Republic of India

India
Feasibility Study on the Bottom of the Pyramid (BOP) business promotion on Drinking Water Supply with flocculants
Summary

April 2014

Japan International Cooperation（JICA）

Poly-Glu International Co., Ltd.

Kaihatsu Management Consulting, Inc.

OS
JR
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Table of Contents

Abbreviation

BIS	Bureau of Indian Standard
BOP	Base of Pyramid
FDA	Food and Drug Administration
FIPB	Foreign Investment Promotion Board
GDIA	Genuine Dhamma International Association
GDP	Gross Domestic Product
GP	Gram Panchayat
JICA	Japan International Cooperation Agency
NGO	Non-Government Organization
NRDWP	National Rural Drinking Water Program
OBC	Other Backward Class
ODA	Official Development Assistance
PCB	Pollution Control Board
PHED	Public Health and Engineering Department
RBI	Reserve Bank of India
SME	Small and Medium Enterprise
UPA	United Progressive Alliance
WHO	World Health Organization

＜Exchange rate as of April 2014＞

INR 1 = JPY 1.69

Location of Project Site

Outlines of Study

＜Objective＞

The study aims to examine the feasibility of business which utilizes flocculants developed by Nippon Poly-Glu International to produce and supply safe drinking water to low-income population living in the area where people have a difficulty in access to safe drinking water.

＜Project Site＞

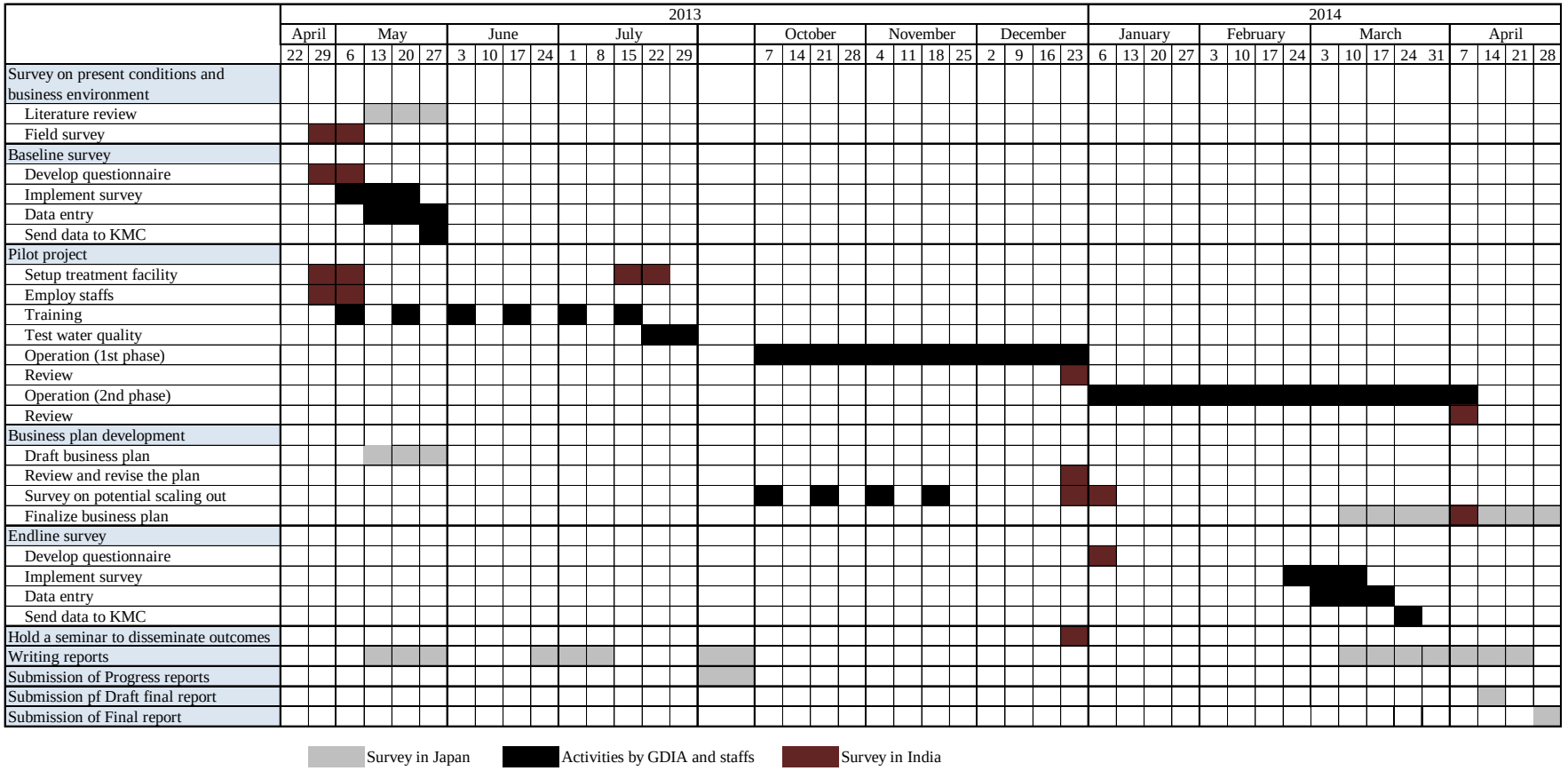
Udasa village, Nagpur District, Maharashtra, India

＜Study schedule＞

The study was conducted between June 2012 and April 2014.

Study schedule in Maharashtra is shown in the next page. The activities in August and September 2013 were cancelled due to unfavorable weather conditions.

Study Schedule



Summary

Chapter 1　Business environment

(1)　Overview

India, with its population of 1.2 billion, is a great regional power in South Asia. India has been a parliamentary democracy, the world's largest, since its independence in 1947. India began to liberalize its economy in 1991 and has sustained high economic growth while increasing its presence in the global economy. To attract foreign investment, the Indian government has been gradually deregulating its foreign investment regime.

(2)　Policies and legal framework for drinking water supply

The national Ministry of Urban Development is in charge of the urban drinking water supply, while the Ministry of Rural Development takes care of rural areas. Drinking water supply projects are fundamentally state responsibilities, however; the central government is limited to providing policy guidance as well as technical and financial assistance to state governments.

Under India's flagship rural drinking water supply program, the National Rural Drinking Water Program (NRDWP), state governments are responsible for planning, monitoring, and providing technical assistance for their water supply projects. The Gram Panchayats (GPs) are responsible for implementing the projects in their villages.

The Bureau of Indian Standard (BIS) sets India's water quality standard. To sell drinking water widely in urban areas, businesses must satisfy a water quality standard, pass a water safety appraisal by the Pollution Control Board (PCB), and obtain permissions from the Food and Drug Administration (FDA) and the BIS. However, a business can sell drinking water to a limited number of people in rural areas if it has obtained permission from the village's GP.

(3)　Present conditions of the drinking water supply

The 2011 census reveals that 32% of India's households use treated tap water; the rest use untreated tap water, well water, or surface water. States show wide gaps in their tap water coverage, and tap water coverage is higher in urban areas than in rural areas.

In Maharashtra, most households in both urban and rural areas use tap water. However, less than 60% of households have access to tap water, while almost 90% of urban households do. Almost half of rural households use wells, and 10% are dependent on unprotected water sources.

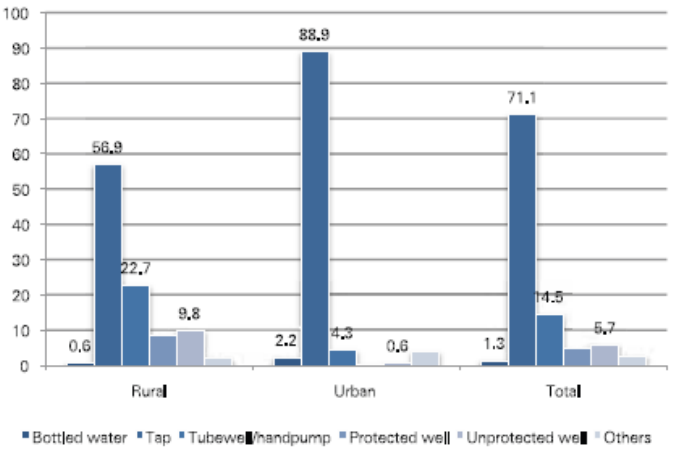


Figure 1-1 Water sources in Maharashtra, as a percentage (2008/09)
(Source: http://mahades.maharashtra.gov.in/files/publication/unicef_rpt/chap7.pdf)

Urban and rural areas display very different water source usages. While 60% of urban households use water sources exclusively for themselves, 69% of rural households share their water sources with others, and 60% of rural households use water sources owned by the community; this suggests that fetching water is still a heavy burden in rural areas.

Many rural households in Maharashtra depend on shared wells and suffer from inadequate water volumes. Thus, securing sufficient water remains a significant issue in rural areas.

(4) Present conditions of water contamination

As the use of ground water increased in rural areas, chemical contamination (especially that of arsenic and fluoride) became a significant issue, as its impact on health is very serious. As shown in the table below, water quality issues are especially serious in Rajasthan.

Among India's water contaminations problems, bacteria, fluoride, and arsenic are the most serious in terms of both gravity and scale.

Using small point-of-use appliances such as filters is the common way to address bacteriological contamination, while state governments have installed special purification plants in arsenic-prone areas.

However, no affordable, low-cost solutions for fluoride contamination suitable for low-income populations have yet been found, and the government has been slow to address this issue because of the high costs and technical difficulties involved. Consequently, many people suffer from fluorosis, which can affect bones and joints.

Table 1-1　Affected populations by state

No	State	Total population affected	Fluoride	Arsenic	Iron	Salinity	Nitrate
1	Rajasthan	8,819,007	3,969,304	0	10,663	3,584,401	1,254,639
2	Andhra Pradesh	4,548,172	2,777,478	0	153,067	1,185,148	432,479
3	Bihar	3,977,418	451,810	245,857	3,279,278	0	473
4	Assam	3,872,447	2,122	142,606	3,727,719	0	0
5	West Bengal	3,554,608	77,910	1,297,072	2,178,657	969	0
6	Maharashtra	2,254,685	807,993	0	316,973	392,693	737,026
7	Orissa	2,051,603	60,675	0	1,776,361	206,897	7,670
8	Kerala	1,798,904	207,246	0	1,187,877	303,185	100,596
9	Karnataka	1,618,996	784,911	15,064	247,962	222,680	348,379
10	Tripura	1,386,488	0	0	1,386,488	0	0
11	Chattisgarh	958,359	28,116	0	889,977	40,266	0
12	Madhya Pradesh	692,551	590,367	0	49,591	52,593	0
13	Uttar Pradesh	453,814	160,467	139,672	51,240	101,849	586
14	Punjab	260,080	0	0	256,205	3,875	0
15	Tamil Nadu	197,427	1,579	0	179,094	16,204	550
16	Uttarakhand	95,711	10,810	0	70,919	0	13,982
17	Gujrat	93,385	13,595	0	0	0	79,790
18	Nagaland	33,602	0	0	33,602	0	0
19	Arunachal Pradesh	31,340	0	0	31,340	0	0
20	Haryana	25,735	25,735	0	0	0	0
Total		36,773,496	9,974,818	1,840,271	15,869,820	6,112,417	2,976,170

1.Habitations with any contamination including arsenic are counted under "arsenic" column.
2.Habitations with any contamination including fluoride and without arsenic are counted under "fluoride" column.
3.Habitations with any contamination including iron and without arsenic and fluoride are counted under "iron" column.
4.Habitations with any contamination including salinity and without arsenic, fluoride and iron are counted under "salinity" column.
5.Habitations with only nitrate contamination are counted under "nitrate" column.

（Source: http://indiawater.nic.in)

The figure below compares the percentages of households using unimproved water sources by wealth quintile. The percentage is much higher in rural than in urban areas. As household incomes decrease, the percentage of households using unimproved water sources increases, indicating that poor people are disproportionately affected by water contamination.

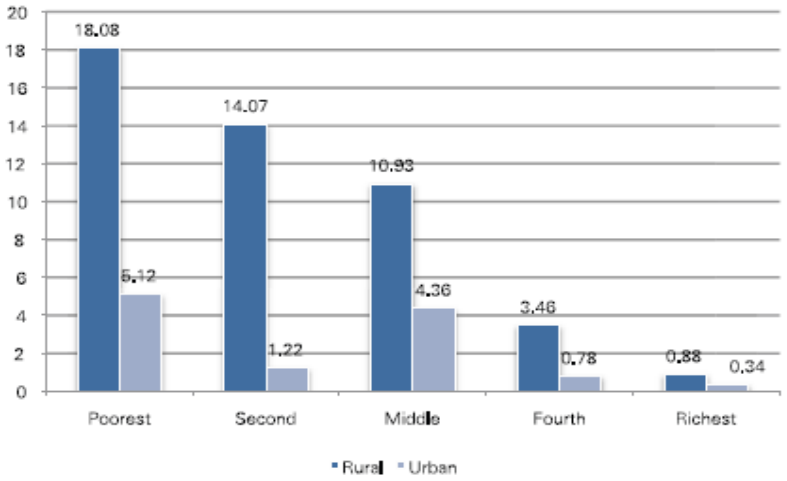


Figure1-2　Percentage of households using unimproved water sources by wealth quintile
(Source: http://mahades.maharashtra.gov.in/files/publication/unicef_rpt/chap7.pdf)

The government recommends using contaminated water for washing and bathing and water from

safe sources for drinking. If no safe water source is available, the government recommends 1) establishing new stand posts for safe water, 2) establishing new water sources, and 3) defluoridating existing high-fluoride water sources.[1]

Chapter 2 Pilot Project

The pilot project examined the feasibility of a business model for producing and selling clean water using Poly-Glu flocculants. The key tasks were 1) building an efficient low-cost operation mechanism and 2) motivating local people to pay for their clean water sustainably.

(1) Business model

Nippon Poly-Glu aims to enable local communities to enjoy independent and sustainable access to safe drinking water. Nippon Poly-Glu will supply the flocculants, and the production and sale of the clean water is to be carried out by an NGO or a village water management committee. The intended business model is shown in Figure 2-1below.

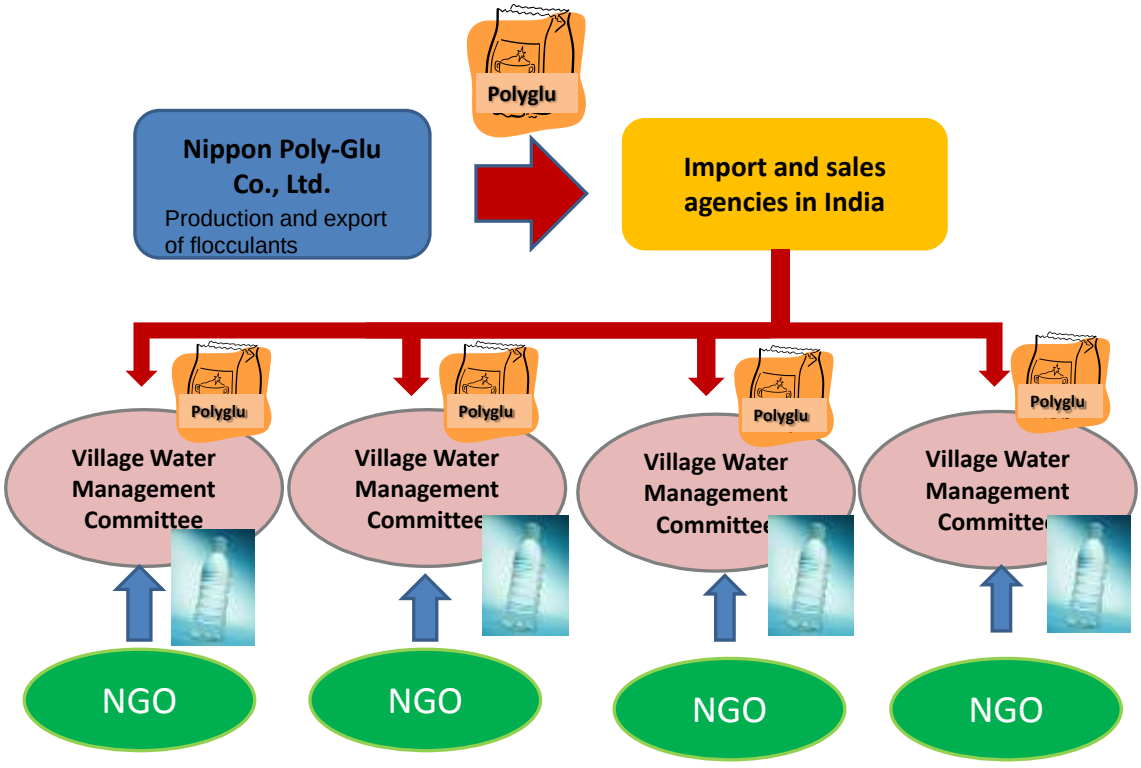


Figure 2-1 Intended business model

[1] A.K. Susheela, "Strategy for Fluorosis Mitigation Program in India," 4th International Workshop on Fluorosis Prevention and Defluoridation of Water, March 2004.

Table 2-1 Tested business model

Entity	Task	Issues examined
Nippon Poly-Glu Co. Ltd.	Production and export of flocculants, technical support	・ To export flocculants at a price and volume sufficient to ensure profit. ・ To establish processes for the stable supply of safe water
Import and Sales agencies	Import and sales of flocculants	・ To establish a stable and efficient sales system for flocculants
Village Water Management Committee	Purchasing water and consumption	・ To establish a mechanism for producing and selling clean water sustainably using Poly-Glu flocculants ・ To establish a mechanism for sustainably recovering the costs required to carry out the tasks listed above
NGO	Production and sale of treated water and awareness-raising activities	

The pilot project aimed to establish a model by which an NGO can produce and sell clean water in a village using Poly-Glu flocculants.

(2) Pilot Project

1) Project site

The natural and social conditions of Udasa village, the pilot site, were investigated. The results are listed below.

- Natural conditions

Udasa village is 38 km from Nagpur, the second biggest city in Maharashtra. It takes about an hour by car from Nagpur to Udasa.

The village is in a flat area. It is completely dry during the dry season but experiences heavy rainfall during the rainy season. Its annual rainfall is around 1,300 mm. Nagpur is known as the hottest city in India. Temperatures in Udasa can reach up to 45 degree centigrade in April and May.

- Social and economic conditions

Udasa has around 3,000 people and approximately 600 households. Although most inhabitants are farmers, some are migrants working for the steel company or coal mines in the area. The village's main crops are soybeans and rice.

Of the village's population, 60% are in the Other Backward Class (OBC), 20% in tribes, 15% are Buddhists, and 5% are "others." Village incomes are very low; the average annual household income is between INR 21,000 and INR 40,000. A quarter of the population lives below the poverty line of INR 21,000 per household per year.

The village's education level, and especially that of its tribes, is low. The literacy rate for both

males and females is around 25%. However, the Buddhist community is highly aware of the importance of education and has achieved a 100% literacy level. The entire village has seen an increased interest in education, recently achieving a 100% primary-school enrolment rate for boys.

2) Baseline survey

A questionnaire survey assessing the baseline social and economic conditions of the village was conducted on 100 samples living in Udasa. The samples consist of 60 respondents from among the OBC, 20 from among the tribes, and 20 from among the Buddhists. The respondents were married women with children; they had to be at least 17 years old and be able to respond to the questions and explain their household's conditions.

Table2-2 Composition of questionnaire

Category	Questions
1. Water use	Water source, Fetching water, Water consumption, Water quality, Water treatment, Cost of treatment
2. Health conditions	Level of understanding of the relation between water and health, Health conditions, Water-borne diseases, Cost of medical treatment
3. Willingness to pay	Willingness to pay, Payable amount, Concerns about water safety
4. Personal information	Occupation, Education level, Monthly consumption, Number of household members

The outcomes of the baseline survey are shown in Table 2-3 below.

Table 2-3 Summary of outcomes of baseline survey

Category	Outcomes of survey
1. Water use	・ 80% of respondents use tap water from a government tank that sources water from the river. However, many people also use water from public wells or buy water from tankers between April and June, when the river is dry in the dry season. For those fetching water from a well, it takes ten to thirty minutes to reach one. ・ Water shortages and poor water quality are among the village's major water-related issues. More than 80% of respondents identified water color and smell as problems. ・ Almost all respondents treat the water before drinking it, usually by putting alum in it and filtering it with a cloth.
2. Health conditions	・ Almost all respondents understand that water can be a cause of illness. ・ Only 20% of respondents said they had no health problems, while 80% said they had some health problems. Major health issues include stomach ache (62), dehydration (50), and high fever (42). skin irritation (22) and headache (18) were also cited. ・ Udasa has no medical facility. Patients go to district hospitals in Nagpur or private doctors in Umred.

Category	Outcomes of survey
	・ As the chances of sickness are high, medical expenses are also high. Respondents spend an average of INR 10,000 annually on medical expenses.
3. Willingness to pay	・ 84% of respondents said they wanted to buy clean water. ・ When asked how much they would pay for 10 liters of clean water, respondents ranged from INR 1 to INR 20, for an average of INR 2 to INR 4. ・ More than 90% of respondents expressed concerns about the safety of Poly-Glu's flocculants, which reveals a high level of water quality awareness. In addition, 85% of respondents said they trusted NGOs' opinions on water safety most highly.

Although the pilot project area has a water supply scheme, poor water quality and a high incidence of waterborne diseases indicate the acute need for safe and clean drinking water, for which most villagers are willing to pay. On the other hand, as people are very concerned about water safety, customers need to have the safety of Poly-Glu demonstrated to them when they are being sold clean water treated by Poly-Glu flocculants.

3) Implementation

The pilot project occurred between September 2013 and March 2014. Safe and clean water treated by Poly-Glu flocculants was produced by a NGO and distributed to the local community. The project is summarized in the table below.

Table 2-4 Summary of the pilot project

Period	Sep.–Dec. 2013	Dec. 2013–Mar. 2014
Water production capacity	1 ton/time	2 tons/time
Water production volume	2 tons/day	4 tons/day
Distribution volume/house	20 liter/day	20 liter/day
# of households	70	137
Price	INR 100 /month	INR 100 /month
Payment	1 time/month	1 time/month

(3) Review of pilot project

The pilot project was implemented smoothly and efficiently to a successful completion due to the efforts of the NGO that took a leading role.

The NGO's staff was trained in setting up a water treatment facility and a water purification process. The staff also conducted awareness-raising activities on health and sanitary issues and followed sanitary procedures during their daily operations. The NGO's door-to-door water delivery system gained a good reputation among customers and helped increase the system's customer base.

Despite its smooth operation, the project struggled to secure sufficient water sources, optimize delivery, ensure proper sludge management, upgrade its awareness-raising program, and improve its accounting. These are the main challenges for the future.

Moreover, the project ran a deficit of INR 17,000, as the cost of delivering the source water was high, and the sales volume remained way below target. The project could be profitable if a pipeline from the river were laid and if the sales target were achieved, as the table below shows.

Table 2-5 Operating costs necessary to produce 5.4–6 tons in Udasa

Operation Cost necessary for producing 5.4~6tons			
Items	unit cost (Rs)	unit	subtotal
Clorine	460	4.5litters	2,070
Transportation for delivery	350	30days	10,500
Fulltime staff	4,000	5 person	20,000
Parttime support staff	1,500	4 person	6,000
Electricity	400	1 month	400
PolyGlu		9kg	7,000
Total			45,970
Revenue	200	300	60,000
Balance			14,030

Chapter 3 Business Plan

An overview of the business plan is shown in Figure 3-1 below. In the first phase, a model for rural water supply is established by studying the feasibility of the program's operational mechanism and cost recovery through the pilot project. The model is then disseminated in Maharashtra in the second phase. Issues such as business experience, market needs, and potential business are studied in the third phase, during which the business is rolled out throughout the country.

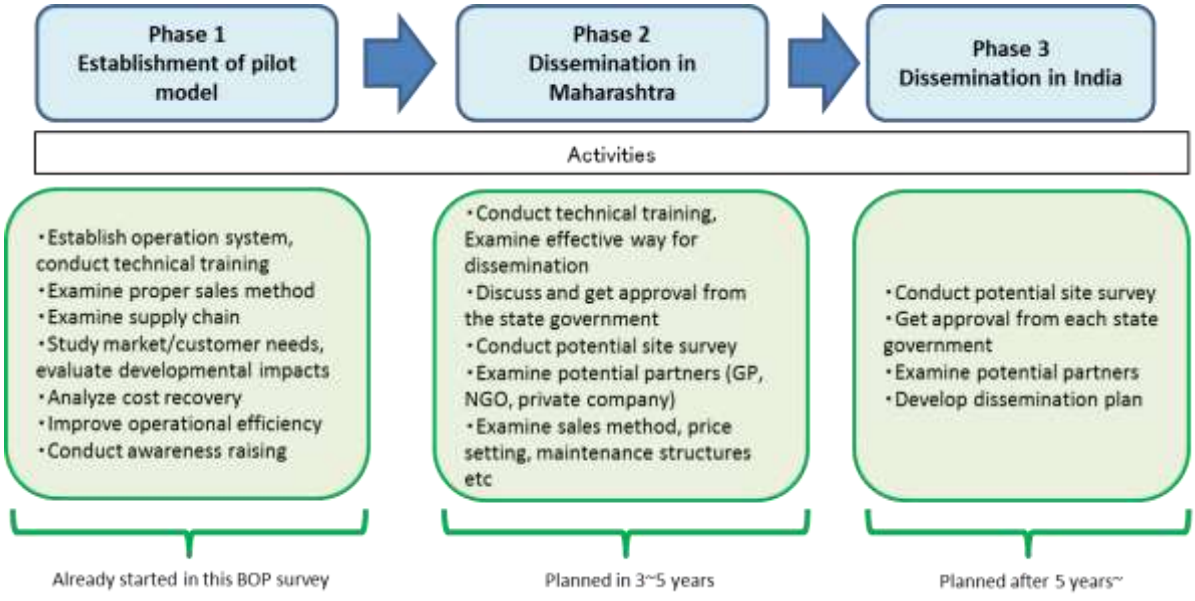


Figure 3-1 Overview of business plan

(1) Business operational mechanism

The pilot project demonstrated the feasibility of establishing a water purification process and an operational mechanism for water production and sales. It also showed that an experienced staff with the appropriate knowledge and skills was necessary to disseminate the pilot to other areas in India. An analysis of the pilot project resulted in the planned business model being changed from that seen in Figure 2-1 to that seen in Figure 3-2 below.

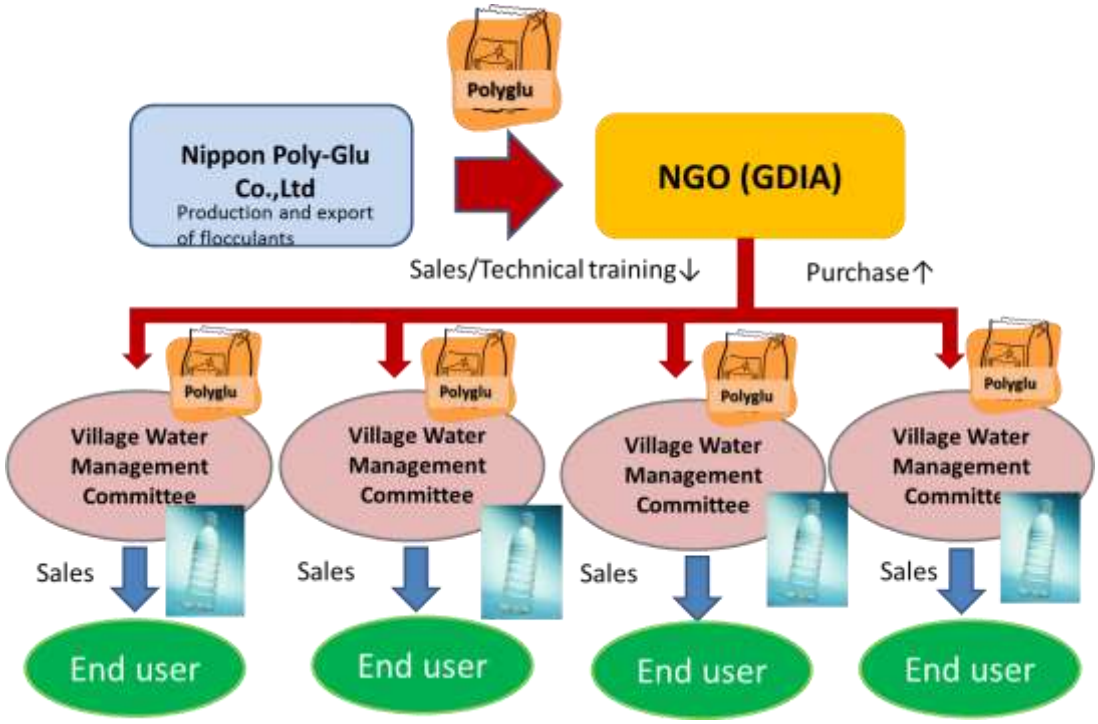


Figure 3-2 New business model

The roles of each of the concerned program entities are described below.

Entity	Role
Nippon Ply-Glu Co., Ltd.	Produce and export the flocculant, provide technical advice for NGO, conduct regular monitoring
NGO (GDIA)	Import and sell the flocculant, provide technical training on establishing facilities, water purification process, and water quality tests as well as on conducting maintenance and awareness-raising for village water management committee or implementing entity
Village water management committee/implementing entities	Establish and maintain water treatment facility, produce and sell water to end-users, conduct awareness raising activities for promotion
Import and sales agency	Import and sell the flocculant to private businesses and public organizations for public works

(2) Profit and cost estimates

The model is to be disseminated in Maharashtra over the coming five years and then all over India beginning in 2020. Nippon Poly-Glu's marketing plan is shown in Table 3-1 below. The estimated necessary volume of flocculant for one site is as was estimated for the pilot project (i.e., 219 kg per year).

	Dissemination in Maharashtra						In all India
	2014	2015	2016	2017	2018	2019	2020～
# of sites	3	6	20	50	100	200	300～
Sales volume	657kg	1,314kg	4.38ton	10.9ton	21.9ton	43.8ton	65.7ton
Sales amount	413,391	827,820	2,759,400	6,898,500	13,797,000	27,594,000	41,391,000
Sales cost	377,055	786,429	2,621,430	6,523,650	13,107,150	26,214,300	39,321,450
Operating profit	36,336	41,391	137,970	374,850	689,850	1,379,700	2,069,550

Installing a water treatment facility and starting operations in three villages, including Udasa, are planned for 2014. Successful pilot projects and clear developmental impacts will facilitate state government approval to disseminate the technology. Operational profits for Nippon Ply-Glu are estimated to reach 1,379,700JPY if the project expands as planned and facilities are installed in 2,000 villages by 2019.

Chapter 4 Possibility of collaborating with other JICA schemes

(1) Possible public funding to apply

Nippon Poly-Glu's business model is to secure profit only by exporting its flocculants; it will not be involved in selling clean water to consumers. This model is easy to adjust to local conditions, and its operational costs are low. The model is considered effective in areas where people's purchasing power is low.

On the other hand, maximizing profits and making the business sustainable require increasing flocculant sales. Replicating the business model examined in this study to other areas is thus important. The most serious bottlenecks impeding this process are the initial capital needed to secure source water and the need to establish the necessary infrastructure and the water treatment facilities. Although the expenditure required depends on local conditions, a half million to a million Japanese yen are sometimes needed. It may be difficult to cover the cost using only the fees collected from the customers; public funding is thus necessary to cover this kind of initial cost.

Two schemes are applicable to this project.

Table 4-1 Possible public funding sources

Scheme	Funding organization	Possible support	Funding

Grant assistance for grassroots projects	Embassy of Japan	Infrastructure development, provision of equipment	JPY 10 million
Pilot survey for disseminating SME's technologies	JICA	Infrastructure development, provision of equipment and technical assistance	JPY 100 million

The former scheme supports equipment installation as an initial investment in a single NGO project site. Although its application and selection processes are simple and quick, it cannot be applied to large scale or multiple project sites.

The latter scheme verifies and disseminates the products and technologies of Japanese small and medium enterprises (SMEs) in response to the needs of developing countries. This scheme requires a government agency to act as an implementation organization.

(2) Scenario applying pilot survey

1) Basic concept

- To examine the feasibility of a low-cost water supply model using Poly-Glu flocculants in the fluoride-affected areas of Maharashtra.
- The government of Maharashtra will be the implementation organization.
- The pilot will be implemented as a part of the NRDWP. The fund will cover infrastructure development, the installation of treatment facilities, and technical assistance. If the pilot is successful, the model may be spread through the NRDWP to other areas or states. The operational mechanism of the model is shown below:
  - Installation of treatment facility and infrastructure development: central and state governments
  - Ownership of facilities: village water management committee
  - Management of facilities: village water management committee
  - Facility operation, including cost recovery: NGO

2) Discussion with the counterpart organization

Three meetings were held with the Director, Water Supply and Sanitation Department, Government of Maharashtra, in December 2013 and in January and April 2014. He was particularly interested in the ability of Poly-Glu flocculants to remove fluoride. As the water sources of some areas in Maharashtra suffer from fluoride contamination, they require a low cost technology for removing fluoride safely. However, they requested more detailed information on the safety of Poly-Glu flocculants and the water produced by it as well as on its production cost.

Chapter 5 Development Impacts

(1) How to measure development impacts

A baseline survey was conducted to assess the social and economic conditions and water usage of the people living in the pilot village before the pilot project began. An endline survey was also

conducted on the same samples used for the baseline survey as well as on people who bought water cleaned by Poly-Glu during the pilot period just before the pilot project was completed. The results of the endline survey were compared with those of the baseline survey to evaluate the development impacts.

(2) Targeted development impacts and indicators

The project aims to improve the health and economic conditions of its beneficiaries by improving their access to safe drinking water. However, as observing clear changes within the limited study period would be difficult (since health and economic conditions take a long time to change), it was decided to include satisfaction levels along with water quality as a development indicator.

(3) Outcomes of endline survey

The endline survey was conducted using a questionnaire. The samples consist of 34 OBC, 48 tribal, and 39 Buddhist Poly-Glu-treated water customers and 39 OBC, three tribal, and five Buddhist non-Ply-Glu-treated water customers. The results of the survey are shown in Table 5-2 below.

Table 5-2 Summary of endline survey results

Category	Outcomes of survey
1. Satisfaction with water	・ % of respondents who have problems with the water they use decreased drastically. ・ % of respondents who said that their water quality is poor decreased from 83% to 33%: bad taste issues went from 42% to 12%, muddiness issues went from 94% to 29%, smell issues went from 83% to 2%, and color problems went from 97% to 10%. ・ % of respondents with water shortages remained unchanged. This problem was not solved. ・ Almost all customers are satisfied with the quality of Poly-Glu-treated water. ・ The customers like Poly-Glu-treated water because of its lack of color and taste. ・ % of respondents who were concerned about the safety of Poly-Glu-treated water decreased from 94% to 0%. ・ About half of the customers want to continue buying Poly-Glu-treated water even though the price rose to INR.150.
2. Health conditions	・ Large improvements were observed in many aspects of health. The number of respondents with stomach aches decreased from 62% to 33%, that with skin irritation issues went from 22% to 1%, and that with dehydration problems went from 50% to 4%. ・ The rate of health problems concerning Poly-Glu-treated water customers is much lower than of non-customers. ・ 65% of respondents feel that their health improved after they started

	drinking Poly-Glu-treated water.
3. Economic conditions	・ Employment was created for six people. ・ No change was observed in the number of people who buy tanker water. ・ Average annual medical expenses decreased from INR 11,000 to INR 4,810. ・ Average medical expense of customers in the past six months is much lower than that of non-customers.

The outcome of the survey showed that, despite the limited study period, the pilot project for supplying safe water treated by Poly-Glu flocculants offered significant developmental impacts on both the health and economic conditions of the target beneficiaries.