DETAILED FEASIBILITY REPORT

Milk Powder Production Unit

in conformity with

The Royal Government of Bhutan's Vision of Achieving

Economic Self-Reliance

June 2015

Ministry of Economic Affairs

Royal Government of Bhutan

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ABBREVIATIONS AND DEFINITIONS

BEP	Break Even Point
BOD	Biochemical Oxygen Demand
BHU	Basic Health Units
BTL	Bhutan Telecom Limited
CAGR	Cumulative Average Growth Rate
COD	Chemical Oxygen Demand
CUSP	Caltech-USGS Seismic Processing
DSCR	Debt Service Coverage Ratio
EA	Environment Assessment
EI	Environmental Information
EMP	Environment Management Plan
EPI	Expanded Program on Immunization
ETP	Effluent Treatment Plant
IMNCI	Integrated Management of Neonatal and Childhood Illness
IRR	Internal Rate of Return
ISPs	Internet Service Providers
LDPE	Low Density Polyethylene
MRP	Maximum Retail Price
MT	Metric Ton
NACP	National HIV/AIDS & STIs Control Program
NEC	National Environment Commission
NPV	Net Present Value
NTCP	National Tuberculosis Control Program
OHS	Occupational Health & Safety

ORC	Out Reach Clinics
PET	Polyethylene Terephthalate
RH	Reproductive Health
RPM	Revolutions Per Minute
RWSS	Rural Water Supply and Sanitation Program
SPM	Suspended Particulate Matter
TSPM	Total Suspended Particulate Matter
TSS	Total Suspended Solids
TICL	Tashi Info Comm Limited
VDCP	Vector Borne Disease Control Program
VHW	Village Health Workers Program
WMP	Whole Milk Powder
WFP	World Food Program

1.0 EXECUTIVE SUMMARY

This report is a detailed feasibility study on the production of milk powder in Bhutan conducted by the Department of Industry under the Ministry of Economic Affairs, Royal Government of Bhutan.

Bhutan has the potential to produce milk powder domestically as the major raw material, milk, is available in plenty. According to the Bhutan Trade Statistics, the import rate of milk powder over the past 10 years has grown at an alarming rate. Strikingly, milk powder imports in 2012 amounted to Nu. 511 million. The Cumulative Average Growth Rate (CAGR) for the last five years (2008-2012) is estimated at 8.23% and 21.63% for quantity and value of imports respectively. Thus, available statistics clearly indicate a good scope for setting up milk powder manufacturing units to meet the growing domestic demand of milk powder.

The report presents in detail the justification of the project, market analysis of milk powder, resources required, technology used, plant location, environmental aspects, implementation of the project, cost presentation and financial analysis.

(i) **Justification of the Project:** A large amount of milk powder is imported every year in Bhutan for households as dairy products form an important component of the Bhutanese dietary system. Milk, the principal raw material for milk powder, is available in Bhutan.

(ii) **Market Analysis:** There is presently no manufacturer of milk powder in Bhutan. The high volume of import indicates a high demand for milk powder. The principal byproduct in milk powder manufacturing is butter & ghee. Dairy products form an important component of the Bhutanese dietary system.

(iii) **Resources required**: The main raw material for production of milk powder is milk. Apart from this, the unit requires electricity & water, which are also easily available in Bhutan.

(iv) **Technology required**: High end technology that employs a spray drying method has been proposed for this plant.

(v) **Plant Location**: Considering the availability of milk in the neighbouring region, Bondyema, 30 km from Mongar, has been proposed as the ideal location for the plant.

(vi) **Environmental Aspects**: The production of milk powder causes air and water pollution but this may be reduced up to a great extent by following the recommended measures.

(vii) **Implementation of the Project**: The implementation of the project will take 12 months including pre-project activities.

(viii) **Cost Presentation and Financial Analysis:**

Table 1: Project Summary

Plant Capacity:	2 MT per day (640 MT per annum)
No. of Shift:	One (8 hours per shift) per day
Working Days in Year:	320
D.S.C.R. :	1.95
B.E.P. :	19.66%
IRR :	16.92%
NPV :	Nu. 16.39 million

The Internal Rate of Return of the project is 16.92%, which is much higher than the bank rate of 13%. Hence the project is financially viable. The NPV of the project is positive (Nu. 16.39 millions) at the discount factor of 13% during the first 10 years of operation considered.

This implies that the project is financially viable.

2.0 JUSTIFICATION OF THE PROJECT

2.1 The Need for the Project

General Scenario: At present, there is no milk powder manufacturer in Bhutan, and the present requirement for milk powder is met by import of milk powder brands such as Everyday, Krematop, and Coffee-Mate. Milk powder is expensive in relation to other food items. For instance, the maximum retial price for a kilogram of Everyday milk powder in March 2014 was Nu. 342. In addition to dairy products, butter also forms an important component of the Bhutanese dietary system.

What is of concern is the fact that the price of milk powder is increasing rapidly. In India the price of milk powder in 2010 was Rs. 131 per kg (Source: The Economic Times, 16th July 2010). This had risen almost 3 times by 2014 (Source: Gujarat Cooperative Milk Marketing Federation, Delhi, June 2014). Since Bhutan imports most of its milk powder from India, this has contributed to a dramatic increase in milk powder prices in Bhutan. Per a news report published on 14th March in Kuensel, milk powder prices in Bhutan had registered an 18% increase in the last six months.

Luckily, milk - the main ingredient for making milk powder - is readily available in Bhutan. According to Department of Livestock, Ministry of Agriculture & Forests, total milk production of Bhutan in 2013 amounted to 30,900 metric tons.

Scope for reducing trade deficit: Bhutan imports huge amount of milk powder from other countries. More strikingly, milk powder imports in 2012 amounted to Nu. 511 million, reflecting a CAGR (Cumulative Average Growth Rate) of 8.23% in quantity imported and 21.63% in import value. Thus the aggregate value of milk powder imports more than doubled over the five-year period. Therefore, an opportunity exists for scaling up capacity in the dairy processing sector and to cater to the domestic demand for milk powder.

The table below shows the amount of milk powder imported:

Table 2: Import of Milk Powder

Year	Quantity Imported (kg)	Value of Imports (Nu.)
2012	2,036,607	510,965,885
2011	1,160,099	265,736,902
2010	1,590,602	297,972,734
2009	1,470,806	252,849,340
2008	1,484,057	233,479,635

(*Source*: Bhutan Trade Statistics, Department of Revenue and Customs, Ministry of Finance)

Thus, available statistics clearly indicates that there is a good scope for setting up milk powder manufacturing units to meet the growing demand of milk powder.

2.2 Competition Analysis

There are no manufacturing units for milk powder in Bhutan. Milk powder and other substitutes are imported from India & other countries.

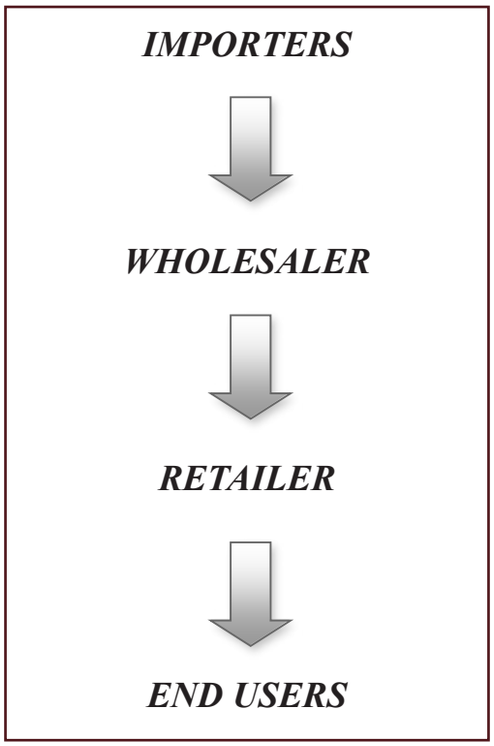
In Bhutan, the major importers of milk powder are Bhutan Dairy Limited, Tashi Commercial Corporation, Damchen and 8Eleven.

3.0 MARKET ANALYSIS

3.1 Structure of the Industry

The Key Stakeholders

For Bhutan, marketing system for milk powder can be said to comprise of following stakeholders:



Importers: The person or firm that imports milk powder, butter and ghee from other countries.

Wholesaler: Intermediary entity in the distribution channel that buys large quantity of milk powder, butter and ghee from the manufacturers and resells it to retailers.

Retailers: Businesses that buy milk powder, butter and ghee from wholesalers and sell it to end users.

End Users: End users are those who buy milk powder, butter and ghee from retailers and are the consumers.

3.2 Demand vs. Supply

Dairy products, especially butter and cheese, form an important component of the Bhutanese diet. According to the Bhutan Trade Statistics, 2,000 metric tons of milk powder was imported in 2012.

Taking the data from Table 1, the CAGR of 8.23 % mentioned under **Section 2.1** and extrapolating beyond 2012 – the expected volume of imports in 2015 is found to be 2,580 metric tons. .

Table 1: Quantity & Value of milk powder imported year on year

Year	Quantity Imported (kg)	Value of Imports (Nu.)
2012	2,036,607	510,965,885
2011	1,160,099	265,736,902
2010	1,590,602	297,972,734
2009	1,470,806	252,849,340
2008	1,484,057	233,479,635

3.3 Pricing & Marketing Strategies

This marketing effort will call for a strategy based on segmenting, targeting & positioning.

Segmenting: The act of dividing the market into distinct groups of buyers who might require separate offerings in terms of product attributes, pricing, promotion and distribution. Broadly speaking the milk powder market in Bhutan is primarily an urban phenomenon. It can be classified in to **1. Individual consumers 2. Institutional buyers**

Further classifications can be done – **Individual consumers** can be broken down to

1.1 High Income

1.2 Middle Income

1.3 Low income groups

Similarly Institutional buyers can be split into the following groups

2.1 Hotels & Restaurants

2.2 Hospitals

2.3 Armed forces

2.4 Factory canteens

2.5 Canteens in residential schools & college

Targeting: This is the act of choosing some of the segments identified from considerations of commercial attractiveness. As Bhutan is a small market, it may be worthwhile to address all three individual consumer groups. Accordingly, the company can offer large packets for high income groups, economy packs for middle income groups and sachets for low income groups.

Similarly, among institutional buyers, a properly devised sales plan must emphasise the consistency in quality as well as quantity in supplying the product. Time and again, consultations with hotel and restaurant owners and boarding school administrators have yielded the feedback that while they would prefer to purchase agricultural and livestock products from local vendors, the inability to meet demand consistently is the main challenge.

Positioning: This is the act of providing a viable competitive positioning of the firm and its offer in each target market. It should ideally communicate uniqueness that adds value.

Some viable positioning statements could be

- Made in Bhutan – the authentic Bhutanese milk powder
- A Quality product – meets established quality standards
- Desirable product benefits – tasty & nutritious
- Affordably priced
- Readily available

The marketing mix should accordingly be defined to highlight various aspects such as product attributes (quality and packaging), pricing strategy, promotion and distribution and logistics all carefully designed to ensure a high level of consumer satisfaction.

Product: By supplying proper quality of product the unit can ensure that their products are considered at par with imports. The units must brand their supplies with an appropriate logo printed on stickers.

Price: To establish the product in the market competitive pricing strategy would be used. As there is no manufacturer of milk powder the price will be compared with the imported milk powder and therefore the price cannot be very different. Similarly there should be attractive margins for the trade – in keeping with or ahead of the market.

Promotion: The promotional strategy for individual buyers could be as follows. For individual consumers, the company would target dealers, wholesalers and consumers to convey to them the benefits of the products through proper media channels like radio, television and outdoors. There should be attractive performance recognition schemes and contests for dealers – particularly for the first year of operation. For institutional buyers, the sales team would ensure that the segment is well covered by initiating cold calls and staging product presentations to spread awareness and generate interest. For customers who already are in a higher state of readiness and floating enquires, the Sales team would respond to them by sending in quotations followed by a discussion and negotiation leading to closures.

The table below shows the promotional activities that must be undertaken

Table 3: Promotional Activity

Serial Number	Promotional Activity
01	The product must be launched with coverage on the radio, TV and newspaper, magazine.
02	Occasional TV and radio advertisements to make households aware about the benefits of the product.
03	Outdoor displays like POPs in groceries
04	There should be attractive performance recognition schemes and contests for dealers – particularly for the first year of operation.
05	Free trials to households by distributing sachets to make them aware of the advantages of the product
06	Regular liasoning with institutional buyers

Place: Superior distribution & logistics is the key to success in a geographical area where rural roads as well as transportation facilities are still at a development stage. The appropriate location for the product would is urban areas. As volume grows, stocking points will have to be contemplated near major urban areas.

3.4 Technological Changes that could Impact Costing

There are a number of technological changes that can impact costing. A set of observations and caveats on technology are listed below:

1. One of the major technological changes that could impact costing is packaging material. There is a variety of packaging options available which must be judged on the basis of attractiveness to consumers as well proper storage and preservation of products and byproducts. The prices of these materials vary with their features. The packaging options are given below:

Table 4: Packaging Options

S. No.	Option	Description
1	Pouch Packaging for Milk Powder	1. 3 – 5 layers pouch bags may be used to store milk powder that can protect the milk powder from light, oxygen etc 2. High quality paper may also be used for packaging

2	Regular Slotted Containers	Containers made out of aluminum may be used to store milk powder
3	Butter Wrap	Wax based or extrusion laminated paper may be used to wrap butter
4	Leak Proof Packets	These packets may be used for storing ghee. These are relatively cheaper
5	Bottle	Bottles may be used to store ghee
6	Disposable Containers	Disposable containers are usually used to store butter and ghee

Needless to state, choosing a cost effective mode of packaging will reduce cost appreciably. For example, if a milk powder unit using metallic cans moves to pouches, there would be a noticeable reduction in cost.

The packaging machinery offered for the plant would use plastic. This is from the point of view of convenience and reduced price of the machinery (approximately 25%). With a steady increase in oil prices in recent years, plastic prices have also shown an upward trend. Once production volumes have increased significantly, it is worth exploring the possibility of shifting to paper, given its lower environmental impact. Minimum estimated savings are expected to be more than 10%.

2. One of the biggest technological changes that can impact the way the unit would conduct business in the future would be the progress of e-commerce and IT adopting in the Bhutanese economy.

In India it has been successfully adopted in contract agricultural farming by ITC using e-choupals – electronic virtual market places that farmers can access from designated nodal centres in villages which would give them an idea about demand conditions and pricing trends so that they can take informed selling decisions ensuring a better return on their investments which in turn can motivate them to produce more. Milk farmers can perhaps be inducted onto a similar model. The Ministry of Agriculture and Forests in Bhutan attempts to keep farmers informed of produce prices through a market information hotline and through SMS services. Greater IT adoption can also prove beneficial to customers as they are informed of market prices and trends.

The impact of all this would be a reduction of the business cycle, greater predictability and control - which would ultimately help to reduce the cost and therefore the price of products.

3. Improvement of the supply chain system for collection of raw milk is essential for improving the cost effectiveness of the product. Milk collections centers can be established who have an understanding or an agreement with the farmers in the area for regular and standardized supply of milk. It is also important that the incoming milk collected from the farmers should be checked and tested such that

appropriate quality standards are adhered to. With a streamlined and continuous supply of standardized raw material the costing would tend to stabilize.

4. The proposed plant is based on a single shift operation. Once the production process stabilizes, adequate supply of milk is guaranteed, it is strongly recommended that the unit moves to a 2 shift operation. The fixed costs would then be more evenly spread, leading to a lower per kg cost.

3.5 Competitiveness of the Project

The project advocates setting up a manufacturing unit of milk powder. The milk powder produced from this proposed unit would compete against imported supplies.The unit aspires to deliver quality products at prices that are in keeping with the market. It is therefore expected that there would be a demand pull at the customer end which can be further strengthened through innovative promotional strategies. The demand pull is estimated to be significant ensuring lowering of costs through economies of scale.

3.6 Special Attributes Desired By Target Customers

In general customers would prefer the following:

1. High Quality Graded Milk Powder
2. They would prefer an affordable price
3. Some would look forward to promotional offer
4. Ready availability
5. Durability of the product
6. Nutritional Value of the milk powder

Details of specification of product are given under the heading Specification of Product & By Product if any **(Section 5.6, Page: 41)**.

3.7 Terms & Conditions and Product Specifications Desired by Target Customers

Product

WMP (Whole milk powder)

Whole milk powder (WMP) is obtained by removing water from pasteurized, homogenized whole milk through evaporation and spray drying processes. It possesses all the appealing qualities of milk and, in its dry form, is an important ingredient in a wide range of food products.

Byproduct

The main byproduct from the process are butter & ghee.

Butter: Butter is water-in-oil emulsion resulting from an inversion of the cream, the milk proteins are the emulsifiers. Butter remains a solid when refrigerated, but softens to a spreadable consistency at room temperature, and melts to a thin liquid consistency at 32–35 °C (90–95 °F).

Ghee: Clarified butter – what remains after milk solids and water has been removed from butter by heating.

3.8 Packaging & Transportation

Figure 1: Packaging of Milk Powder

Multilayer pouch bags are used for packaging of milk powder and for packaging of butter wax based or extrusion laminated film are used. These are low cost materials that are imported and costing is included in the sales and distribution costs showed in the cost working in chapter 10. Milk powder may also be packed in hermetically sealed tinplate containers in Nitrogen or a mixture of Nitrogen and Carbon dioxide gas. Other packing material that may be considered is bag-in-box having inner layers made of PET/LDPE which can be gas flushed. Infant milk food and whole milk powder when manufactured by the spray drying process should be packed in Nitrogen or a mixture of nitrogen and carbon dioxide gas.

It needs to satisfy the following objectives:

1. Protects the quality of the product.

2. Provides information to buyers, such as variety, weight, specification of the product, quality grade, producer's name, country, area of origin, etc.

Refrigerated vans would be required for the transportation of raw milk and butter to keep them from spoliing, whereas regular vans are adequate for the transportation of milk powder and ghee.

3.9 Assessment of Comparative Advantage

a) Abundance of Hydroelectric Power

Bhutan is an energy surplus state. 97% of its energy is obtained from hydro power. During the summer months Bhutan exports quite a bit of electricity to India. Total exports to India were Nu. 10,633.639 million for 2013 – 14. The cost of electricity is lower than many power deficient economies.

b) Availability of Water

Bhutan is endowed with perennial water resources fed by permanent glaciers, glacier lakes and a recurrent monsoon season. The per capita mean flow availability is as high as 109,000 m^3. This compares very

favourably with a developing economy like India which has per capita mean flow availability as low as 1588 m^3.

c) Ready Availability of Milk: Availability of milk in Bhutan is one of the most important factors that must be taken into account for the production of milk powder.

Availability of Milk in Bhutan (2013)

Table 5: Availability of milk in Bhutan

Dzongkhag	Milk (kg)
Bumthang	1,542,007
Chukha	1,580,178
Dagana	1,541,943
Gasa	384,958
Haa	1,362,964
Lhuentse	998,515
Mongar	2,631,807
Paro	2,072,403
Pemagatshel	963,820
Punakha	1,156,811
SamdrupJongkhar	1,732,185
Samtse	1,999,507
Sarpang	1,905,009
Thimpu	1,172,304
Trashigang	3,855,964
Trashiyangtse	1,111,988
Trongsa	1,114,243
Tsirang	1,281,553
Wangdue	1,660,932
Zhemgang	851,172
Total	30,920,261

(*Source*: Department of Livestock, Ministry of Agriculture & Forests, Thimphu, Bhutan)

3. 10 Potential for Marketing Collaboration

There is a potential for marketing collaborations at the customer end of the supply chain.

The unit can appoint independent sales agents or establish exclusive partnerships with certain stores. Ghee can be exported to India, where there is a ready market.

In Bhutan, the major suppliers of milk powder are Tashi Commercial Corporation, Damchen and 8Eleven. The unit can collaborate with these suppliers for marketing purposes.

Tashi Commercial Corporation

Post Box No. 78

Phuentsholing, Bhutan

Contact No: 00-975-5-252246/252420/252417

Fax: 252110

8 Eleven

8 Eleven Group

The Group has a base in Phuentsholing, with outlets in Thimphu.

Contact No: 00975-2-339902/ 00975-02-333007

4.0 RESOURCE

4.1 Sources of Inputs Including Water

Utilities required by the plant consist of electricity and water.

Electricity

Electricity is required to run the production machinery and to provide lighting for the plant. The vast majority of Bhutan's energy is provided by hydroelectric power stations. So except for very remote areas availability of electricity is not a handicap.

Water

Bhutan is endowed with perennial water resources fed with permanent glaciers, glacier lakes and a recurrent monsoon season. The per capita mean flow availability is as high as 109,000 m^3. This compares very favourably with a developing economy like India which has per capita mean flow availability as low as 1588 m^3.

Fresh and hygienic water is the prime requirement for milk processing plant. The source of water supply, quantity available and suitability for the purpose has to be studied and assured. For the project, suitable provision of water @ 10,000 liters per day is required to be designed and depending on the quality of water, a water softening plant may be considered. A 5,000-liters storage water tank needs to be built.

Piping systems

For proper cleaning of a facility, sufficient hose stations positioned strategically around the structure should be installed. Hoses must be sufficiently long so as to ensure all locations can be reached without the need for draping or hanging the hose on to equipment. Ideally, each hose station should have its own hose and hose hanger. Cracked hoses should be immediately replaced.

4.2 Comparative Analysis of Critical Inputs

Electricity: It may be possible to set up one's own generator set and produce electricity. Theoretically it may also be possible to set up one's own solar panels and be self sufficient on electricity. But it would certainly be more cost effective to source power from the grid. Keeping a small generator as a part of redundancy may be considered to take care of the lighting load.

Water: The most cost effective manner of catering to the requirements of water would be to locate the plant near a river. This is because deep tube wells may not be feasible owing to the mountainous terrain and from the point of view of cost. It is recommended however a hard water treatment plant be set up as the water is likely to be hard and unsuitable for boiler operation.

4.3 Sources of Raw Materials

The raw material required for production of milk powder is unprocessed milk, which can be procured directly from farmers. The plant would require 14.6 metric tons of raw milk per day.

According to the Department of Livestock, Ministry of Agriculture & Forests, 30,920 metric tons of raw milk was produced in Bhutan in 2013.

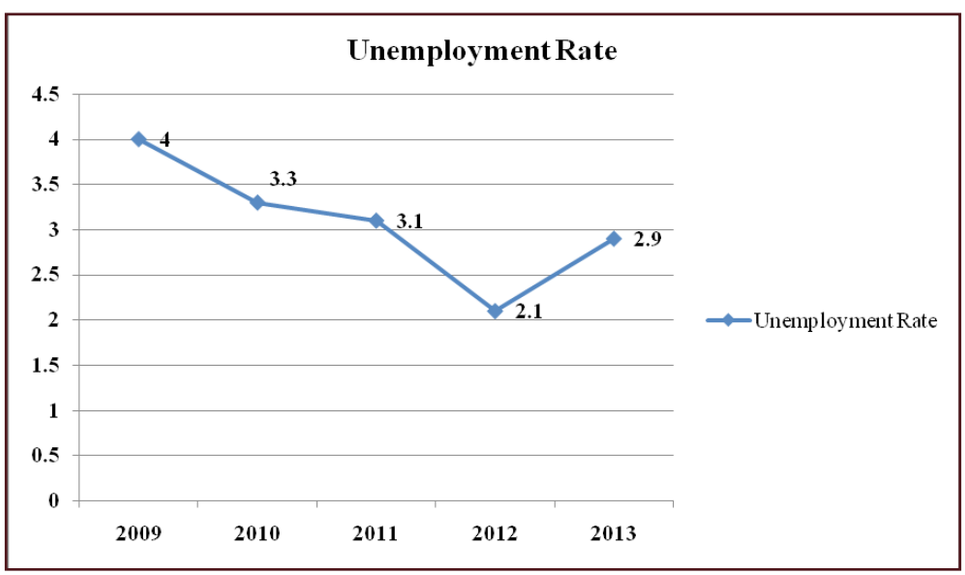
Milk collection can be best achieved through partnerships with local dairy cooperatives in the region. While some groups may be able to deliver the milk to the unit, refrigerated vans can follow an established route to neighbouring communities and pick up milk at a scheduled time and location.

4.4 Availability of Manpower and Skills

The Labour Force Survey Report 2013 finds that the agriculture sector employs over 55 percent of total employed persons, while 17 percent are employed in public administration & defense, education, electricity, gas & water supply sectors, and the remaining 28% in real estate, construction, hotels & restaurants, and mining & quarrying sectors.

The survey finds that a total of 335,870 individuals were employed and 9,916 were found to be unemployed out of a total projected population of 745,939 in 2013, making unemployment rate at the national level by 2.9%.

Chart 2: Unemployment Rate in Bhutan (2009-13)



The Labour Force Survey Report 2012 indicates that by 2020 there will be 267,000 students seeking jobs. A variety of skills are available from the various training institutions to support any service enterprise. However, higher technical courses for engineering & technology, international law and finance are required to meet the requirements of the imminent future.

4.5 Need for Skill Development

As the workforce is not so much skilled there is a need to develop their skills according to the need of the industry. Workshops or on-site short term trainings may be organized by the suppliers of machineries on how to control the temperature, operate machineries etc. The training should be a combination of theory sessions, on the job coaching sessions and on the job supervision. For new joiners with no relevant experience training on their respective functional area would be mandatory. There should be a periodic skill assessment done by the management on the basis of observation of on the job performance. Based on the findings, a training calendar needs to be drawn up.

5.0 THE PLANT

5.1 Choice of Technology

Manufacturing Process

There are three acceptable technology areas defined by three different drying methods which are in vogue. These are a) Drum drying; b) Spray drying and c) Freeze drying

Drum drying: It is a slightly old technology suitable for low volumes where the output comes out as flakes. In the drum-drying process, pureed raw ingredients are dried at relatively low temperatures over rotating, high-capacity drums that produce sheets of drum-dried product. This product is milled to a finished flake or powder form.

Freeze drying is the latest technology but expensive and suitable for those products which can loose their properties when they are heated.

Spray drying: is a method of producing a dry powder from a liquid or slurry by rapidly drying with a hot gas. This is the preferred method of drying of many thermally-sensitive materials such as foods and pharmaceuticals.

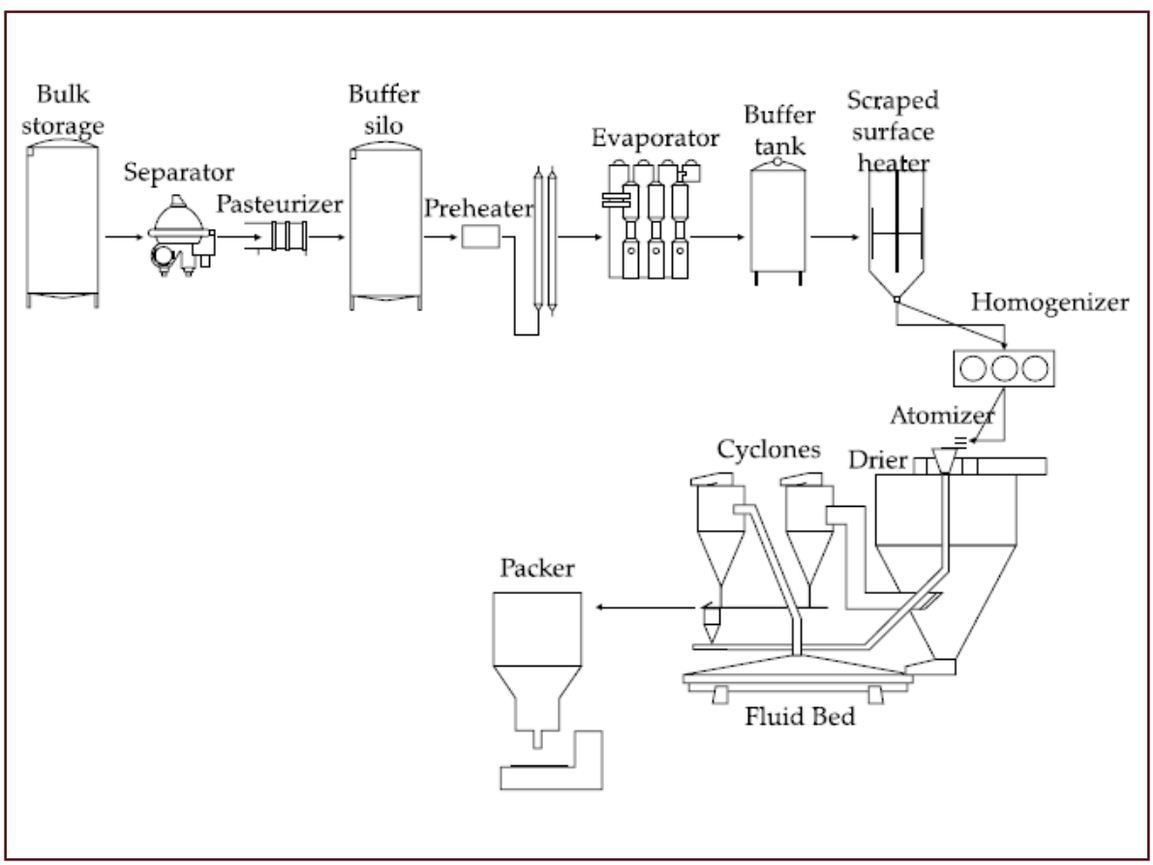


Figure 2: Manufacturing Process of Milk Powder

Spray Drying Technology has been recommended because it is a modern process which is more cost effective than freeze drying and extremely popular in the world over processing dairy products.

Milk powder manufacture involves the gentle removal of water at the lowest possible cost under stringent hygiene conditions while retaining all the desirable natural properties of the milk - color, flavor, solubility, nutritional value. Whole (full cream) milk contains, typically, about 87% water and skim milk contains about 91% water. During milk powder manufacture this water is removed by boiling the milk under reduced pressure at low temperature in a process known as evaporation. The resulting concentrated milk is then sprayed in a fine mist into hot air to remove further moisture and so give a powder. The milk powder manufacturing process is shown in the following schematic and is described in detail below.

Separation / Standardization

The conventional process for the production of milk powders starts with taking the raw milk received at the dairy factory and pasteurizing and separating it into skim milk and cream using a centrifugal cream separator. If WMP is to be manufactured, a portion of the cream is added back to the skim milk to produce milk with a standardized fat content (typically 26-30% fat in the powder). Surplus cream is used to make butter or anhydrous milk fat.

Preheating

The next step in the process is "preheating" during which the standardized milk is heated to temperatures between 75 and 120°C and held for a specified time from a few seconds up to several minutes (*cf.* pasteurization: 72°C for 15 seconds). Preheating causes a controlled denaturation of the proteins in the milk and it destroys bacteria, inactivates enzymes, generates natural antioxidants and imparts heat stability. The exact heating/holding regime depends on the type of product and its intended end-use. High preheats in WMP are associated with improved keeping quality but reduced solubility. Preheating may be either indirect (via heat exchangers), or direct (via steam injection or infusion into the product), or a mixture of the two. Indirect heaters generally use waste heat from other parts of the process as an energy saving measure

Evaporation

In the evaporator the preheated milk is concentrated in stages or "effects" from around 9.0% total solids content for skim milk and 13% for whole milk, up to 45-52% total solids. This is achieved by boiling the milk under a vacuum at temperatures below 72°C in a falling film on the inside of vertical tubes, and removing the water as vapor. This vapor, which may be mechanically or thermally compressed, is then used to heat the milk in the next effect of the evaporator

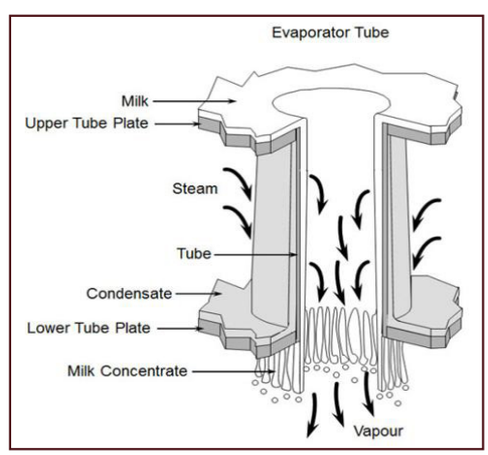


Figure 3: Evaporation Technique

which may be operated at a lower pressure and temperature than the preceding effect. Modern plants may have up to seven effects for maximum energy efficiency. More than 85% of the water in the milk may be removed in the evaporator. Evaporators are extremely noisy because of the large quantity of water vapor travelling at very high speeds inside the tubes.

Spray Drying

Spray drying involves atomizing the milk concentrate from the evaporator into fine droplets. This is done inside a large drying chamber in a flow of hot air (up to 200°C) using either as pinning disk atomizer or a series of high pressure nozzles. The milk droplets are cooled by evaporation and they never reach the temperature of the air. The concentrate may be heated prior to atomization to reduce its viscosity and to increase the energy available for drying.

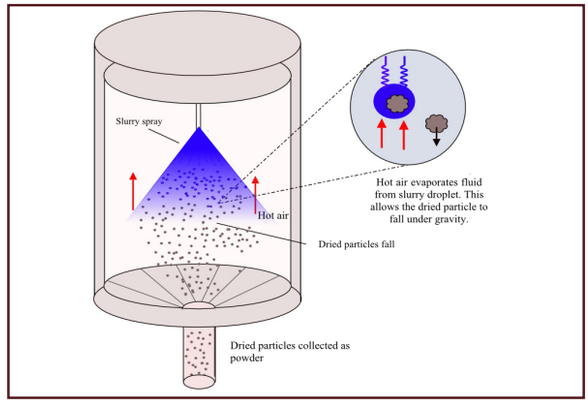


Figure 4: Spray Drying Technique

Much of the remaining water is evaporated in the drying chamber, leaving a fine powder of around 6% moisture content with a mean particle size typically of < 0.1 mm diameter. Final or "secondary" drying takes place in a fluid bed, or in a series of such beds, in which hot air is blown through a layer of fluidized powder removing water to give product with moisture content of 2-4%. Precautions must be taken to prevent fires and to vent dust explosions should then occur in the drying chamber or elsewhere. Such explosions can be extremely dangerous to life, property and markets.

Packaging and Storage

Milk powders are immensely more stable than fresh milk but protection from moisture, oxygen, light and heat is needed in order to maintain their quality and shelf life. Milk powders readily take up moisture from the air, leading to a rapid loss of quality and caking or lumping. The fat in WMPs can react with oxygen in the air to give off-flavors, especially at higher storage temperatures (> 30°C) typical of the tropics.

Milk powder is packed into either plastic-lined multi-wall bags (25 kg) or bulk bins (600 kg). WMPs are often packed under nitrogen gas to protect the product from oxidation and to maintain their flavor and extend their keeping quality. Packaging is chosen to provide a barrier to moisture, oxygen and light. Bags generally consist of several layers to provide strength and the necessary barrier properties. Shipments of milk powder should never suffer prolonged exposure to direct sunshine especially in tropical countries. A few hours at elevated temperatures (> 40°C) during transshipment can negate many weeks of careful storage.

Agglomerated Powders

Standard powders, because of their fine dusty nature, do not reconstitute well in water. "Agglomerated" and "instant" powders were specifically developed to counter this. The manufacture of an agglomerated powder initially follows the standard process of evaporation and drying, described above. However, during spray drying small particles of powder leaving the drier (the "fines") are recovered in cyclones and returned to the drying chamber in the close proximity of the atomizer. The wet concentrate droplets collide with the fines and stick together, forming larger (0.1-0.3 mm), irregular shaped "agglomerates". Agglomerated powders disperse in water more rapidly and are less dusty and easier to handle than standard powders.

Instant Whole Milk Powder

With WMP, an extra step is required after agglomeration to make the product truly "instant" and overcome the hydrophobic (water-hating) nature of traces of free fat on the surface of the particles. This extra step consists of spraying minute quantities of the natural surfactant or wetting agent, soy lecithin, on to the powder in a fluid bed. Soy lecithin is extracted from soy bean oil. Lecithins are widespread in nature and they occur naturally in milk.

5.2 Source

Plant and Machinery

Selection of plant and machinery is the most important decision for setting up a milk powder production unit. All machinery and equipments used in the processing line should have proper efficiency. All the plant and machinery should be erected in such a way that the material flow is unidirectional to avoid cross contaminations. The machinery should not occupy more than 1/3rd of the total floor area for smooth operation of labour. Various plant and machinery proposed for this model are discussed in this section.

Evaporator

Table 6: Machineries for Evaporation

S. No.	Particulars	Qty.	Capacity	Make
1	Evaporating plant- Semi Auto	1	2500 LPH	DTEC
2	Balance tank	1	500 LPH	DTEC
3	Line filter	1	2500 LPH	
4	Feed pump	1	As per feed rate	Zeutech/Shri Zeuzer
5	Flow control valve	1	As per feed rate	DTEC/kepser

6	Pre-heaters	As per Flow pattern	As per feed rate	DTEC
7	DSI/High heater	1	As above	DTEC
8	Flash vessel—SS 304	One set	-	DTEC
9	Calandrias	3	-	DTEC
10	Vapor separators	3	-	DTEC
11	Product pumps	As per Flow pattern	-	Zeutech/Shri Zeuzer
12	TVR	1	-	DTEC
13	Vacuum cooler	1	-	DTEC
14	Condensate pump	1	3 HP	Zeutech/Shri Zeuzer
15	Vacuum pump	Two 1 standby	As per plant	JV VAC
16	Vapor ducting	One lot	-	DTEC
17	Mcc ,Instrument & Local Mountings	One set	-	DTEC
18	Pipe supports & Fittings	One lot	-	Apex/Kasper

Powder Production

Table 7: Machineries for Powder Production

S. No.	Particulars	Qty.	Capacity	Make
1	Weigh Bowl	1	500 kg	DTEC
2	SS Dump tank	1	1000 L	DTEC
3	Duplex filter	1	5000 LPH	DTEC
4	Milk pump	1	5000 LPH	Zeutech/ Shri
5	Tanker unloading pump	1	5000 LPH	Zeutech/ Shri
6	Milk chiller	1	5000 LPH	GEA/HMT
7	Milk transfer pump	1	5000 LPH	Zeutech/ Shri
8	Raw milk silos	2	15 KL	DTEC
9	Milk Pasteurizer	1	10000 LPH	GEA/HMT
10	Pasteurizer feed pump	1	10000 LPH	Zeutech/ Shri

11	Hot water battery	1	Matching with pasteurizer	DTEC
12	Hot water pump (Mono block type)	1	3 HP	Krilosker
13	Milk separator	1	5000 LPH	Tetrapack
14	Cream balance tank	1	100 L	DTEC
15	Cream pump	1	1000 LPH	Zeutech/Shri
16	Cream pasteurizer	1	1000 LPH	GEA
17	Cream transfer pump	1	1000 LPH	Zeutech/Shri
18	Process Milk Silo	2	15 KL	DTEC
19	Cream ripening tanks	2	2000 L	DTEC

Butter & Ghee Production

Table 8: Machineries for Butter and Ghee Production

S. No.	Particulars	Qty.	Capacity	Make
1	Butter churn	1	2000 L	DTEC
2	Butter milk pump	1	1 HP	Zeutech/ Shri
3	Butter Milk Chiller	1	1000 LPH	GEA
4	Butter trolleys	2	500 KG	DTEC
5	Hot water pump (Mono block type)	1	1 HP	Krilosker/ Crompton
6	Butter melting vat	1	1000 L	DTEC
7	Pre-stratification Tank	2	1000 L	DTEC
8	Ghee kettle	1	500 L	DTEC
9	Ghee filtration tanks	2	100 L	DTEC
10	Ghee settling tanks	2	1000 L	DTEC
11	Ghee transfer pumps	4	1 HP	Zeutech/ Zeuzer
12	Ghee clarifier	1	1000 LPH	Tetrapack
13	Ghee storage tanks	2	3000 L	DTEC
14	Jar Filling Machine	1	-	DTEC
15	15 Kg Tin Seaming Machine	1	-	DTEC

Spray Dryer

Table 9: Machineries for Spray Drying

S. No.	Particulars	Qty.	Capacity	Make
1	Feed balance tanks	2	300 L	DTEC
2	Water balance tank	1	100 L	DTEC
3	Duplex filter (pipe in pipe type)	1	-	DTEC
4	Feed Pump	1	-	Zeutech/ Zeuzer/Shri
5	High Speed Disc Atomizer	1	-	DTEC
6	Feed Pipe & Fittings	1 Lot	-	Apex
7	Solenoid Valve	1	-	Donfuss/ equivalent
8	CIP Return Pipe	1 Set	-	Apex
9	Atomizer Stand	1	-	DTEC
10	Lifting Tackle	1	I Ton	DTEC
11	Air Distributor	1 Set	-	DTEC
12	Drying Chamber	1 Set	-	DTEC
13	Cleaning Bridge	1		DTEC
14	Air Outlet Duct	1 Lot	-	DTEC
15	Cyclone Separator	1 Set	-	DTEC
16	Rotary Discharge valves	3	-	DTEC
17	Exhaust Air Duct	1 Lot	-	DTEC
18	Exhaust Chimney	1 Lot	-	DTEC
19	Exhaust Fan	1	-	Dustech/ Flakt/ Nadi/ Equivalent
20	Air Supply System	1 Set	-	-
21	Supply Air Filter	1	-	DTEC
22	Supply Air Fan	1	-	Dustech/ Flakt/ Nadi/ Equivalent
23	Air Heater	1	-	Virtex/ Equivalent
24	Hot Air Duct	1 Lot	-	DTEC
25	Power Conveying	1 Set		DTEC
26	Vibro Sifter	1		Swetek/ Reputed
28	SS Pipe / Fittings	11 Lot		Apex/ DTEC/ Kepser
29	Instrument & Control System	1		DTEC
30	Special Control for Dryer	1 Set		DTEC

Utilities

Table 10: Machineries for Utilities

S. No.	Particulars	Qty.	Capacity	Make
1	Refrigeration Plant	1	-	DTEC / Kirlo-skar
2	Refrigeration Compressor	2	-	Kirloskar
3	Motor of Compressors	2	–	ABB / Kirloskar / Crompton / GEC
4	Oil Separator	1	-	DTEC
5	Condenser	1	-	GEA
6	Cooling Tower Pumps	2	-	Kirloskar
7	Ammonia / Freon Receiver	1	-	DTEC
8	Ice Bank Tank	1	-	DTEC
9	Accumulator	1	-	DTEC
10	Diffuser for Cold Room	1	-	DTEC
11	Chilled Water Pumps	2	-	Reputed
12	Boiler	1	3 TPH	Tecor / Urjex
13	Boiler Accessories	1 Set	-	DTEC
14	Electrical Items	1 Lot	-	DTEC / Reputed
15	SS Pipes – SS 304	1 Lot	-	Apex
16	SS Fittings	1 Lot	-	Kasper
17	Steam Pipes and Fittings	1 Lot	-	Tata / Jindal
18	GI Pipes	1 Lot	-	Tata / Jindal
19	Packaging Machine	1 Lot		Reputed

Details of Supplier (Milk Powder Plant)

1. Dairy Tech. Engineers & Consultants

14-A, Tagore Nagar, Heera Bagh, Dayal Bagh,

Agra: 282005, Uttar Pradesh, India

Contact No: 0562-6455226, 09219500710

Email: fdefooddairy74@.com, info@foodanddairytechengineers.com

Website: www.foodanddairytechengineers.com

2. SSP Pvt. Ltd

13 Milestone, Mathura Road

Faridabad, Haryana, India - 121003

Contact No: +(91)-(129)-4183700 / 4183799

Email: info@sspindia.com

3. Raj Process Equipment & Systems Pvt. Ltd

Jai Ganesh Vision

B Wing. Third floor

Jai Ganesh Fame Buildng, Akurdi Pune, India - 411035

Contact No: +(91)-(8586970143)

Website" www.rajprocess.com

Details of Supplier (Lecithin Powder)

1. Guangdong Yichao Biological Co., Ltd.

Building A, Zone 13-07 & 13-08, Jinyuan Industrial City, Chaoshan Road, Shantou, Guangdong, China (Mainland);Tele - 86-754-88119085

Website: http://www.yichaobio.com/en/index.asp

Details of Supplier (Nitrogen)

1. Delux Industrial Gases, Pune, India.

Building A, Zone 13-07 & 13-08, Jinyuan Industrial City, Chaoshan Road, Shantou, Guangdong, China (Mainland);Tele – (91)844-752-4750

http:// www.deluxegases.com

5.3 Rate of Consumption of Power, Fuel, Utilities & Consumables

Power Consumption

For this project about 225 KVA (180KW) connections will be required. Depending on the requirements of equipment to be installed in the facility, single-phase or three-phase service may need to be installed by the power company. A backup power supply should be available to ensure that operations can continue during a power interruption. Diesel generators are usually used for large applications; the unit to be purchased should be sufficient to operate the entire facility.

Water Consumption

The water requirement for cleaning and washing will be approximately 10,000 liters per day based on the processing capacity of the plant. Water is mostly required for washing and also in various unit operations during processing. Apart from it, water will also be required for domestic consumption purpose. The water should be clean and treated well for hardness before use. It is preferable to carry out water testing from a reputed testing laboratory before setting up a plant.

Since water is in direct contact with the commodity in the spray dryer, it should be of the highest quality.

Consumables

1. Lecithin
2. Nitrogen gas

5.4 Raw Material Consumption

The raw material required for production of milk powder would be unprocessed milk which could be directly procured from farmers. The plant would require 14560 kg of raw milk per day at full load condition

5.5 Manpower Requirement and Organization Chart

A total number of 46 employees will be needed to operate the plant.

The table given below shows the manpower requirement:

Table 11: Manpower Requirement

S.No.	Job Title	Required No.
1	Plant Manager	1
2	Secretary	1
3	Accountant	1
4	Personnel Officer	1
5	Salesperson/purchaser	2
7	Clerks	2
8	Store Keeper	2
9	Production Supervisor	2
10	Maintenance Engineer	2
11	Technician Operators	10
12	Laborers	10
13	Cleaner	4
14	Driver	4
15	Guard	4
Total		**46**

5.6 Specification of Product and Byproduct

Product

Milk Powder is generally classified into the following categories

WMP (Whole milk powder): It is obtained by removing water from pasteurized, homogenized whole milk through evaporation and spray drying processes. It possesses all the appealing qualities of milk and, in its dry form, is an important ingredient in the manufacture of a remarkable range of food products. The durability of milk powder makes it popular to the customer base.

Figure 5: Whole Milk Powder

Instant Whole Milk Powder: With WMP, an extra step is required after agglomeration to make the

product truly "instant" and overcome the hydrophobic (water-hating) nature of traces of free fat on the surface of the particles. This extra step consists of spraying minute quantities of the natural surfactant or wetting agent, soy lecithin, on to the powder in a fluid bed. Soy lecithin is extracted from soy bean oil. Lecithins are widespread in nature and they occur naturally in milk

Nutritional Value of Milk Powder

Table 12: Nutritional Value

Nutrient	Nutritional Value
Protein	25-27%
Carbohydrates	36-38%
Fat	26-40%
Minerals	5-7%

Byproduct

Butter: Butter is a dairy product made by churning fresh or fermented cream or milk, to separate the butterfat from the buttermilk. It is generally used as a spread and a condiment, as well as in cooking, such as baking, sauce making, and pan frying.

Figure 6: Butter

Anhydrous Milk Fat or Ghee: Anhydrous milk fat is 99.9% pure milk fat made from fresh cream. It gives a natural dairy flavor and creaminess to finished products and is the perfect high quality fat ingredient.

Figure 7: Ghee

5.7 Extent of Technical Assistance Needed Including Training

Although food manufacturing production jobs don't typically require formal education, a certificate in food science introduces the fundamental concepts of food production and prepares for entry-level positions in the food manufacturing industry. As the workforce is not so much skilled there is a need to develop their skills according to the need of the industry. Workshops or on-site short term trainings may be organized by the suppliers of machineries on how to control the temperature, operate machineries etc. The training should be a combination of theory sessions, on the job coaching sessions and after that on the job supervision. The duration of training will be of 2 weeks, 1 week for the theory and on the job training and 1 week for the supervision at a pre-fixed rate. The duration of training may be extended later on if required.

6.0 PLANT LOCATION & INFRASTRUCTURE

The location of a plant is determined on the basis of proximity to raw materials, availability of infrastructure and distance to market outlets. The manufacturing unit for production of milk powder should be located in an area where milk is available in plenty. In Bhutan, Mongar Dzongkhag is one of the highest producers of milk. It produced 2,632 metric tons of milk in 2013. Adjoining dzongkhags like Tashigang and Bumthang are also big producers of milk, accounting for 5,798 metric tons of milk in 2013. (Source: Department of Livestock, Ministry of Agriculture & Forests).

The ideal location for this plant is Bondeyma in Mongar Dzongkhag, where a proposed 110.34 acre industrial estate is to be established. Detailed designs and estimates for the road and bridge have been completed and tender documents have been finalized. The road and bridge are to be completed by 2017 and construction of internal road and storm water drains will be initiated in the second half of 2016.

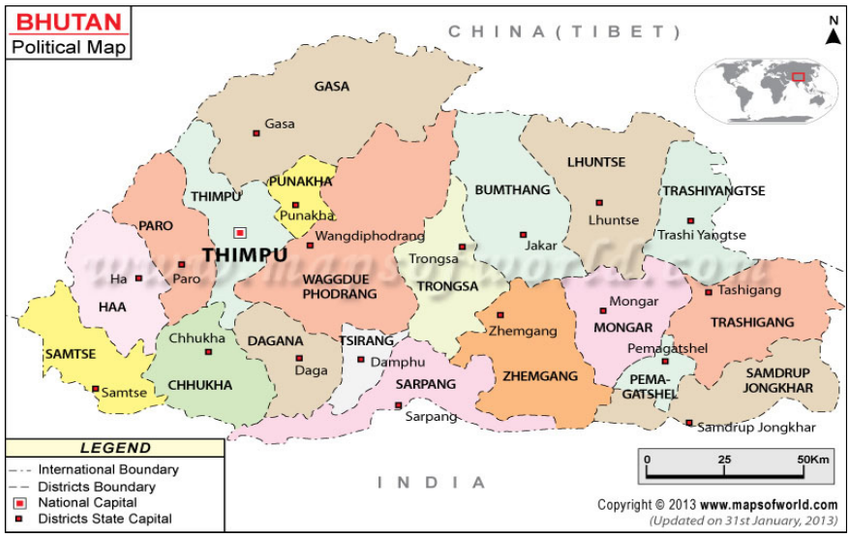


Figure 8: Map of Bhutan

The 60 MW Kurichhu hydropower plant is located in Gyalpozhing, Mongar. The regional hospital for eastern Bhutan is also located in the dzongkhag.

Mongar is the fastest-developing dzongkhag in eastern Bhutan. With the construction of the new Gyalpozhing-Nganglam road, the ease of transporting products to and from India is expected to turn Mongar dzongkhag into an economic hub for central and eastern Bhutan.

The table given below shows the distances of other important towns from Mongar:

Table13: Distances to other Dzongkhags

S. No.	From	To	Distance (km)
1	Mongar	Thimphu	460
2	Mongar	Bumthang	193
3	Mongar	Lhuentse	75
4	Mongar	Trashigang	91
5	Mongar	Samdrup Jongkhar	271

(*Source*: Dzongkhag wise Inventory of Resources, Bhutan, 2006)

6.1 Raw Material Availability

The manufacturing unit for production of milk powder should be located in an area where milk is available in plenty. As per available statistics Mongar along with its adjoining dzongkhags of Bumthang, Lhuentse Trashigang, Zhemgang, Trashiyangtse and Pemagatshel produced 11,955 metric tons of milk in 2013. Assuming a per capita consumption of 100 gms per day and a local population of 199,091, total consumption is estimated at 7,167 metric tons, leaving 4,788 metric tons available for the plant against a maximum demand of 4,659 metric tons and an initial demand of 2,796 metric tons for the first year. The unit has to facilitate milk collection from the farmers and the expense has been budgeted for in the cost of milk procured in the financial estimates.

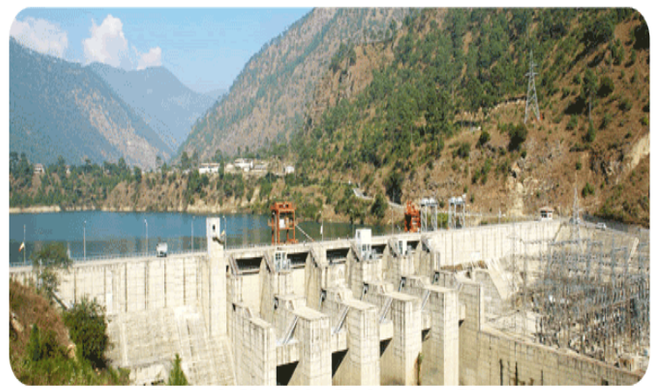


Figure 9: Kurichhu Hydropower Plant

6.2 Availability of Electricity:

Electricity is readily available from the grid. Incidentally, Mongar dzongkhag has a hydro power plant on the Kurichhu river.

6.3 Topography, Hydrology &Seismology Data Requirement

Topography, Hydrology & Seismology of the location must be checked before setting up the manufacturing plant.

Figure 10: Topography of Mongar Dzongkhag

Topography: Topography is a detailed map of the surface features of the land. It represents a particular area in detail, including everything natural and manmade-hills, valleys, roads or lakes.

An objective of topography is to determine the position of any feature or more generally any point in terms of both a horizontal coordinate system such as latitude, longitude, and altitude. Identifying (naming) features and recognizing typical landform patterns are also part of the field. A topographic study may be made for detailed information about terrain (vertical & horizontal dimension of land surface) and surface features is essential for the planning and construction of any major civil engineering, public works, or reclamation projects.

Hydrology: Hydrology is the scientific study of the movement, distribution and quality of water on Earth including the hydrologic science, water resources and environmental watershed sustainability. Hydrology is subdivided into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology.

Application of Hydrology

- Determining the water balance of a region.
- Determining the agricultural water balance.
- Mitigating and predicting flood, landslide and drought risk.
- Real-time flood forecasting and flood warning.
- Assessing the impacts of natural and anthropogenic environmental change on water resources.
- Assessing contaminant transport risk and establishing environmental policy guidelines.

Seismology: Seismology is the scientific study of earthquakes and the propagation of elastic waves through the Earth or through other planet-like bodies. The field also includes studies of earthquake environmental effects, such as tsunamis as well as diverse seismic sources such as volcanic, tectonic, oceanic, atmospheric, and artificial processes (such as explosions).Seismic waves are elastic waves that propagate in solid or fluid materials.

They can be divided into body waves that travel through the interior of the materials; surface waves that travel along surfaces or interfaces between materials; and normal modes, a form of standing wave.

Seismological instruments can generate large amounts of data. Systems for processing such data include:

- CUSP (Caltech-USGS Seismic Processing)
- RadExPro seismic software
- SeisCom

6.4 Availability of Land

Possible land for industrial purpose is available at following places in Mongar:

At Bondyema, about 30 km from Mongar near Kurichu, 110.34 acres of land has been reserved for an industrial estate by government.

Other flat land that could be used for industrial estates are:

- 2 acres of plain land at Gyalpozhing
- 50-60 acres at Wanda
- 20 acres of land at Trailing

6.5 Availability of Transportation Facilities

As of 2013, apart from national highways, the Dzongkhag has a good road network as follow

Table 14: Road Type in Mongar

S. No.	Road Type	km
1	National Highway	233.4
2	Dzongkhag Road	71.4
3	Urban Road	11.4
4	Farm Road	687.2
5	Access Road (Forest Road & Power Tiller Road)	77.6

(*Source*: Statistical Yearbook of Bhutan, 2014)

The EDI (East Development Initiative) identifies and prioritizes road infrastructure development for socio-economic development that would connect all the regional growth centers and to the industries. The report states that despite numerous gewog connectivity and farm roads being built in Eastern Bhutan, a lot still needs to be done especially in terms of usability, long-term sustainability, maintenance and safety. Most roads are narrow with numerous hairpin bends and steep gradient. These roads can be used only during dry seasons. To solve this issue, all gewog connectivity (GC) roads will be taken over from Dzongkhags by Department of Roads for improvement and regular maintenance works.

The Government will explore the possibility of constructing link roads such as connecting Lhuentse Dzongkhag to Trashiyangtse Dzongkhag without having to detour through Mongar. In addition to improving the Yongphula airport and making it ready for use by 2015, the government will also explore the potential of more airports in the east. (Source: The Bhutanese, 29th August, 2014)

6.6 Availability of Ancillary facilities

All organized dairies in the surrounding areas can become ancillary units and an important part of the supply chain. Individual milk farmers and small unorganized dairies in the neighbourhood can constitute the feeder chain on the supply side.

6.7 **Availability of Housing, Schooling and Hospital Facilities Housing**

Figure 10: Topography of Mongar Dzongkhag

The table given below shows the housing condition in Mongar Dzongkhag as of 2007:

Table 15: Housing Condition

Housing Condition	Percentage
Household with straw/leaves roof	2
Household with bamboo roof	7.19
Household with metal roof	51.22
Household with concrete/tiles roof	1.35
Household with shingles roof	34.1

(*Source*: Annual Dzongkhag Statistics, 2010, Dzongkhag Administrator, Mongar)

Schooling

The comprehensive modern education system in Bhutan was introduced with the initiation of economic development plans in 1961. The monastic form of education however existed and continues even today. There are now extensive network of schools and other educational institutions spread throughout the country. Many schools provide boarding facilities for students living in areas far from the school with meals provided through the support of World Food Programme (WFP). The WFP also supports mid-day meals for day scholars who come from distant communities.

The table given below shows the number and type of schools in 2013 in Mongar:

Table 16: Number & Type of Schools

S. No.	Type of School	Number of School
1	Extended Classroom	6
2	Primary School	37
3	Lower Secondary School	7
4	Middle Secondary School	2
5	Higher Secondary School	4
Total		**56**

(*Source*: Statistical Yearbook of Bhutan, 2014)

Hospital Facilities

Figure 12: Regional Referral Hospital, Mongar

Health Care is delivered in a totally integrated three-tiered system with National Referral Hospital at the apex, regional referral hospitals, district hospitals, and Basic Health Units (BHUs) at the Community Level. BHUs serve remote populace and are staffed by well-trained health personnel who are equipped to treat minor ailments and advice on preventive measures to avoid the spread of communicable diseases. Extended Health Centres such as Out Reach Clinics (ORCs) and Sub-posts support these BHUs.

There are also numbers of special health programs in Bhutan administered by the Ministry of Health. These mainly cover Expanded Program on Immunization (EPI), Reproductive Health (RH), Acute Respiratory Infection (ARI) later upgraded to Integrated Management of Neonatal and Childhood Illness (IMNCI), National HIV/AIDS & STIs Control Program (NACP), National Tuberculosis Control Program (NTCP), National Leprosy Program, Rural Water Supply & Sanitation Program (RWSS), Village Health Workers Program (VHW), Vector Borne Disease Control Program (VDCP), Mental Health Program, among others.

The table given below shows the number and type of hospital facilities in 2013 in Mongar:

Table 17: Number & Type of Hospitals

Sl. No.	Type of Hospital	Number of Hospitals
1	Hospital	1
2	Basic Health Units	31
3	Out Reach Clinics with shed	46
4	Out Reach Clinics without shed	3
Total		**81**

(*Source:* Statistical Yearbook of Bhutan, 2014)

6.8 Communication Facilities

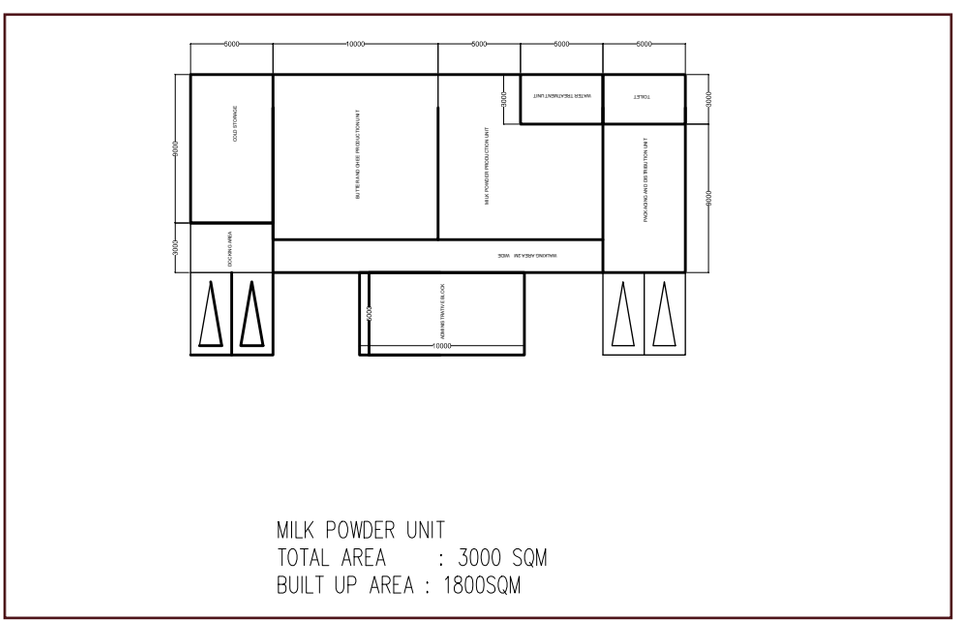
Bhutan Telecom Limited (BTL), Tashi InfoComm Limited (TICL), Samden Tech and Drukcomare the four Internet Service Providers (ISPs) in the country. Bhutan Telecom Limited is the soleprovider of fixed-line telecommunication services while cellular mobile services are provided byB-Mobile (Bhutan Telecom Limited) and Tashi-Cell. With the exception of Bhutan Telecom, allother ISPs are private sector ventures.

6.9 Presence of Approach Road

Presence of approach road from and to the plant must be taken into consideration before setting up the plant.

Figure 13: Road Connectivity to Mongar

6.10 Factory layout plan



7.0 ENVIRONMENTAL ASPECTS

The key environmental issues relevant to this plant are:

• Wastewater Management

• Hazardous Substances

• Noise

• Atmospheric Emissions

These issues are discussed below:

Figure 14: Pollution due to milk powder production

1. **Wastewater Management**

The proposed plant has the potential to impact the quality of water in the vicinity through the release of effluent.

The protected environmental values (PEVs) of the proposed facility are:

A: Protection of Aquatic Ecosystems: Protection of modified (not pristine) ecosystems from which edible fish are harvested.

B: Protection of water chemistry for the hydro power plant

C: Agricultural Water Uses like Irrigation

D: Industrial Water Supply – Food Processing

Wastewater Disposal

Due to the presence of milk solids (e.g. protein, fat, carbohydrates, and lactose), untreated wastewater from this industry may have a significant organic content, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). The main sources of wastewater are raw material (predominately milk) and product losses from leaking equipment and pipelines, and spills caused by equipment overflows and malfunctions and by poor handling procedures. In addition to general domestic wastewater, wastewater will be produced by the process in the form of evaporator condensate generated during the evaporation and drying stages of the milk powder production process. Other sources of wastewater are start-up and shutdown losses, stack losses, bagging losses and losses during cleaning of evaporators and driers.

Management measures

The following management measures are recommended:

- Evaporator condensate will be reused as per the reuse hierarchy e.g. wastewater may be disinfected (probably by chlorine dioxide) and used for the 'cleaning in place' (CIP)process.

CIP is a fully automated cleaning of all equipment involving rinsing with detergents and cold water and with nitric or phosphoric acid.

- All evaporator condensate discharged from the process evaporator/dryer will be monitored for pH, dissolved oxygen, conductivity and temperature.
- Unless a Discharge Management Plan for discharge of evaporator condensate to the drainage line has been approved, all evaporator condensate will be discharged to CMW (Cradle Mountain Water) via the dedicated sewer line.
- On line water quality equipment will be monitored to ensure it is operational and calibrated

  as per manufacturer's specification; performance deficiencies will be addressed accordingly.
- Domestic wastewater will be discharged to sewer.
- Milk tanker washing (either inside tanks or general cleaning of exterior) will not occur onsite under any circumstances.

2. **Hazardous Substances**

Description

The inappropriate storage and handling of hazardous substances has the potential to cause contamination of land and water. Hazardous substances on site include:

- Hydrocarbons - No bulk fuel stores will be located on site.
- Chemicals – Sodium hydroxide as a cleaning agent; Nitric or phosphoric acid for CIP chlorine dioxide for condensate sterilization prior to use in CIP
- Gases - Carbon Dioxide and Nitrogen to gas pack the finished product and protect whole milk powder from oxidising; Liquid Petroleum Gas.
- Milk and milk products

Management Measures

The following management measures are recommended:

- Should a spillage occur, appropriate measures will be taken to contain the spill
- Dangerous Goods storage and handling will comply with the requirements of Dangerous Substances (Safe Handling) Act 2005.
- Undertake a review of the annual environmental management plan for approval by the Director, Environment Protection Authority

- Milk spillage in the unloading area will be 100% discharged to sewer.
- The milk unloading area has been specifically designed with the following:
- The unloading area will be hard-stand with no opportunity for spilt product to contaminate nearby surface soils or enter groundwater.
- Any unloading will be strictly monitored by the tanker driver. Interconnecting pipes will be regularly checked to ensure they do not rupture or have any slow leaks.
- The milk unloading/delivery bay will be contoured to direct any spilt milk into a dedicated sump and hard piped to sewer for discharge. Note that all unloading is undertaken in a covered area with all drainage directed to sewer.
- Milk powder handling (including truck loading) is undertaken within the confines of the building, and therefore has very little chance of entering the storm water system.
- All lactose delivered to site will be stored within the warehouse.
- Any lactose spillage will be immediately cleaned up and disposed in secure covered waste bins.
- If any soil is contaminated during construction, it will be removed and the excavation is mediated. The contaminated soil will be disposed of at an appropriate treatment facility by an authorized controlled waste transporter. If necessary, appropriate authorities will be notified.
- The Chlorine dioxide dosing system is likely to take the form of a small fully contained package plant.
- Laboratory chemicals and acids will be stored in accordance with the Dangerous Substances (Safe Handling) Act 2005. Quantities to be stored on site will be kept to a minimum.
- Material Safety Data Sheets will be filled as necessary for chemicals stored on site and used by emergency authorities and referenced as required.
- All chemicals will be handled appropriately and training undertaken by staff if necessary.
- Gas is likely to be stored in either banks (skid mounted) of bottled gas, or larger single tanks filled from delivery vehicles.

3. **Noise**

Description

Noise emissions from the proposal during construction and operation have the potential to cause an environmental nuisance at sensitive uses, including residences, in the vicinity. The noise mainly occurs from forklifts, truck, ventilation fans, mobile air compressor/ generator etc.

Management measures

Where possible use mufflers to stifle the sound of equipment. Use of silencers/noise isolators is recommended for employees working in areas where noise levels are high.

4. **Atmospheric Emissions**

Description

Emissions of particulate matter from any source have the potential to adversely affect air quality, and the health of the residents in the local area. The main emissions from milk powder manufacturing plant are odors, dust and exhaust gases.

Odors in and around milk powder processing plants come from the biological decomposition of milk derived organic matter, generally found in wastewater. Emissions of dust include fine milk powder residues in the exhaust air from the spray drying systems and bagging of product. Exhaust gas emissions (carbon dioxide, nitrogen oxides and carbon monoxide) in the dairy processing sector result from the combustion of gas and fuel oil or diesel in turbines, boilers, compressors and other engines for power and heat generation.

Management measures

The following management measures are recommended:

- Dust emissions from the site will be managed during periods of high winds with watering and construction will cease if site activities are causing dust nuisance.
- The bag-house will be maintained in accordance with the manufacturer's specifications. It is likely that a complete bag filter replacement will be required every two years.
- The performance expectations of the bag filter will be monitored and deficiencies addressed accordingly commissioning
- Bag filters will be cleaned and maintained in line with operating specifications

5. **Other Environmental Issues**

In addition to the key issues, the following environmental issues are considered relevant to the proposal would have to be evaluated.

- Stormwater
- Solid and Controlled Waste Management
- Traffic Impacts (noise, dust and odour)
- Acid Sulphate Soils (ASS)

- Site Contamination
- Heritage
- Geoconservation
- Flora/Fauna
- Decommissioning and Rehabilitation

Solid waste is generally defective product packaging, recovered wastewater treatment sludge, solid and semi-solid intermediate or finished product spills. Solid waste often is the easiest to see, quantify and correct.

Recommended measures to reduce and manage solid waste:

- Optimize product filling and packaging equipment to avoid product- and packaging-material waste.
- Fit screens/traps to prevent solid wastes from entering waste water disposal system.
- Train staff to minimize spills and use dry sweeping to collect spills.

Energy Consumption: Dairy processing facilities consume considerable amounts of energy. Approximately 80 percent of the energy requirements are for thermal uses to generate hot water and produce steam for process applications (e.g. pasteurization, evaporation, and milk drying) and cleaning purposes. The remaining 20 percent is used as electricity to drive processing machinery, refrigeration, ventilation, and lighting.

Compliance requirements of the Environment Assessment Act

This part covers the environment management aspects for the project. The degree of detail is based on the Reference Document, Environment Assessment Act, 2000 and the Regulation for the Environmental Clearance of Projects, 2002.

Reference has also been made to the Procedures for Project Review in the NEC guidelines and rules and regulations for establishment and operation of Industrial and commercial ventures in Bhutan, 1995. In accordance to these, for this project an Environment Assessment (EA) document including Environment Management Plan (EMP) and a monitoring plan shall be required. Since the impacts of the project are known, an Initial Environmental Evaluation is not required.

This report however includes characterization of environmental consequences due to various project activities, both during the construction phase as well as the operational phase and measures to mitigate them. The elaboration of these features shall meet the requirements of EA document. The environmental elements considered for this purpose are shown in the following table.

Table 18: Elements considered for environmental impacts

S.No	Element	S.No	Element	S.No	Element
1	Land Use	2	Soil	3	Ecology
4	Subsidence and Landslide	5	Noise Quality and Ground Vibration	6	Vehicular Movement
7	Water Resources	8	Hydrology	9	Water Quality
10	Air Quality	11	Solid Waste	12	Human Settlement
13	Socio-economic Conditions	14	Aesthetics	15	Site of Cultural Heritage and Scenic Importance

The environmental information is based on meteorological data collected from secondary sources. The environmental information is based on meteorological data collected from secondary sources. Analysis of this data has to be carried out in order to establish the existing environmental scenario in and around the proposed plant sites and the mines.

Mitigation measures based on the systems & practices foreseen in plant design, for addressing each environmental component has been described.

It is to be understood that this report meets the requirements of initial Environmental Information (EI), as per the prevalent norms in Bhutan.

Environmental Impacts

The environmental impacts that are likely to arise out of the proposed project, during their construction and operation phases, are summarized in the sub-sections that follow.

During Construction Phase

Table 19: Environmental impacts during construction phase

S. No	Attributes	Problem Impacts due to Plant
1	Land Use	Degradation in land values due to construction waste & construction silt runoff.
2	Soil	Loss of soil due to clearing, excavation, soil removal, road construction, etc.
3	Ecology	Encroachment in ecology; loss of flora and fauna.
4	Water Resources	Depletion of ground water resources, if used.

5	Water Quality	No effect of domestic waste, if a sewage treatment plant will be installed for the labour camp as well as the plant.
6	Air Quality	Fugitive emission and dust impair air quality.
7	Noise Quality	Increase in noise levels.
8	Vehicular Movement	Traffic congestion/accidents and adverse effects on air quality & noise levels.
9	Solid waste	Increased excavated soil, debris, garbage, etc., at the construction site.
10	Aesthetics	Depreciation of environmental aesthetics by project structures.
11	Site of Cultural, Historical and Scenic Importance	Impact on the site of Cultural, Historical and Scenic Importance, if available

During Operation Phase

Table 20: Environmental impacts during operation phase

S. No	Attributes	Problem Impacts due to Plant
1	Land Use	Area is industrial/agricultural land.
2	Soil	Positive impact due to horticulture and plantation.
3	Ecology	No major impact due to vegetation and plantation in the surrounding area.
4	Subsidence and Landslide Problems	No impact.
5	Water Resources	Depletion of water resources due to water withdrawal.
6	Water Quality	Discharge of sewage and storm water run-off may cause deterioration of water quality.
7	Air Quality	Increase in TSPM and RPM levels and impairment of ambient air quality.
8	Noise Quality	Increase in noise level in the surrounding area
9	Vehicular Movement	Traffic congestion/accidents in conjunction with loss in air quality.

10	Solid Waste	Inappropriate disposal of garbage/ sewage could be hazardous.
11	Aesthetics	Loss in environ-aesthetics to some extent.
12	Site of Cultural, Historical and Scenic Importance	Impact on the site of Cultural, Historical and Scenic Importance, if available
13	Human Settlement	No impact as no relocation/resettlement required if industrial area.
14	Socio-Economic condition	Increased economic activities in the region resulting in additional jobs. Improvement in quality of life of people.

Environmental Management

Mitigation measures, including prevention and control for each environmental component, are described in the sub-sections below.

During Construction Phase

Table 21: Mitigation measures during construction phase

S. No	Attributes	Problem Impacts due to Plant
1	Land Use	Plantation and green belt development shall commence.
2	Ecology	Plantation and vegetation shall commence
3	Water Resources	Controlled use of water resources
4	Water Quality	Debris shall be isolated from waste water and disposed off separately. All waste shall be treated in septic tanks and ETP.
5	Air Quality	Regular water sprinkling at the construction site. Construction materials shall be totally covered during transportation.
6	Noise Quality	Use of silencers, noise isolators etc. in machines. Use of equipment, which keep noise levels within limits prescribed by regulatory agencies.
7	Solid Waste	Sewage treatment plant will be installed in the colony as well as at the plant.
8	Vehicular Movement	Proper metallic access road will be constructed upto the site.
9	Aesthetics	Construction activities commensurate with landscaping in the area.

During Operation Phase

Table 22: Mitigation measures during operation phase

S. No	Attributes	Problem Impacts due to Plant
1	Land Use	Development of green belt in and around the plant.
2	Soil	Tree plantation all around the plant.
3	Ecology	Development of green belt in and around the plant.
4	Water Resources	There shall be a perpetual demand on water resources. There will not be any substantial requirement of water at the plant other than for sanitation and general cleaning purposes. The water requirement in the plant will have no adverse effect on the water source and the water required at the plant can be adequately met from the current allocation to the plant from the community.
5	Hydrology	The plant shall take into consideration the local geological, geomorphologic and hydro-geological settings.
6	Water Quality	There will be substantive generation of waste water at the plant premises besides the use at the staff quarters for sanitation purposes. This waste water will be collected in septic tanks.
7	Air Quality	Provision of suitable bag filters for dust control. Provision of leak proof and properly covered transport equipment to prevent dust from being airborne. Adequate dust suppression and extraction facilities at material handling and transfer points. Provision of green belt around the plant. Provision of a well-equipped workshop for regular maintenance of vehicles in order to control emissions.
8	Noise Quality and Ground Vibration	Noise abatement at source by choosing machinery and equipment suitably. Proper mounting of equipment and ventilation systems. Provision of noise insulating enclosures or padding, wherever possible. Provision of personal protective equipment for workers. Dense belt of trees to act as acoustic barriers.
9	Vehicular Movement	Provision of wide tar/concrete road. Provision of a well-equipped workshop for regular maintenance of vehicles in order to control emissions.
10	Solid Waste	Proper disposal of the waste based on terrain, landscaping, drainage & aeration. Septic tanks will be constructed at the staff quarters.

11	Aesthetics	Landscaping and use of vegetation.
12	Human Settlement	Not applicable.
13	Socio-Economic Conditions	Maintaining good communication with local communities before, during and after construction. Training of local personnel for specific (skilled) positions. Welfare measures for local populace.

Solutions Adopted In the Technical Concept

The guidelines for various industrial units stipulate "limiting values" for water, air and noise quality.

For the project, adequate pollution control equipment has to be considered. The general requirement and measures to be considered for arresting the pollutants is tabulated in the following table.

Table 23: Estimated release of pollutants

S.No	General Requirement		Measure Considered
1	Water Quality		
	For plant		
	Treated Effluent discharges should have a pH in the range of 6-9.		Sewage treatment plant of adequate capacity to control the pH and TSS.
2	Air Quality		
	For Plant		
	The air quality should conform to the limiting values of SPM, limiting values of SPM.		Bag Filters & modern burner with precise fuel dosing system should be considered for the air quality.
3	Noise Quality		
	For Plant		
	A maximum increase in background levels of 3 dB (A) or the following levels:		The plant should be designed not to generate more than 60 dB (A) maximum. All high noise emitting machinery will be enclosed in a housing (lined with a 2 inch glass wool) so as to minimize sound emissions outside the plant. The walls of the structure housing the machinery will be made of mud bricks to absorb the sound.
	Residential	55/45 dB (A)	
	Industrial	75/70 dB (A)	
	Commercial	65/55 dB (A)	

Occupational Health and Safety

All workers in the plant must be provided with and be mandated to use protective gear and equipment to ensure their personal safety. Safety boots, gloves, eye goggles, helmets, nose masks (wherever necessary), ear plugs, reflective jackets and other protective equipment will be provided by the company. Trainings on safety for all new recruits as well as refresher courses on safety for the regular staff will be conducted regularly in order to ensure that safety procedures are followed at all times.

A safety inspector shall be appointed (plant manager) and an OHS committee comprising of employees formed to monitor and ensure compliance to safety norms and procedures.

8.0 PROJECT IMPLEMENTATION & SCHEDULE

The key factors for facilitating successful and timely project implementation are:

- Proper choice of technology and machinery suppliers.
- Adequate diligence in formulating the technical concept and system design.
- Proper choice of contractors for civil construction and erection of equipment.
- Formulation of an effective project team led by an experienced Project Manager.
- Establishment of an efficient system for project planning & monitoring including reporting procedures for progress review & co-ordination.

Implementation Strategy

Typically any project has four core dimensions:

- Engineering: this directly impacts the smooth operations of the plant over its entire life.
- Procurement: is critical on account of the impact that it has on investment and performance benchmarks and also in ensuring the choice of appropriate technology.
- Construction: is critical in terms of its impact on completion quality and the duration of the project phase.
- Project Management: other than its obvious impact on project timeliness, it also contributes to risk minimization for the promoter.

Implementation Schedule

It is suggested that the project implementation will not take more than 12 months out of which six months will be allotted for pre project activities. And the rest should be done within the next six months from the date the project is approved by the Ministry of Economic Affairs.

Pre-project Activities Includes:

1. Hydrological investigations for ensuring the availability of the requisite quantum of water.
2. Receipt of requisite clearances from competent authorities with respect to :
    - Environmental clearance
    - Sanction and supply of power
    - Sanction and supply of water

- Tying up sources of funds for the project to achieve financial closure
- Procurement of land
- Topographic & Seismologic survey for plant area
- Floating tender inquiries and evaluation of order

3. Site Preparation & Levelling of land

The table given below shows the project schedule:

Table 24: Project Schedule

S.No.	Activity	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Site Preparation & Levelling of Land												
2	Construction of factory shed & Civil Infrastructure												
3	Hiring of People (Phase 1)												
4	Installation of Machineries												
5	Hiring of People (Phase 2)												
6	Training & Commissioning of People												
7	Trial Production Runs												

Table 25: Color Coding

Color Coding	
	Site Preparation
	Construction & Civil Infrastructure
	Manpower Hiring (Phase 1)
	Installation of Machineries
	Manpower Hiring (Phase 2)
	Training & Commissioning
	Trial Production Runs

9.0 COST PRESENTATION

Project Cost /Total Investment

Summary:

Table 26: Project Summary

Plant Capacity:	2 MT per day (640 MT per annum)
No. of Shift:	One (8 hours per shift) per day
Working Days in Year:	320
D.S.C.R. :	1.95
B.E.P. :	19.66%
IRR :	16.92%
NPV :	Nu. 16.39 million

Cost of Project:

The total cost of the project is estimated at Nu. 108.72 million as per the particulars given in the following table

Table 27: Cost of Project

S. No.	Particulars	Value (Nu. In Millions)
1	Land 3,000 sq. meters (On lease)	
2	Building & Civil Construction	20.8
3	Plant and Machinery	57.8
4	Misc. Fixed Assets	5.0
5	Preliminary Expenses	0.1
6	Pre Operative Expenses	13.49
7	Margin Money for Working Capital	3.17
8	Contingencies 10% of Fixed Assets	8.36
Total		**108.72**

Means of Finance

Table 28: Means of Finance

S. No.	Particulars	Value(Nu. In Millions)
1	Promoters' Equity	43.49
2	Term loan from FIs	65.23
Total		**108.72**

The term loan has been arrived at based on a 60:40 Debt Equity Ratio

9.1 Capital Cost

Building and Civil Works

About 3000 sq. meter of land will be required for this project and built up area required will be 1800 sq. meter consisting of milk reception, milk processing, milk storage etc. The land will be leased @ Nu.4.00 per sq. ft. per annum for first three years and @ Nu. 6.00 per sq feet for the fourth year and subsequently @ 3% increase every year.

Building & Civil Works: The cost is estimated at Nu. 20,8 million taking construction cost per square feet to be Nu. 13000/square meter.

Plant and Machinery

The cost of plant & machinery is estimated at Nu.57.8 millions including installation and commissioning. The installed production capacity is 250 kg/hour. The cost estimates for plant & machinery have been worked out based on the cost figures available from budgetary offers and/or orders placed for similar items in the recent past, duly updated to cover the price escalation in the intervening period. The detailed itemized estimates are given below

Freight and insurance have been considered on the assumption that all goods are transported by road. Utilities include packaging machine using plastic.

Table 29: Plant and Machinery

Serial Number	Stage Number	Stage Name	Stage Cost (Nu. In Millions)	Total Landed Price (Nu. In Millions)
1	I	Reception	1.8	2.6
2	II	Process Equipments	5.0	7.3

3	III	Butter & Ghee Equipment	2.7	4.0
4	IV	Evaporator	5.6	8.2
5	V	Powder Production	2.7	4.0
6	VI	Spray Dryer	9.5	11.0
7	VII	Utilities	13.3	19.5
8	VIII	Erection& Installation Charges	0.80	1.2
	Total			**57.8**

Misc. Fixed Assets

Nu. 5 million has been estimated under the heading of MFA. The details of miscellaneous fixed assets and their associated costs are been shown in table below:

Table 30: Misc. Fixed Asset

Sl. No.	Particulars	Qty. (No.s)	Rate (Nu. In Millions)	Amount (Nu. In Millions)
1	Office Equipment	-		0.1
2	Furniture and Fixture			0.5
3	Electrical Accessories			0.5
4	Electrical cabling, ducting & earthing			1
5	Computer System			1
6	Water Treatment Plant – 5000liters per hour			0.25
7	Fire Fighting	10	0.005	0.05
8	Utility Vehicles	02	0.8	1.6
	Total			**5**

Preliminary Expenses

Table 31: Preliminary Expenses

S.No.	Particulars	Estimation (Nu. In Millions)	Amount (Nu. In Millions)
1	Company Formation Expenses, Legal & Liaisoning	0.1	0.1
Total			**0.1**

Pre-Operative Expenses

Expenses incurred prior to commencement of commercial production are covered under this head that total Nu. 13.51 millions.

Pre-operative expenses include establishment cost, rent, taxes, traveling expenses, interest during construction insurance during construction and other miscellaneous expenses. Based on the financing pattern envisaged, interest during construction has been estimated considering the phasing of in the cash requirements and the norms prevalent for various sources of funds. It has been assumed that the funds from various sources shall be available, as required.

Based on the project implementation schedule, the expected completion dates of various activities and the estimated phasing of cash requirements, interest during construction has been computed.

Other expenses, under this head have been estimated on a block basis, based on information available for similar projects.

Table 32: Pre Operative Expenses

S. No.	Particulars	Estimation	Amount (Nu. In Millions)
1	Interest up to Production @ 13% on Term Loan Amount of 64.23	for 1 year on Term Loan	8.50
2	Insurance during Construction Period	0.25% of factory assets	0.21
3	Electricity Charges during Construction Period(Estimated)		0.3
4	Marketing Launch Expenses		2.5
5	Technology Know-how and Consultancy Fees		1
6	Training Expenses		0.5
7	Travelling Expenses		0.5
Total			**13.51**

9.2 Operating Cost

Cost of Raw Materials

Milk Consumption

The machinery has a capacity for input feed rate of 1820 kg/hour

If we assume that the plant is fully operational for 8 hours/day& assume 320 working days in a year then we get;

1. Milk Consumption per hour: 1,820 Kg/hour
2. Milk Consumption per day (8 hour day) : 14,560 Kg/day
3. Milk Consumption per annum (320 working days): 4,659,200 Kg/annum

Therefore we get: 4659.2tonnes of raw material (milk) consumed in a year

It is assumed that this is raw and unprocessed milk procured at Nu. 40/kg with cost of transportation at 5%.taken to be Nu. 2/kg as the milk would have to be collected and transported from the milk farmers.

Table 33: Cost of Raw Materials

S. No.	Amount of Milk (kg)	Unit Cost (Nu./kg)	Cost (Nu. In Millions)
1	4,659,200	42	195.69
Total			**195.69**

Land Lease Rate

The land area of 3,000 square meters (10,758 square feet) has been considered on lease @ Nu.4.00 per sq. ft. per annum for first three years and @ Nu. 6.00 per sq. ft. for the fourth year and subsequently @ 3% increase every year.

The table below shows the rate of land lease.

Table 25: Land Lease Charges

Sl. No.	Year	Lease Rate Per Sq. Ft Per Year (Nu.)	Lease Charges Per Annum (Nu. In Millions)
1	1st Year	4.00	0.129
2	2nd Year	4.00	0.129
3	3rd Year	4.00	0.129
4	4th Year	6.00	0.194
5	5th Year	6.20	0.2

6	6th Year	6.40	0.206
7	7th Year	6.60	0.212
8	8th Year	6.80	0.219
9	9th Year	7.00	0.226
10	10th Year	7.21	0.232

Sales Realization

1. Milk Powder

The average selling price for milk powder in Bhutan is Nu. 340 per kg. Recommended pricing at a premium of 2% is Rs 347/-. The output rate of the plant at 100% capacity is 250 kg/hour. The output of the plant at 100% capacity 640 metric tons per annum.

2. Butter

The average selling price for butter in Bhutan is Nu. 374 per kg. The pricing recommended at an approximately 2% premium is Rs 382 per kg. Per available literature, 20 kg of milk produces 1 kg of butter. The estimated yearly consumption of milk is 4,659 metric tons at full capacity. The expected amount of butter produced would then be 233 metric tons per annum.

Table 35.A. Sales Realization

S. No.	Particulars	Production Per Annum(Kg)	Rate Per Kg(Nu.)	Total Amount Per Annum (Nu. In Millions)
1	Milk Powder	6,40,000	347	222.08
2	Butter	2,32,960	382	88.99
			Total	**311.07**

Table 35.B: Sales Realization

	Milk Powder (Nu. In Millions)	Butter (Nu. In Millions)	Total (Nu. In Millions)
Total sales realization @100%	222.08	88.99	311.07
First year @60%	133.25	53.39	186.64
Second year@70%	155.46	62.29	217.75
Third year@80%	177.67	71.19	248.86

Salary and Wages

Salaries & wages for different categories of employees have been considered based on present day expenses being incurred by other industries in the vicinity. Adequate adjustments have been considered for expatriates.

The breakdown of manpower and incidence of salaries & wages are detailed in the following table. Salary & wages are increased @ 5% every year. Fringe benefits taken to additional 15% on the figures quoted.

Table 36: Salary and Wages

S. No.	Job Title	Required No.	Annual Salary (Nu. In Millions)
1	Plant Manager	1	0.2
2	Secretary	1	0.25
3	Accountant	1	0.14
4	Personnel Officer	1	0.25
5	Salesperson/purchaser	2	0.288
7	Clerks	2	0.18
8	Store Keeper	2	0.12
9	Production Supervisor	2	0.3
10	Maintenance Engineer	2	0.4
11	Technician Operators	10	1.2
12	Laborers	10	0.72
13	Cleaner	4	0.216
14	Driver	4	0.36
15	Guard	4	0.24
Total			**4.864**

Electrical and Water Consumption Charges

Power & water charges are increased @ 5% every year. The unit cost of electricity has been considered @ Nu.1.81/ kwh assuming that the entire power requirement is met from the grid. A power supply of 225 KVA equivalent to 180 KW taking a poer factor of 0.8 is deemed appropriate. The expense on water supply, treatment and distribution has been suitably considered, based on the Thimphu City Corporation water tariff of Nu.3.49/ m^3 with an additional 50% levy for sewerage. Water requirements are approximately 10,000 liters per day.

Table 37: Power and Water Requirement

S. No.	Description	Amount Per Annum (Nu. In Millions)
1	Power Consumption	0.834
2	Water Consumption	0.017
	Total	**0.851**

Term Loan Requirement from Financial Institutions

Table 38: Term Loan Requirement

S. No.	Head	Cost	Promoter's share	Bank Loan
1	Land 3000 sq. meters			
2	Building and Civil Construction	20.8		
3	Plant and machinery	57.8		
4	Other Misc. & Fixed Assets	5		
5	Preliminary Expenses	0.1		
6	Pre-operative Expenses	13.49		
7	Margin Money for Working Capital	3.17		
8	Contingencies	8.36		
		108.72	**43.49**	**65.23**

The above calculations have been arrived at by taking a Debt Equity Ratio of 60:40

Working Capital Requirement

Working capital requirements have been worked out in the following table:

Table 39: Working Capital Requirement

S. No.	Particulars	Period	Margin	Amount (Nu. In Millions)	Promoters Contribution (Nu. In Millions)	Bank Loan (Nu. In Millions)
1	Raw Material	15 days	25%	4.89	1.22	3.67
2	Receivables	15 days	25%	7.78	1.95	5.83
Total				**12.67**	**3.17**	**9.50**

Estimated Cost of Production & Profitability

The profitability projections have been worked out for 10 years; at 60% capacity utilization during first year of operation, 70% in second year and 80% from third year onwards and following assumptions and basis as relevant and applicable to Bhutan have been considered while preparing the profitability.

- Repairs & maintenance have been taken as @4% p.a. on fixed assets.
- Bank interest rate has been calculated @13% p.a. on term loan & working capital loan.
- Insurance charges @0.25% on all assets in first year, then @5% decrease every year.
- Power charges are increased @5% every year.

- Administrative expenses have been increased @5% every year.
- Debt equity ratio has been taken to be 60:40 for term loan
- Margin money on bank loan has been considered @ 25% on working capital
- Bank loan has been considered for repayment in 8 years with one year moratorium
- Preliminary exp. will be written off @10% every year in next 10 years.
- Pre operative exp. will be written off from II year @10% every year in next 10 years.
- Straight Line Depreciation has been charged taking useful life for buildings to be 30 years with a residual value of 10%; 7 years on other fixed assets and 6 years on machinery with no residual value.
- Insurance, lease rent & interest has been taken as fixed cost for calculating B.E.P.
- Income tax has been charged @30% every year as per Bhutan's tax rates.

10.0 FINANCIAL ANALYSIS

10.1 Profitability

Table 40: Profitability

Heads	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
RM	117.41	136.98	156.55	156.55	156.55	156.55	156.55	156.55	156.55	156.55
Utilities	0.851	0.89	0.94	0.99	1.03	1.09	1.14	1.20	1.26	1.32
Salary	4.86	5.10	5.36	5.63	5.91	6.20	6.51	6.84	7.18	7.54
Fringe benefits	0.73	0.77	0.80	0.84	0.89	0.93	0.98	1.03	1.08	1.13
Insurance	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.15	0.14	0.13
Repair & mainten-ance	3.34	3.51	3.68	3.87	4.06	4.26	4.48	4.70	4.93	5.18
Land Lease Rate	1.29	1.29	1.29	1.94	1.99	2.05	2.11	2.18	2.24	2.31
Other Admin expenses	0.19	0.20	0.21	0.23	0.24	0.25	0.26	0.27	0.29	0.30
Producti-on Cost	128.88	148.94	169.03	170.21	170.84	171.50	172.19	172.91	173.67	174.47
Sales	186.64	217.75	248.86	248.86	248.86	248.86	248.86	248.86	248.86	248.86
S&D Cost	28.00	32.66	37.33	37.33	37.33	37.33	37.33	37.33	37.33	37.33
Cost of Sales	156.88	181.61	206.36	207.54	208.17	208.82	209.51	210.24	211.00	211.80
PBIDT	29.76	36.14	42.50	41.32	40.69	40.04	39.35	38.62	37.86	37.06
Interest on TL	8.50	7.97	6.91	5.84	4.78	3.72	2.66	1.59	0.53	0
Interest on Loan for WC	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24

Total Interest	9.74	9.21	8.15	7.08	6.02	4.96	3.90	2.83	1.77	1.24
PBDT	20.02	26.94	34.36	34.24	34.67	35.08	35.45	35.79	36.09	35.82
Heads	9.71	9.71	9.71	9.71	9.71	9.71	8.88	0.62	0.62	0.62
Deprecia-tion	10.31	17.22	24.64	24.52	24.96	25.36	26.57	35.16	35.47	35.20
PAD	0	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Write off POE	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Write off PE	10.21	15.77	23.20	23.07	23.51	23.91	25.12	33.71	34.02	33.75
PBT	3.06	4.73	6.96	6.92	7.05	7.17	7.54	10.11	10.21	10.13
Tax @ 30%	7.14	11.04	16.24	16.15	16.46	16.74	17.58	23.60	23.81	23.63
PAT	156.88	181.61	206.36	207.54	208.17	208.82	209.51	210.24	211.00	211.80

10.2 Calculation of Interest on Term Loan

Table 41: Interest on Term Loan

Year	Opening Balance (Nu. in Millions)	Repayment (Nu. in Millions)	Closing Balance (Nu. in Millions)	Interest (Nu. in Millions)
1	65.23	0.00	65.23	8.48
2	65.23	8.15	57.08	7.95
3	57.08	8.15	48.92	6.89
4	48.92	8.15	40.77	5.83
5	40.77	8.15	32.62	4.77
6	32.62	8.15	24.46	3.71
7	24.46	8.15	16.31	2.65
8	16.31	8.15	8.15	1.59
9	8.15	8.15	0.00	0.53

10.3 DSCR Calculation

Computation of Net Operating Income

Table 42: Net Operating Income

	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10
PAT	7.14	11.04	16.24	16.15	16.46	16.74	17.58	23.60	23.81	23.63
Dep	9.71	9.71	9.71	9.71	9.71	9.71	8.88	0.62	0.62	0.62
Int	9.74	9.21	8.15	7.08	6.02	4.96	3.90	2.83	1.77	1.24
NOI	26.60	29.96	34.10	32.95	32.19	31.41	30.36	27.06	26.21	25.49

Computation of Debt Services

Table 43: Computation of Debt Services

	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year 10
Repayment	0.00	8.15	8.15	8.15	8.15	8.15	8.15	8.15	8.15	
Lease	1.29	1.29	1.29	1.94	1.99	2.05	2.11	2.18	2.24	2.31
Int	9.74	9.21	8.15	7.08	6.02	4.96	3.90	2.83	1.77	1.24
DS	11.03	18.65	17.59	17.17	16.16	15.16	14.16	13.16	17.76	13.23

Computation of DSCR (Net Operating Income/Debt Services)

Table 44: Computation of DSCR

	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10
DSCR	2.41	1.61	1.94	1.92	1.99	2.07	2.14	2.06	1.48	1.93

Average = 1.95

10.4 Break Even Point

Table 45: Break Even Point

Elements	1st Year	2nd Year	3rd Year
Sales	186.64	217.75	248.86
Variable Cost	155.38	180.12	204.88
Fixed Cost	11.24	10.70	9.63
Break Even Point (B.E.P)	21.57	19.90	17.51
Average B.E.P	19.66%		

Note on unit Costing & Pricing

Table 45a: Unit Costing & Pricing

Product	**Milk Powder**	**Butter**
Heads		
Raw Material	218.28	240.30
Sales Distribution Costs	52.05	57.30
Overheads	61.75	67.98
Margin	14.92	16.42
Total	347.00	382.00

10. 5 NPR and ROI

Table 46: NPR and RI

Ratio	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**	**6th Year**	**7th Year**	**8th Year**	**9th Year**	**10th Year**
Accu-mulated Profit	7.14	18.19	34.42	50.57	67.03	83.77	101.35	124.95	148.76	172.39
NPR	3.83	5.07	6.52	6.49	6.61	6.73	7.07	9.48	9.57	9.49
ROI	4.46	7.34	10.79	10.74	10.94	11.13	11.69	15.69	15.83	15.71

10.6 Cash Flow Statement (Nu. In Millions)

Table 47: Cash Flow Statement

S. No.	**Years**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Inflows											
1.1	Net Profit After Tax	0.00	7.14	11.04	16.24	16.15	16.46	16.74	17.58	23.60	23.81	23.63
1.2	Deprecia-tion	0	9.71	9.71	9.71	9.71	9.71	9.71	8.88	0.62	0.62	0.62
1.3	Preliminary Expenses Write Off	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

1.4	Pre Operative Expenses Write off	0	0	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
1.5	Total inflow	0	16.96	22.67	27.87	27.78	28.09	28.37	28.38	26.14	26.35	26.17
2	Outflows											
2.1	Investment in Fixed Assets	83.60										
2.2	Investment in Working Capital	1.24										
2.3	Interest on Term Loan and WC		9.74	9.21	8.15	7.08	6.02	4.96	3.90	2.83	1.77	1.24
2.4	Total Outflow	84.84	9.74	9.21	8.15	7.08	6.02	4.96	3.90	2.83	1.77	1.24
3	Net cash flow	-84.84	7.22	13.47	19.72	20.70	22.07	23.41	24.49	23.31	24.58	24.93
4	Net Present Value	-84.84	6.39	10.55	13.67	12.70	11.98	11.25	10.41	8.77	8.18	7.34

Internal Rate of Return (IRR) 16.92%

Net Present Value (NPV) at 13% Nu.16.39 Millions

Project Viability: - The Internal Rate of Return of the project is 16.92%, significantly higher than the bank return rate of 13%.Hence, the project is deemed financially viable. The NPV of the project is positive (Nu. 16.39 millions) at the discount factor of 13% during the first 10 years of operation considered. This implies that the project generates sufficient funds to cover all its cost, including loan repayments and interest payments during the period. This also indicates that the project generates profits even after 10 years and hence the project is viable over the long run.

REFERENCES

Bhutan Trade Statistics 2014, Department of Revenue and Customs, Ministry of Finance, Royal Government of Bhutan (2014)

Dzongkhag-wise Inventory of Resources, Ministry of Economic Affairs, Royal Government of Bhutan (2005)

Environmental Assessment Act, 2000, National Environment Commission, Royal Government of Bhutan (2000)

Gujarat Cooperative Milk Marketing Federation, Delhi, June 2014

Labour Force Survey Report 2012, Department of Employment, Ministry of Labour and Human Resources, Royal Government of Bhutan (2012)

Labour Force Survey Report 2013, Department of Employment, Ministry of Labour and Human Resources, Royal Government of Bhutan (2013)

Livestock Statistics 2013, Department of Livestock, Ministry of Agriculture and Forests, Royal Government of Bhutan (2013)

Milk Powder Cheaper on Imports, Lower Demands, The Economic Times, July 16, 2010, http://articles.economictimes.indiatimes.com/2010-07-16/news/28454341_1_milk-powder-flush-season-milk-producer, Accessed: 30 June 2015

Regulation for the Environmental Clearance of Projects, 2002, National Environment Commission, Royal Government of Bhutan (2002)

Statistical Yearbook of Bhutan 2014, National Statistics Bureau, Royal Government of Bhutan (2014)

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