstration and dissemination project has been determined -- the ID. ID made a strong request to cooperate with the Japanese agency through the entire schedule. Joint implementation of works throughout

the entire project schedule from technical guidance on planning and design, plus installation and distribution, up to review of the maintenance approach and system and training of engineers (1) is expected to raise the level of the micro hydropower generation technology in general as requested by ID and (2) will prove the adaptability to the development issue of eliminating any un-electrified villages.

#### 4.2 Effect on business development of the proposing SME

The demonstration and dissemination project will bring about beneficial experiences, findings, and information concerning identification and considerations (including legal regulations, tax system, and business custom) for the objectives of overseas business development, recognition of business process, verification of adaptability, establishment of the business model and implementation structure, funding/distribution/retail plan, risk aversion measure, and so forth.

Future business development in which these experiences and findings can be utilized will promote further integration of technical capabilities, fostering of creative human resources, expansion of job opportunities, etc. This in turn will achieve regional vitalization in the Hokuriku area and will be the first step to break into the global market which is in line with the science and technology policies proposed by the prefectural government. In addition to market extension and integration of technologies of Hokuriku Seiki through globalization, this will also contribute greatly to development of the regional economy and also to international exchange between Japan and Myanmar.

### 5. Proposals for Formulating ODA Projects

#### 5.1 Outline of the demonstration/dissemination project of micro hydropower generation

- Counterpart agency: Irrigation Department: ID
- Outline of ODA project:

Outline of Demonstration/Dissemination Project

Item/proposed site	Site 1: PedonmyaungV. (Suburb of Nay Pyi Taw City)	Site 2: BawniV. (Northern Part of Bago District)
Beneficial households	250 households	500 households
Subject facility	Irrigation canal/drop structure	
Waterwheel type	Vertical axial flow	
Generation capacity	10 kW	20 kW
Energy charge	No charge	
O/M system	Community electrification committee	





Site 1 (Nay Pyi Taw)



Site 2 (Bago District)



Rural Community at Site 1

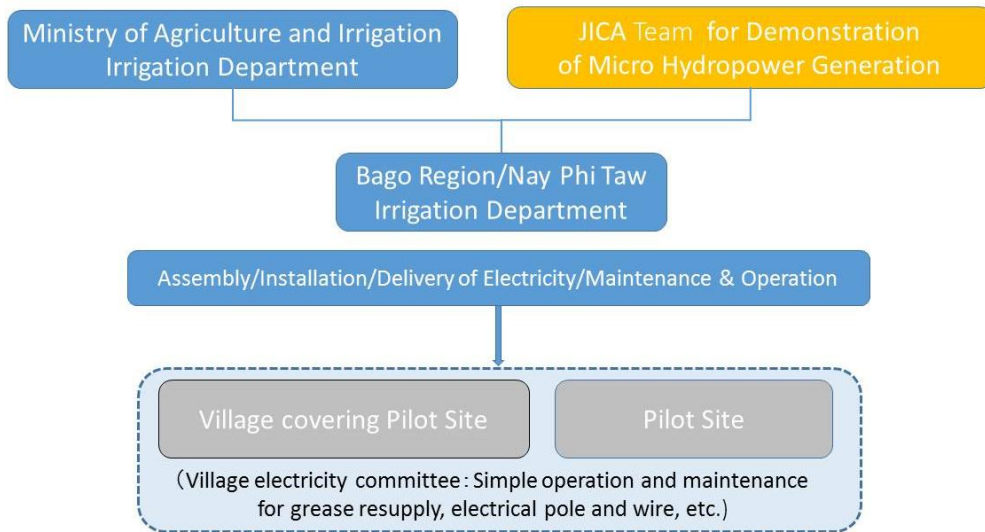


Rural Community at Site 2

Proposed Site

## 5.2 Implementation Structure

- Implementation of the project jointly with the Counterpart Agency (ID)



Implementation Structure for Demonstration/Dissemination Project

### 5.3 Implementation Schedule

- The implementation period will be two years.
- First year: Field survey, basic design/detailed design, manufacturing, transport, installation, test operation, and power distribution
- Second year: Micro hydropower generation demonstration test (operation and distribution state, high power generation efficiency, stability, applicability to other areas, cost reduction measures, maintenance approach and system, etc.) and its dissemination activities (engineers training, on-the-job training, acceptance of visitation from the outside, public relations, etc.)

Item/Time	2014												2015												2016											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Pre-feasibility Study	[Yellow bar]																																			
<b>Demonstration and Dissemination Project</b>																																				
Site survey													[Yellow bar]																							
Basic and Detailed Design													[Yellow bar]																							
Manufacturing													[Yellow bar]																							
Transportation													[Yellow bar]																							
Installation													[Yellow bar]																							
Works of distribution of electricity													[Yellow bar]																							
Test operation													[Yellow bar]																							
Demonstration and dissemination													[Yellow bar]												[Yellow bar]											
Questionnaire survey													[Yellow bar]																							
Method of operation/maintenance													[Yellow bar]																							
Setup of operation/maintenance system													[Yellow bar]																							
Technical seminar													[Yellow bar]																							
Reporting													[Yellow bar]												[Yellow bar]											
<b>Business Development</b>																																				
Cooperation with local company													[Blue bar]																							
Technical exchange													[Blue bar]																							
Setup of production system													[Blue bar]																							
Setup of selling system													[Blue bar]																							
Setup of community electricity committee													[Blue bar]												[Blue bar]											
Start of business													[Blue bar]												[Blue bar]											

Tentative Schedule to Demonstration/Dissemination Project and Business Development

**Project Formulation Survey**  
**Republic of the Union of Myanmar, Micro Hydropower Generation**

**SMEs and Counterpart Organization**

- Name of SME : Joint Venture of Hokuriku Seiki Co., Ltd.
- Location of SME: Toyama Pref., Japan
- Survey Site • Counterpart Organization: Central Dry Zone • Irrigation Department, Ministry of Agriculture and Irrigation

**Concerned Development Issues of Myanmar**

- Myanmar depends on hydraulic power generation for up to 67% of the total power required, and is suffering from chronic power shortage.
- The hurdles to overcome are the difference in the electricity generated between dry and wet seasons and the loss during power transmission.
- The electrified households account for about 26% of the total households and more than half of the generated power is consumed in the urban area where the population is concentrated. There are many unelectrified villages in the rural areas.

**Products and Technologies of SMEs**

- The micro hydropower generation system – the vertical axial flow waterwheel (“Power Archimedes”) – has waterwheel blades arranged in a spiral manner, enabling highly efficient power generation even with the low flow and small drop.
- This is a 100% Japanese product which components manufacturing and assembling are done in its own plant. Customization and maintenance can be readily adopted to the installation site.

**Proposed ODA projects and Expected Impact**

- The electric power generated by using irrigation channels/drop structures can be supplied, together with the Irrigation Department, the Ministry of Agriculture and Irrigation, to villages not covered by the national power grid. This will help to improve the living environment of the villages while the use of electricity will enhance the agricultural productivity.
- Establishment of the maintenance system in the rural areas leads to fostering of human resources and to expand the regional job opportunity.



**Future Business Development of SME**

- It is intended to ensure dissemination among local authorities and villages in Myanmar by means of local production of the micro hydropower generation system through technical tie-up with local corporations in terms of production, retail, installation, and maintenance.
- Order accepted for production of the micro hydropower generation system (about 50 million yen) in the “Isabella Province Micro Hydropower Generation Project,” the grant aid project for the Philippines.