PROLOGUE

This Detailed Feasibility Report on Mineral Water Project - Bhutan
is Presented in THREE REPORTS, as

Report A: Detailed Feasibility Report on Mineral Water Project at Demola

Report B: Detailed Feasibility Report on Mineral Water Project at Eusuna

Report C: Detailed Feasibility Report on Sparkling Spring Water Project at Aipoly

Report A Detailed Feasibility Report on Mineral Water Project at Demola

Report B Detailed Feasibility Report on Mineral Water Project at Eusuna

Abbreviations and Definitions

Short Form	Elaboration
^{o}C	Degrees Centigrade
BPM	Bottles per Minute
Codex	Codex Alimentarus (Food Standards) of the European Union
FDA	U.S. Food and Drug Administration
FMEA	Failure Mode and Effects Analysis : a risk assessment technique for systematically identifying potential failures in a system or process
GMP	Good Manufacturing Practice
HACCP	Hazard Analysis of Critical Control Points
IS	Indian Standard
KL / kl	Kilo litre
km	Kilo metre
KVA, kva	Kilo Volt Ampere
kw	Kilo watt
Lacs, lakh	100,000
Lph, lph	Litres per hour
Lpm, lpm	Litres per minute
m, M	Metre
Mg/litre, mg/l	Milligrams per litre
ml	Milli litre
mio	Million
mm	Milli metre
MT	Metric Ton = 1,000 kilograms
MTBF	Mean Time Between Failure: a measure of reliability of equipment
MoEA	Ministry of Economic Affairs of the Royal Government of Bhutan
Nu	Ngultrum (Currency Unit of Bhutan)
pa	Per annum
pH	Unit of measure of acidity or alkalinity of a solution (water)
Rs	Rupee (Currency Unit of India)
SS	Stainless Steel
PE	Polyethylene
PET	Polyalkylene Terepthalate
S.No., Sr. No.	Serial Number
sq m	Square metre
sq yd	Square yard
TDS	Total Dissolved Solids (measure of the mineral content of water)
US, USA	Referring to the United States of America
USP	Unique Selling Proposition (of the product)
VAC	Volts Alternating Current
5 S	Japanese ‘Five S’ techniques for maintaining an orderly workplace for higher productivity

Japanese Term	English Equivalent	Meaning in Japanese Context
Seiri	Tidiness	Throw away all rubbish and unrelated materials in the workplace
Seiton	Orderliness	Set everything in proper place for quick retrieval and storage
Seiso	Cleanliness	Clean the workplace; everyone should be a janitor
Seiketsu	Standardization	Standardize the way of maintaining cleanliness
Shitsuke	Discipline	Practice 'Five S' daily - make it a way of life; this also means 'commitment'

Executive Summary

The Royal Kingdom of Bhutan has the potential to provide pure drinking water to the global market. This water is available from the numerous snow and rain fed streams that abound in the country, as well as from a large number of natural springs. The water from such natural springs universally commands the highest price as packaged natural mineral water.

To give a positive direction to the concept of exploitation of the Nation's mineral water wealth, the Department of Industry, Ministry of Economic Affairs of the Royal Government of Bhutan had awarded the assignment to us for conducting a Detailed Feasibility Study in selected Dzongkhags of Bhutan for Natural Mineral Water, and submitting three (3) Detailed Feasibility Studies for Mineral Water Projects in Bhutan.

Exploitation of this natural resource of Bhutan is completely in accord with the enlightened policies of His Majesty and the Royal Government of Bhutan for green, clean and environment friendly development that generates employment and encourages private sector participation.

Terms of Reference for the Project
In the Terms of Reference, the investigation was defined for the following Dzongkhags:

'Tsirang/Gelephu, Samdrup Jongkhar and Punakha/Wangdue'

However, at the time of presentation of the Inception Report and on subsequent advice of the Director General, Department of Industry, the scope was enlarged to cover specified areas in the following Dzongkhags:

1. Punakha
2. Wangdue Phodrang
3. Paro
4. Samtse
5. Sarpang
6. Samdrup Jongkhar
7. Chhukha (Tala)

Packaged Mineral Drinking Water
The Project hinges around a clear understanding of what is 'Packaged Mineral Drinking Water', as distinct from 'Bottled or Packaged Drinking Water'. The ordinary packaged drinking water is defined in the European Codex CAC/RCP 48-2001, as "Water filled into hermetically sealed containers of various compositions, forms and capacities that is safe and suitable for direct consumption without further treatment". The Indian standard for this water is 'IS 14543: 2004 Packaged Drinking Water (Other than Packaged Natural Mineral Water)'. As against this, **packaged mineral drinking water** is under a separate standard, viz. the Codex Standard for Natural Mineral Waters Codex Stan 108-1981 (amended 2001) and the Indian Standard IS 13428:2005, which specify that mineral water is :

"Clearly distinguishable from ordinary drinking water, because

a) It is obtained directly from natural or drilled sources from underground water bearing strata for which all possible precautions should be undertaken within the protected perimeters to avoid any pollution of, or external influence on, the chemical and physical qualities.
b) It is characterized by its content of certain mineral salts and their relative proportions and the presence of trace elements or of other constituents.
c) Of the constancy of its composition and the stability of its discharge and its temperature, due account being taken of its cycles of natural minor fluctuations.
d) It is collected under conditions, which guarantee the original microbiological purity and chemical composition of essential components.
e) It is packaged close to the point of emergence of the source with particular hygienic precautions.
f) It is not subjected to any treatment other than those permitted by this standard."

The Indian Standard fully incorporates the European Codex Standard for Natural Mineral Waters, and goes beyond it, in respect of specifying

a. The minimum and maximum limits for the Total Dissolved Solids (TDS)[1] in the water, as 150 mg/litre and 700 mg/litre respectively (this is not a requirement as per the Codex).
b. Certain microbiological criteria not covered in the Codex.

These standards meet the criteria for drinking water specified in the WHO standards. The US FDA Standard of Identity at 21 CFR 165.110(a) (2)(vi) states:

> 'Mineral water is spring water that contains at least 250 mg/litre (or 250 parts per million) of Total Dissolved Solids (TDS) up to 249 mg/litre, it is classified as 'spring water'. From 250 to 500 mg/litre, it is considered 'Low Mineral Content' or 'Light Mineral Water' and above 500 mg/litre to 1000 mg/litre is called 'Mineral Water - High Mineral Content.'

Spring Water

As the name suggests, this is water derived from a natural spring as shown in the diagram below:

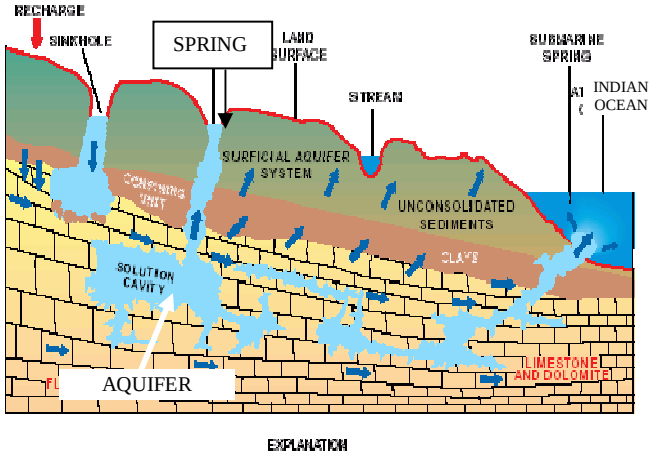

Fig. 1: Formation of a Mineral Spring

Spring water must be collected directly from the source (shown in light blue in the fig.1) without any possibility of contamination with ground water (shown in red). When this water has a significant mineral content in it, it is classed as 'Natural Mineral Water'. The amount of mineral content is expressed as Total Dissolved Solids (TDS) in units of milligrams per litre of water. The Indian Standard requires a minimum TDS content of 150 mg/l, whereas the American classification of 'Low Mineral Content Spring Water' starts at 250 mg/l.

1.0 Site Selection and Survey Process

The site for setting up a mineral water based project is to be selected as close as possible to the source of the water, since transport of the water by tanker is not permitted by the applicable standards. It is permitted to pipe the water where it is not possible to build a plant near the source of the water, but the costs of the pipe and laying of the pipeline are significant.

1.1 Parameters for Site Selection and Survey Process

The search for mineral water sources was conducted in the specified Dzongkhags with the following criteria:

1. The water must have a significant TDS content, ideally above 150 mg/l.
2. The flow of water must be from a perennial ground source and it must be in a commercially viable volume.
3. The source should be capable of being sealed from contamination by surface water.
4. There must be no habitation in the catchment area of the source.
5. The source should be reasonably close to a road.
6. Land should be available in close proximity for setting up the treatment and bottling plant.

[1] Total Dissolved Solids–this is the weight in grams of the residue left after the sample of water is evaporated at 180 °C, expressed in mg/l.

1. 2 Selection Matrix

To arrive at the best sites for setting up of projects, a selection matrix was designed, which provided different weights to each of a number of factors which impact site selection, as listed below:

1. Land Access Conditions
2. Environmental Conditions
3. Socio Economic Factors
4. Investment Considerations
5. Operational Logistics
6. Future Development Possibilities
7. Water Characteristics

Each of these factors was assigned a sub-set of factors to enable a closer examination of the ground reality for arriving at a more balanced perspective. The sites surveyed and their ranking is shown in table 1 below:

1.3 Sites Surveyed

S. No.	Dzongkhag	Survey Ref. No.	Location	Rank	Remarks
I	Thimphu	1	Thrinleygang		Excluded as advised
		2	Goenchhu (Goenekha)		Rejected due to habitation near the source
II	Punakha	3	Lobesa	15	
		4	Koma Tshachhu	18	
III	Wangdue Phodrang	5	Tiki Zampa	9	
		6	Rakhe Zam		Rejected due to foul smell/taste
		7	Basachhu		Rejected due to habitation
IV	Paro	8	Eusuna, Chuzom Paro Road	4	
		9	Shari Village		Rejected due to insufficient flow from source
		10	Nemi Zampa (Below Dzong)		Rejected due to habitation
		11	Below Taktshang		Rejected due to low TDS
		12	Jangtoena Village		Rejected due to habitation near the source
V	Samtse	13	Bhotedhara	11	
		14	Chengmari – Dhapper	10	
		15	Chengmari Village		Rejected due to low TDS/habitation
		16	Kuchidiana		Rejected (river water)
		17	Panidhara		Rejected due to low TDS and habitation near the source
		18	Darankhola		Rejected due to low TDS
		19	Hungay Village		Rejected due to low TDS and habitation near the source
VI	Sarpang	20	Simsar Pokhari, Noon Pani	13	
		21	Kami Khola		Rejected due to low TDS and habitation near the source
		22	Jigmecholing village, Surey	16	Rejected in chem. analysis
		23	Box Cutting	14	
		24	Gelephu Tshachhu		Rejected due to foul smell/taste
		25	Activated Charcoal Factory		Rejected due to low TDS and insufficient flow from source
		26	Aipoly Upper Source	5	
		27	Aipoly Lower Source	8	

S. No.	Dzongkhag	Survey Ref. No.	Location	Rank	Remarks
VII	Samdrup Jongkhar	28	Ngelong		Rejected due to insufficient flow from source
		29	Ngelang Chiloo	12	
		30	30/1 Culvert Lamsarong	7	
		31	25 km N of SJ Town	3	
		32	Marthang 0		Rejected due to insufficient flow from source
		33	Marthang Bridge	6	
		34	Demola	2	
		35	Demola Bridge	1	
VIII	Chhukha	36	C Adit of Tala Power Station	17	

Table 1: Sites Surveyed

The sites, which had major disqualifying factors observed, were rejected and the balance ranked according to weighted decision factors. The sites, which were rejected during the site physical survey, were not included in the ranking process for the final selection. In such sites the rank column in above table is blank.

1.4 Laboratory Test Reports

Water samples were tested in the field with portable instruments, and the promising samples sent to accredited testing laboratories in India for testing against the standard for mineral drinking water viz. IS: 13428:2005.

The reports of chemical analysis from these accredited laboratories have been summarized and reproduced on a single sheet in chapter 1.0 section 1.2 and the detailed laboratory test reports are given in Appendix III. Where the chemical parameters have been exceeded, the site has been rejected since there is no chemical correction permitted by the standard (e.g. pH value of the water being 5.97, the site of Jigmecholing village is rejected).

The salient features of the test report for Eusuna Spring sample prepared by SGS India Pvt. Ltd.[2], Report No. CA: GL: 7120001418 dated February 20th 2007, are given below:

S. No.	Tests	Requirement/Limit As Per IS:13428:2005		Results
		Min.	Max.	
1	Alkalinity (HCO_3)	75 Mg/L	400 Mg/L	206.57 Mg/L
2	Calcium (as Ca)		100 Mg/L	27.61 Mg/L
3	Chloride (as Cl)		200 Mg/L	18.58 Mg/L
4	Chromium (as Cr)		0.05 Mg/L	<0.05 Mg/L
5	Colour (Hazen Units)		2	2
6	Fluorides (as F)		1.0 Mg/L	<0.10 Mg/L
7	Iron (as Fe)	not Specified		<0.10 Mg/L
8	Magnesium(as Mg)		50 Mg/L	17.26 Mg/L
9	Manganese (as Mn)		2.0 Mg/L	<0.02 Mg/L
10	Nitrate (as No_3)		50 Mg/L	0.89 Mg/L
11	Nitrite (as No_2)		<0.02 Mg/L	<0.02 Mg/L
12	Odour		Agreeable	Agreeable
13	pH	6.5	8.5	7.75
14	Sodium (as Na)		150 Mg/L	3.90 Mg/L
15	Sulphate		200 Mg/L	11.92 Mg/L
16	Sulphide (as H_2S)		0.05 Mg/L	< 0.05 Mg/L
17	Taste		Agreeable	Agreeable
18	Total Dissolved Solids	150 Mg/L	700 Mg/L	198 Mg/L
19	Turbidity (in NTU)		2 NTU	< 0.50 NTU

Table 2: Salient Features of Laboratory Test Report for Eusuna Spring Water.

[2] SGS India Pvt. Ltd., Behala Industrial Complex, Phase II, First Floor, 620, Diamond Harbour Road, Kolkata 700034, India

1.5 Selection of Projects

The top rankings were given to the following locations:

Ranking	Location	Score	Dzongkhag
1	Demola Bridge	74.8	S/J
2	Demola (Marthang)	72.3	S/J
3	25 km Milestone N of Samdrup Jongkhar Town	70.7	S/J
4	Eusuna	70.0	Paro
5	Aipoly Top Spring	69.1	Sarpang

Table 3: Selected Projects

Out of these, we noted that the first 3 sites are located within a few kilometres of each other, on the Samdrup Jongkhar - Trashigang road. We have recommended that one project is set up at the best of these three sites, viz. Demola bridge, for a 50 BPM Natural Mineral Water Bottling Plant. After this project (detailed in Report A of the Study) goes on stream and the market picks up, other units can be established on the same access road.

Eusuna, Paro comes next in ranking on the list, and we recommend setting up of a 25 Bottles per minute natural mineral water bottling plant at this location (detailed in Report B of the study).

The third ranking is of the Aipoly Top Spring. However, at this site, the water has a TDS of 69 only, which excludes it from certification under IS: 13428:2005, for the Indian market, but

a. It is natural mineral water acceptable for European and Far Eastern markets.
b. It can be introduced to the Indian market as 'Sparkling Spring Natural Mineral Water', which will be its unique selling point, placing it in a premium niche market.

Therefore, the 3rd project is recommended for set up at Aipoly Top Spring for a 50 Bottles per Minute Sparkling Spring Natural Mineral Water Plant (detailed in Report C of this Study).

2.0 Justification of the Project at Eusuna

The Project is justified by the proven quality of the Eusuna spring water for being classed as 'Natural Mineral Water' - a valuable resource without optimal utilization. It is also justified by the high ranking. It has received in the selection matrix, which is based on criteria that define all the relevant parameters affecting the project.

2.1 Need and Importance of the Project to the Economy are as follows:

- There is no commercial utilization at present of the natural mineral water of Bhutan, while the worldwide demand for it is increasing rapidly.
- There is no significant industry in Paro Dzongkhag, at present, in this range of investment.
- The local population has a significant percentage in search of employment.
- The site has high visual publicity since it is on the main air – road link of Thimphu with the rest of the world.
- The setting up of the project will generate revenues for the state.

The significant economic benefits, are as given below:

S. No.	Parameter	Change Due to Project Implementation	
		Before (Present)	**After** (Future)
1	Employment – Direct	0	62
2	Employment – Indirect comprising services for • Transport of raw materials • Transport of finished products • Transport of personnel • Gardening and afforestation • Canteen and food • Phone, courier etc.	0	100 (estimated)

S. No.	Parameter	Change Due to Project Implementation	
		Before (Present)	**After** (Future)
3	Direct impact on economy		
	• Land lease charges (1st year)	0	Nu. 1.07 Lacs
	• Interest paid out (1st year))	0	Nu. 19.42 Lacs
	• Insurance charges (1st year)	0	Nu. 0.48 Lacs
	• Employee salaries (1st year)	0	Nu. 36.78 Lacs
	• Employee fringe benefits (1st year)	0	Nu. 5.52 Lacs
	• Income Tax paid (1st year)	0	Nu. 19.87 Lacs pa
	• Power consumption charges (1st yr)	0	Nu. 6.50 Lacs
	• Sales generated (100% capacity)	0	Nu. 616.80 Lacs pa
	• Misc. local purchasing	0	Nu. 5.00 Lacs (estimated)

Table 4: Micro and Macro Economic Analysis

Te local economy will get a boost by way of transportation services for raw material, finished goods as well as personnel. The general business environment will substantially improve as the export of the mineral water increases. The unit will contribute to the national exchequer by way of income tax, land lease charges, power consumption charges. Product export will earn in Indian currency as well as hard currencies as the Japanese, Middle Eastern and European markets are tapped progressively. At the national level it will help in solving the unemployment problem to some extent.

3.0 Market Analysis

Due to the increase in awareness brought about by advertising, consumers have started differentiating between mineral water and packaged drinking water, and are ready to pay the higher prices mineral water commands over ordinary packaged drinking water. Mineral water is somewhat less likely to be found in developing countries, where packaged drinking water is available in huge quantity.

Premium natural mineral water brands in the world market are Masafi, Evian, San Pellegrino, Nestle Perrier, and Hildon, which are priced between US$ 3 to US$ 4 a litre. Natural mineral water, brands such as, Himalayan and Catch, are priced around Rs. 20 to Rs. 25 a litre in India, which is the largest market in the neighborhood of Bhutan. The mineral water market is increasing at a compound average growth rate of 10% in the world. The biggest markets for mineral water in the year 2005 were, worth US$ 9.8 billion in the United States, US$ 7.4 billion in Germany and US $3.4 billion in Italy.

Western and European consumers believe that natural mineral waters have medicinal or other health properties. Thus, the long term demand supply positions will be more market and segment driven with brand and segments playing a bigger role in consumer's choice of water.

World mineral water market structure:

Year	**Value**(US $ Billion)	**Volume**(Billion Litres)
2005	58.00	120.20
2006	63.80	132.22
2007 (Projected)	73.37	145.44
2008 (Projected)	84.38	159.99
2009 (Projected)	97.03	175.98
2010 (Projected)	111.59	193.58
Growth per year	10%	12.32%

Table 5: World Mineral Water Market Structure Projections

Market analysis of major world market reveals that 'Made in Bhutan' Mineral water can find ready markets in Japan, South Korea, Taiwan, Thailand, Indonesia, Bangladesh and India. The Middle East is also a promising market provided the logistics of transportation is established.

India has one of the biggest and most attractive water markets in the world. In 2004, it was the tenth largest bottled water consumer in the world with a turnover of Rs.10 billion (Rs.1000 crores). With over a thousand bottled water producers, there are more than 200 brands, nearly 80 percent of which are local, meeting local demands.

Despite the large number of small producers, the industry is dominated by big players. In the forefront are Parle (Bisleri), Coca-Cola (Kinley), PepsiCo (Aquafina), Mohan Meakins, SKN Breweries (Yes), G. C. Beverage (Natural Fresh), D. S. Foods (Catch) etc. Parle was the first major Indian company to enter the bottled water market in the country when it introduced Bisleri in India, 25 years ago.

Himalayan and Catch are the main brands of mineral water in India. The demand of natural mineral water in 2005-06 was 180 million litres per year and is increasing at the rate of 12% per year.

Year	**Demand Supply Gap Trends India** (Million litres per year)
2005-06	169.20
2006-07 (Projected)	188.58
2007-08 (Projected)	209.28
2008-09 (Projected)	234.83
2009-10 (Projected)	261.15
2010-11 (Projected)	293.29

Table 6: Demand Supply Gap – India

According to industry estimates, the main consumers of mineral water are not only restricted to the upper class but also include the middle class families as well.Apart from domestic and commercial use of mineral water, the Indian railways and airlines are also having the other potential market for it. Mineral Water bottles, especially the 1 litre bottle is the fast mover among the traveling population.

Thus, there is a ready market for Eusuna mineral water and the sale of the entire production may be fully booked within a short period. The "Paro" brand Mineral water, once established, will also find increasing acceptance in Indian markets.Mineral Water from Bhutan has to compete with packaged drinking water in neighboring countries like India, which has a volume market.

The ex-works price worked out for a one litre "PARO" Mineral Water bottle is Nu. 9.00, which can be sold in India after covering Bhutan Sales tax, Indian VAT, transportation and distribution chain costs, at Rs. 18/- to Rs. 20/- all over the country, from North to South and East to West, at par in MRP with local mineral water like "Ganga" and the recently launched "Bisleri Mineral".

After its launch and local publicity as 'Bhutan's Premier Natural Mineral Water', it will be ready for the export market. The next step would be the supply to the Druk Air and other international airlines operating out of the Kolkata and New Delhi, so the brand awareness is generated. Being better priced than the imported water, it will also attract a new market segment of discerning consumers who would switch over from ordinary packaged drinking water to Natural Mineral Water.

The estimated production and projected supply of Eusuna mineral water are as follows:

Year	**Production Capacity** (%)	**Production** (million litre per year)	**Expected Export to India**	**Domestic Consumption**	**Expected Export to other Countries** (Excluding India)
1st	60	4.32	3.00	0.30	1.02
2nd	70	5.04	3.50	0.30	1.24
3rd	80	5.76	4.00	0.35	1.41
4th	80	5.76	4.00	0.35	1.41
5th	80	5.76	4.00	0.35	1.41
6th	80	5.76	4.00	0.35	1.41
7th	80	5.76	4.00	0.35	1.41

Table 7: Eusuna Mineral Water Production & Supply.

It is suggested to adopt a two-fold strategy for establishing the brand and determining the distribution channels. For local (Bhutanese markets) existing channel of distribution will be used for expediency to reduce the time taken to establish new market channels. The existing distributors are located mostly in Phuentsholing and Thimphu, and are known not have any brand preference, as their customers are not demanding specific brands and their business dictates are to get the highest margins or incentives.

Suitable marketing tie-ups for accessing niche markets will have to be investigated as the brand is established and the plant capacity is fully sold. The idea is of progressively finding the more lucrative markets, so that the water can be moved up into the higher premium segments.

4.0 Resources

The main inputs to the project have been examined in chapter 4.0 and found to be adequate for the success of the project.

4.1 Technological Inputs

The technology required for this project is for the following processes:

a. Treatment of the water for physical and microbiological impurities through :
   - Multistage filtration
   - Ultraviolet radiation
   - Ozonation
b. Manufacture of PET Bottles for packaging the water
c. Bottling the water (with carbonation, if required), labeling and packaging it

The technology for each of the above is available from India and its successful field implementation is fully supported by select equipment manufacturers. Alternate technologies are reviewed and the most cost effective and universally acceptable technologies selected. Details are provided in chapter 5.0, which also provides capacity sizing concepts, detailed specifications of plant and machinery, as well as the civil and electrical engineering requirements.

4.2 Water

The water suitable for classification as ‘Natural Mineral Water to IS: 13428:2000’ is available at this location at a flow rate of 30 litres per minute, which is sufficient to enable commercial exploitation to the extent of 25 litres per minute. The adequacy of water through the seasons has been iverified from local inhabitants of the area. The ground water resources evaluation, involving hydrogeological and geoelectric surveys and related tests, will be required to establish water availability over a longer period of time. The nominal process and other needs of water are met from the Parochhu flowing nearby.

4.3 Power

The total load is estimated at 200kva and the total power consumption costs are estimated at Nu. 6.50 Lacs per annum, based on the cost of Nu. 1.45 per unit (kwh). The project does not require a high-tension supply, but provision has been kept for stepping down power from 33 kv to 440 V, before distribution to the plant facilities. Sufficient electrical power is available at a short lead distance in the area.

4.4 Raw Material

The main raw material required is PET granules for manufacture of the bottles, and this will be imported from India along with bottle caps, adhesive stickers and packaging materials. Cartons may be developed progressively in Bhutan. Details of suppliers are given in Appendix V.

4.5 Consumables

The main consumables are laboratory chemicals, oils, lubricants and machine consumables such as water filter elements and ultra-violet lamps, workmen’s clothing and miscellaneous cleaning and office supplies. These requirements will be sourced from equipment suppliers and existing local channels. Details of suppliers are given in Appendix V.

4.6 Human Resource Requirement

A total strength of 62 heads is envisaged at the full two shift operation of the plant. Local labour will be available for the plant from surrounding villages and skilled labour will initially be required from India to train them. Staffing requirements will be met by Bhutanese, but senior management and marketing executives may be recruited from India. Suitable training and skill development programmes will be scheduled for the entire workforce.

5.0 The Plant

International standards lay down strict guidelines for the bottling of natural mineral water and the plant is designed to achieve the finished product using permissible processes only. The technology of the requisite processes is well known and several equipment suppliers are available in India and elsewhere for supplying equipment to meet the requirements of the standards. Alternate technologies were considered for the bottling of the water, but it was seen that natural mineral water is universally packaged in PET bottles (though there are exceptions) and this route is selected.

The technology selected for the raw water treatment comprises micro-fine filtration and biological treatment using ultra-violet radiation and ozonation, as allowed by the Standard IS: 13428:2005. The equipment capacity has been based upon the availability of the mineral water at the flow rate of 30 lpm or 1,800 lph. Keeping safety factors in mind, the raw water treatment plant capacity has been kept at 4,000 lph.

PET bottles are manufactured on site to prevent contamination in handling. The process requires PET granules to be injection moulded to make preforms, which are then heated and stretch blow moulded into the finished bottles. The equipment is designed for a throughput of 25 (1,000 ml) bottles per minute. Bottle sizes of 200 ml, 500 ml, 1,000 ml and 2,000 ml are processed on the same equipment with minor setup changes, since the bottles have a uniform neck size of 28 mm, but the output varies in proportion to the bottle volume.

The plant design takes into account the related civil engineering considerations, including site topography. The main structures are a Collection Room at the spring source, a pipeline to the Main Plant building, a Utilities Block and a Time Office block. The electrical distribution system takes incoming power at 33 kv and reduces it to 440 VAC before channeling it through Distribution Boards to the various points of consumption. The Indian plant and machinery manufacturers & suppliers have been considered as the most suitable for Bhutan. Names and addresses of the prominent suppliers are given in the Appendix V.

6.0 Plant Location and Infrastructure

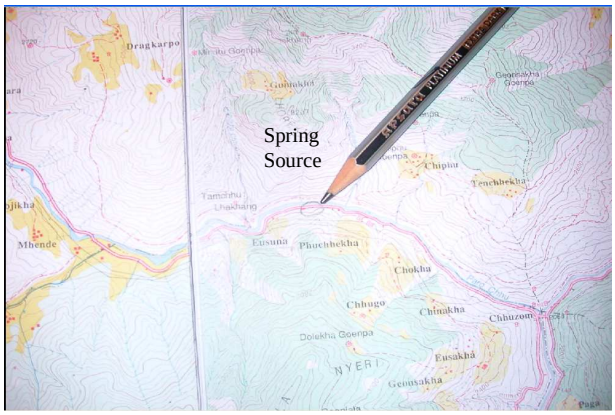

Fig. 2: Location of the Eusuna Spring & Proposed Available Land (Topo sheet scale = 1:50,000)

Site survey revealed that there is land available immediately between the road and the river Parochhu, which runs parallel at this point.

The site of the plant at latitude 27^{o} 19’ 50” N and longitude 89^{o} 31’00” E, is pointed out on Toposheet No.78 E/11 (Survey of Bhutan), reproduced and given in fig. 2.

It is proposed to lease 2,500 sq. m of land for setting up the Treatment Plant at a location close to the Paro-Chuzom-Thimphu road, as well as the Paro-Chuzom-Phuentsholing road. Public transport is available for employees but charter arrangements may be worked out with public bus companies to suit the factory shift timings.

At present, the road is marked for widening by another 10 m and the embankment is going to be cut. Since the water is coming from a deep source, no problem is envisaged in cutting further into the embankment by another 5 m to ensure that a Source Room can be constructed to seal the source to contain the water and prevent ingress of rainwater or other contaminant.

Other than the road, there are no facilities such as telephone or post office, immediately near the site, at present. Bhutan mobile phones work in the area and it is expected that regular telephone links would be established with the network expansion of Bhutan Telecom. Privately owned courier services are expected to come in once the plant is established and the need is felt.

7. 0 Environmental Considerations

Maintaining and sustaining the environment is of paramount importance and this project meets all the requirements for a non-polluting and sustainable industry. It does not create any adverse sociological impacts, but generates employment and provides an opportunity for the economic development of the area.

This project has no polluting processes and there is no adverse impact on the environment. However, an environment management plan is to be cast integrally with the Quality Management System for the plant, to ensure that there is no carelessness in management of wastes.

8. 0 Project Implementation

The stages of project implementation are planning, erection, single shift operation and two shift operation. Production is expected to commence in 52 weeks and two-shift production in 62 weeks.

The principal strategy governing project implementation would, perhaps, be in relation to the implementation model chosen. The following implementation models are generally envisaged in the execution of a project:

- Turnkey, in which the project costs are generally about 20% higher than the Shopping Model but in which, the co-ordination is the best (with its possible implication on the project gestation period).
- Semi-turnkey, in which the project costs are about 10% higher than the Shopping Model, but in which, co-ordination is only about half as good as the Turnkey Model.

- Shopping, in which the project costs would be the lowest but, in which, co-ordination aspects are perhaps the most difficult.

Of these, the semi-turnkey model is recommended as the most suitable, since the coordination aspects are expected to be taken care of by the consultant to the project along with the major equipment suppliers.

9.0 Cost Presentation

The total project cost estimate for the proposed project works out to Nu. 273.27 lacs. This includes the capital cost for the project as well as the margin for working capital requirement.

The project cost has been arrived at on the basis of the requirement of fixed and variable assets to meet the prescribed production requirements.

Cost of Project:

S. No.	Particulars	Value (Nu. in Lacs)
1	Land 2500 sq. metres (On lease)	
2	Building & Civil Construction	77.09
3	Plant & Machinery	73.77
4	Misc. Fixed Assets	42.88
5	Preliminary Expenses	1.00
6	Pre-operative Expenses	35.87
7	Margin Money for Working Capital	23.30
8	Contingencies @ 10%	19.37
	Total	**273.27**

Table 8: Cost of Project

Means of Finance:

S. No.	Particulars	Value (Nu. in Lacs)
1	Promoters' Equity	136.64
2	Term Loan from FI's	136.64
	Total	**273.27**

Table 9: Means of Finance

The unit costs of products are as follows:

Product Range	(Nu. /bottle)
▪ 200 ml	Nu.4.56
▪ 500 ml	Nu.5.67
▪ 1,000 ml	Nu.7.22

The incidence of these costs is based on that incurred by similar operating installations in India. Freight expenses have been worked out based on the envisaged distribution pattern of the packaging mix of the mineral water bottles manufactured from the plant. The cost of packing has been worked out @Nu. 8.00 per carton of 12 bottles of one litre each.

Statutory expenses include excise duty and sales tax. The former is not applicable for goods produced in Bhutan according to the present statute. The local sales tax of the state, in which the goods are sold, shall however, be applicable.

10.0 Financial Analysis

The analysis covers the estimated cost of production and profitability, projected cash flow, projected balance sheet, financial performance indicators, sensitivity analysis, indicators of performance as well as a review of tariff and pricing policy.

It is assumed that 60% capacity will be achieved during first year of operation and subsequently 70% in second year and 80% from the 3rd year onwards. Revenues from the project, in terms of the cash flow from sales, would thus start accruing after one year of construction period. Financial performance indicators are as follows:

S. No.	Indicator	Values
1	Payback Period	2.95 years
2	Debt Service Coverage Ratio (Average)	4.22
3	Return on Investment (Average)	55.60 %
4	Net Profit Ratio (Average)	22.70 %
5	Break Even Point (Average)	43.30 %
6	Debt Equity Ratio (Average)	0.36
7	Return on Capital Employed (Average)	15.62%
8	Net profit after Tax (average)	Nu.75.97 Lacs
9	Financial Internal Rate of Return (FIRR)	47.72 %

Table 10: Financial Performance Indicators

The NPV of the project is positive (Nu. 318.65 Lacs) at the discount factor of 12% (i.e. the WACC) during the first 10 years of operation considered. This implies that the project generates sufficient funds to cover its cost, including loan repayments and interest payments during the period. This also indicates that the project can continue making profits even after 10 years, and hence the project is financially viable.

11.0 Economic Analysis

This analysis covers the calculation of standard conversion factor, calculation of shadow costs, and discounted cash flow.

The discounted cash flow statement, which details total cash inflow, total cash outflow and net cash flow has been given in the following table and calculated for the construction period. Financial expenses and taxation have not been taken as these are considered as transfer payments.

The five -year projection of discounted cash flow is as follows: (Nu. in Lacs)

S. No.	Years	Construction Period	1	2	3	4	5
1	**Inflows**						
1.1	Net Profit after taxation	0.00	46.37	61.72	80.20	79.11	78.24
1.2	Depreciation	0.00	19.81	19.81	19.81	19.81	19.81
1.3	Cash Flow from Operations	0.00	29.45	79.08	97.55	102.60	101.74
1.4	Salvage Value	0.00	0.00	0.00	0.00	0.00	0.00
1.5	Total Inflow	0.00	29.45	79.08	97.55	102.60	101.74
2	**Outflows**						
2.1	Investment (Excl. Margin Money)	193.74	0.00	0.00	0.00	0.00	0.00
2.2	Loan for Working Capital	23.30	0.00	0.00	0.00	0.00	0.00
2.3	Total Outflows	217.03	0.00	0.00	0.00	0.00	0.00
3	**Net Cash Flow**	-217.03	29.45	79.08	97.55	102.60	101.74

Table 11: Discounted Cash Flow Statement

- Economic Rate of Return (EIRR) = 33.23%

Economic Internal Rate of Return of the project is 33.23%, which is higher than the WACC of 12%. Hence the project is economically viable.

1.0 Site Selection and Survey Process

The site for setting up a mineral water based project is to be selected as close as possible to the source of the water, since transport of the water by tanker is not permitted by the applicable standards. It is permitted to pipe the water where it is not possible to build a plant near the source of the water, but the costs of the pipe and laying of the pipeline are significant. The various steps in the process of site selection are detailed in the following sections.

1.1 Parameters for Site Selection and Survey Process

The first step in the process was the identification of a suitable mineral water source. The parameters affecting the selection of a particular site among several sites surveyed are described below:

1.1.1 Selection Parameters

A. Land Access Conditions

a. Land Availability near Source: An area of approximately 3,000 sq yards is required to build the Treatment and Bottling Plant, in close vicinity of the source – carriage of water is not allowed in tankers, so it can only be piped in SS or permitted PE grades of pipe. The longer the lead, the more expensive the pipeline.
b. Road Connectivity: To bring in raw materials, labour and take out finished goods, it is essential to have direct or indirect connectivity to a main road. The shorter the lead the less the transportation costs to markets.
c. Accessibility to Power Supply: The plant will require power supply of 440 VAC/ 3 Ph/ 200 kw approximately to start with. However, if BPC cannot supply power, the more uneconomical route will have to be taken to generate own power.
d. General Topology: Difficult geography of the source would necessitate building access paths to the source. Construction to protect the source would also be more expensive at difficult to reach heights.

B. Environmental Considerations

a. Water Hydrology: Investigation of the hydrology of the source requires checking the possibility of flooding and contamination of the spring water. Protection measures will entail extra costs.
b. Ecology: The impact of construction near the source as well as measures to protect the source have to be considered on the local flora and fauna. The minimal impact is desirable.

C. Socio Economic Factors

a. Land Use: The present land use has to be considered – whether it is forestland or plantation (of teak, or areca nuts or orange or apple orchards, for example), or farmland or for dairy or residential purposes. The ideal land will be comparatively level, fallow with little soil cover.
b. Employment : Generation of employment in rural areas is to be preferred.
c. Quality of Life : This is determined by the availability of civic facilities for the workers. Locations in proximity to such facilities as Hospital, Post Office, Bank, School and Market is desirable.
d. Present Use of Spring Water : It is undesirable to appropriate water from a source, which is already being utilized by the local population.

D. Investment Considerations

a. Land & Site Development : The civil construction work of leveling the site and bringing in the road lead is a major cost factor in the capital cost of plant, the more extreme the topography, the more the costs.
b. Power Step-down & Distribution: The higher the power supply tension, the more the costs. While power supply at 440 V will entail minimal installation costs, that at 33kv will require vacuum circuit breakers, transformers, lightning arrestors etc.
c. Water Source to Plant Linkage: The cost of laying and maintaining the pipeline from the spring to the Treatment and Bottling Plant is proportional to the distance between the two.

d. Habitation near Source: If there is habitation within the perimeter of the catchment area of the source, it is a disqualification, which has to be removed. The cost of displacing inhabitants may be considerable. Similarly, the presence of orchards or agriculture is undesirable, for fear of contamination through fertilizer or pesticide.

E. Operational Logistics

a. Raw Material Transport : The lead distance from sources of raw material to the plant is an important consideration for transport costs.
b. Finished Goods Transport : The lead distance from the plant to the market (by land, sea or air) and the time taken to reach it, are important considerations for feasibility of export and transport costs.

F. Future Development Possibilities

a. Project Expansion : The availability of land will govern the possibility of expansion of the project for higher value addition products in the future.
b. Ancillary : Availability of land will also enable setting up of ancillary functions such as manufacture of caps, cartons and other industries.

G. Water Characteristics

a. Taste, Odor & Pathogenic Micro-organisms : Both taste and odour are not likely to change in the standard filtration treatment so the quality must be high to start with. Excess of pathogenic micro-organisms may indicate ground water contamination and is undesirable.
b. TDS : This is a key parameter since the mineral content will determine if the water meets the requirements of the Indian Standard, for marketing in India, or of the US FDA for marketing in USA, which specify the minimum levels at 150 mg/litre and 250 mg/litre respectively.
c. pH : The pH of the water must be within the prescribed limits (7 to 8.5) at the source, as no subsequent chemical correction is permissible.
d. Flow Rate: The higher the available volumes the greater the possibility of expansion and diversification.

1.1.2 Survey Process

Field surveys involve time and costs and the following aspects were considered in planning the surveys:

A. Site Identification

The following process was followed for the identification of sites:

1.1.2.1 Defining the sites of springs in the assigned Dzongkhags

a. Based upon Topographical Sheets of the Survey of Bhutan and the Survey of India
b. Additional specific advice of Director General and officers
c. Local information obtained on actual site visits

1.1.2.2 Planning the site surveys for the sites

a. Determining the best time of the year for the survey
b. Arranging and briefing the team
c. Arranging the necessary equipment and logistics
d. Planning the data collection required
e. Determining best testing policy
f. Arranging the necessary permissions

1.1.2.3 Collecting samples of water and arranging their testing

a. Preliminary field testing
b. Accredited laboratory testing for biological and chemical testing
c. Collating all available data including test results

1.1.3 Timing

These site visits were planned for the winter months:

a. So as to remove the possibility of melting snow or rainwater contaminating the spring water sources at the point of collection.
b. So as to ensure that the minimum flows would be recorded and compared against local information on whether the flow swelled in the summer or rainy season.

1.1.4 Formulation of Survey Team

Accurate on-site investigation was planned to be done by a team with the following skill sets and attributes:

a. Expertise in geological, seismological and hydrological assessment of rock strata and local topography
b. Training in measurement of base parameters of the water on portable equipment
c. Expertise in setting up of a project after assessing the significant factors expecting the resource
d. Physical ability to access sites at a reasonable distance from an arterial road

1.1.5 Survey Report Format

Looking to the difficult terrain and the essentiality of collecting data on the first visit to the site, a format was designed to ensure that no relevant data was missed. The data relevant to the site included parameters related to water quality, the terrain, the facilities, habitation and land use etc.

1.1.6 Determining Testing Policy

The standards require testing of water to be carried out for its chemistry and its biological content. The option was to set up a Survey Lab or use an accredited Lab for the chemical analysis. In setting up a Lab, the constraint would be that, though the Lab be well equipped and manned, the results would not have any official sanction. It was therefore, decided to use a Three Step approach:

Step I Equip and train the Field Team to check certain basic parameters of the water on site.

a. For Total Dissolved Solids : using a portable electronic TDS Meter
b. For Temperature of the water : using a TDS Meter with this feature
c. Volume of the flow : using a stop watch and 5 litre container
d. pH (measure of acidity/alkalinity of water) : using a portable pH meter

If the water showed a good Total Dissolved Solids count, a sample to be collected and other parameters such as temperature, pH and flow measured and recorded, along with site data (as per format).

Step II Get the samples tested in a Government recognized Lab and obtain a detailed Test Report on parameters identified in the IS 13428:2005 for chemical analysis.

Step III Obtain sterilized glass bottles from the Public Health Labs in the Dzongkhag and submit water sample to them for testing. This step could not be followed in all cases, since most of the Public Health Laboratories accepted samples only within 6 hours of collection, and did not accept any samples after 1.00 pm, by when it was often not possible for the survey team to return from interior areas.

With the single basic criterion for selection of the chemical test Laboratory being its Bureau of Indian Standards (BIS) or Government recognition, the following Labs were short-listed:

S. No.	Name of Laboratory	Contact Person	Address	Accreditation
1	SGS India Pvt. Ltd.	Dr. Nemai Ghosh	Laboratory Behala Industrial Complex Ph II, 1st Fl, 620 Diamond Harbour Rd, Kolkata -700034,WB	Bureau of Indian Standards
2	TEAM Test House	Dr. S.C Rastogi	Laboratory G1-584, Sitapura Industrial Area, Jaipur - 302001, Rajasthan	Government of India Approved Lab vide MOEF Notification No.S.O.2031(E) Dated: 27.11.06

Table 1.1: List of Laboratories

1.2 Site-wise Survey Reports Paro Dzongkhag

The Survey Team started field investigation work on January 20, 2007 and completed it by March 6, 2007.Table 1.2 is an index of the summarized survey reports, which is given below:

S. No.	Dzongkhag	Survey Ref. No.	Location	Rank	Remarks
I	Thimphu	1	Thrinleygang		Excluded as advised
		2	Goenchhu (Goenekha)		Rejected due to habitation near the source
II	Punakha	3	Lobesa	15	
		4	Koma Tshachhu	18	
III	Wangdue Phodrang	5	Tiki Zampa	9	
		6	Rakhe Zam		Rejected due to foul smell/taste
		7	Basachhu		Rejected due to habitation
IV	Paro	8	Eusuna, Chuzom Paro Road	4	
		9	Shari Village		Rejected due to insufficient flow from source
		10	Nemi Zampa (Below Dzong)		Rejected due to habitation
		11	Below Taktshang		Rejected due to low TDS
		12	Jangtoena Village		Rejected due to habitation near the source
V	Samtse	13	Bhotedhara	11	
		14	Chengmari – Dhapper	10	
		15	Chengmari Village		Rejected due to low TDS/habitation
		16	Kuchidiana		Rejected (river water)
		17	Panidhara		Rejected due to low TDS and habitation near the source
		18	Darankhola		Rejected due to low TDS
		19	Hungay Village		Rejected due to low TDS and habitation near the source
VI	Sarpang	20	Simsar Pokhari, Noon Pani	13	
		21	Kami Khola		Rejected due to low TDS and habitation near the source
		22	Jigmecholing village, Surey	16	Rejected in chem. analysis
		23	Box Cutting	14	
		24	Gelephu Tshachhu		Rejected due to foul smell/taste
		25	Activated Charcoal Factory		Rejected due to low TDS and insufficient flow from source
		26	Aipoly Upper Source	5	
		27	Aipoly Lower Source	8	
VII	Samdrup Jongkhar	28	Ngelong		Rejected due to insufficient flow from source
		29	Ngelang Chiloo	12	
		30	30/1 Culvert Lamsarong	7	
		31	25 km N of SJ Town	3	
		32	Marthang 0		Rejected due to insufficient flow from source
		33	Marthang Bridge	6	
		34	Demola	2	
		35	Demola Bridge	1	
VIII	Chhukha	36	C Adit of Tala Power Station	17	

Table 1.2: Summarized Survey Reports

The sites, which had major disqualifying factors observed, were rejected and the balance ranked according to weighted decision factors. The sites which were rejected during the site physical survey were not included in the ranking process for the final selection. In such sites the rank column in above table is blank.

1.2.1 Detailed Survey Report - Paro Dzongkhag

Paro is situated in the northwestern part of the country. It covers a total land of 1,285.5 sq. km. Paro is one of the developed Dzongkhags in the country. In the west of the Dzongkhag lies Haa, in the east is Thimphu and in the south is Chhukha Dzongkhag. It is located at an altitude of 2,250 m above the sea level. About 65.2 % of the land is covered by forest.

The Dzongkhag has national highways linking it to both Phuentsholing and Thimphu. The only Airport in the Kingdom is located in the Dzongkhag, which offers development opportunities related to being the only port of arrival and departure by air for international tourists.

For mineral water project in Bhutan, site surveyed in Paro Dzongkhag are as follows:

- Eusuna, Chuzom Paro Road
- Shari Village
- Nemi Zampa (Below Dzong)
- Below Taktshang
- Jangtoena Village

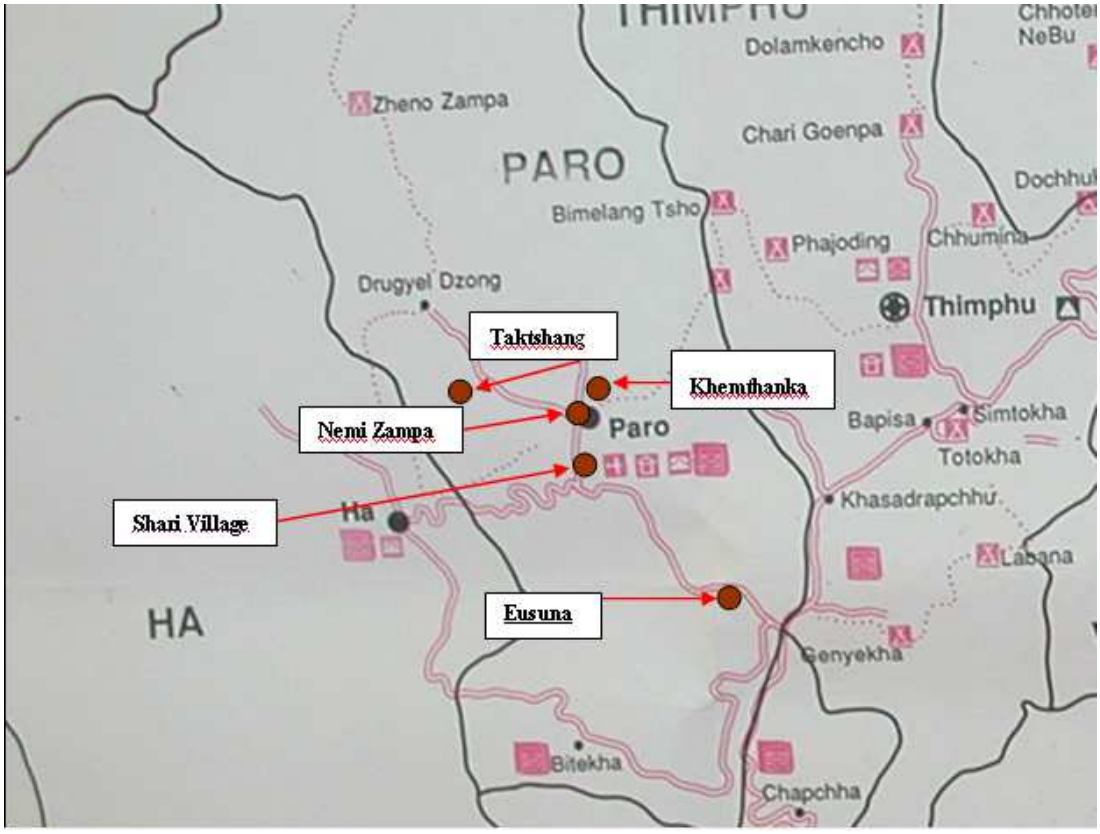

Fig.1: Site Surveyed Paro

***Detailed site survey reports are given in the Appendix – I: Site–wise survey reports**

a. Eusuna

Survey Ref. No. 8:
Sample ID # 7

Five km on the road from Chuzom Bridge to Paro, there is a spring water source right on the road at Culvert 5/1. This is a steady source of sweet water used by passers-by as well as the Forest Plantation on the land between the road and the river Parochhu below. The upper reaches of the source are uninhabited and there is no farming or orchard growing in the catchment area. However, the highway is being widened and the spring source may be disturbed.

Measurements of the water showed the following readings:

TDS: 183 / 177 mg/litre **Temperature**: 15 / 16 ^{o}C **Volume:** 30 lpm

Classification of water is:

As per IS:13428:2005	US FDA	European Union Codex
Natural Mineral Water	Spring Water	Mineral Water

Spring water comes out through angular boulders of quartzite and hard schistose rocks in a small depression in the sheared and weathered mica schist zone of 30 metre width. On either side of the weathered mica schist band, there is unweathered mica schist dipping steeply in a northerly direction. The weathered zone forms a slight depression in topography, which extends for about 200 m up the slope with only bushy jungle. There is no well developed drainage above the spring and no possibility of contamination of the water source. In fact the whole area looks very dry with scanty vegetation.

About 500 m from the Eususna spring towards Chuzom is another spring at a place called Arikha. The source is located about 50 m above the road, secluded from public view.

Fig. 2: Checking the spring water at Eusuna

Field test results of the water showed:

TDS: 193mg/litre **Temperature:** 15^{o}C **Volume**: 20 (estimated) lpm

As per IS:13428:2005	US FDA	European Union Codex
Natural Mineral Water	Spring Water	Mineral Water

There is about one acre of Government land on the other side of the Paro Chhu (directly opposite the Arikha spring source) to which a bridge over the river as a part of village farm road, is being constructed presently.

Power supply is available in the area. Land for plant may be taken from forest nursery below the Eusuna spring or a private apple orchard located at about 1.6 km towards Paro or the Government land opposite the Arikha spring. Workforce may be available from Eusuna village or can be brought in from Thimphu or Paro.

Therefore, the spring water from Eusuna and Arikha may be combined to set up a natural mineral water treatment and bottling plant.

b. Shari Village

Survey Ref. No. 9

Driving about 3 km northeast of Paro Town on a metalled road and 2 km on a rough village road brings one to the Shari village. A 150 m walk through houses, are located 2 spring sources at the base of the hillslope to the east of the village. The hillslope consists of micaceous quartzite with reddish topsoil just above the ponds. About 30 m up the slope, thicker vegetation starts and no rocks are exposed. The whole hillside forms a very stable gently sloping terrain.

Fig. 3: With Gup Dep Dorji at Shari Village

The area is dry and the village has an irrigation channel flowing about 50 m above the springs. Some water from the channel was seen flowing/seeping into the spring water ponds. Gup Dep Dorji said that water was just enough for 5 households in the immediate neighborhood but 15 households of the village were using it and some contamination from the channel could not be avoided.

Test readings of the water were:

TDS: 45 mg/litre **Temperature:** 16^{o}C **Volume:** 50 lpm (estimated)
(Note: these readings are not reliable due to mixing of irrigation water).

If the water proves to be from a spring source which can be isolated, the classification is:

As per IS:13428:2005	**US FDA**	**European Union Codex**
Not Natural Mineral Water	Spring Water	Mineral Water

The access to water source is good but it is not even sufficient for use by the village. Flat land though privately owned is available close by for treatment and bottling plant but it is all paddy field, which by law, can not be converted for any other use.

Thus, this site is dropped for DFR preparation due to uncertainty of water quality and its insufficiency.

c. Nemi Zampa

Survey Ref. No. 10

About 150 m walk from the traditional wooden bridge (Nemi Zampa) below Paro Dzong on the left bank of Paro Chhu, there is water (drupchhu – holy water) coming out from under the Monastery below the Dzong. The source channel is at a height of about a metre above the Paro Chhu at its low flow level. This spring source is reported to be completely submerged during the rainy season in summer (see photos). Test results were:

TDS: 183 mg/litre **Temperature:** 15 ^{o}C **Volume:** 70 lpm (estimated)

If the water source can be identified and isolated, the classification will be:

As per IS:13428:2005	US FDA	European Union Codex
Natural Mineral Water	Spring Water	Mineral Water

The Paro Dzong is built on a massive rock base which consists of flaggy quartzite of the Paro / Shumar Formation. Solution of carbonate rocks is seen on the surface of the quartzite outcrop in a number of places. The whole slope in the vicinity of the Dzong, above the spring water source has scanty vegetation and is very dry during the winter months.

Land, power supply and other infrastructure facilities are available. The source itself is considered holy and this could be the USP of the water.

On the other hand, it would be extremely difficult to locate the actual source of the water below the Dzong structure, which is built atop massive rocks. If isolated, it would also need to be protected from contamination with river water, which is reported to rise above this source during the rainy season.

Fig.4: View of the spring as it emerges from below the Dzong

Fig. 5: View of spring water joining the Paro Chhu

There is also the issue of habitation in the Dzong above, unless it can be proved that the water source comes from a different catchment area altogether.

Transport costs will be reckoned to the border at Phuentsholing town (165 km).

Attractive though it appears, this source is not considered further for purposes of the DFR.

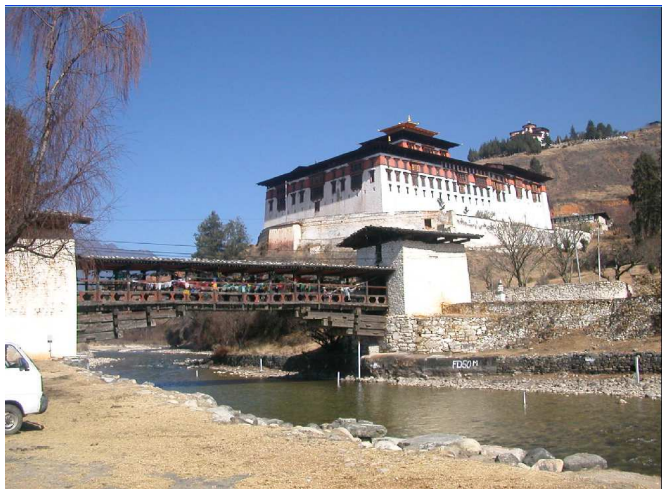

Fig. 6: Nemi Zampa leading to Paro Dzong

d. Taktshang Monastery Base

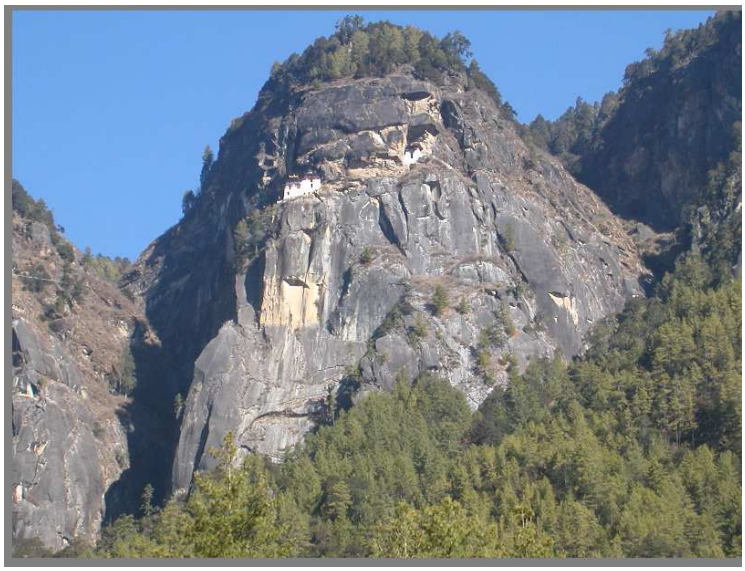

Fig. 7: The Monastery at Taktshang

About 8 km north of Paro Town and another 3 km east over Paro Chhu, one reaches the base of the promontory housing the famed Taktshang Monastery of Guru Rimpoche. The metalled motor road ends at a parking lot for the Monastery pilgrims. Walking 500 m up along a footpath, one is at the base of the vertical cliff on a ledge of which is perched the Taktshang Monastery.

At this location there are two streams (a) one flowing from the RHS & (b) the other from the LHS of the promontory /Monastery. Stream (a) is a high discharge stream from a lake above the Monastery flowing through the steep rocky gullies on the western slopes of the Monastery.

Stream **(a)** drives a large Prayer Wheel. Tests of this water showed:

TDS: 17 mg/litre **Temperature:** 6^{o}C **Volume:** 200 lpm(estimated)

Stream **(b)** is smaller and flows from the base of the rocky slope on the eastern side of the promontory/Monastery.

Test readings were:

TDS: 19 mg/litre **Temperature:** 5^{o}C **Volume:** 75 lpm (estimated)

The 3rd water **(c)** drives the prayer wheel near the car parking for the Monastery pilgrims. The stream water flows from the high mountains east of the Taktshang Monastery, the slopes of which consist of the Taktshang gneiss of the Thimphu formation. The stream water flows from the high mountains through well-developed drainage pattern in the area. Test readings were:

TDS: 9 mg/litre **Temperature:** 5^{o}C **Volume:** 150 lpm (estimated)

All the waters conform to following classification (if the spring sources are verified)

As per IS: 13428:2005	**US FDA**	**European Union Codex**
Not Natural Mineral Water	Spring Water	Mineral Water

The rocks in the area consist of the Taktshang gneiss of the Thimphu formation. The Monastery is built on a ledge in the massive steep-faced gneissic rock about 400 m from the base of the vertical cliff. The total height of the cliff is about 600 m. The area can be assumed to fall in Seismic zone IV.

Relatively flat land, power supply and other infrastructure facilities are available for a mountain spring water treatment and bottling plant. However, such a plant already exists near the main market of Thimphu, the Bhutan Agro-Industries Ltd. at Wangchhu Taba. Transporting the product to Phuentsholing for 176 km may not be viable for non-mineral water, and this area is dropped from further consideration for the DFR.

e. Khemthanka in Chang Jangtoena Village

Survey Ref. No. 12

Dzongkhag: Paro

Driving 3 km south from Paro Dzong towards Bondey, there is a turn off towards northeast for Jangtoena village. Two km rough track starts with a steep climb and 300 m is on a footpath through a wide valley with extensive habitation and agriculture, to reach a small pond among the paddy fields.

Fig. 8: Small spring at Jangtoena Village

The test results of this water were:

TDS: 164 mg/litre

Temperature: 14^{o}C

Volume is not measurable but is low and barely sufficient to fill a horizontal 1" pipe. Classification of this spring water is:

As per IS:13428:2005	US FDA	European Union Codex
Natural Mineral Water	Spring Water	Mineral Water

Another small spring was seen below towards west of the first one.

The stream flowing through the village originates high up in the mountains, which consist of the rocks of the Paro/Shumar formation. The Stream water through village was also checked and gave the following results:

TDS: 142 mg/litre

Temperature: 11^{o}C

Volume: Large volume could not be estimated on account of multiplicity of channels, which irrigate the fields in the village. If the source could be identified as a spring and isolated, its classification would be:

As per IS :13428:2005	US FDA	European Union Codex
Not Natural Mineral Water	Spring Water	Mineral Water

The survey team searched for the village named 'Chimithang' in the list given by the MTI, but no such village was found in the area. Villagers in Jangtoena informed the team that there was a place called Khemthanka about 1 km upstream from Jangtoena village, where there were small ponds of Menchhu (medicinal water) but with little discharge. The slopes of Khemthanka had reddish looking topsoil cover with scanty vegetation and no rocky outcrops on the slopes.

Relatively flat land, power supply and other infrastructure facilities are available for a mineral water treatment and bottling plant.

However, the spring is located below the paddy fields from which contaminated water would seep into the spring water during the summer season. Also, the discharges from the ponds are minimal. Looking to the virtual impossibility of securing the perimeter due to considerable habitation, this source is not considered further for the DFR.

***Detailed site survey reports are given in the Appendix – I: Site–wise survey reports**

1.3 Site Selection Matrix

For the selection of top three sites, a comparison is possible only when the various parameters (discussed in section 1.1) are assessed numerically to enable a balanced comparison. As such, each parameter is graded from 1 to 10 for each site. However, each parameter does not carry equal importance for the selection of the site. As such, recourse is taken to the standard weighted averages method and a site selection matrix developed.

1.3.1 Weighted Averages Method

A weighted average is the average obtained after giving weights to different numbers in proportion to their importance. In site selection, there are 'Hard' factors, implying that the ground conditions are inflexible or 'Soft' implying that adjustment is possible to accept any adverse aspect. Each factor is assigned a weight such that the total of all weights is 100. The relative importance of each factor is thus considered. The assigned weights are listed below in tables 1.3, 1.4 and 1.5.

1.3.2 Factors affecting Site Selection

S. No.	Criteria	Weight Percent (%)
A	**Soft Factors**	
1.0	Land Access Conditions	16
2.0	Environmental Considerations	8
3.0	Socio Economic Factors	16
	Total	**40**
B	**Hard Factors**	
4.0	Investment Considerations	20
5.0	Operational Logistics	10
6.0	Future Development Possibilities	10
7.0	Water Characteristics	20
	Total	**60**

Table 1.3: Site Selection Criteria

Further, each factor has a number of criteria (sub-factors) that compose it. These sub-criteria are also weighted in order of importance as shown in tables No.1.4 and 1.5.

A. Soft Factors:

S. No.	Sub-criteria	Weight Percent (%)
1.0	**Land Access Conditions**	
1.1	Land Availability near Source	4
1.2	Road Connectivity	4
1.3	Power Availability	4
1.4	General Topology	4
2.0	**Environmental Considerations**	
2.1	Water Hydrology	4
2.2	Ecology	4
3.0	**Socio Economic Factors**	
3.1	Land Use	4
3.2	Employment	4
3.3	Quality of Life	4
3.4	Present Use of Spring Water	4

Table 1.4: Soft Factors

B. Hard Factors:

S. No.	Sub-criteria	Weight Percent (%)
4.0	**Investment Considerations**	
4.1	Land & Site Development	5
4.2	Power Availability	5
4.3	Source to Plant Linkage	5
4.4	Habitation at Source	5
5.0	**Operational Logistics**	
5.1	Raw Material Transport	5
5.2	Finished goods Transport	5
6.0	**Future Development Possibilities**	
6.1	Project Expansion	5
6.2	Ancillary	5
7.0	**Water Characteristics**	
7.1	Taste & Odor	5
7.2	TDS	5
7.3	PH	5
7.4	Volume	5

Table 1.5: Hard Factors

1.3.3 Site Ranking Methodology

The sites are rated against the above criteria and the rating score against each criterion is multiplied by the weight assigned to that criterion. This figure is added for all criteria and finally divided by the total of the weights assigned viz. 100. The process is

1. Rating (between 1-10) given for each site under each sub head (parameters) for all 7 heads.
2. Each rating is multiplied by the corresponding weight per cent.
3. The product (Rating X Weight %) is totaled for all the criteria to give the Weighted Score.
4. The Weighted Score for each subhead is totaled to give the total score.
5. The sites are then ranked according to this total score.

This is depicted in the matrix on the following page.

Example of ranking method

Ranking Procedure:

Weighted Score = (Average of sum of sub-head weight %) X (Sum of rating of all criteria under subhead)
Total Score = Sum of all weighted scores of heads
Ranking = Gradation of total scores from highest to lowest

Ranking of Eusuna Paro (Survey Ref. No. 8)

Head 1
Weighted score =1.24

Weighted Score = [{(4+4+4+4)/4 *100} X {(8+8+8+7)}]
= [{(16/4*100)} X {(31)}]
= [0.04 X 31]
= [1.24]

Total Score = Sum of all weighted scores of heads (one to seven as given in table 1.3.4 column 1st)
= [1.24+0.64+1.12+1.45+0.5+0.5+1.55]
= 7.00

Ranking = Gradation of Total Scores from highest to lowest
Eusuna Paro: Ranking = 4

Survey Ref. No.			3	4	5	8	13	14	20	22	23	26	27	29	30	31	33	34	35	36
HEAD	**Sub Head**	**Weight Percent**	**Lobesa Punakha**	**Koma Tshachhu (lowerSource) Punakha**	**Tiki Zampa WP**	**Eusuna Paro**	**Bhotedhara Samtse**	**Dhapper Samtse**	**Simsar Pokhari**	**Jigmecholing Village**	**Boxcutling Sarpang**	**Aipoly Upper Spring S/J**	**Aipoly Lower Spring S/J**	**Ngelang Chiloo S/J**	**Culvert 30/1 Lamsarong S/J**	**25 km stone N of S/J**	**Marthang bridge S/J**	**Demola S/J**	**Demola Bridge S/J**	**Nr C Adit of Tala Power**
			Site Rating																	
1	1.1	4	8	1	8	8	8	8	7	7	5	4	6	7	1	5	7	6	6	6
	1.2	4	8	1	8	8	8	8	2	4	7	6	6	7	7	7	7	7	7	6
	1.3	4	7	1	6	8	7	7	6	6	6	6	6	7	6	6	7	7	7	8
	1.4	4	7	3	7	7	7	7	4	7	5	5	7	7	7	7	6	7	7	6
Weighted Score			**1.2**	**0.24**	**1.16**	**1.24**	**1.2**	**1.2**	**0.76**	**0.96**	**0.92**	**0.84**	**1**	**1.12**	**0.84**	**1**	**1.08**	**1.08**	**1.08**	**1.04**
2	2.1	4	4	7	8	8	5	5	4	6	6	7	6	7	7	7	7	7	7	5
	2.2	4	8	2	6	8	6	6	6	7	6	7	7	7	7	7	8	8	8	9
Weighted Score			**0.48**	**0.36**	**0.56**	**0.64**	**0.44**	**0.44**	**0.4**	**0.52**	**0.48**	**0.56**	**0.52**	**0.56**	**0.56**	**0.56**	**0.6**	**0.6**	**0.6**	**0.56**
3	3.1	4	5	6	6	8	5	5	7	1	3	7	7	4	1	8	8	8	8	3
	3.2	4	5	2	7	8	6	7	7	7	7	7	7	7	7	7	7	7	7	7
	3.3	4	7	1	8	5	7	7	6	6	5	6	6	6	6	6	6	6	6	6
	3.4	4	5	1	8	7	6	5	7	1	7	9	8	6	9	8	7	9	9	6
Weighted Score			**0.88**	**0.4**	**1.16**	**1.12**	**0.96**	**0.96**	**1.08**	**0.6**	**0.88**	**1.16**	**1.12**	**0.92**	**0.92**	**1.16**	**1.12**	**1.2**	**1.2**	**0.88**
4	4.1	5	4	2	7	6	8	8	5	5	3	8	8	6	3	6	6	6	6	1
	4.2	5	6	2	6	7	7	7	7	7	6	7	7	6	5	6	6	6	6	8
	4.3	5	8	3	8	7	7	7	8	7	5	3	5	7	3	5	7	6	6	4
	4.4	5	6	9	8	9	4	3	5	5	4	9	7	6	8	7	8	8	8	4
Weighted Score			**1.2**	**0.8**	**1.45**	**1.45**	**1.3**	**1.25**	**1.25**	**1.2**	**0.9**	**1.35**	**1.35**	**1.25**	**0.95**	**1.2**	**1.35**	**1.3**	**1.3**	**0.85**
5	5.1	5	4	1	4	5	7	7	5	6	6	8	8	8	8	8	8	8	8	5
	5.2	5	4	1	4	5	7	7	5	6	6	8	8	8	8	8	8	8	8	5
Weighted Score			**0.4**	**0.1**	**0.4**	**0.5**	**0.7**	**0.7**	**0.5**	**0.6**	**0.6**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.5**
6	6.1	5	1	1	5	5	7	7	6	6	5	8	7	1	8	8	4	7	8	2
	6.2	5	1	1	5	5	7	7	6	6	5	8	7	1	8	6	4	6	7	1
Weighted Score			**0.1**	**0.1**	**0.5**	**0.5**	**0.7**	**0.7**	**0.6**	**0.6**	**0.5**	**0.8**	**0.7**	**0.1**	**0.8**	**0.7**	**0.4**	**0.65**	**0.75**	**0.15**
7	7.1	5	7	1	8	8	7	7	7	8	7	8	8	8	8	8	7	8	8	7
	7.2	5	8	9	1	8	1	2	5	3	7	3	3	5	7	7	9	9	9	7
	7.3	5	7	9	5	8	1	1	4	1	9	9	1	7	9	9	9	9	9	1
	7.4	5	1	8	5	7	6	6	8	6	5	8	6	1	9	9	1	6	9	1
Weighted Score			**1.15**	**1.35**	**0.95**	**1.55**	**0.75**	**0.8**	**1.2**	**0.9**	**1.4**	**1.4**	**0.9**	**1.05**	**1.65**	**1.65**	**1.3**	**1.6**	**1.75**	**0.8**
Total Score			**5.41**	**3.35**	**6.18**	**7.00**	**6.05**	**6.05**	**5.79**	**5.38**	**5.68**	**6.91**	**6.39**	**5.80**	**6.52**	**7.07**	**6.65**	**7.23**	**7.48**	**4.78**
Ranking			**15**	**18**	**9**	**4**	**11**	**10**	**13**	**16**	**14**	**5**	**8**	**12**	**7**	**3**	**6**	**2**	**1**	**17**

Table 1.6: Site Selection Matrix

Ranking Procedure:

Weighted Score = (Average of sum of sub-head weight %) X (Sum of rating of all criteria under subhead)
Total Score = Sum of all weighted scores of heads
Ranking = Gradation of total scores from highest to lowest

1.4 Selection of Three Best Locations

The matrix on the preceding page indicates that the following locations are the best choices for setting up the projects:

Ranking	Location	Score	Dzongkhag
1	Demola Bridge	74.8	S/J
2	Demola	72.3	S/J
3	25 km Milestone N of Samdrup Jongkhar Town	70.7	S/J
4	Eusuna	70.0	Paro
5	Aipoly Top Spring	69.1	Sarpang

Table 1.7: Selection of Best Locations

Out of these selections, we note that the first 3 sites for Natural Mineral Water are all on the Samdrup Jongkhar Town to Trashigang Road within a few kilometres of each other. It is recommended that the project is set up at one of these 3 sites. As soon as this project goes on stream and the market picks up, the other units can be established on the same modular basis that is presented in the detailed report in Volume A. Thus, we select Demola Bridge as the site for setting up the first 50 bottles per hour Natural Mineral Water Bottling Plant.

Eusuna, Paro comes next in ranking on the list, and we recommend setting up of a 25 Bottles per Minute Natural Mineral Water Bottling Plant at this location.

This volume in your hands is Volume B presenting the Detailed Feasibility Study Report for Mineral Water Plant at Eusuna.

The next ranking is of the Aipoly Top Spring. However, at this site, the water has a TDS of 69 only, which excludes it from certification under IS: 13428:2005, for the Indian market, but

a. It is natural mineral water acceptable for European and Far Eastern markets
b. It can be introduced to the Indian market as 'Sparkling Spring Natural Mineral Water', which will be its unique selling point

Therefore, the 3rd project is recommended for set up at Aipoly Top Spring for a 50 Bottles per Minute Sparkling Water Plant.

These selections are therefore finalized and the Detailed Feasibility Reports made for each of these locations and presented in three reports follows:

Report A: Natural Mineral Water Project at Demola, Samdrup Jongkhar Dzongkhag
Report B: Natural Mineral Water Project at Eusuna, Paro Dzongkhag
Report C: Sparkling Spring Water Project at Aipoly, Sarpang Dzongkhag

This report contains:

"Natural Mineral Water Project at Eusuna, Paro Dzongkhag –Bhutan".

2.0 Justification of the Project

The justification of the Natural Mineral Water Project at Eusuna is obtained by examination of several factors broadly grouped under two heads, viz.:

1. Need and importance of the Project to the economy
2. Current and future prospective of the Project

The project itself has to be found viable and this viability depends upon:

1. Quality and available volume of the water
2. Feasibility of putting up a treatment and bottling plant near the source

These factors are examined below to enable an investment decision.

a. Water Quality and Availability

The special characteristics of Natural Mineral Water have been explained earlier in chapter 1.0. It must originate from an underground water table or aquifer, and emerge as a spring. It should be possible to tap it at the natural bore without any possibility of contamination. It must come from an officially recognized spring and must be microbiologically wholesome and be naturally free from pollution and parasitic, pathogenic and other harmful micro-organisms. It must be bottled at source. Natural mineral water is characterized by its chemical composition and may not be treated in any way that alters this composition.

Eusuna has emerged proven on all the above counts and its water is eminently suitable (see note in chapter 5.0) for being marketed as "Packaged Natural Mineral Water".

- Under Indian Standard IS: 13428: 2005
- Under the European Codex CAC/RCP 33-1985 : Code of Practice for Collecting, Processing & Marketing of Natural Mineral Water
- Under the US FDA Regulations as 'Spring Water'

b. Feasibility of the Plant

The feasibility of setting up this project is determined by its physical and financial aspects. The physical aspect has been determined by the scores for this location in the Site Selection Matrix (see chapter 1.0 Section 1.3). The scores for this project in the section, 'Selection of the Best Sites', are shown below.

Selection Criteria Scores

S. No.	Criteria	Eusuna (Score out of 10)
1.0	**Land Access Conditions**	
1.1	Land Availability near Source	8
1.2	Road Connectivity	8
1.3	Power Availability	8
1.4	General Topology	7
2.0	**Environmental Considerations**	
2.1	Water Hydrology	8
2.2	Ecology	8
3.0	**Socio Economic Factors**	
3.1	Land Use	8
3.2	Employment	8
3.3	Quality of Life	5
3.4	Present Use of Spring Water	7
4.0	**Investment Considerations**	
4.1	Land & Site Development	6
4.2	Power Availability	7
4.3	Source to Plant Linkage	7
4.4	Habitation at Source	9
5.0	**Operational Logistics**	
5.1	Raw Material Transport	5

S. No.	Criteria	Eusuna (Score out of 10)
5.2	Finished Goods Transport	5
6.0	**Future Development Possibilities**	
6.1	Project Expansion	5
6.2	Ancillary	5
7.0	**Water Characteristics**	
7.1	Taste & Odor	8
7.2	TDS	8
7.3	pH	8
7.4	Volume	7

Table 2.1: Scores of Eusuna site on Selection Criteria

The financial feasibility has been worked out and the project is financially and economically justified (see chapters 10.0 and 11.0). The Financial Performance Indicators for the project are:

S. No.	Indicator	Values
1	Payback Period	2.95 years
2	Debt Service Coverage Ratio (Average)	4.22
3	Return on Investment (Average)	55.60
4	Net Profit Ratio (Average)	22.70 %
5	Break Even Point (Average)	43.30 %
6	Debt Equity Ratio (Average)	0.36 %
7	Return on Capital Employed (Average)	15.62 %
8	Net Profit after Tax (Average)	Nu.75.97 Lacs

Table 2.2: Performance Indicators

It is seen that the project is justified as presented.

2.1 Need and Importance of the Project to the Economy

Micro and Macro Economic Analyses reveal the following:

- There is no commercial utilization at present of the natural mineral water of Bhutan, while the worldwide demand for it is increasing rapidly.
- There is no significant industry in Paro Dzongkhag, at present, in this range of investment.
- The local population has a significant percentage in search of employment.
- The site has high visual publicity since it is on the main air – road link of Thimphu with the rest of the world.
- The setting up of the project will generate revenues for the state.

It is expected that Paro Dzongkhag in general and Gewog Doger in particular, will benefit greatly from this project in the following ways:

S. No.	Parameter	Change Due to Project Implementation	
		Before (Present)	**After** (Future)
1	Employment – Direct	0	62
2	Employment – Indirect comprising services for • Transport of raw materials • Transport of finished products • Transport of personnel • Gardening and afforestation • Canteen and food • Phone, courier etc.	0	100 (estimated)
3	Direct impact on economy • Land lease charges (1st year) • Interest paid out (nominal) • Insurance charges (1st year • Employee salaries (1st year) • Employee fringe benefits (1st year)	 0 0 0 0 0	 Nu. 1.07 Lacs Nu. 19.42 Lacs pa Nu. 0.48 Lacs Nu. 36.78Lacs pa Nu. 5.52 Lacs

S. No.	Parameter	Change Due to Project Implementation	
		Before (Present)	**After** (Future)
3	• Income tax earning (1st year) • Power consumption charges • Sales generated • Misc. local purchasing	0 0 0 0	Nu. 19.87Lacs pa Nu. 6.50acs Nu. 616.80 Lacs pa Nu. 5.00 Lacs (estimated)

Table 2.3: Micro and Macro Economic Analysis

It is seen that there will be direct employment offered for 62 persons, and the local economy will get a boost by way of transportation services for raw material, finished goods as well as personnel. Support services such as gardening and afforestation will be required as well as petty cash purchasing for the unit, creating direct and indirect employment for the locals. The general business environment will substantially improve as the export of the mineral water increases.

The unit will contribute to the national exchequer by way of income tax, land lease charges, power consumption charges. Product export will earn in Indian currency as well as hard currencies as the Japanese, Middle Eastern and European markets are tapped progressively. At the national level it will help in solving the unemployment problem to some extent.

Paro Dzongkhag will benefit in the following other ways also:

- The industrial environment is non-existent at present and this unit will provide the nucleus for industrial growth in the Dzongkhag.
- Local labour will receive training in industry and this will spur the growth of technical institutes in the Dzongkhag.
- An impetus will be provided for generation of services in the food and clothing sector.

2.2 Current and Future Prospective of the Project

Since there is no competition in Bhutan at present and limited production in India, the current outlook is very good. The local demand for bottled spring water is partly served by the existing company, Bhutan Agro Industries Limited, Thimphu, with its flagship brand “Mountain Spring Water”. This is also exported to neighboring countries such as Bangladesh and India and finds a good response, because it is the only water available to these markets in the form of natural water. Locally bottled water users feel the difference while drinking “Mountain Spring Water” from the Himalayan mountain range, harvested at over 9,000 feet in a pristine environment. However, an estimated 30,000 litres of packaged drinking water is imported from India, in the border regions.

The Bhutan Agro Industries average production volume has been 70,000 one litre bottles per month and this is being increased significantly. The spread of its market outside Bhutan is mostly confined to the border areas in India and Bangladesh. Further, it must be noted that this water is not ‘Natural Mineral Water’ as defined by IS 13428:2005, and will not meet the demand of India, which is presently met by European brands only (two new Indian brands have now entered the Indian market).

Eusuna Mineral Water can be branded as “PARO” to be positioned as exclusively packed from a natural mineral water source and marketed as an exclusive product for a niche market. The clientele for this product would include top five star hotels, upper market retail chains in India, Japan and other Asian Countries like Maldives Islands, Thailand, Korea, Taiwan, Malaysia and Singapore. The European market would be addressed subsequently.

As such, the present prospective is good. The future prospective of the project hinges around the continued availability of the natural mineral water from the spring source. With that assured, there is no constraint on the demand for it, since the worldwide demand for natural mineral water is increasing exponentially.

The strategy for marketing Paro Mineral Water will be to first service the market in Bhutan for natural mineral water, which is presently being met by default, with uncertified ordinary natural water viz. Mountain Spring with a low mineral content. In view of the increasing inflow of high spending tourists who discriminate between packaged bottled water and mineral water, the future of this project at Eusuna is assured.

After its launch and local publicity as ‘Bhutan’s Premier Natural Mineral Water’, it will be ready for the export market. Its introduction on Druk Air, will lead to high brand publicity in the export markets in India, Japan, Middle East and Europe.