Ministry of Economic Affairs

Detailed Feasibility Study on Industrial Linkages and Cluster (Mineral Based Industry)

Department of Industry

June 2018

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Thimphu: Bhutan

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Project carried out by:

Norlha Engineering and Management Consultancy

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Abbreviations

ABI	Association of Bhutanese Industries
ADB	Asian Development Bank
AWBI	Association of Wood Based Industries
BCCI	Bhutan Chamber of Commerce and Industry
BHU	Basic Health Unit
CO_2	Carbon dioxide
dB	Decibel
EDP	Economic Development Policy
EU	European Union
FICCI	Federation of Indian Chambers of Commerce and Industry
GCP	Gas Cleaning Plant
GDP	Gross Domestic Product
MW	Megawatt
MWh	Megawatt hour
MT	Metric Tonne
PM	Particulate Matter
RGOB	Royal Government of Bhutan
SWOT	Strengths-Weaknesses-Opportunities-Threats
SWM	Solid Waste Management
TVET	Technical and Vocational Education and Training
UN	United Nations
UNFCCC	United Nations Framework Conference on Climate Change
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar

EXECUTIVE SUMMARY

This report is a Detailed Feasibility Study on Industrial Linkages and Cluster on mineral based industry in Bhutan through the Department of Industry, Ministry of Economic Affairs of the Royal Government of Bhutan.

The objective of the study is to assess the industrial activities which can have industrial linkages and cluster development within the framework of environment friendly industrial development. The current pattern of industrial development in the country is rather haphazard wherein the private sector proposes to establish their industry as and where they wish to. This kind of pattern has negative impact on the overall industrial growth in the country. Accordingly, mineral based cluster and linkage industry was undertaken for detailed analysis. The report presents in detail the justification of the project, market analysis of the products, resources required, and technology used in the plant, plant location, environmental aspects, and implementation of the project, cost presentation and financial analysis.

a) **Justification of the Project:** Industrial development in Bhutan has happened in an ad-hoc manner based on preferences of the entrepreneurs and the market conditions. The unrelated industries are located within one specific geographical area, in close proximity to each other without considering inter-industrial synergies and complementarities. This has resulted in haphazard development with very little scope for enhancing productivity and improving efficiency. So based on the experiences from past industrial development, the need to develop industries in a cluster with well-planned linkages was felt necessary as per the Economic Development Policy 2016.

b) **Market Analysis:** In the present scenario, minerals mined from the mining activities are directly exported in raw form to other countries. So if there is some value addition in the minerals, then there are opportunities for domestic consumption as well as for export.

c) **Resources required:** Raw materials required for processing and production of various products from the cluster industry are limestone, gypsum, marble/dolomite, granite and quartzite along with some other additives in the production process. All these raw materials are already available in the country and only few additives need to be imported from India. Apart from this, the industry requires electricity, water and manpower - which are available in Bhutan.

d) **Technology required:** State of art technology has been proposed for the industry cluster as per the latest technologies available in the market along with the identification of technology suppliers from India. The details have been put in the annexure.

e) **Plant Location:** Considering the central location to raw materials, infrastructure and other advantages, Jigmeling Industrial Park has been proposed as the ideal location for the cluster industry.

f) **Environmental Aspects:** The production of mineral based products may cause noise pollution and water pollution but this can be reduced up to a great extent by following the recommended measures.

g) **Implementation of the Project:** The implementation of the project will take 25 months including pre-project activities.

h) **Financial and Economic Analysis:** The average Internal Rate of Return of the project is above 21%, which is much higher than the bank rate of 13%. Hence the project is financially viable.

CHAPTER 1: INTRODUCTION

1.1Background

Industrial development is a key driver for economic development and diversification, job creation, export enhancement and revenue generation among others. It is one of the expansionary sectors that is expected to diversify the economic base through creation of new sustainable activities. However, owing to numerous inherent constraints, manufacturing sector has remained rather stagnant with its contribution to GDP hovering in the range of 8.1% to 8.8% during 2010-2014.

Stimulating investments in the key sectors of the economy namely the five jewels and other areas with comparative advantages will therefore be essential to foster industrial development. At the industry level, leveraging on the comparative advantages, industrial sector shall be encouraged to foster backward and forward linkage to the economy and move up the industrial value chain over the long-term. The Royal Government as the enabler shall continue to improve environment for business establishment and operation through policy reforms and necessary interventions.

Bhutan embarked on to planned economic development by early 1960s and through successive five year plans, economy witnessed a major transformation over the last six decades. With the establishment of basic infrastructure as well as major investment in hydro-power, the overall focus is now on expansion of economic base through increased investment in business activities within the broad framework of environment friendly sustainable development.

In the industrialization process, the Royal Government assumes a role of facilitator/enabler with the private sector given the lead for making investment in commercial ventures. Besides its efforts to create an enabling environment, it provides support in creating industrial infrastructure, human resource development, studies and advisory support in business opportunities.

Within this framework, the Department of Industry, Royal Government of Bhutan, with the responsibility to promote industrial development, is initiating identification of project ideas for private sector investor.

The Royal Government is keen to promote industrial units that will serve to increase revenue earning/productivity of resources/facilities available within the country. While the Government is keen to pursue private sector led growth, there is a dearth of project ideas for diversification of industrial products. The EDP 2017 states that “Industries shall be developed with a cluster approach in order to benefit from the close geographical proximity among industries that are linked by commonalities and complementarities”.

The objective of the proposed assignment is to firstly assess the industrial activities which can have industrial linkages and cluster development within the framework of environment friendly industrial development. The current pattern of industrial development in the country

is rather haphazard wherein the private sector proposes to establish their industry as and where they wish to. This kind of pattern has negative impact on the overall industrial growth in the country.

So the focus of the study is to carry out study on mineral based industrial activities for industrial linkages and cluster development.

1.2 Economic Growth of Bhutan

The Kingdom of Bhutan cautiously opened its borders to outsiders in the 1970s and joined the United Nations1in 1971. The Bhutanese currency, ngultrum (BTN) was introduced in 1974 which was pegged to the Indian rupee. Till the 1960s, economic aid from India was the only source of revenue to the government. However, with admittance to the United Nations, Bhutan began to receive development assistance from multilateral and other bilateral donors.

The rugged terrain, compounded by the lack of access to sea, does not provide economic advantage to Bhutan. Its geographic placement makes navigation, communication, construction of infrastructure, development, and establishment of industries rather difficult and expensive. Starting with the commissioning of the first hydropower plant in 1988, Bhutan has largely expanded its economy by exploiting natural resources for the generation of hydropower. It is one of the world's smallest economies[2], with a GDP representing less than 0.01% of the world economy. Bhutan grew rapidly with the commissioning of the fifth hydropower project in 2005. The economy grew by 8 per cent in 2005[3], by 14% in 2006 and it was the second fastest growing economy in the world in 2007 with an annual growth rate of 22.4%. The GDP reached an all-time high of 1.82 USD billion in 2011 but remained the same in 2014[4]. Further as per the outlook 2017 report released by ADB, Bhutan's economy is to grow by 9.9% in 2018 based on the assumption that there will be a lot of activity investment projects in Bhutan which will boost the economy in the country and lower the inflation rate in the next few years.

Bhutan's economy is based on agriculture, forestry, tourism and sale of electricity. 56% of the population depend on agriculture, 22% depend on industry and 22% on services. In 2014, agriculture contributed to 14.4% of the GDP, industry contributed 41.6% and services contributed 44%[5].

[1]International Encyclopedia of Himalayas (5 Vols. Set). Ramesh Chandra Bisht. 2008. Mittal Publication.
[2]The World Factbook, Central Intelligence Agency. www.cia.gov/library/publications/the-world-factbook/geos/bt.html
[3]Bhutan Millennium Development Goals - Needs Assessment and Costing Report (2006-2015). November 2007. Planning Commission. Royal Government of Bhutan.
[4]An investment guide to Bhutan Opportunities and Conditions 2013. United Nations Conference on Trade and Development (UNCTAD)
[5]Bhutan Country Strategy Paper 2007 – 2013. European External Action Service

Agrarian practices consist largely of subsistence farming and animal husbandry. Agricultural produce includes rice, chilies, dairy (some yak, mostly cow) products, buckwheat, barley, root crops, apples, citrus and maize. The primary sources of water for irrigation are streams and rain. Though agriculture has been the mainstay of Bhutan's economy and a majority of its population depends on farming, only 2.9% of the country is under agriculture. The industrial sector is at a nascent stage, and though most production comes from cottage industry[6], larger industries are being encouraged by the Royal Government of Bhutan. Small cottage industries manufacturing food products, handicrafts and handloom are found in several regions. The manufacturing sector in Bhutan includes ferrous silica, cement, wood products, alcoholic beverages, calcium carbide, construction material and agricultural products. Much of the material for everyday consumption is imported from other countries. The country has an installed generation capacity of 1,623.03 MW and claims a hydropower potential of about 30,000 MW[7], out of which 24,000 MW is economically viable potential. Though Bhutan has a coal reserve of 1.3 million tonnes, it mines less than 1,000 tonnes a year[8]. There has been recent growth in the technology sector, in areas such as green tech, consumer internet and e-commerce. Also, software imported from India is packaged in Bhutan and exported to Hong Kong and Singapore.

Bhutan's major imports are petroleum products, mineral products, base metals, machinery and electrical appliances, automobiles and spares, wood, plastic, rubber, spices, and processed food. 80% of all imports are from India and the remaining is sourced from South Korea, Thailand, Singapore, Japan, China and Nepal. Bhutan's main export partner is India which accounts for around 90% of the total. Export of electricity to India constitutes around 50% and other exports include metals, minerals, chemical products, timber, raw silk, fruit products and rubber products. Other exports partners include Hong Kong, Bangladesh, Japan, Nepal and Singapore.

[6]Cottage & Small Industry of Bhutan – Overview. 2011. Ministry of Economic Affairs. www.moea.gov.bt/documents/files/pub0nu5370zv.pdf

[7]Sustainable Hydropower Development Policy. 2008. Royal Government of Bhutan

[8]Bhutan's Experiments with Happiness. Nitya Jacob. 31 October 2013. Down to Earth

CHAPTER 2 JUSTIFICATION OF THE PROJECT

2.1 Project Concept

The project is intended to carry out a feasibility study to explore the development of industrial cluster and linkages in Bhutan for the mineral based industries with the objective of enhancing productivity, improving efficiency and facilitating transfer of skills and technology geared towards economic diversification and sustainable socio-economic development.

The objectives of the study are as listed below:

a) To study the feasibility of establishing industrial clusters in Bhutan.
b) To identify and scope out linkages among the cluster stakeholders.
c) To guide the establishment of a cluster based on the principles of eco-industrial park.

2.2 Project Justification

Bhutan is passing through a fast growing phase of development. Starting in early1960s, Bhutan embarked on planned economic development through successive five year plans. Over the years, ever increasing generation of electricity by installation of new hydro power projects has facilitated the establishment of new industries within the broad framework of sustainable and environmental friendly development. As power, transport and other infrastructure are the basic requirements for economic growth, the development of infrastructure has also been in the focus of developmental programmes. Over the years a number of power projects, roads, bridges, hospitals, schools and commercial and residential buildings have been built. This has resulted in a rapidly growing construction industry which utilizes various mineral based products.

Industrial development in Bhutan has happened in an ad-hoc manner based on preferences of the entrepreneurs and the market conditions. The unrelated industries are located within one specific geographical area, in close proximity to each other without considering inter-industrial synergies and complementarities. This has resulted in haphazard development with very little scope for enhancing productivity and improving efficiency. Based on experiences from past industrial development, the need to develop industries in a cluster with well-planned linkages was taken up as a policy directive in EDP 2016.

The establishment of industrial cluster and linkages is most suited for development in specific area. The following factors contribute to its growth:

a) Requires local resources such as minerals and other ancillary ingredients. These raw materials are available across the southern belt of the country near to the development activities.
b) The industries could be set up near the source of raw materials and market minimizing the transportation cost which is otherwise too heavy.

c) Plant with selected machinery and equipment can produce various types of materials required in the construction & infrastructure development activities and thereby facilitating the industry to market their production throughout the year and attain regular margins and economics of production.

So the development of clusters is anticipated to bring about synergies in the industrial activities and further promote linkages to improve the industrial ecology leading to enhanced productivity at the least environmental and social costs. Clusters can build up on the clean and green image of Bhutan and find niche markets for products made in Bhutan using Brand Bhutan.

Mineral based products are essential for such development and therefore products like gypsum boards, tiles, marbles, cement concrete blocks, hollow blocks, pavers and tiles etc. are essential. The manufactures of these products are environment friendly and could be commercially exploited profitably with low investment. These items are extensively used in various activities of infrastructure development like housing, roads, bridges and commercial building which is part of urban development. With a view to cut down the cost of import of raw materials in construction industries or import of mineral related products and also to accelerate the pace of industrialization in Bhutan, the government is keen to promote industrial cluster and linkage product manufacturing. Setting up of such industries would help in easy availability of mineral based products at economic prices, generation of employment opportunities, optimum use of natural and human resources and above all accelerating the pace of industrialization in the country.

Dusk at Pasakha Industrial Estate

CHAPTER 3: MARKET ANALYSIS

3.1 Structure of the Industry

Key stakeholders: The mineral based industry interacts with various stakeholders as explained below:

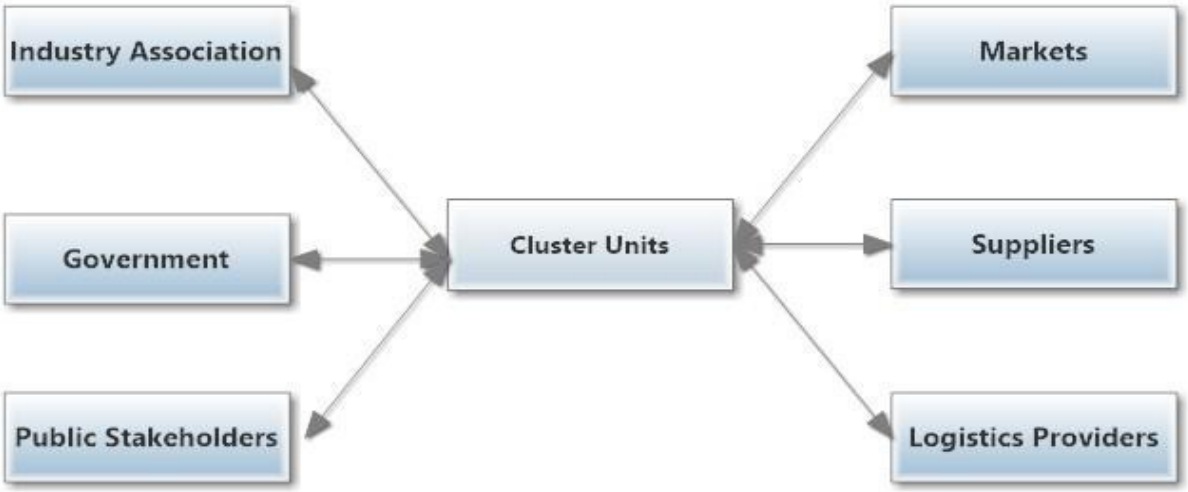

Fig 1: Key stakeholders

Government: The Government plays an important role in providing a stable and reliable policy and regulatory environment conducive to the growth and development of the cluster. The government can streamline approval and clearance procedures, provide fiscal and non-fiscal incentives and subsidies and assist in improving the access to both local and international financing sources. The units in the cluster, in turn can help in delivering the economic and social objectives of the government through creating employment and revenue stream to the government in addition to improving the balance of trade and payments of the country.

Industry Associations: Industry associations can play a more pro-active role in provision of business and promotion activities to the cluster units through product labeling and certification services. They can also provide the much needed capacity building in the industry sector by tying up with both bilateral and multilateral agencies and providing focused TVET and management trainings. The cluster units, by being a member of the industry association will contribute to its revenue stream through membership fees and align the strategic directions of the association through inclusive and participatory planning.

Markets: The final products from the cluster will need a market and in this sense the market comprises of the domestic market as well as the export market. While Bhutan and India enjoy free trade arrangements and Bhutanese products have a ready market in India, it is important to explore other markets in third countries to reduce the risk of single market stagnation.

Suppliers &Logistics Providers: The suppliers of the raw materials to the cluster system are the miners who extract the minerals. The mined minerals need the services of transporters and logistic companies to ferry the raw materials from the mines to the end users and therefore, in using these services, another economic activity is added to the system.

Public Stakeholders: All mineral extraction activities take place with the blessings of the stakeholders who are directly or indirectly affected and it is important to engage these stakeholders actively. Stakeholder engagement should not end with the initial public consultation exercise and in an ideal situation, representatives of the stakeholders should be on the governing board of the industrial cluster to ensure that the strategic direction of the cluster development contributes to both social and economic development.

3.2 Demand and supply scenario

The mineral based products envisaged to be manufactured in the clustering industry are the basic building blocks of any construction industry. For a developing economy like Bhutan, mineral based products become the major activity in various spheres of development. Evidently, strengthening of infrastructure has become a focused sector for development in Bhutan. It could be observed that a lot of construction activities are either in the process of implementation or planned to be taken up in near future both in public and private sector. With the growing pace of development in infrastructure sector mainly power & roads and increasing trend of urbanization, the construction activities are likely to gain further momentum which will further spur demand for Mineral based products.
As per the estimate of the experts, demand for building construction units for load bearing & partition wall is around 5% of the cost of construction, 5% for flooring tiles and paving blocks is 2-3% of the construction & development cost of buildings. Thus the mineral based products shall account for a total of 10% of the estimated cost of building construction envisaged for urban & rural development.

Taking into consideration, the financial allocation to the different sectors as per the 11th five year plan of Bhutan and considering the requirement of mineral based products at around 1.5% of the total cost in various projects and around 10.5% in various development projects, the total projected requirement of mineral based products works out to approximately Nu. 680million. besides, there would be additional demand of about Nu. 70 million from private sectors and thus the total demand would be around Nu. 750million. This would lead to a demand level of around Nu.150 million of mineral based products per annum.

In addition, minerals and mineral-based products, including base metals and related articles account for 40% of exports from Bhutan to India[9].Bangladesh and Hong Kong are Bhutan's next-biggest export clients, but each accounting for only about 3% of exports[10].

[9] Mineral and mineral-based commodity exports from Bhutan include salt, sulphur, earths and stone, plastering materials, lime and cement, ores, slag and ash, mineral fuels, mineral oils, and bituminous substances

Exports of minerals and mineral-based products account for nearly half of total exports of Bhutan[11]. Consequently, the existing mineral based industries are mostly located at the southern region of the country due to proximity to the Indian market as well as cross border trade. The existing production of various minerals from all these industries is shown in the table above.

Minerals	Production (MT in 2016)
Dolomite	2,367,659.00
Lime stone	1,257,101.00
Gypsum	317,597.00
Marble	75,031.00
Quartzite	92,770.00
Granite	6,463.00
Total	**4,116,621.00**

Table 1: Mineral Production in 2016 (source NSB 2017)

Minerals	Unit	Export	Domestic use	Total
Dolomite	MT	2,283,723	83,934	2,367,657
Limestone	MT	1,244,999	12,102	1,257,101
Gypsum	MT	241,650	75,948	317,598
Marble	MT	36,358	38,674	75,032
Quartzite	MT	2,745	90,025	92,770
Granite boulders	MT	5,860,390	96,827	5,957,217
Total		**9,669,865**	**397,510**	**10,067,375**

Table 2: Mineral export and domestic use 2016 (Source NSB 2017)

As per the Bhutan Trade Statistics 2017 report, the export of dolomite, limestone, gypsum and granite products are more compared to other minerals as shown in the table above.

Minerals	Quantity (KGM)	Value (Nu.)
Marble	1,939,104.87	20,093,814.00
Gypsum	14,230.00	801,973.00
Plasters	70,506.24	1,072,466.00
Limestone	78,126.00	996,519.00
Quick lime	33,420,778.00	265,684,149.00
Granite tiles	1,058,195.45	25,751,716.00
Total	**36,580,940.56**	**314,400,637.00**

Table 3: Mineral import from other countries (source: Bhutan Trade Statistics 2017)

The import of minerals such as marble, gypsum, plasters, limestone including quick lime and granite tiles are given in the table below. It is found that about Nu. 265.684 million worth of quicklime has been imported followed by Nu.25.751million of granite tiles and Nu.20.093 million of marbles in 2007.

[10] Bangladesh has a 3.2% share (oranges, apples, cardamom, fruit juices and processed foods and beverages, and mineral products, including dolomite, gypsum and limestone), and Hong Kong has a 2.8% share (cordyceps and furniture) in Bhutanese exports.

[11] UNDP Diagnostic trade integration study

3.3 Indian market scenario

India is the major importer of Bhutanese products due to free trade agreement between the two countries and a closest neighboring country. There is ample opportunity for market for the mineral based products since India being one of the fastest growing economies in the world with 1.225 billion populations. The mineral based products like gypsum board is substituting traditional solutions such as brick and mortar, and plywood. In the next few years, India's GDP is expected to continue to grow on the back of economic development, rapid urbanization, thrust on infrastructure investment, improved private investment, strong industrial activity and increasing consumption. The Government's focus on "Make in India" (hike manufacturing share in GDP from the current 17% to 25% by 2022), "Housing for all by 2022", smart cities, power for all, modernization of railways and aggressive highway construction targets will drive growth at a faster pace in end-user industries including power, cement, construction and infrastructure, which will in turn boost domestic mineral consumption[12].

With a large number of real estate development projects and boom in the construction of multiplexes, shopping complexes, hotels, airports, educational institutions, hospitals and other construction projects, the demand for mineral based products is likely to grow at a very fast pace in the Indian market. Further, with the growing emphasis on environmental protection, sustainable development emphasis on construction of green buildings of international standards, mineral based products would find more and more application in the construction industry in India. For example, extensive use of gypsum board in the construction of new terminal at India Gandhi International (IGI) Airport is an indicator of about the future trend in the application of gypsum board in India.

3.4 Global market scenario

World demand for minerals will be affected by three general factors-uses for mineral commodities, the level of population that will consume these mineral commodities, and the standard of living that will determine just how much each person consumes. As new materials and applications are found, markets for mineral commodities can expand considerably. Although it is impossible to foresee all of the new products that will be developed for use by society in the future, they certainly will be composed of chemical elements and minerals. Thus, minerals will retain their dominant role as the basis for products used by society and, therefore, as the basis for world manufacturing and agriculture. Until new and significantly cheaper energy sources become available, global mineral demand probably will focus on the same metals and minerals that are of interest today.

Asia Pacific was the largest region in the metal and mineral manufacturing market in 2017, accounting for around 56% market share. North America was the second largest region accounting for around 13% market share. Eastern Europe was the smallest region accounting

[12] Achieving 25% of GDP from manufacturing, 100 million jobs by 2022 difficult: Survey,' Economic Times

for around 4% market share[13]. It was also reported by the European Commission that securing a sustainable supply of raw materials is a key priority for the EU. Raw materials, such as metals and minerals have become increasingly important to the EU's economy, growth, and competitiveness. More than 30 million jobs in the EU and many key economic sectors such as automotive, aerospace, and renewable energy are dependent on a sustainable supply of mineral based raw materials[14].

3.5 Pricing & Marketing Strategies

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

Segmenting: The market segmentation can be divided into distinct groups of buyers who might require separate offerings in terms of product attributes, pricing, promotion and distribution.

The clientele can be classified into:

a) Individual consumers (High income, middle income);
b) Institutional buyers (Corporate bodies, hotels, government agencies and private parties) and;
c) Influencers (policy makers, consultants and other market players)

Targeting: This is the act of choosing some of the segments identified from considerations of commercial attractiveness.

Among institutional buyers, if the company decides to address all segments, the sales team should have clearly spelt out responsibilities for team members to address the segments with a properly devised sales plan. As the product gains a market foothold, direct procurement through ecommerce portals could also be encouraged for institutional buyers where the deal size is below a certain threshold.

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

Some viable positioning statements could be “Made in Bhutan”, where a quality product at par with imported products can be produced in terms of durability, aesthetics and ability to reduce noise or energy efficiency aspects. It can be made readily available in the market.

The marketing mix should accordingly be defined encompassing aspects like the product attributes including quality, 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 industry can ensure that their products are considered at par with imports. The company must adopt an appropriate logo for their product to effectively communicate value.

[13] https://www.reportlinker.com/p05312923/Metal-And-Mineral-Manufacturing-Global-Market-Report.html
[14] https://ec.europa.eu/growth/sectors/raw-materials_en

Price: To establish the product in the market, competitive pricing strategy shall be used since there are no cluster industries with similar products being manufactured for comparison purposes. It can be compared with the imported products and therefore the price cannot be very different from imported products. Similarly there should be attractive margins for trade – in keeping with or ahead of the market.

Promotion: Some of the promotional strategies which can be used for the following potential buyers and policy makers are:

a) **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 for dealers – particularly for the first year of operation.

b) **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 to buy the products.

c) **Influential or policy makers**: Part of the Sales team may be given special responsibilities to meet key influencers like government policy makers and market players and make convincing technical presentations so that mineral based products in general and product in particular, gets a greater degree of acceptance in the market.

d) **General**: For customers who are already 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.

In order to achieve the above strategies, below are some of the promotional activities to be undertaken:

a) The product could be launched with coverage on the TV and newspaper.
b) Regular TV and newspaper advertisements to make the market players including wholesalers, retailers & customers are aware of the benefits of the product through exhibitions.
c) Performance recognition schemes and contests for dealers in the first year of operation.
d) Meeting with large institutional buyers to present the value proposition adequately and respond to their enquiries.
e) Meeting with consultants and policy makers in the government to ensure that mineral based products get a higher degree of acceptance in building and construction projects.
f) Arranging or sponsoring periodic meets and symposiums for builders, architects and policy making bodies to encourage use of locally produced products specially in public constructions.

3.6 Technological changes that could affect production costs and substitutions

One of the biggest technological changes that can impact the way the cluster industry would conduct business in the future would be the use of information technology in shaping ecommerce and its adaption in the Bhutanese economy.

It may be used to find out the customers on line. Similarly it may be possible to generate and respond to customer's enquiries on line and transact business with those who stays outside the country. In the process some non value-adding intermediaries may be flushed out from the supply chain leading to greater efficiency.

It has been found that most of the ingredients of production are imported and therefore expensive. If ancillary units can be set up, say for portion of the mining using latest technology which can influence production efficiency, and then the production cost can be minimized significantly. Considering the large deposits of limestone, marbles, gypsum or granite in Bhutan, it appears to be a distinct possibility.

Another factor influencing the risk of supply is the potential for raw materials to be substituted by other materials. If at any time a substitute is found for all the applications of a mineral, then that mineral will no longer be scarce. Brown and Field (1979), in research about steel and copper, used neoclassical analysis and found the labour force to be an appropriate substitute for them. Similarly, Humphrey and Moroney (1975) showed that labour force and to some extent capital can be appropriate substitutes for most of the minerals. As such if some new innovations in technology comes through, then the products from the cluster industry will be substituted which can affect production cost. One of the most important is that substitution of capital for a natural resource is relatively limited due to the physical laws of nature, and these constraints cannot be overcome by technological progress.

3.7 Competitiveness of the Project

The project is targeted for clustering mineral based manufacturing plants within the same location and closer to the raw material sources. Further, there is no clustering of industries at the moment which would be an advantage. The industry aspires to deliver quality products by meeting the customers' specifications through use of superior technology for manufacturing to ensure the availability of appealing product in the market. It is 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.

Most of the end products such as gypsum panel board and other related products from the minerals would be a relatively new product in Bhutan although there are fewer similar industries. So it could be used in the construction sector as part of replacement to the age old construction materials such as for ceiling and wall paneling instead of woods and in place of bricks for interior partitions. So there are ample opportunities for use of mineral based products such as flooring tiles, gypsum boards etc. The project envisages the production of mineral based products on the basis of indigenously available minerals in the country and the cost of production is likely to be quite competitive viz a viz imported similar products.

3.8 Special Attributes Desired By Target Customers

In general, customers would prefer the following:

a) Quality product comparable or superior to imported products.
b) Comparable or cheaper price from those of imported products.
c) Promotional offer
d) Timely delivery in good condition

However the customer needs and wants may vary from one customer segment onto the other.

3.9 Packaging & Transportation

Bhutan is a member of two regional economic cooperation (i.e. South Association for Regional Co-operation (SAARC) and BIMSTEC), which seek to promote free trade area in the region. Besides Bhutan have bilateral trade agreements with India and Bangladesh. Initiatives are underway to establish bilateral trade agreements with Nepal and Thailand. India continues to be the major trading partner of Bhutan constituting 97 % of export and 90% of import, this is mainly due to the free trade agreement between the two nations and its geographical proximity.

Bhutan being a landlocked country surrounded by India on three sides and China on the north, the country has to rely on overland transit through neighboring countries to make use of sea ports. Most of the overseas trade from Bhutan is currently carried through Kolkotta port, India which is governed by transit agreement regarding the movement of Bhutanese exports and imports to and from third countries

Thus for transport of both import as well as export, there is need of proper packaging system as per the international standard to ensure minimum damage to the products. Accordingly, proper leveling needs to be carried out for all the products to indicate the produce from Bhutan and to deliver to the right agency in the international market.

3.10 Assessment of Comparative Advantages

a) Reliable and competitively priced power

Bhutan is an energy surplus nation with 97% of its energy being generated from hydropower plants. The surplus energy is exported to India and as per the NSB 2017 report, energy volume of 5,763.13MU amounting to Nu 11,983.49 million was exported to India in 2017. The cost of electricity is comparatively cheaper than any other countries in the region for power intensive industries.

b) Availability of Water

Bhutan is endowed with rich perennial water resources fed by permanent glaciers, glacier lakes and recurrent monsoons. The per capita mean annual flow availability is as high as 109,000 m3. This compares very favorably with a developing economy like India which has per capita mean annual flow availability as low as 1,588 m3[15].

Water is a vital resource for all mining operations and is used in every process from minerals processing, power generation and dust management to the drinking and sanitation facilities

[15] Bhutan water quality standard 2016, NEC

used by staff in the industries. As such every industry has certain level of water requirements in the production as well as for other usages. So Bhutan has competitive edge on the water front.

c) Availability of minerals

Bhutan has readily available deposits of limestone, marble, dolomite, gypsum and granite which are the core raw materials required for the cluster industries. So it has a comparative advantage than those industries where main raw materials are imported from other countries. This will contribute towards lower cost of production and subsequently to more competitive price of final product in the international market.

d) Access to regional market

Bhutan has access to regional market through various regional economic instruments being established among the countries in the region such as SAARC and BIMSTEC. There is also a free flow of goods and services from the regional countries both for import as well as export. The advantage of such arrangement can enable easy entry of products from the cluster industries to the regional market.

3.11 Potential for Marketing Collaboration

There is a tremendous potential for marketing collaborations at the customer end of the supply chain. The industries can think of appointing independent sales agents or exclusive tie ups with certain distributors or outlets. Collaboration with foreign marketing agencies can also be explored. The similarities in the processes of production, raw materials and technology provides an ideal opportunity for the members of the cluster to collaborate and share the costs of marketing, costs of introducing new technology and costs of capacity building.

CHAPTER 4: CLUSTER PRODUCTION REQUIREMENTS

The following resources need to be put in place since this clustering and linkage industry is the first of its kind in the country, so multi-sectoral collaboration and approach would be essential in the project.

a) Land and building
b) Plant and machinery
c) Raw materials
d) Power
e) Water
f) Skilled and non-skilled workers

4.1. Land and building

It is envisaged that the land for setting up this industrial cluster would be available from the Government of Bhutan on lease basis. The building and the shed for housing the machineries and equipment and the offices has to be constructed as per the requirement. The manufacturing section shall be shed construction. The warehouses, offices shall be accommodated in constructed building. The total land requirement for setting up of the project would be 20,500 sq. meters. The requirement of total built up area and other constructions would be as under:

a) Total land requirement – 20,500 sq. meter
b) Constructed area for warehouses, offices and Testing lab – 1,500 sq. meter
c) Industrial sheds for installations of machines – 5,050 sq. meter

4.2 Plant & Machinery requirements

The details of plant and machineries required for each of the industries are mentioned below.

Raw material	**Products**	**Plants and machineries**
Limestone	Quick lime	a) Feed Hopper b) Feeder c) Bucket Elevator d) Vertical Shaft Kiln e) Refractory Brick Lining f) Kiln Feed Double bunker with hydraulic Feeder g) Temperature and Pressure Indicator and Control System h) Reciprocating Type Kiln Discharge i) FD Fan j) ID Fan with Silencer k) Multi clone Type Exhaust Dust Collector l) Recuperator m) Natural Gas Burners and its control systems (in case natural gas is used as fuel) n) Exhaust Dust Collector Reverse Jet Bag House o) Electrical & Instrument cabling & wiring with cable tray p) Temperature Indicator & Control System q) Kiln Pressure Indicator r) Related Piping, Platforms and structure, VFD, Prime Movers

		s) MMI of Electrical Control Panel
	Dry Hydrated lime	a) Storage SILO b) Disintegrator/Hammer Mill c) Bucket Elevator d) Storage Silos e) Rotary valve with Floater f) Hydrated Slacker g) Screw Conveyor h) Air Classifier i) Hopper j) Impex - Pulveriser k) Related Base frame & structure
	Precipitated Calcium Carbonate	a) Slinking Tank b) Lime Storage Tank c) Screening Bank d) Carbonization chamber/ cylindrical mild Steel vessel fitted with Agitator e) Centrifuge/Rotary vacuum filter f) Turbo Spin Flash Dryer g) Cyclo-Dust Collector h) Coal Gasifier with all accessories i) Ancillaries and other material handling system
Gypsum	Gypsum and Calcined Gypsum Powder	a) Gypsum Washing Tank b) Jaw Crusher c) Pulveriser d) Floatation Tank e) Ball Mill f) Calciner
	Plaster of paris	a) Attrition type Disc Pulveriser, capacity 0.5 MT/hour b) Rotary cylindrical Drum Calciner, capacity 2 MT c) Weighing scale d) Gypsum Washing Tank e) Test Sieves
	Plaster boards	a) Wooden tables of 4’ x 5’ with highly polished marble slabs at the top b) Mixing tank with Agitator c) Water storage tank d) Weighing scale, Platform type e) Moulds, Tools and testing equipment
Marble granite	Sawing, marble slabs, Roofing & Flooring tiles	a) Grinding and Polishing Machine with motor and starter. b) Edge – cutting machine c) Overhead Water Tank d) Misc. Tools and Fixtures
Yellow Maize, Wheat Brain, Rice Polishing, Ground nut cake, Fish meal, Molasses, Limestone, Mineral mix, Steamed Bone meal, Vitamin Mix	Animal feed	a) Disintegrator b) Ribbon Blender c) Gyratory Sifter d) Platform weighing machine e) Gunny Bag sealing machine f) Miscellaneous equipment & fixture

Table 4: Plant and Machineries

4.3 Raw materials for the cluster

The list of raw materials required for the cluster industry consists of the following:

Industry	Product	Raw materials	Remarks
Limestone	Quick lime	• Lime stone • Coal	• All raw materials locally available
	Dry Hydrated lime	• Quick Lime	
	Precipitated Calcium Carbonate	• Quick Lime • Water • CO2 Gas	
Gypsum	Calcinated gypsum powder	• Gypsum • Coal	• All raw materials locally available
	Ground gypsum	• Gypsum	
	Plaster of paris	• Gypsum • Coal	
	Plaster boards	• Plaster of paris • Colouring material • Reinforcement materials • Water	• All raw materials locally available except few ingredients which need to be imported
Marble & granite	Sawing, marble slabs, Roofing & Flooring tiles	• Marble • Water etc.	• All raw materials locally available
Product mix	Animal Feeds	Yellow Maize, Wheat Brain, Rice Polishing, Ground nut cake, Fish meal, Molasses, Limestone, Mineral mix, Steamed Bone meal, Vitamin Mix	• All raw materials locally available except minor ingredients which can be imported

Table 5: Raw Materials

The assessment of the availability of raw materials is based on (Gansser, 1983) and (National Statistics Bureau, 2017). As shown from the geological map of Bhutan, the formations in the immediate vicinity of the project (radius of 50 km) fall in the Lower Lesser Himalayan, Upper Lesser Himalayan, metasedimentary and orthogneiss units which are indicative of quartzite deposits with isolated deposits of limestone.

While the mineral deposits are ascertained for limestone, gypsum, dolomite and quartzite, the deposit of marbles and granite has not been ascertained, however, it is estimated that the scattered deposits of marbles and granite would total to about 15 Million MT (Pradhan, 2018). The remaining deposits as of 2016 are as follows (National Statistics Bureau, 2017):

Mineral	Deposits & Extraction in 2016 (Million MT)	
	Extraction	Remaining Deposits
Limestone	1.26	158.4
Gypsum	0.32	133.05
Quartzite	0.09	4.54
Dolomite	0.002	14532.23

Table 6: Mineral deposit and extraction (Source environment inventory 2016, NSB)

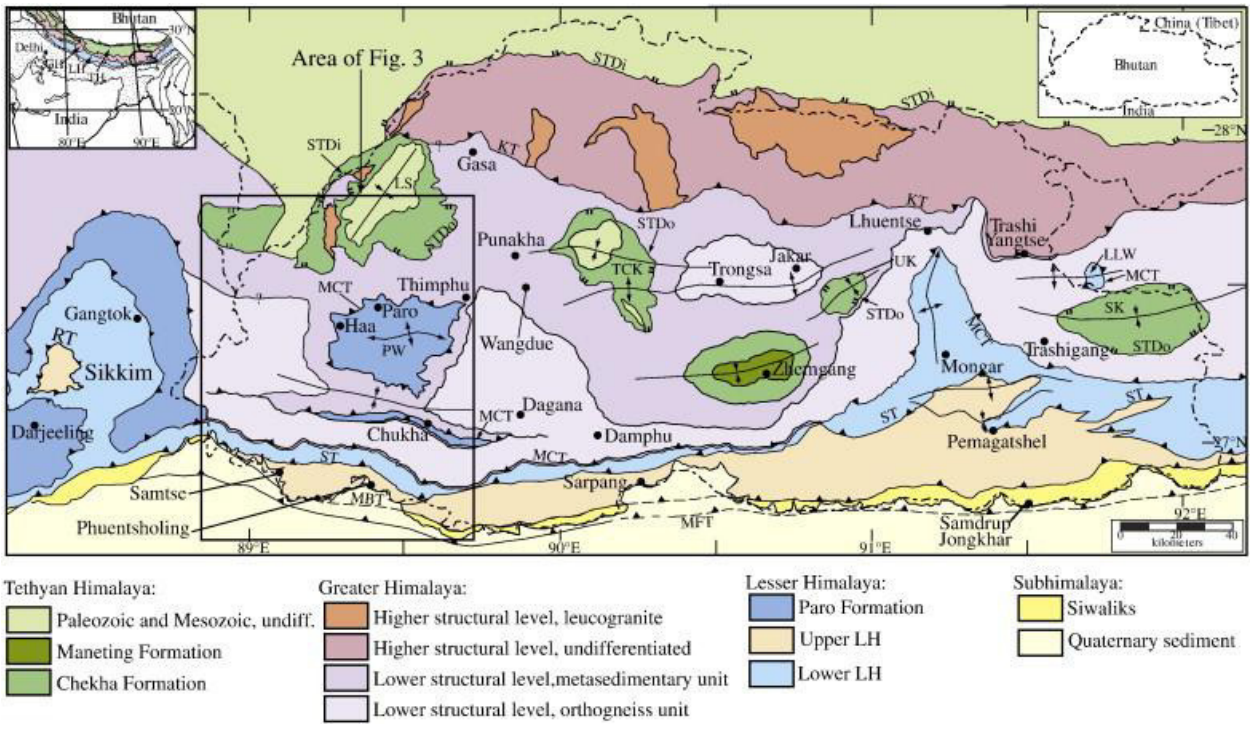

Figure 2: Geological Map of Bhutan (Source: Dept. of Geology and Mines)

Natural gypsum mines constitute the only source of gypsum in Bhutan as there is no production of synthetic gypsum or reprocessed gypsum. Gypsum mine in Bhutan is located in the Khothakpa region of Pemagatshel. Most of gypsum mined in this area is transported to Penden Cement Plant in Gomtu, Bhutan and other adjacent Indian States viz West Bengal, Assam and Arunachal Pradesh, etc.

On the other hand, limestone and dolomite are mined in the areas of Gomtu in Samtse for to be used in the cement plant while marble/dolomite is being mined in Thimphu and Paro areas. Most of the minerals are being mined and exported in raw form except few minerals such as calcium carbide, cement, and ferrosilicon which have some kind of value addition through plants in Pasakha in Phuntsholing and Motanga in Samdrupjonkhar.

4.4 Assess the availability of manpower

As per the Labour Force Survey 2016, a total of 354,652 were employed and 9,916 were found to be unemployed out of total projected working age population of 570,230, making unemployment rate at the national level by 2.3%. The Report indicates that in 2020 there would be 267,000 students seeking jobs.

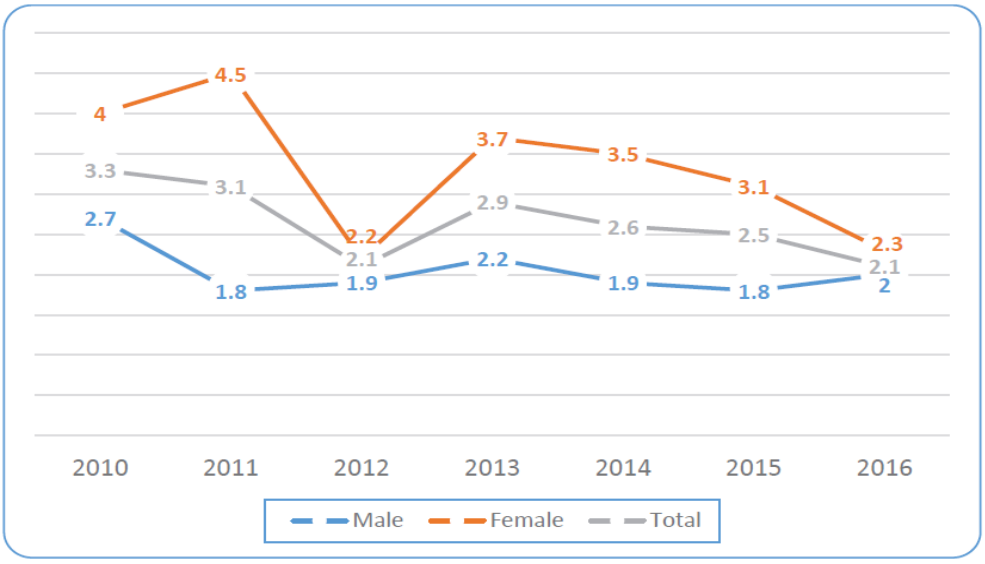

Fig 3: Unemployment rate (Source: Labour force survey report 2016)

Out of the total 2,263 graduates who have attended National Graduate Orientation Program in 2017, 51.6% are female and 48.4% are male. There is increasing supply of graduates more specifically in the field of business studies and general arts are the dominant composition of courses attended by the students[16].

4.5 Assess the 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 operate and maintain machineries and equipments in the industry. The training should be a combination of theory sessions, on the job coaching sessions and on the job supervision. For new recruits 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.

[16] Labour Market information bulletin 2017, MoLHR

5. PLANT LOCATION AND INFRASTRUCTURE

5.1 Location description

The location of the cluster industry is determined on the basis of proximity to raw materials, availability of infrastructure and distance to market outlets. It is proposed that the cluster be located within Jigmeling Industrial Park in Sarpang so that access to raw materials and export of products become easier. Jigmeling Industrial Estate has a total identified area of 733 acres located in Chokhorling gewog under Sarpang Dzongkhag in Southern Bhutan. It is about 2.5 km north of the Indo-Bhutan International boundary and it is 9 km and 12 km to the west of Gelephu domestic airport and Gelephu town which is also the gateway to border towns of India as well as interconnection to rest of the country. It is 18 km to the east of Sarpang town. The biological corridor connecting the Royal Manas National Park and Phibsoo Wildlife Sanctuary is located about 2.7 km towards the north. So it is more or less centrally located in terms of easy access to raw materials and linkage with the existing industries as well as for logistics for sale and distribution of products. Further, majority of the ingredients in the manufacture of the proposed products from the cluster industry need to be imported from India. So, it would be easy since the location is just along the border closer to the nearby Indian towns of Siliguri and Guwahati.

The Sarpang Dzongkhag has an area of approximately 1,655 square kilometers and has one Dungkhag (Gelephu) and 12gewogs. It is bordered by four Dzongkhags of Zhemgang, Trongsa, Tsirang, Dagana and Chhukha and the Indian state of West Bengal and Sikkim in the south. It has an elevation of 200-3600 m above sea-level and lies in the subtropical monsoon climate zone with good forest cover. The monthly temperature ranges between 18 degree Celsius in winter to 26 degree Celsius in summer and receives an annual rainfall of 1500-4000 mm. The summer is hot and humid and winter is dry and moderately cool.

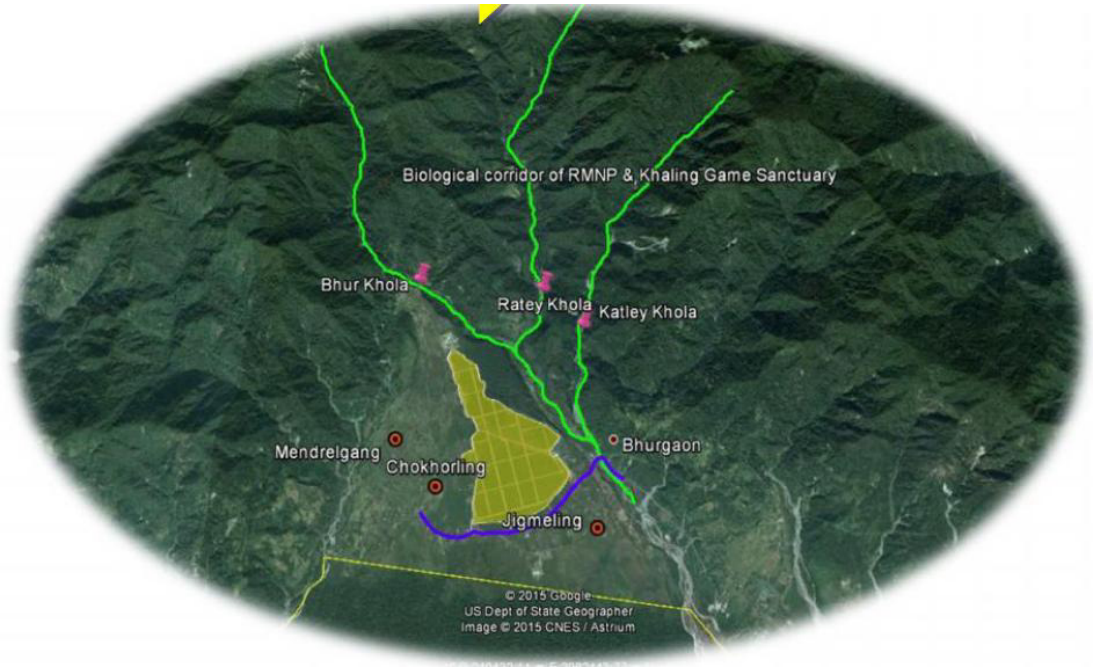

Fig 3: Location of Jigmeling

5.2 Selection of suitable location

In order to select the suitable location for the manufacturing plant, various parameters viz availability of land, vicinity to raw material sources, vicinity to markets, investments considerations, operational logistics, future development possibility, socio-economic factors including availability of services like transport and communication facilities etc. have been taken into consideration for ranking the locations. The table below shows the ranking of locations.

Ranking of possible locations was carried out based on certain parameters (Details are given in the annexure VI)

Locations	Accessibility	Proximity to raw materials	Proximity to market	Investment consideration	Operational logistics	Future development	Overall rating
Pasakha	7.5	7	8	8	8	8	46.25
Jigmeling	**8**	**6.4**	**8**	**8**	**8**	**8**	**46.40**
Motanga	7	6.4	7	7	7	7	41.40
Samtse	7	7	7	8	8	8	45.00
Gomtu	7	7.4	8	7	8	7	44.40
Bondeyma	5	6	6	7	6	6	36.00

Table 7: Selection of location

5.3 Availability of Electricity

As per the National Transmission Grid Master Plan, Jigmeling was identified as the pooling station connecting the grid between eastern and western region. With the commissioning of the substation, it is expected to solve the power outage in the country. That is when there is a power problem in the west, the power can be evacuated from the east through the Substation and likewise. The substation is also envisaged to cater power to the Industrial estate in Jigmeling and export surplus power to India via Alipurduar. Following are the sources of power in Bhutan:

Sl.No.	Generating station	Generation Capacity	Remarks
1	Chukha	336 MW	Under operation
2	Tala	1020 MW	
3	Basochhu (Stage I & II)	64MW	
4	Kurichhu	60MW	
5	Dagachhu	118MW	
6	Punatsangchhu I	1200MW	Soon commissioning
7	Puantsangchhu II	1020MW	
8	Mangdechhu	786MW	
9	Kholongchhu	486MW	Under construction
10	Nikachu	210MW	

Table 8: Source of power

The supply of electricity is evacuated through 48.2km 220kV D/C Transmission line from Dagachhu, Tsirang to Jigmeling, 132 kV D/C East-West Link from Lodrai to Jigmeling with about 12 km line, 400 kV line from Mangdechhu to Jigmeling via Goling pooling station and 400 kV line from Punatshangchhu-II to Jigmeling. The interconnecting substations of 220/132kV substation along with 400kV GIS substation were already being commissioned to supply power to the Jigmeling industrial estate.

Fig 4: 400kV GIS Power Substation, Jigmeling

5.4 Topography, hydrology, seismology and site development

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

Topography:

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.

The contour map with 1 meter interval generated from the topographic survey data is presented in the figure below as per the survey carried out by Himalaya Engineering and Management Consultancy. The topography consisted of relatively plain land with gentle slopes and seasonal drainages. The terrain is mostly alluvial deposits demonstrating evidence of rock and boulder deposits from a historic flood(s).

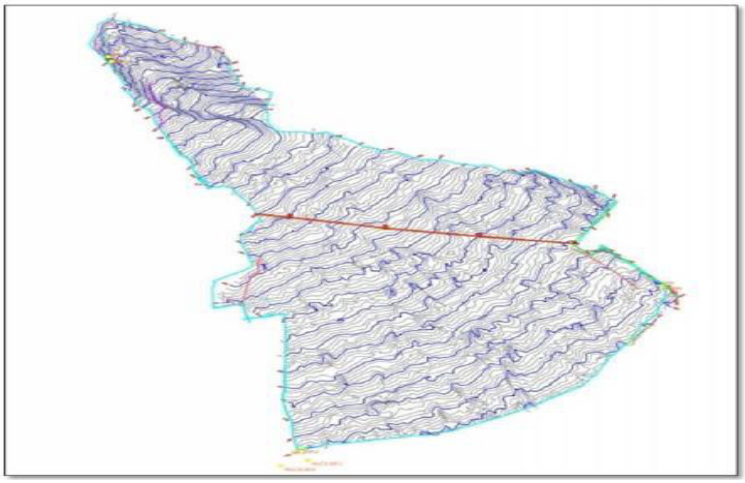

Fig 5: Contour map of the Jigmeling Industrial park (Source DPR)

Hydrology:

Hydrology is subdivided into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology.

Jigmeling Industrial Estate is funnel shaped and located between the valley of Bhur Khola and Dhol Khola, surrounded by the foothills of the Lesser Himalayas towards the east, west and north while the southern side continues with the plain of Assam in India. The site is a flat plain with altitudes ranging between 415 m in the south to 575 m in the north. The site slopes from north to south and south east. Therefore, the storm water drainage has to be planned and designed according to the natural slope of the site.

The climatic condition of the site is humid and sub-tropical in nature and experiences heavy monsoon rains in summer from May to October. The daily average rainfall is maximum from June to September. The highest daily average rainfall recorded was 78 mm in July 2007. The rainfall data of the past years can be used to estimate drainage discharge and to design the hydraulic structures.

The daily variation of average maximum temperature ranges from 20 to 32^{o}C while the daily variation of average minimum temperature ranges from 11 to 26^{o}C. The temperature variations will have bearing on the ecological and environmental processes that take will place in the industries and hence affect the design of facilities such as waste water treatment plant and landfill site.

The daily relative humidity ranged from 57% to 94% and the highest humidity (more than 80%) was observed in the months from June to September while the lowest humidity (less than 60%) was observed in the months from November to March.

The pre-dominant wind direction is from South-South west. The average daily wind speed recorded is 0.7 m/sec. The maximum wind speed recorded was more than 3.8 m/sec in March 26, 2013 (DHMS, 2015). The information on wind direction would be used in the zoning of the industries.

Application of Hydrology:

a) Determining the water balance of a region.
b) Determining the agricultural water balance.
c) Mitigating and predicting flood, landslide and drought risk.

d) Real-time flood forecasting and flood warning.
e) Assessing the impacts of natural and anthropogenic environmental change
f) Assessing contaminant transport risk and establishing environmental policy guidelines.

Seismology:

Geo-physically, Bhutan is located in one of the most seismically active zones in the world. Although a detailed and comprehensive seismic zonation of Bhutan is unavailable, its proximity to the north-eastern parts of India, which is in the 'most active' seismic Zone V (according to Bureau of Indian Standards), indicates that the majority of Bhutan is either in Zone IV or V. One of the most awaking disasters faced by Bhutan is the 2009 earthquake followed by the 2011 Earthquake. Bhutan has been affected several times by the past earthquakes like 1897 earthquake measuring M8.7 with the epicenter located in Shillong Plateau, India, which affected many Dzongs in Bhutan. Though no major record of earthquake have been recorded in the area, the proposed Jigmeling Industrial Estate lies in the high hazard zone of earthquake as shown in the map below.

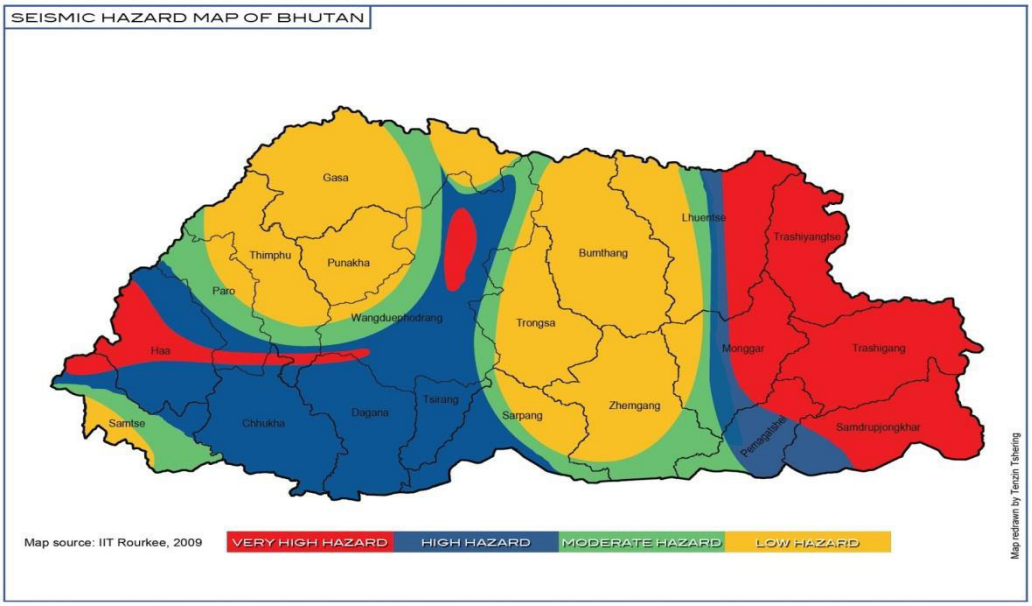

Fig 6: Seismology map

5.4 Availability of Land

There is already an identified area at Jigmeling Industrial Estate in Sarpang allocated for specific industries. An approximate area of 756 acres has been already registered as industrial area, out of which 155 acres with 48 plots has been year marked for mineral based industries. Presently, basic infrastructures are under construction to allow industries to be developed in the area. Allotment of plots has been already initiated recently.

5.5 Availability of transportation facilities

Apart from national highways, the Park has been connected with good network of roads and bridges along with domestic airport. Proximity to the Indian Railway as well as to Asian

Highway is 72km to the nearest town of Bogaigoan. There is also an access to sea port via Port of Kolkata, India 694.2 Km, Mongla 666.8 Km and Chittagong 756 km ports in Bangladesh.

Length of road	Quantity
Dzongkhag roads (km)	40.3
Thromde roads (km)	14.60
Gewog connectivity roads (km)	94.70
Farm roads (km)	330.99
Forest roads (km)	111.3
Motorable bridges (Nos.)	10
Non-motorable bridges (Nos.)	28
Taxis (Nos.)	245
Buses operating (Nos.)	36

Table 9: Transport facilities

5.6 Availability of Ancillary Facilities

Ancillary facilities are those available from other industrial unit which manufactures parts or intermediaries, or provides services to the industry cluster. The existing industry such as Bhutan Hydro Power Services carries out repair and maintenance of hydropower equipment. So the services of this industry can be useful for the repair and maintenance of some of the cluster industries as well. On the other hand, there is availability of technical graduates from the Vocational Training Institute which can be recruited by the cluster industries. Further, the products from the cluster industry such as quicklime or hydrated lime can be utilized within the related industries in the region or proximity of the cluster industry.

Bhutan Hydropower Service Limited

Distillery Plant, Gelephu

Vocational Training Institute, Dekiling

5.7 Availability of housing, Education and Health facilities

Housing

Housing in Gelephu has received a major boost by the delineation of the Thromde Local Area Plan in addition to the private sector developments taking place in the surrounding areas. Further the city is expanding from Gelephu to Jigmeling industrial area which will add housing facilities in future.

Education

The table given below shows the number and type of schools available in the Sarpang Dzongkhag.

Education facilities	Numbers
Central schools	2
Higher secondary schools	3
Middle secondary schools	1
Lower secondary schools	7
Primary schools	11
Extended class room	3
Non-formal education centres	71
ECCD	12
Other VTI Institutes	2

Table 10: Education facilities

Heath Care Facilities

There are adequate healthcare facilities in available in Sarpang Dzongkhag and particularly in Gelephu with the establishment of Regional Referral Hospital. It also has easy access to India where private medical institutes offer a range of health care solutions. The table given below shows the number and type of health care facilities available in the Dzongkhag.

Healthcare facilities	Numbers
Regional Referral Hospital	1
Indigenous Units	2
Basic Health Units (BHUs)	12
BHU I	2
BHU II	10
Outreach clinics	13
With sheds	11
Without sheds	2
Ambulance	8

Table 11: Health care facilities

5.8 Communication Facilities

Bhutan Telecom Limited (BTL), Tashi InfoComm Limited (TICL), Samden Tech and Drukcom are the four Internet Service Providers (ISPs) in the country. Bhutan Telecom Limited is the sole provider of fixed-line telecommunication services while cellular mobile services are provided by B-Mobile (Bhutan Telecom Limited) and Tashi-Cell. With the exception of Bhutan Telecom, all other ISPs are private sector ventures. Accordingly, facilities available in the Sarpang Dzongkhag are as shown in the table below.

Communication facilities	Numbers
Telephone connections	1,031
Internet lease line connections	14
Internet broadband connection	1,231
Cable TV operators	5

Table 12: Communication facilities

5.9 Approach road

Some portion of the landscaping development and approach road has already being developed in the area through Industrial Park Development Project of the Department of Industry, MoEA. This approach road is connected to the Sarpang- Gelephu National Highway and terminates at the border gate in Gelephu.

Approach road under construction

CHAPTER 6: CLUSTER ANALYSIS & LINKAGES

6.1 Cluster Description

The proposed cluster consist of interlinked industries with primary raw materials available as mineral deposits in Bhutan, namely, limestone and dolomite, gypsum, marble and granite and quartzite. The cluster is designed based on the principles of industrial ecology where the waste from one industry is used as a raw material in the other or in certain cases where the common wastes of the cluster are used as raw material for producing another finished product. This ensures value addition to not only the raw materials but also to the by-products of the manufacturing process. The cluster components and their linkages are depicted in the cluster map in Figure 7.

Limestone

Quick Lime

Precipitated CaCO3

The non-metal mineral processing units have higher linkages and co-benefits in a cluster than the other sub-sectors in the manufacturing sector as almost the entire raw material mix can be sourced from within the country. The principle products of hydrated lime and quicklime can be a product in themselves as well as raw materials for the production of precipitated CACO3 which is higher up the value chain and can fetch a higher market price. Similarly, the current practice of exporting gypsum as a plaster of paris can be discouraged and these plaster of paris can be used to produce gypsum boards and panels which again has a higher market price and therefore value addition. In the following paragraphs, the cluster and linkage analysis is presented using the World Bank Methodology (World Bank, 2009).

As evident from the cluster map, the primary raw materials of limestone is processed into quicklime, hydrated lime and finally in precipitated calcium carbonate with almost double fold value addition along the production process. The carbon dioxide, a by-product gas from the manufacture of quicklime is a greenhouse gas which needs to be controlled and instead of deploying high cost capture and storage technologies, the gas is piped and used in the manufacture of precipitated calcium carbonate. Similar value additions are seen in the manufacture of plaster of paris and eventually gypsum boards and panels from raw gypsum as well as marble tiles and counter tops from marble and granite slaps.

Following the methodologies presented in (World Bank, 2009), the cluster analysis is carried out in the following paragraphs:

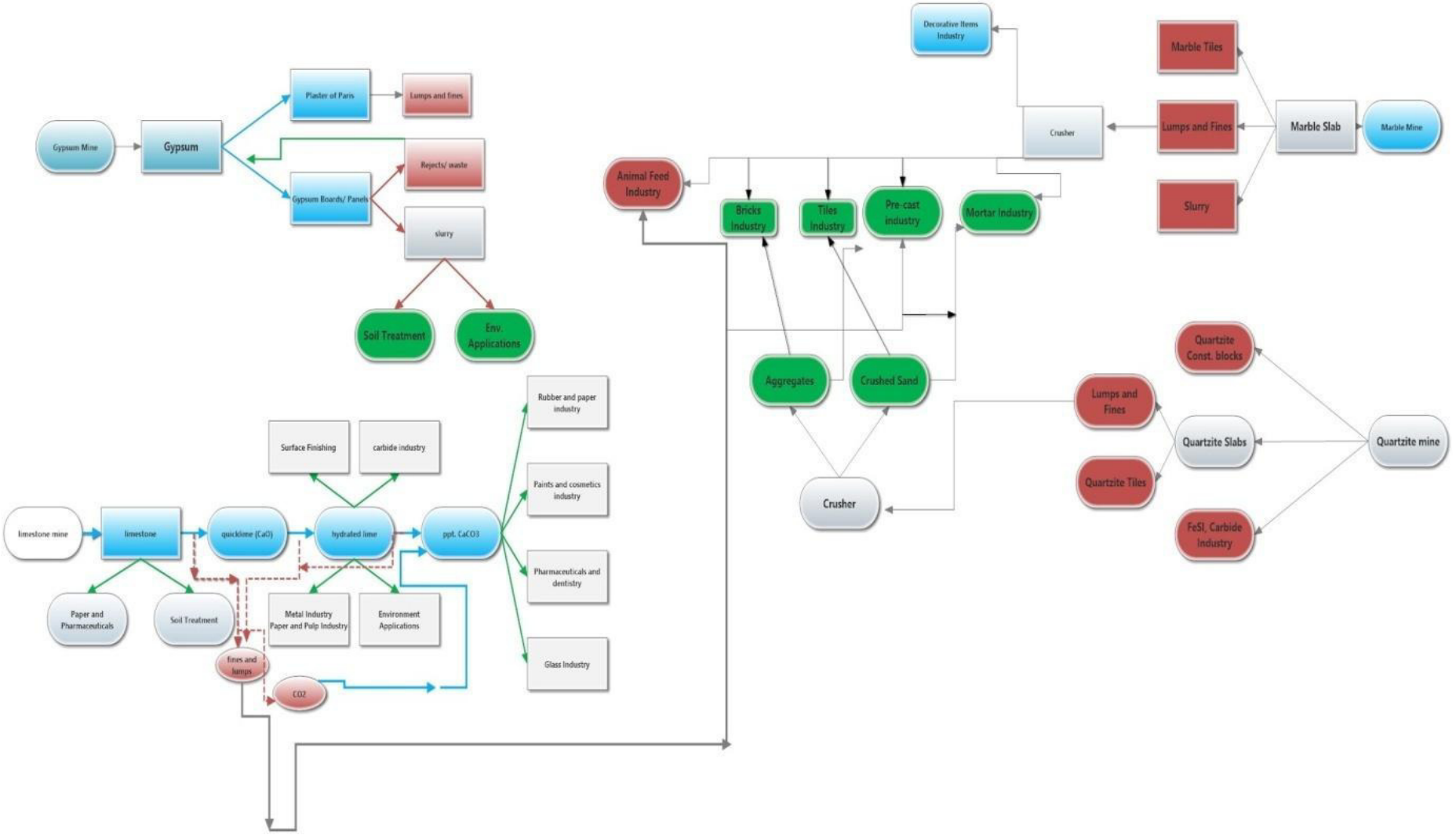

Fig 7: Cluster Map

6.2 Product and Market Segmentation

The current practice of manufacturing mostly intermediary products which need to be sold to another manufacturing entity to be used either as a raw material or a catalyst leaves the price determination of the product as well as the factor productions to the third party. The intention of the cluster industry is therefore to identify an agglomeration of activities including logistic providers and service providers and to let the market determine the true value of the products. The current and potential product and market segmentation of the constituents of the cluster are summarized below:

Sl. No	**Current**		**Potential**		**Current Byproduct**	**Potential Byproduct**
	Product	**Market**	**Product**	**Market**		
1	Limestone	Cement, Carbide industry, export market	Hydrated Lime Quick Lime	Ppt. $CaCO_3$ Process Ppt. $CaCO_3$ Process	Fines: Brick Factories, cement industry	CO_2 to Ppt. $CaCO_3$ Process Fines and lumps to feed, cement and construction materials industry
2	Gypsum	POP Market Cement industry	Plaster of Paris Gypsum Boards and Panels	Gypsum Products (boards and panels)	Fines Lumps, wasted	Fines and Lumps to feed and construction materials
3	Marble and Granite	Semi-finished export, Aggregates for construction	Floor Tiles, Tops and decorative products	Domestic as well as export market	Slurry is an environmental nuisance	Slurry used for decorative items molding
4	Quartzite	Raw material for ferro silicon industry, construction aggregate	Calcined Quartz	Export market	Fines and lumps wasted	Fines and Lumps to animal feed and construction industry

Table 13: Product & Market Segmentation

6.3 SWOT (Strengths, Weaknesses, Opportunities, Threats)

The SWOT analysis of the cluster industry is as follows:

Strengths	**Weaknesses**
• Local raw materials • Power Supply Source reliable • Stable government and policy environment • Brand Bhutan: Market Recognition Fiscal incentives	• Power tariff uncertainty • Raw material price • Seasonal disruption; natural disasters • Bureaucratic burden: clearances • Technical capacity and human resources • Access to low interest finance • Pollution and weak monitoring
Opportunities	**Threats**
• Access to Indian and Bangladesh markets • Access to sea ports in India and Bangladesh • Free Trade and Preferential Trade with India and Bangladesh • Value addition to the electricity from hydropower plants • Employment creation and social development	• Tax regimes in the export markets. • Agitation by NGOs across the border. • Political stability along the transit routes leading to transit blockades. • Competitive pricing on similar goods in the export markets. • Technology change and product substitution.
Summary: The SWOT analysis showed that the internal strengths are high and the weaknesses managed with sound policy interventions from the Royal Government of Bhutan. The external threats are difficult to manage but will not have a significant impact on the cluster operation while the opportunities presented have the potential to contribute to the long term goal of economic self-reliance	

6.4 GAP Analysis

The GAP analysis carried out for the cluster combined with the results of the sensitivity analysis of the factors of production resulted in the following gaps/intervention needs:

6.4.1 Availability of local skilled manpower

For the industry cluster to create employment, the available manpower pool has to match the requirements of the cluster. The cluster would need skilled and semi-skilled personnel to operate the machines, man the control rooms and carry out repair and maintenance of the production line. Carrying out a detailed needs assessment of the manufacturing sector and then training the required man-power would be needed to ensure that the co-benefits of the cluster on employment creation are achieved.

6.4.2 Power tariff

The manufacturing industries operating in Bhutan used to enjoy the availability of relatively cheaper electricity owing to the abundance of power generated by the hydropower stations. An analysis of the hydropower tariff showed that the middle voltage (MV) tariff had increased from Nu. 0.70/kWh in 2000 to Nu. 1.34/kWh in 2018 (Bhutan Electricity Authority, 2017) or an escalation of 191% in a span of 18 years and there is an additional Nu. 300/kVA as monthly demand charge. Understanding that power used in the domestic market adds value to the locally available raw materials, creates employment and generates other positive spinoff developments, there needs to be certain subsidies on energy to ensure that the only real comparative advantage of Bhutanese industry is protected.

6.4.3 Fiscal Incentives

The Economic Development Policy 2016 and the Rules on Fiscal Incentives Act 2017 provide time bound (mostly 5 year period) incentives to the manufacturing industries in Bhutan, the caveats in the legislation restricts reinvestment and adoption of environment friendly technology not sufficiently attractive. There is a need to continue the fiscal incentives beyond 5 years and to increase the share of allowable reinvestments and expenses on environment friendly technology to promote higher percentage of reinvestment and adoption of environment friendly technology. The industrial establishments in the neighboring states of Arunachal Pradesh and Meghalaya in India, who are the direct competitors in the Indian market for the products manufactured in Bhutan, enjoy relatively higher subsidies and incentives, thus reducing the comparative advantage of the Bhutanese industry sector.

6.4.4 Role of Industry Associations

The Bhutan Chamber of Commerce and Industry and the Association of Bhutanese Industries are the two industry associations and enhancing their capacities to provide advisory as well as business promotion activities would ensure higher productivity and efficiency in the manufacturing sector. With adequate support, these industry associations can play a larger role in organizing technical trainings and capacity building programs targeting the manufacturing sector and also promote their role in influencing policy decisions, particularly on incentive schemes and power tariff.

6.4.5 Preferential Lending/Access to Finance

The Bhutanese manufacturing sector access loans from the commercial banks at interest rates ranging from 10 to 13% and this plays a substantial role in determining the profitability of the industries. As can be seen from Figure below (adapted from (The World Bank, 2018), Bhutan has one of the highest interest rates among the selected countries at an average of 14.50%.

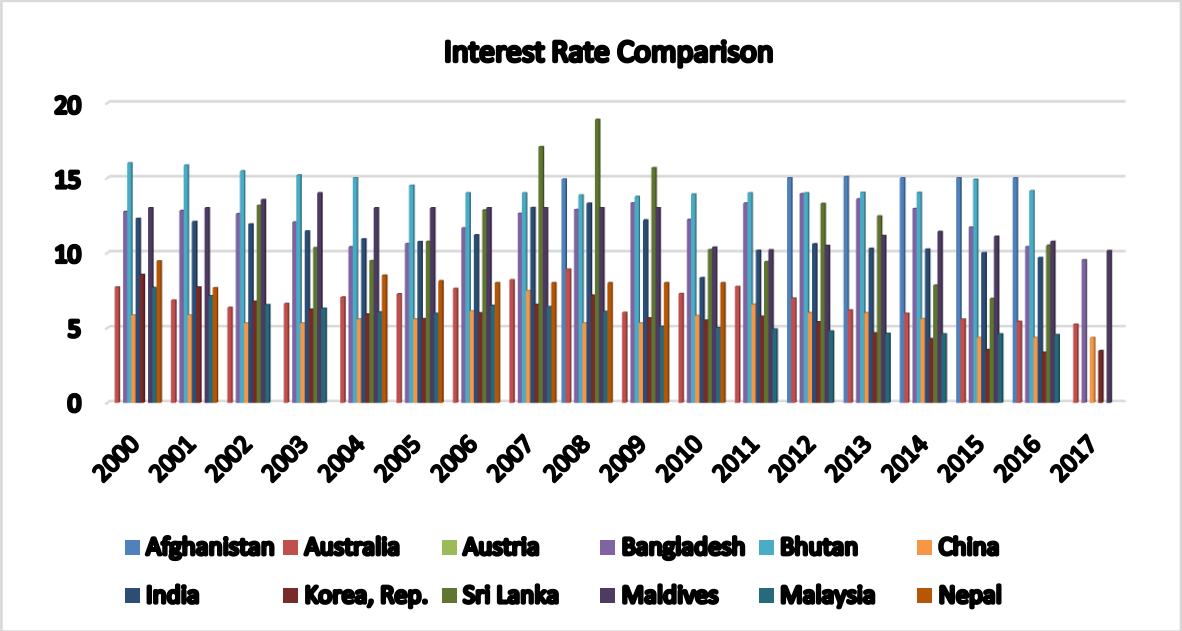

Fig 8: Interest Rate Comparison

This indicates that here is an urgent need to subsidize the interest component of loans to the manufacturing sector to reduce the cost of capital and this can be achieved through subsidized domestic lending, establishing an economic activity fund or through improved access to international low interest loans from bilateral or multilateral development partners through sovereign guarantees.

6.4.6 Ease of Doing Business

The Ministry of Economic Affairs, in collaboration with other relevant agencies and the National Environment Commission has initiated several reforms to improve the Ease of Doing Business over the last 10 years primarily through streamlining approval and clearance procedures. However, the private sector feels (Dorji, 2018) that the approval and clearance system is one of the biggest hurdles in starting a business. This may be resolved by instituting a single window clearance system with fixed turn-around-time (TAT) for line agencies with the directive that silence beyond the TAT can be interpreted as consent.

6.5Porter's Five Forces Analysis

The Porter's Five Forces Analysis is carried out for the Cluster as per the framework provided in Figure 9 and described in the subsequent paragraphs.

Rivalry

In the manufacturing units proposed for the cluster, there is no dominant player in the local market as the products chosen are innovative and aimed at improving the value chain within the country. Therefore, local rivalries are not a major issue. However, since these products will have to compete in the Indian and third country markets, the main rivals are already operating industries producing similar products.

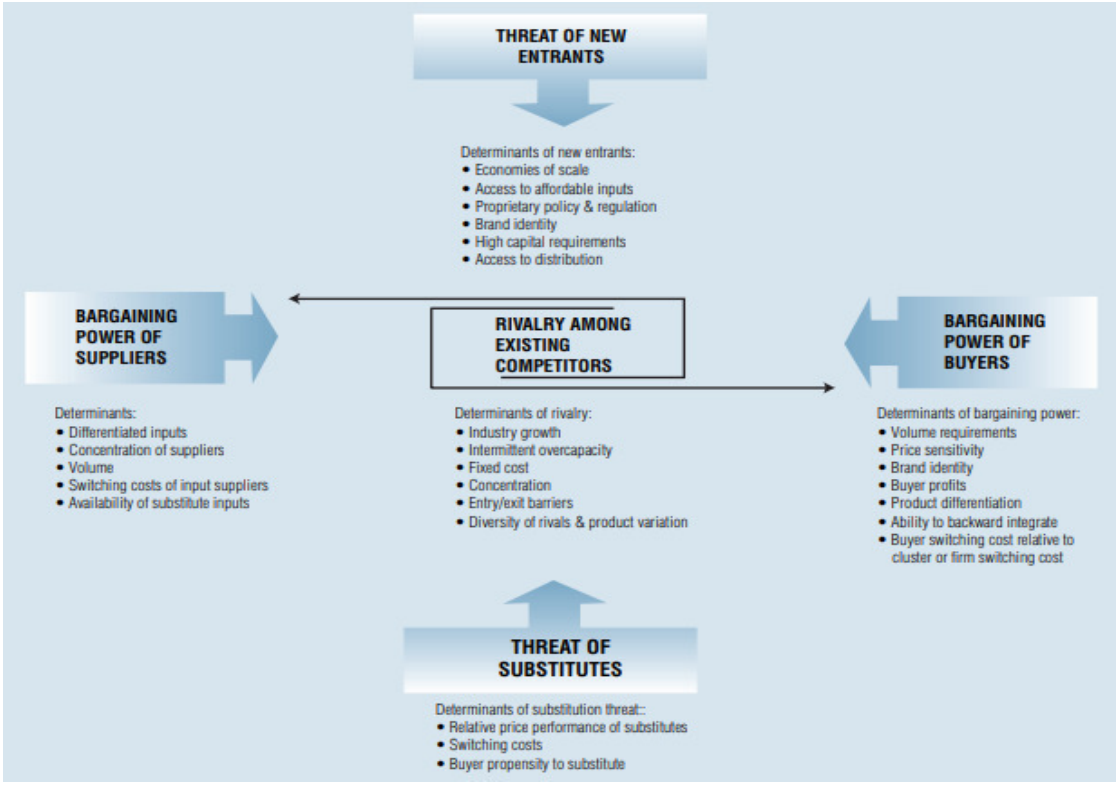

Fig 9: Porter's Five Forces Framework

Threats of new entrants

Given the scarcity of land to develop additional industrial areas outside of the identified industrial parks and the absence of a domestic vibrant market, the threat of new entrants is almost non-existent. The only threat here is the entry of new players in the Indian production scene and from data analyzed over the last five years, this is not a significant issue as only 7 mid-sized units came into operation in West Bengal.

Threat of substitute products

The products identified for production in the cluster are mostly essential commodities and have niche markets, for instance, the marble and granite tiles are high end construction and decorative items and rarely get substituted even where there is abundant choice of ceramic tiles. Similarly, calcined quartz is an essential raw material required for the manufacture of Alumino–Silica Glasses, Lead–Alkali–Silicate Glasses, Potash Glasses, Boro–Silicate Glasses and scientific technical glasses and does not have substitutes in the market. Owing to the versatility and wide applicability of precipitated CaCO3, substitution of these materials in a few key sectors will not have a significant impact on their overall demand in the market.

Bargaining Power of Buyers

The Bhutanese manufacturers generally buy and sell their raw materials and products through middle-men/ traders and they have tremendous bargaining powers both in the supply of raw materials and purchasing the finished products. However, from experiences in the trade of micro-silica from the ferro-silicon plants in Pasakha, these traders are prone to look at long term sustainability of their businesses and do not resort to short term gains. Over the last few

years, the number of such traders has grown in the neighboring Indian state of West Bengal and this ensures that fair market value is obtained for finished products while required raw materials are also obtained at fair market value.

Bargaining power of suppliers

For the units proposed in the cluster, the major suppliers are expected to be Bhutanese quarry operators and industrialists. While the bargaining power of the supply of limestone, quartzite and marbles is limited owing to more players in the field, the suppliers of semi-finished goods such as quick lime and hydrated lime may have a higher bargaining power as they would enjoy a natural monopoly in the supply market unless new units producing similar goods enter the market. However, should the price of the monopolistic good increase beyond the profitability of the manufacturing process, precipitated CaCO3 can also be produced directly from screened limestone, thus reducing the bargaining power of the monopoly.

6.6 Linkages and Value Chain Analysis

The linkages in the Cluster are of two types: a functional linkage where various players outside the cluster engage with the production units in the cluster. These players include transporters, logistic and service providers who are involved in the ferrying of mined materials from the mines to the processing plants and then to the production facilities as well as ferrying of finished products from the production facilities to the markets. The mines and quarries are the source of the primary raw materials which would be directly sold to the end users or through traders, in both the cases, the transporters/logistic service providers will be engaged. Similarly, the finished products from the production process will be ferried to the market by the transporters. The government is an important player in the cluster as it provides the policy, the regulatory, the enforcement as well as the promotional role. As already described in Figure 6 reproduced below, there are several linkages within the cluster itself and these linkages assist not only in making the cluster model successful but also conducive to collective bargaining, value addition and capacity building. In the proposed Cluster involving the use of lime stone, the raw limestone after physical transformation of granulation into uniform lumps are transferred to the hydrated lime production process. After the calcination, the hydrated lime can be sold directly to the market or value addition can be done to this by subjecting it to hydrolysis and result in slaked lime. The carbon dioxide which is a process emission from the manufacture of hydrated lime can be piped to the manufacture of precipitated CaCO3 where the gas is a main raw material. The fines, lumps and slurries in the cluster are to be used as raw materials for the manufacture of construction materials such as bricks, blocks, pre-cast walls and the manufacture of animal feeds. The slurries from the wet processes can be used as raw materials for the manufacture of decorative items using concrete molding processes. The entire manufacturing process in the cluster is therefore proposed as a closed loop manufacturing system where by-products of one unit can be used as raw materials in another unit.

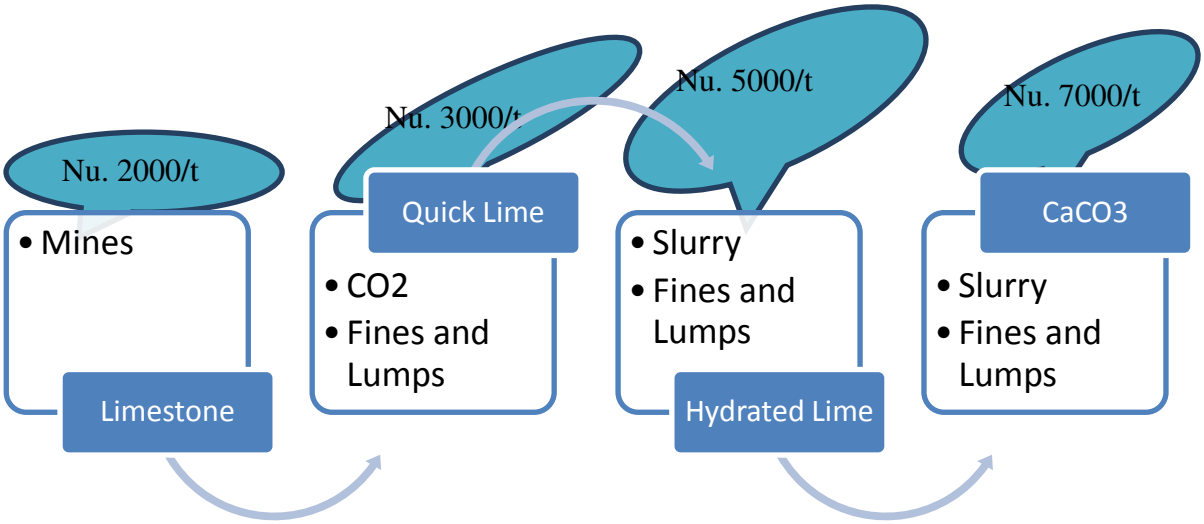

Fig 10: Value addition in a cluster

6.7 Recommendations

The cluster analysis exercise carried out through the SWOT analysis, GAP analysis and Porter's Five Forces analysis point out that there are several internal strengths as well as weaknesses and external opportunities and threats. While many of the weaknesses and threats are beyond the control of the national boundaries, taking timely policy and regulatory measures as well as interventions by the government can reduce them and enhance the strengths and opportunities. Key recommendations to improve cluster development and competitiveness are as follows:

Continuation of Fiscal Incentives

The Economic Development Policy 2016 and the Rules on the Fiscal Incentives Act of Bhutan 2017 provide several incentives to promote the growth of industries in Bhutan. However, the period of fiscal incentives is relatively short and the window of starting the business to avail the fiscal incentives is restrictive. To encourage investments in the manufacturing sector, it may be worthwhile to continue many of the incentives beyond the 5 years period and increase both the reinvestment allowance and expenses for adoption of environment friendly technology beyond the current allowance of 25% of the capital investment.

Investment in Infrastructure

Understanding that the manufacturing sector contributes substantially to the national GDP as well as provides employment and tertiary business opportunities, investments in ancillary infrastructure such as road networks, bridges and telecommunication facilities is of utmost importance. Current practice of depending on uniform RGOB budget allocation for road maintenance for heavy traffic roads to industrial areas have led to numerous discontentment

and inconveniences affecting the businesses substantially (Rai, 2017). Priority investments in road networks, banking facilities and telecommunication networks both within and outside the industrial areas connecting it to markets and suppliers will promote the growth of not just the industries but also townships surrounding the industrial area.

Investment in Human Resources

Industrialization in Bhutan was a late started with the first few industries taking root only in the 1980s and the operation of the first industrial estate catering to heavy industries coming into operation in the early 2000s. As a result, human capacities to man the industrial establishments have not been built. The knowledge required and the skills to be developed needs to be prioritized to match the job vacancies available in the industries with the skill set of the job seekers. Additional programmes to build capacity of employees already working in the industrial sector needs to be promoted to improve productivity and efficiency of the sector. Technical assistance from bilateral as well as multilateral development partners in collaboration with the Department of Technical and Vocational Education would be a good step towards investments in human resources.

Strengthening Industry Associations

The Bhutan Chamber of Commerce and Industry, the Association of Wood Based Industries and the Association of Bhutanese Industries are the industry associations in the manufacturing sector and enhancing their capacities to provide advisory as well as business promotion activities would ensure higher productivity and efficiency in the manufacturing sector. With adequate support, these industry associations can play a larger role in organizing technical trainings and capacity building programs targeting the manufacturing sector and also promote their role in influencing policy decisions, particularly on incentive schemes and power tariff. As with industry associations in neighboring countries, the role of product and process certification in alignment with international best practices can be taken up by these institutions.

Improving access to low interest finances

The Bhutanese manufacturing sector accesses loans from the commercial banks at interest rates ranging from 10 to 13% and this plays a substantial role in determining the profitability of the industries. This indicates that here is an urgent need to subsidize the interest component of loans to the manufacturing sector to reduce the cost of capital which can be achieved through subsidized domestic lending, establishing an economic activity fund or through improved access to international low interest loans from bilateral or multilateral development partners through sovereign guarantees. While the concept of low interest finances from international sources through sovereign guarantees have been considered risky and undermining national security in the past, relatively smaller loans for industrial activities would need a rethink at the national level considering the impetus it would give to the growth of the sector.

Streamlining Clearance and Approval Procedures

The Ministry of Economic Affairs, in collaboration with other relevant agencies and the National Environment Commission has initiated several reforms to improve the Ease of Doing Business over the last 10 years primarily through streamlining approval and clearance procedures. There is still room for improvement in the provision of environmental services by the government. Institution of short and reliable Turn-Around-Times (TAT) for government agencies, use of information technology for approvals and instituting a single window clearance system are timely interventions that the government can take in reducing the governance burden on the private sector.

International Trade Diplomacy

Bhutan has an almost infinite demand for goods and services in the Indian market and this need to be used to our advantage. The major hurdle to trade across borders currently is the time taken for customs clearances both for export of finished products and import of raw materials. This can be resolved at Government to Government level through dialogues and concessional arrangements. The identification and promotion of additional markets for products from the cluster can also be taken up through international trade diplomacy, such as improving the role of trade attaches in the Bhutanese embassies and missions abroad and strengthening their role towards promoting not just agricultural but all products manufactured in Bhutan.

Improving comparative advantage on power tariff

The manufacturing industries operating in Bhutan used to enjoy the availability of relatively cheaper electricity owing to the abundance of power generated by the hydropower stations. However, comparing the overall basket of incentives between industries in Bhutan and the neighboring north eastern states of India almost renders the comparative advantage negligible owing to higher increases in power tariff and lower non-power incentives in Bhutan. Understanding that power used in the domestic market adds value to the locally available raw materials, creates employment and generates other positive spinoff developments, there needs to be certain subsidies on energy to ensure that the only real comparative advantage of Bhutanese industry is protected.

CHAPTER 7: ENVIRONMENTAL ISSUES

Environmental issues in operation of the units in the cluster primarily include the following: · Air Emissions, Wastewater, Solid waste generation and Noise. As a minimum requirement, compliance with the statutory environmental requirements and the deployment of environment friendly and cleaner technology methods will have to be ensured.

7.1 Air Emissions

Air emissions in lime manufacturing are generated by the handling and storage of intermediate and final materials, and by the operation of kiln systems, coolers, and mills. For lime manufacture, there are 4 basic types of kilns used to produce different types (reactivity) of quicklime: rotary, vertical shaft (more than 10 types), traveling grate, and gas suspension calcination.

7.1.1 Particulate Matter (PM) and Metals Emissions.

The kiln is the largest ducted source of PM and metals emissions from lime production. PM and metals emissions can also occur from coolers, but only in plants where exhaust gases are not recycled back through the kiln. Emissions from ordinary hydrators are generally readily controlled, whereas emissions from pressure hydrators are somewhat more difficult to control. In addition to these sources, PM and metals emissions can also occur at primary and secondary crushers, mills, screens, transfer points, storage piles, and roads.

7.1.2 Gaseous Pollutants.

As previously mentioned, carbon monoxide, carbon dioxide, sulfur dioxide, and nitrogen oxides are produced along with lime. The source of most sulfur dioxide emissions is the fuel used to fire the kiln. The composition of the kiln feed, the quality of the lime being manufactured, and the type of kiln affect the amount of sulfur dioxide produced. Most of the sulfur dioxide from the kiln fuel is never released because it reacts with the lime within the kiln. Pollution control equipment can further limit sulfur dioxide emissions.

6.2 Climate Change Considerations

In addition to the gaseous pollutants created by burning fossil fuels, the chemical reaction that occurs during calcination produces a large volume of carbon dioxide. Limestone is approximately 44 percent carbon dioxide by weight, and this carbon dioxide is released during calcination. CO2 thus released is a greenhouse gas and needs to be accounted in the national GHG Inventory. To the extent possible, the CO2 must be separated from the process gas using acid scrubbers and reused in the precipitated CaCO3 process to reduce the GHG emission.

7.3 Solid Waste Management

A major by-product of the lime industry is stone spalls, or pieces of limestone that do not meet the size requirements for kiln feed. Sometimes limestone spalls can be further processed and sold as limestone pebbles, granules, and fines, but where no market exists, spalls may accumulate into huge piles, creating a disposal problem (Boynton, 1980). Another by-product is kiln dust. The composition of kiln dust varies depending on the nature of the kiln feed and fuel used. In the past, lime producers generally disposed of kiln dust in abandoned quarries or landfills. In the early 1970s, a shortage of lime caused by a combination of high demand and labor strikes at lime plants forced consumers to try using kiln dust to meet their needs. Since then, the use of kiln dust for agricultural and industrial purposes has increased.

7.4 Wastewater

Wastewater is generated mainly from utility operations for cooling purposes in different phases of the process (e.g. bearings, kiln rings) Process wastewater with high pH and suspended solids may be generated in some operations. Techniques for treating industrial process wastewater in this sector include flow and load equalization with pH adjustment; sedimentation for suspended solids reduction using settling basins or clarifiers; multimedia filtration for reduction in non-settleable suspended solids.

7.5. Noise

Noise pollution is an issue both during the construction and the operation phase of the project. During the construction phase of the project, use of heavy machineries and tools are the main sources of noise pollution while the operation of heavy duty crushers, pumps, motors, machineries and transport trucks are the sources of noise pollution during the operation phase. The following are the recommended measures for noise pollution:

a) Use of low noise construction technologies.
b) Carrying out routine noise level checks around the leased boundary to ensure compliance with provisions of Bhutan Environmental Standards 2007.
c) Using acoustic construction materials in areas prone to high noise level.
d) Erection of noise barricades.

CHAPTER 8: PROJECTIMPLEMENTATION

The successful and timely implementation of the project will depend on the following factors:

a) Proper choice of technology, machinery and equipment.

b) Adequate diligence in formulating the technical concept and system design.

c) Proper choice of contractors for civil construction and erection of equipment.

d) Formulation of an effective project team and their efficiency in project management.

e) Weather conditions during the actual implementation of the project.

f) Establishment of an efficient system for project planning & monitoring including reporting procedures for progress review & co-ordination.

Implementation Schedule

It is suggested that the project implementation should take place within 5 years in line with the development priorities of the Royal Government of Bhutan. The implementation should be done simultaneously once the projects are being approved by the Ministry of Economic Affairs. The implementation schedule will include the following:

a) Hydrological investigations for ensuring the availability of the requisite quantum of water.

b) Receipt of requisite clearances from competent authorities with respect to :

i. Environmental clearance
ii. Sanction and supply of power
iii. Acquiring the fund for the project
iv. Acquiring the land
v. Topographic & Seismologic survey for plant area
vi. Floating tender inquiries and evaluation of order

c) Site Preparation &development

The table given below shows the project schedule:

Project Implementation Schedule

		Months																								
Sl. No	Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Project Idea Development and securing finances																									
2	Engineering, Planning and Design finalization																									
3	Processing approvals and clearances																									
4	Lease of land																									
5	Construction of manufacturing shed																									
6	Procurement of Plants and Machineries																									
7	Installation of plants and machineries and training of manpower																									
8	Trial production																									
9	Commercial Production																									

CHAPTER 9: FINANCIAL AND ECONOMIC ANALYSIS

9.1 Financial Analysis

The estimated financial costs of the units in the cluster are presented in the following tables with a financial analysis carried out using the cash flow and IRR method. The Costs are separated into Capital Costs and Operational Costs with the following assumptions:

a) Investment of 60% loan and 40% equity
b) Interest rate of 12%
c) Term of loan: 20 years

9.1.1 Capital costs

Particulars	**Amount (Nu.)**
a) Hydrated Lime	48,395,000
b) Precipitated CaCo3	49,395,000
c) Gypsum Board and Panels	24,975,000
d) Animal Feed	3,970,000
e) Marble, Granite& Quartzite Tiles	3,615,000
f) Stone Crusher	19,940,000
Total	**150,290,000**

The total cost of capital investment is Nu.150,290,000 (Refer details in the annexure VII)

9.1.2 Operational cost

Particulars	**Amount (Nu.)**
1) Hydrated Lime	
a) Salary and wages	3,840,000
b) Utility and fuel	1,260,000
c) Administrative cost	300,000
Sub total	6,000,000
2) Precipitated CaCo3	
a) Salary and wages	4,440,000
b) Utility and fuel	1,260,000
c) Administrative cost	300,000
Sub total	6,000,000
3) Gypsum Board and Panels	
a) Salary and wages	3,840,000
b) Utility and fuel	660,000
c) Administrative cost	1,000,000
Sub total	5,400,000
4) Animal Feed	
a) Salary and wages	2,040,000
b) Utility and fuel	132,000

c) Administrative cost	20,000
Sub total	2,072,000
5) Marble, Granite and Quartzite Tiles	
a) Salary and wages	1,152,000
b) Utility and fuel	132,000
c) Administrative cost	35,000
Sub total	779,000
5) Stone Crushers	
a) Salary and wages	3,840,000
b) Utility and fuel	12,060,000
c) Administrative cost	520,000
Sub total	16,420,000
Total Operational Cost	**39,881,000**

The total operational cost is Nu. 39,881,000 (Refer details in the annexure VII)

9.1.3 Financial Analysis

Particulars	**IRR**
Hydrated lime	16%
Precipitated CaCo3	19%
Gypsum board and panels	16%
Marble, Granite and Quartzite Tiles	20%
Animal Feed	31%
Stone Crushers	21%

The financial analysis carried above indicates that all the activities proposed in the cluster are feasible with the estimated costs and revenues. As the interest rate assumed for loans is 12%, IRR below 12% was not considered for implementation. Details of the analysis are provided as an annexure VII to this report.

9.2 ECONOMIC ANALYSIS

9.2.1 Economic Rate of Return (ERR)

Economic Rate of Return is the interest rate at which the cost and benefits of a project, discounted over its life, and equal. ERR differs from Financial Rate of Return in that it takes into account the effects of factors such as Price Controls, Subsidies and Tax breaks from local government, to compute the actual cost of the project to the economy.

The economic rate of return also includes indirect benefits to the economy that are likely to be ploughed back to the investors, people, government and other government or nongovernment agencies, over a longer period of time.

9.2.2 Relevance of ERR to the project

This concept of ERR is more relevant for big projects involving large capital deployment. For small projects, like the project under consideration, there may not be significant difference between Financial Rate of Return and Economic Rate of Return, as while formulating the project, factors like Price Controls, Subsidies and Tax breaks from local government and also socio-economic benefits have not been taken into account.

9.2.3 Socio-Economic Impact of the Project

As stated above, the concept of ERR is not quite relevant for this project and the impact of the proposed unit would not be quite significant on the overall economic scenario of Bhutan. However, over a long time horizon and setting up of a number of similar units would result into following socio-economic benefits for the country.

a) Value addition to indigenously available gypsum mineral, a major part of which is being presently exported at a lower price.
b) Indigenous production of gypsum board/gypsum panels would lead to self-reliance for these items in the field of construction industry. This would also make available a modern construction material to the Bhutanese construction industry.
c) The production of gypsum board/gypsum panel shall enable the construction industry to use green construction material or eco-friendly materials for in line with the concept of green buildings.
d) Gypsum board / gypsum panels can partly replace wood in the construction and their use would result in protection of environment and ecology.
e) There exist possibilities of export of the gypsum board/gypsum panel to eastern and north-eastern parts of India and other neighboring markets. This would lead to earning to foreign exchange for the country.
f) There are not many medium and small-scale units manufacturing units in Bhutan. Setting up of this unit would have a catalytic effect on growth of entrepreneurship in medium and small-scale sector.
g) The setting up of the project would lead to generation of direct and indirect employment, both for skilled and unskilled workers which would result into economic up-liftment of local population. This would also lead to up gradation of skills.
h) There are employment opportunities in the project for persons with managerial, technical, financial and marketing capabilities. The employment of such people in the local industry would provide them an option to have an employment in private sector in Bhutan and also reduce the migration of qualified manpower.
i) There would be revenue generation for the local government by way of excise, sales tax/VAT and income tax from the unit as well as from its promoters.

Finally, the project would lead to enhancement of economic activities in the field of construction, transport of raw materials and finished goods, marketing and trade, repairs and maintenance, etc. It is important here to mention that above benefits can only be listed but these cannot be quantified based on a single unit with small investment. However, as mentioned above, if a number of such units in school supplies sector or any other sector of economy are setup, these would have a significant impact on overall economy of Bhutan.

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ANNEXURE I: DETAILED DESCRIPTION LIMESTONE & DOLOMITE SUB-CLUSTER

Limestone and Dolomite

Bhutan has a good reserve of Limestone and dolomite which are key raw materials for both manufacturing and construction industry. As of 2016, Bhutan had a good reserve of dolomite and limestone. The wide applicability of lime in building, chemical, metallurgical, agricultural and numerous other types of industries have resulted in concerted efforts being made all over the world during recent times for developing more and more efficient and economical methods of lime manufacture at lower fuel consumption, using alternative fuel, increasing kiln capacity and production rate, feed size control, continuous, semi-continuous operation and utilizing waste heat for pre-heating the stone.

In the sub-cluster of limestone and dolomite are the following downstream industries and products:

a) Quick Lime
b) Hydrated Lime
c) Precipitated Calcium Carbonate

Quick Lime/hydrated lime

Uses and Application of Lime/Hydrated Lime

a) Concrete, Mortar and Plasters

Lime and Lime Pozallonas can partly or wholly replace the use of cement in certain applications with techno–economic advantages. These advantages are normally realized in:

i. Plain concrete for simple spread foundation in ordinary buildings
ii. Masonry mortars and plasters
iii. Terracing on top of structural roofs
iv. Small masonry bridges and culverts
v. Small to medium masonry dams
vi. Masonry piers and abutments of moderate height canal lining, etc.

b) Lime – Soil Stabilization

Lime soil stabilization is used in all types of roads, parking slots, airport runways, under building foundation, in embankments and earth dam, rail road beds, etc.

c) In mineral mix for Animal and Cattle – feed as a source of Calcium Supplement
d) In Iron and Steel industries as Flux
e) In Non – ferrous Industry, Lime and Limestone are required in many strategic non-ferrous metallurgical processes.
f) In Pulp and Paper Industry, paints and Distempers, Plastic and Glass industry.
g) Environmental Uses
   i. In Water – Treatment plants

ii. In Waste – Management
iii. In Air – Pollution Control
iv. In Solid – Waste Disposal

Chemistry of Lime/Dry Hydrated Lime Manufacture

Manufacture of lime involves thermal decomposition of limestone as per equation: -

$$CaCo3 \longrightarrow CaO+Co2 +42.52 \text{ Kcal}$$

Depending on the grain size, impurities in the limestone, the dissociation temperature varies from 812 to 928^{o}C.

For proper calcinations to take place, the limestone has to be heated to the dissociation temperature in a kiln, the material to be retained for specific time depending upon the stone size and carbon dioxide (CO2) gas evolved during calcination must be removed rapidly.

Hydrated Lime is a stable and dry fine powder produced by the chemical combination of quicklime with specific amount of water, as per the following chemical reaction:

$$CaO+H2O \longrightarrow Ca(OH)2$$

Process of Manufacture of Quicklime

Although a large number of technologies are available for the manufacture of lime, the two most developed and widely used technologies shown in Figure X are: -

a) Rotary Kiln
b) Vertical shaft Kiln.

Rotary Kiln

Rotary Kiln technology for the manufacture of lime is well established with the advantages of large scale production and use of pulverized coal as fuel. Modern Rotary kilns incorporate various designs of pre-heaters, kiln in intervals and coolers for better productivity.

Vertical Shaft Kiln

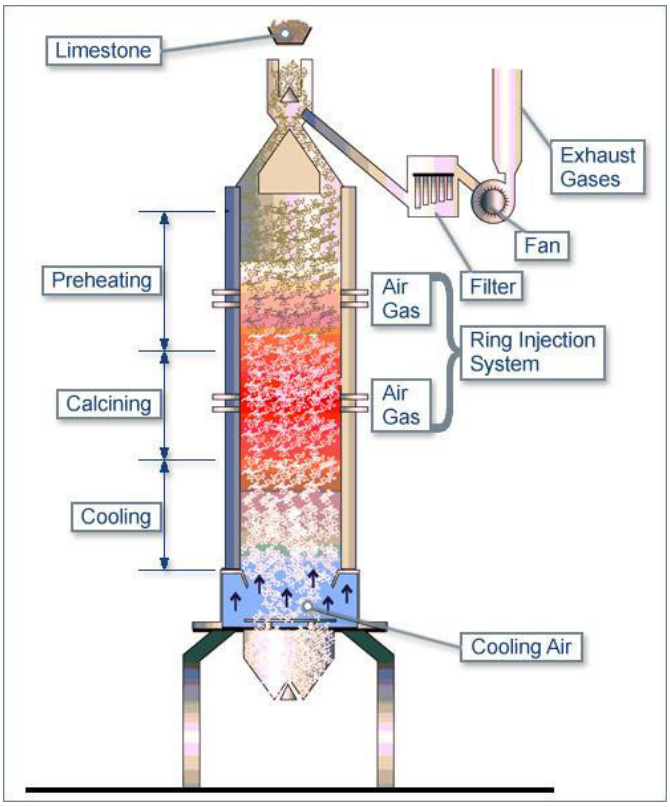
Mixed feed kiln are the conventional and most widely used Vertical Shaft Kilns (VSKs) in the world and are both continuous and semi – continuous type. The most widely used modern Vertical Shaft Kilns are Double Inclined, Annular Shaft and Parallel flow regenerative types. VSKs are less capital intensive compared to the rotary kilns and ideal for small and medium scale production.

Choices of Technology

Rotary Kilns technology though have the advantage of large scale production and use of pulverized coal as fuel, there are however disadvantages such as high capital investment, higher average energy consumption, lack of flexibility in single –kiln plants and the complicated and expensive dust –collection system.

Barring a few exceptions of mechanized rotary kilns operating as captive kilns to the organized industries like steel, sugar, paper and chemicals etc. by far a vast majority of Indian Kilns can be classified as Mixed Feed Vertical Shaft Kilns due to the following advantages viz.,

a) It is a mixed feed vertical shaft kiln with Theoretical fuel consumption similar to modern Vertical kilns (900 to 1100 K Cal/kg).
b) Continuous feeding and discharging to render higher production.
c) Minimum retention of bed in calcination zone.
d) Feed size grading appropriate for efficient heat flow.
e) Efficient process control and monitoring.



Schematics of a VSK

The Manufacturing Process and Operation of Kiln

The two raw materials i.e. limestone and fuel (coal/coke) are crushed to desired size and then mixed and the mixed feed is charged into the kiln by a skip hoist.

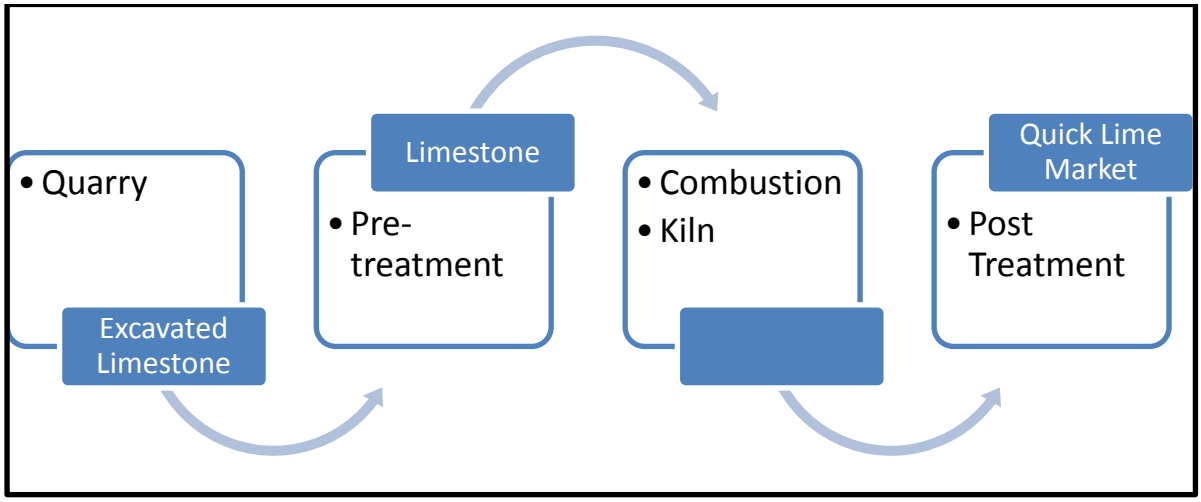
The kiln top has a cup and cone arrangement. Due to variable angle of the distributing cone the charge is evenly distributed over the entire periphery of the kiln-bed facilitating uniform access of the hot gases to the charge resulting in smooth drying and ideal plug flow. When there is no charging into the kiln, the distributing cone acts itself as seal to prevent the exhaust gases from escaping from the top of the kiln. The firing in the kiln is performed according to the principle of counter current. The shaft is divided into four zones which, according to their functions, are defined as follows: -

a) storage zone
b) Preheating zone
c) Calcining/reaction zone, and
d) Cooling zone

The heat realized by the combustion of the fuel in an atmosphere of preheated air calcines the limestone. A major portion of the kiln's interior surface where maximum thermal load encountered is lined with high alumina brick to minimize the heat losses.

The kiln is provided with suitable openings at the bottom for entry of fresh air and the induced draught is created by an ID fan at the top of the kiln, sluice arrangement is provided to discharge the product at a uniform and desired rate. These essentially consist of a plate resting on springs and connected to electro - magnetic vibrator.

The Calcined product quick lime is collected, separated from the ash and un-burnt limestone and ground to the desired size before dispatching for hydration in the hydration plant, or directly to the section for marketing.



Quick Lime Process

Manufacturing Process of Dry Hydrated Lime

Since Lime for building purposes should always be hydrated before use, it is logical that it is supplied in that form for immediate use. The lime hydration takes place in a hydrator. The design and operation of hydrator is such that the maximum possible portion of the hydration reaction takes place in the presence of water. Temperature is controlled so that the hydrate is neither 'drowned' with excess water, nor left un-hydrated due to insufficient water. Rapid agitation of the lime is also essential to ensure that all of it comes into contacts with water.

After passing through the hydrator, the hydrated lime goes to a screening system which removes grit. The hydrated lime, in the form of a fine dry powder, is then conveyed to bins for packing. Packing should be in Polythene – lined bag to avoid access of air.

List of Plant & Machinery for Vertical Shaft Kiln

a) Feed Hopper
b) Feeder
c) Bucket Elevator
d) Vertical Shaft Kiln
e) Refractory Brick Lining

f) Kiln Feed Double bunker with hydraulic Feeder
g) Temperature and Pressure Indicator and Control System
h) Reciprocating Type Kiln Discharge
i) FD Fan
j) ID Fan with Silencer
k) Multi clone Type Exhaust Dust Collector
l) Recuperator
m) Natural Gas Burners and its control systems (in case natural gas is used as fuel)
n) Exhaust Dust Collector Reverse Jet Bag House
o) Electrical & Instrument cabling & wiring with cable tray
p) Temperature Indicator & Control System
q) Kiln Pressure Indicator
r) Related Piping, Platforms and structure, VFD, Prime Movers
s) MMI of Electrical Control Panel

Plant & Machine for Lime Hydration Plant

a) Storage SILO
b) Disintegrator/Hammer Mill
c) Bucket Elevator
d) Storage Silos
e) Rotary valve with Floater
f) Hydrated Slacker
g) Screw Conveyor
h) Air Classifier
i) Hopper
j) Impex - Pulveriser
k) Related Base frame & structure

Total Area Required for 100 TPD Dry Hydrated Lime Plant

a) Total area required for Quicklime plant with Vertical Shaft Kiln – 8000 m^2
b) Total area required for 100 TPD Hydration Plant with Air Classification & Grinding Plant – 1200 m^2

List of Plant and Machinery Suppliers

M/s KINC Mineral Technologies Pvt. Ltd. 14, Haribhakti Estate,
Dabhoi road, Pratap Nagar, Vadodara, Gujarat – 390004
Telefax: +91-265-2581689
Tel: +91-990-9006104
Email: info@kincgroup.com
www.kincgroup.com

Subhadra Engineering Works, No.186/8B, G.T.Road North, Babudanga, Salkia,
Howrah, West Bengal 711106
Phone: 09433302044

Megatech International Private Limited
G-1,1428, RIICO Industrial Area, Phase V, Bhiwadi

Alwar - 301019, Rajasthan, India
Contact Person:
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Mr. Rajneesh Raghuyal
Phone: +(91) - 9772214144
+(91) - 9811019495
+(91) - (1493) – 512430

Allan Smith Engineering Private Limited
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Contact Person:
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Phone: +91-9892312317
+91-22-25895404

Laxmi Engineers, G- 588- B, 2nd Phase, M. I. A., Basni
Jodhpur - 342005, Rajasthan, India
Contact Person :
Vijay Sharma (CEO)
Phone: +(91) - 9829027588
+(91) - (291) - 2740588

M/s Maya Machinery Private Limited
F-14, Industrial Estate, Delhi Road, Saharanpur, Uttar Pradesh 247001
Phone: 09759240885

VIRA ENGINEERING
Factory Address: Akshardham Ind Estate, B/H Pancharatna Estate, Nr Ramol Bridge, Ramol, Vatva, Ahmedabad - 382445, Gujarat, India
Contact Person: Mr. Dik Patel (Proprietor)
Phone: + 917259111719
Mobile: +917259111719

Precipitated Calcium Carbonate

Precipitated Calcium Carbonate (PCC) is an important industrial chemical and a downstream product from Lime, used by largely as filler owing to its particle size, brightness (whiteness), and chemical purity. It is manufactured by carbonation of slaked or hydrated lime

Uses and Application

a) In Natural and synthetic Rubber/Tyre industry and in Hawai Chappals – to improve strength as well as whiteness

b) In Plastics – For PVC pipes, cables, profiles as a filler to improve impact strength and other physical and electrical properties
c) In the Dentifrice industry – As cleaning and polishing agent (Tooth paste)
d) In paints – For improving opacity and brightness (whiteness)
e) In Paper Industry – For improving brightness, opacity and Ink receptivity
f) In Pharmaceuticals – As a calcium source, as an antacid and as a bulking agent
g) In Food & Beverages – As a Calcium Supplement and Filtration Aid
h) In Sealant & Muskets – as a Rheology Modifier
i) In Cosmetics – To control Absorption characteristics and increase fluffiness
j) In Printing Inks – To Control strength and increase body of ink.

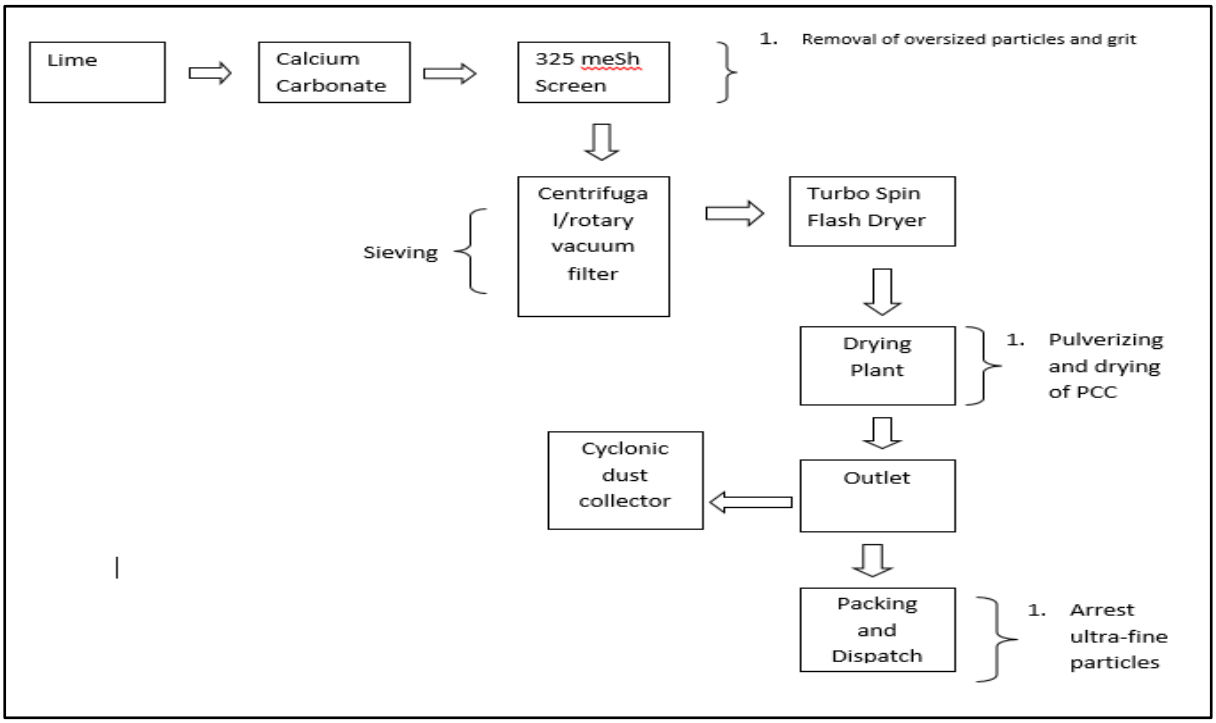
Process of Manufacture of PCC

Carbonization of slaked lime to produce Precipitated Calcium Carbonate (PCC) undergoes as per reaction - $Ca(OH)2 + \longrightarrow CO2\ CaCO3 + H2O$

Carbonation is carried out in Batch Process by taking measured quantities of lime slurry and reacting it with Carbon dioxide from Kiln gases. Particle size and shape of Calcium Carbonate is controlled at this stage to make various grades by the following: -

a) Milk of lime temperature and concentration
b) Agitator speed
c) Gas Flow
d) Carbonation Time

The precipitated Calcium Carbonate slurry is passed through a 325 mesh screen to remove oversized particles and grits, sieved slurry is pumped to centrifuge/rotary vacuum filter for decanting 40% to 60% water prior to drying process.



Process Flow: CaCO3

The PCC cake having 40-60% moisture is then sent to a Turbo Spin Flash Dryer in a controlled manner using VFD driven cake feeder. Wet cake is fluidized and dried with hot air to obtain a final product having a moisture content of less than 0.5%. hot air is generated in a heater by burning superior quality gas oil/LPG/Natural Gas/Producer Gas. This hot air is fed to drying plant where pulverizing and drying of PCC takes place, Outlet of drying unit is led to cyclonic dust collector silos having a certain number of filter bags, which can arrest ultra-fine particles and taken for packing into 25 kg bags and lets out clean air to atmosphere with combustion gases.

Total area required – 8000 m2 for 15 MT per day capacity

List of Plant and Machinery

1. Slinking Tank
2. Lime Storage Tank
3. Screening Bank
4. Carbonization chamber/ cylindrical mild Steel vessel fitted with Agitator
5. Centrifuge/Rotary vacuum filter
6. Turbo Spin Flash Dryer
7. Cyclo-Dust Collector
8. Coal Gasifier with all accessories
9. Ancillaries and other material handling system

Plant & M/c Suppliers

M/s KINC Mineral Technologies Pvt. Ltd.
14, Haribhakti Estate,
Dabhoi road, Pratap Nagar
Vadodara, Gujarat – 390004
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Tel: +91-990-9006104
Email: info@kincgroup.com
www.kincgroup.com

Environmental Issues: The environmental issues in the limestone and dolomite sub-cluster are described below:

Air Pollution

The calcination in both rotary and vertical shaft kilns generate particulate emissions which would cause localized particulate pollution. Without adequate protection systems, the workers are also exposed to fine dust pollution and high noise levels in the working environment.

Water Pollution

The hydration of lime, if not carried out at the correct dosage can generate slaked lime slurries which when discharged into the natural water bodies can increase the alkalinity of the water body and harm the aquatic ecosystem.

GHG emission

The generation of carbon dioxide, a common greenhouse gas from the CaO production process is a significant impact.

Mitigation Measures: To reduce the environmental impact of kiln particulate emissions, the flue gas from the kiln is pumped to a cyclone and a bag house filter with the help of an ID fan. The dust so collected can be sold for environmental treatment uses or recycled through the calcination process to attain higher grade products. Workers need to be provided with ear muffs and dust masks to limit exposure to particulate pollution and excessive noise levels.

The slurry generated from the hydration process can be concentrated and sold as a construction finish (white wash) or sold to farms for treating acidic soil.

The emission of greenhouse gas can be mitigated by connecting the flue gas stream to the $CaCO_3$ plant where the CO_2 is an essential raw material to precipitate the high grade limestone from hydrated lime.

ANNEXURE II: DETAILED DESCRIPTION GYPSUM SUB- CLUSTER

Gypsum or Hydrated calcium sulphate is one of the most important industrial minerals. Gypsum is one of the two forms of Calcium Sulphate found in nature, the second being in anhydrous form. By absorbing 2 Moles of water, anhydrous calcium sulphate turns into Gypsum and this is supposed to be one of the reactions occurring in nature, resulting in the formation of Gypsum beds. Gypsum is also obtained as a by-product of the salt industry.

Gypsum is put to various uses being a common sulphate mineral found abundantly in Earth's crust. The main commercial value of Gypsum depends upon its strength, density, and setting time after calcination.

Uses and Applications

a) Ground Gypsum is used as a filler in paint and distemper, Paper, Rubber and Cotton Industry
b) Powdered Gypsum either alone or mixed with other manures find use in agriculture particularly as a soil conditioner
c) Clean and ground Gypsum called mineral white finds application in Insecticides
d) It is also used as an underground dusting agent in coal mines and as an insulator
e) Gypsum is utilized as a source of Sulphur compound in the manufacture of Sulphuric acid, Ammonium Sulphate and Sulphur
f) Crushed Gypsum is used as a retarder to control the setting of Portland cement

Process of Manufacture

Gypsum is quarried or mined like other non-metallic minerals. Gypsum deposits usually lie close to the surface and are accessed by removing the overlaying clay or soil layer. It is simply crushed and screened by the end user.

Calcination of Gypsum

The process of dehydration of Gypsum is known as Calcination and is achieved by heating of Gypsum in rotary kiln or autoclaves. On the application of heat, the temperature of Gypsum rises steadily. After attaining temperature of 121^{o}C, the decomposition of Gypsum begins and water of crystallization is released. This result in the formation of hemi-hydrate, 2CaSO4.H2O

List of Plant & Machinery

1. Gypsum Washing Tank
2. Jaw Crusher
3. Pulveriser
4. Floatation Tank
5. Ball Mill
6. Calciner

Suppliers of Plant & Machinery

M/s KINC Mineral Technologies Pvt. Ltd.
14, Haribhakti Estate,
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Vadodara, Gujarat – 390004
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Downstream Projects from Gypsum

Following downstream projects from Gypsum may are suggested considering the potential for value addition:

a) Plaster of Paris
b) Plaster Boards

Project Profile for Plaster of Paris

Plaster of Paris which is Calcium Sulphate with half molecule of crystallization, CaSO4.1/2H2O and hygroscopic characteristics is obtained by duly Calcining the raw material, Gypsum (CaSO4.2H2O). It possesses outstanding property of setting and subsequently hardening when mixed with water.

Uses

Plaster of Paris is extensively used in ceramic industry for preparation of models and moulds. It is also used as main raw-material in the manufacture of chalk-cryons, Gypsum plaster boards, Decorative picture frames besides a wide range of applications in the interior decoration of Hotels, commercial complexes, buildings and other establishments.

Production capacity

As the Plaster of Paris is both resource-based and demand based item, the unit should be situated either at close proximity to the deposits of raw material, Gypsum or at the place where suitable infrastructure and considerable demand for the product readily exists. The profile envisages setting up of unit with a production capacity of 650 MT per annum.

Process of Manufacture

The raw material, Gypsum is cleared and washed for removal of impurities. The lumps thus obtained are dried and pulverized. The dried Gypsum powder is calcined in a rotary drum calciner using coal as fuel. The temperature of calcination may vary between 140^{o}C to 170^{o}C. The process of calcination is done over a period of about 2 hours so that once and half molecule of water of crystallization is removed to obtain the required properties. After cooling, the product is further pulverized to a finer mesh size of about 150 Mesh and packed in air-tight Polythene lined gunny bags.

Area required

Total land requirement – 2000m2

List of Plant & Machinery

1. Attrition type Disc Pulveriser, capacity 0.5 MT/hour
2. Rotary cylindrical Drum Calciner, capacity 2 MT

3. Weighing scale
4. Gypsum Weighing Tank
5. Test Sieves

Raw material requirements
1. Gypsum ---- 65 MT per month
2. Coal --------- 7 MT per month

Suppliers of Plant and Machinery

M/s KINC Mineral Technologies Pvt. Ltd. 14, Haribhakti Estate,
Dabhoi road, Pratap Nagar, Vadodara, Gujarat – 390004
Telefax: +91-265-2581689
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Project Profile for Plaster – Boards

Plaster boards are made of Plaster of Paris with Hessian or Sisal fibers, Jute or coconut coir as reinforcing materials. These are in the shape of panels of difference sizes with usually ½' uniform thickness.

Uses

Plaster boards are used for interior decoration and false ceiling in buildings Hotels, Offices and other establishments as substitute of ply wood and other materials due to their better appearance and thermal insulation properties.

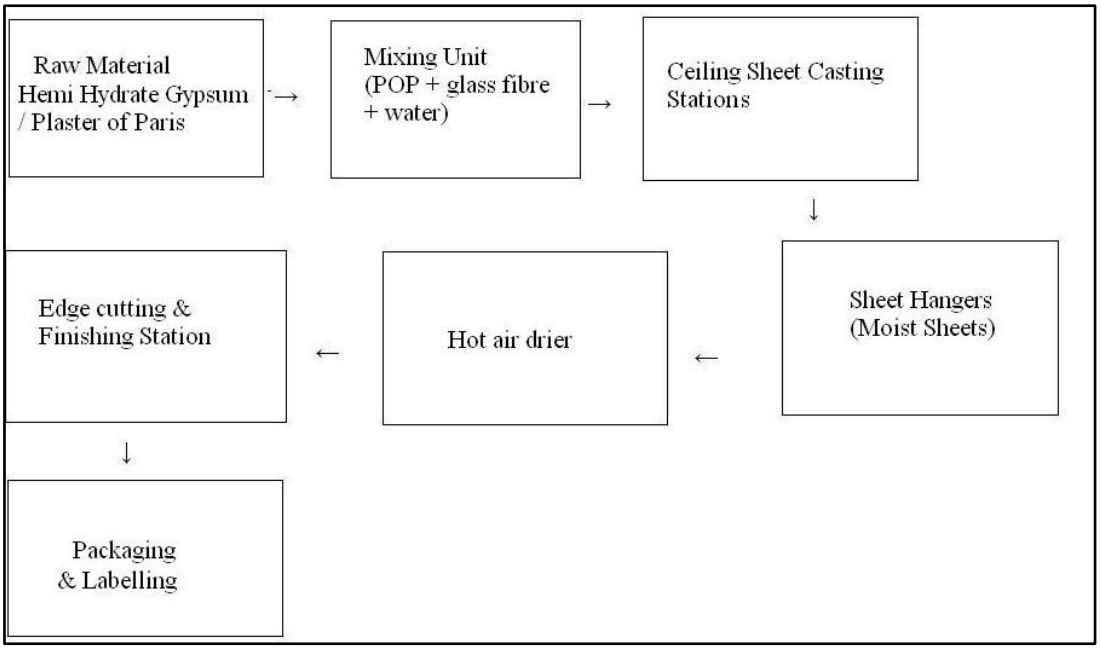
Production Capacity

The profile envisages setting up a unit with a production capacity of 450 MT per annum of assorted sizes of Plaster Boards.

Process of Manufacture

Plaster of Paris and colouring materials are weighed and mixed in suitable proportion and made into slurry by adding requisite quantity of water with constant and vigorous stirring and then poured into the moulds when reinforcement materials are arranged on highly polished marble slabs after duly cleaning and lubricating with oil or soap solution and allowed for proper setting.

After the plaster is initially set, the surface over the mould are leveled with a wooden reaper or straight plank and the excess material, if any, is removed and polished. The properly set boards are then removed from the moulds and left for 3-4. The process is repeated for making required number of boards. The dried products are then inspected and suitably packed for disposal.



Gypsum Board Process

Total Area Required

Total land required ----------500 m2

List of Plant Machinery

1. Wooden tables of 4’ x 5’ with highly polished marble slabs at the top
2. Mixing tank with Agitator
3. Water storage tank
4. Weighing scale, Platform type
5. Moulds, Tools and testing equipment

Plant and machine suppliers

M/s KINC Mineral Technologies Pvt. Ltd.
14, Haribhakti Estate,
Dabhoi road, Pratap Nagar,
Vadodara, Gujarat – 390004
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Gujarat, India
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08048763508

Environmental Issues: Air emission of fine particulates from the calcination and packing process of POP manufacture and generation of slurry from the boards and panels manufacture are the environmental impacts.

Mitigation Measures: To mitigate air emissions, the entire manufacturing unit of POP needs to be enclosed in a covered shed with suction hoods sucking the particulate laden air to a cyclone and eventually to a bag house filter. The bag house dust can be collected and packed as very fine POP which has a higher market value in the pharmaceutical industry. The slurry from the manufacture of gypsum boards and panels can be concentrated and used in the manufacture of decorative items or it can be used directly for soil treatment.

ANNEXURE III: DETAILED DESCRIPTION MARBLE SUB- CLUSTER

Marble is a crystalline form of limestone but commercially any carbonate rock capable of taking polish is called Marble. Marble has been recognized for centuries as an excellent architectural and articulate material.

Uses

Marble is used for roofing and flooring material besides for exterior and interior decoration of buildings, hotels, cinema houses, auditorium, stair treads blusters, base boards and columns etc. due to its sturdy nature, smooth surface in pleasing shades, long life and least maintenance cost.

Roofing flooring tiles of Marble and Granite are also used for the same purpose and could be manufactured with the machinery and equipment given in the down-stream project profile.

Market Potential

Demand for Marble and Granite is directly linked with construction activity. Great upsurge of constructional activity of private, Govt. buildings and establishment, housing projects besides export potential, the scope for setting up of the units in this line of manufacture is quite promising.

Downstream Project from Marble & Granite

Roofing and Flooring Tiles from Marble/Granite

Roofing and Flooring tiles are made from slabs procured from Marble Blocks sawing units and are used as roofing and flooring material besides for exterior and interior decoration.

Production Capacity

A unit on small scale may have annual production capacity of 27,000 sq. ft. of tiles of different sizes.

Process of Manufacture

Marble slabs of required thickness are procured from sawing units and fed to the polishing machine for grinding and polishing. These are then inspected for surface defects. The selected products are cut into desired dimensions of tiles with the help of edge cutting machine. There after the tiles are sorted out size wise and packed.

Total Land Requirement

Total land required ---- 2000 m2

List of Plant Machinery

1. Grinding and Polishing Machine with motor and starter.
2. Edge – cutting machine
3. Overhead Water Tank
4. Misc. Tools and Fixtures

Suppliers of Machines

M/s KINC Mineral Technologies Pvt. Ltd.
14, Haribhakti Estate,
Dabhoi road, Pratap Nagar
Vadodara, Gujarat – 390004
Telefax: +91-265-2581689
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Bareja, Ahmedabad - 387540, Gujarat, India
Phone:

+91-9974088696
08048763508

Environmental Issues: Environmental impacts in this industry include particulate emission from the crushers and screens and sediment loaded waste water from cutting and polishing activities.

Mitigation Measures: For the particulate pollution, mitigation measures include covering conveyor belts, raw material and products and sprinkler system on the jaw crushers. The wastewater needs to be treated with a sedimentation system from which the sediments can be used to manufacture decorative items.

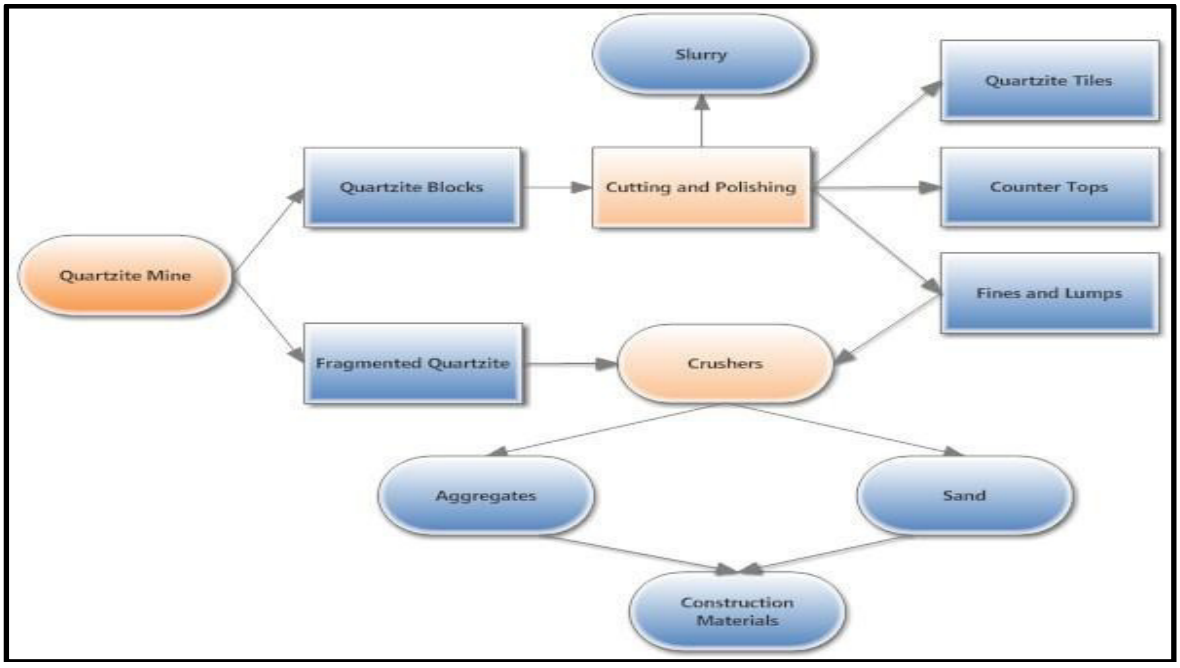
ANNEXURE IV: DETAILED DESCRIPTION QUARTZITE SUB- CLUSTER

Quartzite is a non-foliated metamorphic rock composed almost entirely of quartz. It forms when quartz-rich sandstone is altered by the heat, pressure, and chemical activity of metamorphism. These conditions re-crystallize the sand grains and the silica cement that binds them together.

Uses: High grade quartzite is used in the manufacturing industries as a source of Silica and in Bhutan it is predominantly used in the manufacture of ferro silicon. Quartzite, like marble can also be cut into tiles and counter tops and is known as a better counter top than marbles with a niche market in the high end housing market. Quartzite is also a prominent construction material with its usages ranging from quartzite slabs, aggregates for mortar and crushed sand.

Process of manufacture

The quartzite from the mine can come in two forms, the first one as blocks ranging from 1 m to 5 m and the second as fragmented boulders. The quartzite blocks are cut into thinner tiles and polished to produce quartzite counter tops while the fragmented boulders can be shaped into building blocks or crushed and used as aggregates or sand. The process flow is presented in the following flow chart:



Total area required: 4000m^2

List of Plant & Machinery

1. Block Cutter
2. Quartzite Polisher
3. Jaw crusher
4. Revolving Sieves
5. Platform Type Weighing machine

List of Machinery Supplier

M/s KINC Mineral Technologies Pvt. Ltd.
14, Haribhakti Estate, Dabhoi road, Pratap Nagar, Vadodara,Gujarat–390004
Telefax:+91-265-2581689
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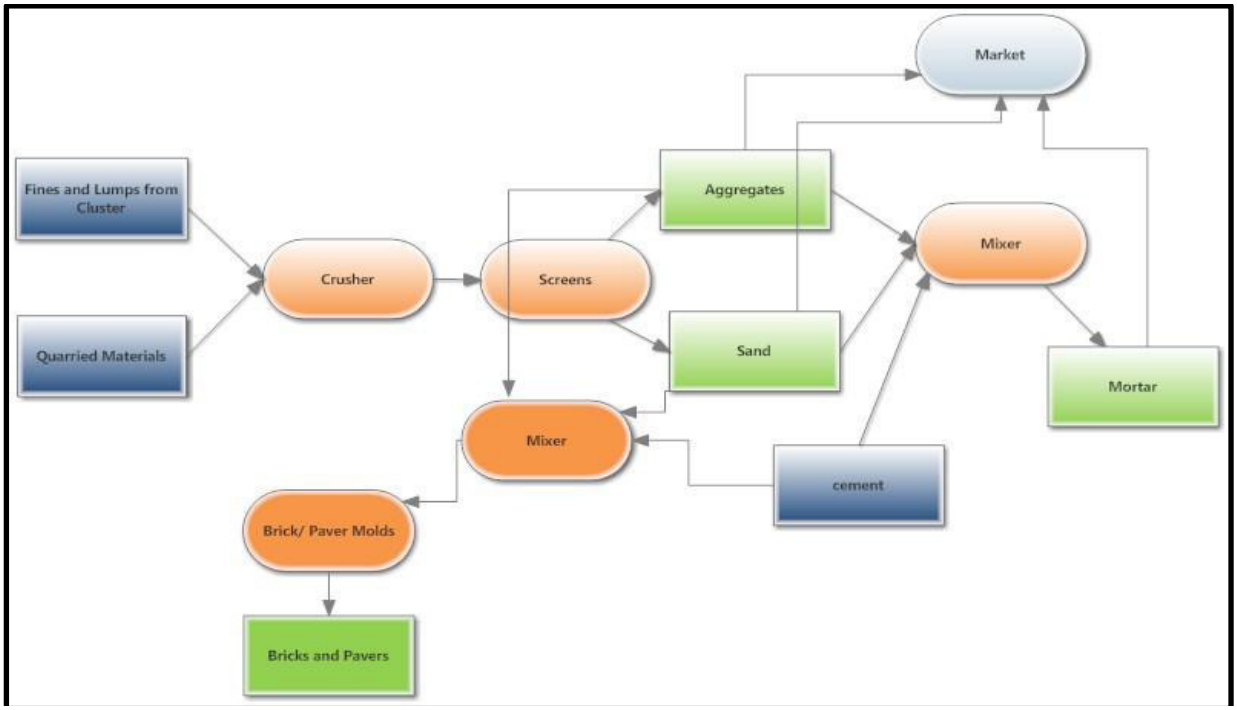
Environmental Issues: Environmental impacts in this industry include particulate emission from the crushers and screens and sediment loaded waste water from cutting and polishing activities.

Mitigation Measures: For the particulate pollution, mitigation measures include covering conveyor belts, raw material and products and sprinkler system on the jaw crushers. The wastewater needs to be treated with a sedimentation system from which the sediments can be used to manufacture decorative items.

ANNEXURE V: DESCRIPTION OF BY-PRODUCT BASED SUB- CLUSTER

Aggregate, Sand and Dry Mortar

Aggregates and crushed sand are essential construction materials and the by-products from the non-metal mineral cluster can be used to manufacture both aggregates and crushed sand. Most of the fines and lumps from the cluster can be sent through the screens and crushers to obtain aggregates of different sizes and crushed sand. The crushed sand and aggregates can be sold as final products in themselves or they can be used to produce dry mortars of different grades such as M15 and M20 concrete which has a high demand in the construction sector. Alternatively, the crushed sand and aggregates can be used to manufacture concrete bricks and pavers. A process flow of the aggregate, sand, dry mortar and bricks and pavers manufacturing is presented below:



List of Equipment:
Jaw Crusher assembly with vibrating screens of varied mesh sizes
Dry rotating Mixer (for dry mortar)
Concrete Mixer (for pavers and bricks)
Pavers and brick moulds

List of Equipment Suppliers
Mewar Hitech Engineering Limited, Hawa Magri Industrial Area, Sukher NH-8, Sukher, Udaipur-313001, Rajasthan, India
Vibhor Chaturvedi (Sales& Marketing Manager)
Tel: +91-8048762615

R. D. Mining Equipments Private Limited, A-18/1,

M. I. D. C. Industrial Area, Ambad, Ambad, Nashik-422010, Maharashtra, India
Rahul Deshmukh (ManagingDirector)
Tel: +91-8048762339

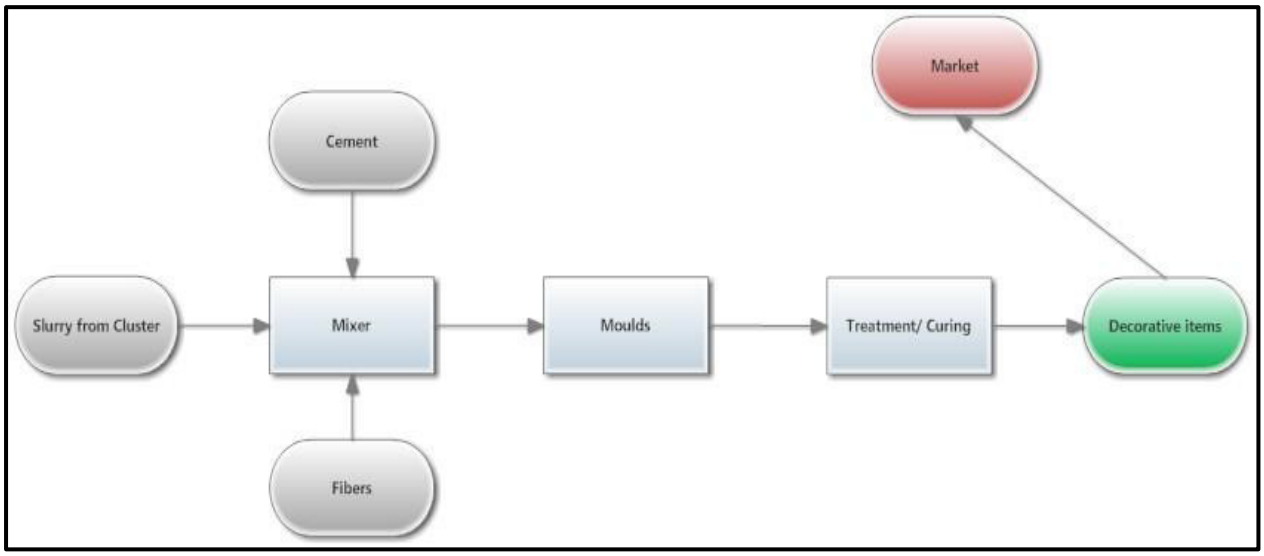
PR Engineers, No. 333, Vishala Supreme Near Torrent Power Sub Station, S. P. Ring Road, Nikol, Ahmedabad - 382350, Gujarat, India
Pratik Suthar (CEO)
Tel:+91-8048577234

Plant Capacity: 100 TPH Crusher, 5000 bricks and Pavers/day or 1000 m3/ day (mortar).

Area Required: 5000 m2

Decorative Items

The slurry from the wet processes of limestone, gypsum, marble and quartzite can be used to manufacture decorative items such as flower pots, statues and other sculptures by using natural or artificial fibers and cement. The process flow chart of such an industry is presented below:



List of Equipment:
Fiber Cutter
Weighing Machines
Mixers
Fiber glass moulds
Autoclave

List of Equipment Suppliers
A.G. Founders & Engineers, Outside Ohri Gate, Near Basant Avenue, Phase II near Amritsar, Nehru Gate, Near City Police Station, Phase 1,

Batala-143505, Punjab, India
Gautam Aggarwal (Managing Director)
+91-8048084322

Leo Enterprises, No. 2/19-B, Old Ganjawala Terrace, Opposite Hindmata Restaurant Tardeo, Mumbai Central, Tardeo,
Mumbai-400034, Maharashtra, India
Nishant Sudhakaran (Proprietor)
+91-8071808094

Rajan Engineers, Survey No. 1258/B, Near Kumareshwar Mahadev Temple Tundav, Savli, Near Kumareshwar Mahadev Temple, Savli,
Vadodara-391775, Gujarat, India
Sandeep Rana (Proprietor)
+91-8045359348

Plant Capacity: varied and dependent on slurry availability
Area Required: 2000 m2

Environmental Issues: For the manufacture of decorative items, the environmental issue relates to release of slurry into the natural water bodies when the quantity of slurry is more than the quantity required by the industry and the generation of solid waste from rejected and damaged products.

For the crushers and screens, the environmental impact stems from the release of particulate dust from the process and silt laden waste water from the washing of both raw materials and products.

Mitigation Measures: Provision of storage tanks or silos to store the excess slurry to be used at a later date and recirculation of damaged products into the manufacturing process. For the particulate pollution, mitigation measures include covering conveyor belts, raw materials and finished products, sprinkling water on the jaw crusher and passing the wash water through a sedimentation tank prior to discharge.

Animal Feed
Anotherdownstreamproductfromvariousminerals/mineralrejectisanimal feed which is the source of Carbohydrates, Proteins, Vitamins and Minerals to the animals. The calcium based mineral rejects are used as calcium supplements. A typical composition of feed is as under:

Ingredients	% by weight
Yellow Maize	26.21%
Wheat Bran	9.39%
Rice Polishing	28.17%
Groundnut Cake	23.50%
Fish Meal	5.16%
Molasses	3.74%
Limestone	2.34%
Mineral Mix	0.5%
Steamed Bone meal	1.12%
Vitamin Mix	0.12%

Process of Manufacture

The process of manufacture of animal feed is relatively simple and consists of reduction of size and blending of the various ingredients as per the formula. The selected ingredients are passed through a disintegrator or pulveriser to reduce the size of the particles to the required mesh size. The different powder e draw materials are taken by the weight as per the formula into a ribbon blender for uniform mixing.

The Vitamins, Minerals mixes and molasses are added at this stage. When uniformly mixed, it is extended to get in pellet for the finished product thus obtained is taken out as such and is packed in gunny bags.

Production Capacity

Production Capacity---- 50MT per month

Total area required

Total area required---- 2000m^2

List of Plant & Machinery

1. Disintegrator
2. Ribbon Blender
3. Gyratory Sifter
4. Platform weighing machine
5. Gunny Bag sealing machine
6. Miscellaneous equipment & fixture

Machinery suppliers

M/s KINC Mineral Technologies Pvt. Ltd.
14,Haribhakti Estate, Dabhoi road, Pratap Nagar Vadodara, Gujarat–390004
Telefax:+91-265-2581689
Tel:+91-990-9006104
Email:info@kincgroup.comwww.kincgroup.com

Mega tech International Private Limited
G-1, 1428, RIICO Industrial Area, PhaseV, Bhiwadi
Alwar-301019, Rajasthan, India
Contact Person:
Parveen Sharma (ManagingDirector)
Phone:
+(91)-9772214144
+(91)-9811019495
+(91)-(1493)–512430

Allan Smith Engineering Private Limited
No.9-C, Linden, Eden Woods, Hiranandani Meadows, OffPokhran Road2, Thane-400610,Maharashtra, India
Contact Person: Shailesh Kumar
Telephone:+91-9892312317+91-22-25895404

Precious Mech-Tech
Pravin Agarwal (MarketingManager)
PlotNo.563,Kanera, Behind Bhatt Brother, District Kheda, Bareja,Ahmedabad-387540,Gujarat,India
Mobile:
+91-9974088696
08048763508

Environmental impacts: The animal feed manufacturing system has the least environmental impact as the raw materials are sourced from process waste of food and mineral processing industry. The process itself does not lead to any significant impact as there is no chemical transformation taking place. The only impact is on occupational health and safety of the workers owing to work place particulate pollution and exposure to noise over extended periods of time.

Mitigation Measures: Ensure usage of personal protective equipment, including dust mask and ear muffs and ensure good housekeeping practices.

ANNEXURE VI: LOCATION SELECTION

Rating was given on the scale of 1-10 for each of the parameters as shown below:

Accessibility of the location

Locations	Closer to international border		Closer to Asian Highway		Closer to Indian Railway		Closer to Air Service		Overall rating
	Distance	Rating	Distance	Rating	Distance	Rating	Distance	Rating	
Pasakha	3km	9	18km	8	18km	8	430km	4	7.25
Jigmeling	2.5km	9	48km	7	72km	7	9km	9	8
Motanga	2.5km	9	48km	7	45km	7	115km	5	7
Samtse	2km	9	48km	7	24km	7	107km	5	7
Gomtu	2km	9	48km	7	15km	7	127km	5	7
Bondeyma	55km	7	265km	4	265km	4	150km	5	5

Note: 0-10km-9; 10-35km-8; 35-75km-7; 76-100km-6, 101-250km-5, 251-300km-4, 301-450km-3, 451-500km-2, above 500km-1

Access to raw materials

Locations	Limestone		Gypsum		Marble		Granite		Quartz		Overall rating
	Distance	Rating	Distance	Rating	Distance	Rating	Distance	Rating	Distance	Rating	
Pasakha	68km	8	345km	5	170km	7	170km	7	68km	8	7
Jigmeling	210km	7	265km	6	235km	6	235km	6	210km	7	6.4
Motanga	45km	9	75km	8	515km	3	515km	3	45km	9	6.4
Samtse	30km	9	425km	5	240km	6	240km	6	30km	9	7
Gomtu	15km	9	418km	5	210km	7	210km	7	15km	9	7.4
Bondeyma	65km	8	65km	8	563km	3	563km	3	65km	8	6

Note: 0-50km-9; 51-100km-8; 101-225km-7; 226-325km-6, 326-425km-5, 427-500km-4, 501-600km-3, 601-700km-2, above 700km-1

Similarly for the other parameters, ratings are provided based on the following assumptions:

Proximity to market: It means market closer to the industrial area for both domestic and international levels. Closer and easy access to the market obtains higher rating than those further and difficult accesses to the market.

Investment considerations: It means investment opportunities in the industrial location by the investors for both domestic and foreign investors. Higher the opportunities, higher are the rating for the investment and lesser the opportunity, lower is the rating.

Operational logistics: It means availability of transportation, communications and other logistical infrastructures in the industrial area. More facilities, higher is the rating and vice versa.

Future development: It means opportunities for future expansion of the industry as well as development aspects in the area. Higher are the chances of development, higher is the rating.

ANNEXURE VII: FINANCIAL AND ECONOMIC ANALYSIS

A. Hydrated Lime

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	480,000
2	Supervisors	2	600,000
3	Marketing and sales	2	600,000
4	skilled workers	4	960,000
5	Un skilled workers	10	1,200,000
	TOTAL		**3,840,000**

Utility			
Sl.No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	1,080,000
2	Diesel and other liquid fuels	Lumpsum	180,000
	TOTAL		**1,260,000**

Equipment			
Sl.No	**Particulars**	**Quantity**	**Amount**
1	Office Equipment (50k per person)	7	350,000
2	Office Furniture and fixtures (10k per person)	7	70,000
3	Other items (5k per person)	15	75,000
	Total		**495,000**

Pricing			
Sl.No	**Particulars**	**Quantity**	**Amount**
1	Production	Ton	7,000
2	Limestone	MT	5000

Summary of Capital Cost				
Sl.No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	700,000	35,000
2	Factory Shed	Nu.	2,000,000	100,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	45,000,000	4,500,000
6	Office Equipment (50k per person)		350,000	35,000
7	Office Furniture and fixtures (10k per person)		70,000	7,000
8	Other items (5k per person)		75,000	7,500
	TOTAL PROJECT COST	Nu.	**48,395,000**	**4,655,000**

B. Precipitated CaCo3

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	480,000
2	Supervisors	2	600,000
3	Marketing and sales	4	1,200,000
4	skilled workers	4	960,000
5	Un skilled workers	10	1,200,000
	TOTAL		**4,440,000**

Utility			
Sl. No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	1,080,000
2	Diesel and other liquid fuels	Lumpsum	180,000
	TOTAL		**1,260,000**

Equipment			
Sl. No	**Particulars**	**Quantity**	**Amount**
1	Office Equipment (50k per person)	7	350,000
2	Office Furniture and fixtures (10k per person)	7	70,000
3	Other items (5k per person)	15	75,000
	Total		**495,000**

Administrative cost			
	Particulars	**Quantity**	**Amount**
1	Advertisement	Lumpsum	100,000
2	HRD	Lumpsum	200,000
	Total		**300,000**

Pricing			
	Particulars	**Quantity**	**Amount**
1	Production sale	Ton	11,000
2	Limestone	MT	3500

Summary of Capital Cost				
Sl. No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	700,000	35,000
2	Factory Shed	Nu.	2,000,000	100,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	46,000,000	4,600,000
6	Office Equipment (50k per person)		350,000	35,000
7	Office Furniture and fixtures (10k per person)		70,000	7,000
8	Other items (5k per person)		75,000	7,500
	TOTAL PROJECT COST	Nu.	**49,395,000**	**4,755,000**

C. Marble and Granite tiles

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	240,000
2	Supervisors	1	300,000
3	Marketing and sales	1	180,000
4	skilled workers	1	240,000
5	Un skilled workers	2	192,000
	TOTAL		**1,152,000**

Utility			
Sl. No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	108,000
2	Diesel and other liquid fuels	Lumpsum	24,000
	TOTAL		**132,000**

Equipment			
	Particulars	**Quantity**	**Amount**
1	Office Equipment (50k per person)	1	50,000
2	Office Furniture and fixtures (10k per person)	1	10,000
3	Other items (5k per person)	1	5,000
	Total		**65,000**

Administrative cost			
	Particulars	**Quantity**	**Amount**
1	Advertisement	Lumpsum	10,000
2	HRD	Lumpsum	25,000
	Total		**35,000**

Pricing			
	Particulars	**Quantity**	**Amount**
1	Production sale	Sq ft	75
2	Raw material	sq ft	10

Summary of Capital Cost				
Sl. No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	350,000	17,500
2	Factory Shed	Nu.	1,000,000	50,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	2,000,000	200,000
6	Office Equipment (50k per person)		50,000	5,000
7	Office Furniture and fixtures (10k per person)		10,000	1,000
8	Other items (5k per person)		5,000	500
	TOTAL PROJECT COST	Nu.	**3,615,000**	287,500

D. Gypsum boards and panels

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	480,000
2	Supervisors	2	600,000
3	Marketing and sales	2	600,000
4	skilled workers	4	960,000
5	Un skilled workers	10	1,200,000
	TOTAL	19	**3,840,000**

Utility			
Sl. No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	360,000
2	Diesel and other liquid fuels	Lumpsum	300,000
	TOTAL		**660,000**

Equipment			
	Particulars	**Quantity**	**Amount**
1	Office Equipment (50k per person)	7	350,000
2	Office Furniture and fixtures (20k per person)	7	140,000
3	Other items (25k per person)	15	375,000
	Total		**865,000**

Administrative cost			
	Particulars	**Quantity**	**Amount**
1	Advertisement	Lumpsum	100,000
2	HRD & Overheads	Lumpsum	900,000
	Total		**1,000,000**

Costs			
	Particulars	**Quantity**	**Amount**
1	Production	piece	500
2	Semi hydrate gypsum	MT	4200

Summary of Capital Cost				
Sl. No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	2,000,000	100,000
2	Factory Shed	Nu.	7,500,000	375,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	14,410,000	1,441,000
6	Office Equipment (50k per person)		350,000	35,000
7	Office Furniture and fixtures (20k per person)		140,000	14,000
8	Other items (25k per person)		375,000	37,500
	TOTAL PROJECT COST	Nu.	**24,975,000**	1,936,000

E. Poultry Feed

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	360,000
2	Supervisors	1	300,000
3	skilled workers	1	180,000
4	Un skilled workers	10	1,200,000
	TOTAL		**2,040,000**

Utility			
Sl. No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	72,000
2	Diesel and other liquid fuels	Lumpsum	60,000
	TOTAL		**132,000**

Equipment			
	Particulars	**Quantity**	**Amount**
1	Office Equipment (50k per person)	1	50,000
2	Office Furniture and fixtures (10k per person)	1	10,000
3	Other items (5k per person)	2	10,000
	Total		**70,000**

Administrative cost			
	Particulars	**Quantity**	**Amount**
1	Advertisement	Lumpsum	20,000
2	HRD	Lumpsum	30,000
	Total		**50,000**

Pricing			
Sl.No	**Particulars**	**Quantity (kg)**	**Amount**
1	Yellow Maize	800	20
2	Wheat bran	200	20
3	Rice Polishing	400	15
4	Groundnut cake	250	20
5	fish meal	50	20
6	molasses	200	15
7	Limestone	50	4.2
8	mineral mix	5	10
9	Bone meal	20	10
10	vitamin mix	25	20

Summary of Capital Cost				
Sl. No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	700,000	35,000
2	Factory Shed	Nu.	1,000,000	50,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	2,000,000	200,000
6	Office Equipment (50k per person)		50,000	5,000
7	Office Furniture and fixtures (10k per person)		10,000	1,000
8	Other items (5k per person)		10,000	1,000
	TOTAL PROJECT COST	Nu.	**3,970,000**	305,000

F. Stone crusher

Salary and wages			
Sl. No	**ACTIVITY**	**Number**	**COST/Year**
1	Manager	1	480,000
2	Supervisors	2	600,000
3	Marketing and sales	2	600,000
4	skilled workers	4	960,000
5	Un skilled workers	10	1,200,000
	TOTAL	19	**3,840,000**

Utility			
Sl. No	**ACTIVITY**	**UNITS**	**COST**
1	Electricity	Lumpsum	10,560,000
2	Diesel and other liquid fuels	Lumpsum	1,500,000
	TOTAL		**12,060,000**

Equipment			
	Particulars	**Quantity**	**Amount**
1	Office Equipment (50k per person)	2	100,000
2	Office Furniture and fixtures (20k per person)	2	40,000
3	Other items (25k per person)	4	100,000
	Total		**240,000**

Administrative cost			
	Particulars	**Quantity**	**Amount**
1	Advertisement	Lumpsum	20,000
2	HRD & Overheads	Lumpsum	500,000
	Total		**520,000**

Costs			
	Particulars	**Quantity**	**Amount**
1	Production	tonne	400
2	RM	MT	250

Summary of Capital Cost				
Sl. No	**Expenditure Head**	**unit**	**AMOUNT**	**Depreciation Rate**
1	Office and Godown	Nu.	2,000,000	100,000
2	Factory Shed	Nu.	7,500,000	375,000
3	Water Storage tanks	Nu.	100,000	10,000
4	Land development	Nu.	100,000	10,000
5	Plant & Machinery	Nu.	10,000,000	1,000,000
6	Office Equipment (50k per person)		100,000	10,000
7	Office Furniture and fixtures (20k per person)		40,000	4,000
8	Other items (25k per person)		100,000	10,000

	TOTAL PROJECT COST	Nu.	**19,940,000**	1,495,000

Cashflow statement of Hyradated Lime

PROFIT AND LOST STATEMENT: HYDRATED LIME										
Project Year		0	1	2	3	4	5	6	7	8
Calender Year	Unit		2018	2019	2020	2021	2022	2023	2024	2025
REVENUE										
Production	Nu		94,500,000	99,750,000	105,000,000	105,000,000	105,000,000	105,000,000	105,000,000	105,000,000
Total Revenue (Nu)			**94,500,000**	**99,750,000**	**105,000,000**	**105,000,000**	**105,000,000**	**105,000,000**	**105,000,000**	**105,000,000**
EXPENSES										
Limestone			67,500,000	71,250,000	75,000,000	75,000,000	75,000,000	75,000,000	75,000,000	75,000,000
Packaging			300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Transportation			2,025,000	2,137,500	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000
Salary & wages			3,840,000	4,224,000	4,646,400	5,111,040	5,622,144	6,184,358	6,802,794	7,483,074
Administration and overheads			300,000	330,000	363,000	399,300	439,230	483,153	531,468	584,615
Utility			1,260,000	1,386,000	1,524,600	1,677,060	1,844,766	2,029,243	2,232,167	2,455,384
Total Expense			**75,225,000**	**79,627,500**	**84,084,000**	**84,737,400**	**85,456,140**	**86,246,754**	**87,116,429**	**88,073,072**
Profit EBITDA			**19,275,000**	**20,122,500**	**20,916,000**	**20,262,600**	**19,543,860**	**18,753,246**	**17,883,571**	**16,926,928**
Depreciation			4,655,000	4,655,000	4,655,000	4,655,000	4,655,000	4,655,000	4,655,000	4,655,000
Profit EBIT			**14,620,000**	**15,467,500**	**16,261,000**	**15,607,600**	**14,888,860**	**14,098,246**	**13,228,571**	**12,271,928**
Interest paid on loan			319,722	319,722	319,722	319,722	319,722	319,722	319,722	319,722
PBT			**14,300,278**	**15,147,778**	**15,941,278**	**15,287,878**	**14,569,138**	**13,778,524**	**12,908,849**	**11,952,206**
Tax			4,290,083	4,544,333	4,782,383	4,586,363	4,370,741	4,133,557	3,872,655	3,585,662
PAT			10,010,195	10,603,445	11,158,895	10,701,515	10,198,397	9,644,967	9,036,194	8,366,544
CASHFLOW										
Investment		(48,395,000)								
Net Operational Cashflow			10,010,195	10,603,445	11,158,895	10,701,515	10,198,397	9,644,967	9,036,194	8,366,544
Net Cash flow		(48,395,000)	10,010,195	10,603,445	11,158,895	10,701,515	10,198,397	9,644,967	9,036,194	8,366,544
IRR		**16%**								
Cumulative Cashflow			**10,010,195**	**20,613,639**	**31,772,534**	**42,474,048**	**52,672,445**	62,317,412	**71,353,606**	**79,720,150**

Cashflow statement of CaCo3

PROFIT AND LOST STATEMENT: PCC (CaCO3)										
Project Year		0	1	2	3	4	5	6	7	8
Calender Year	Unit		2018	2019	2020	2021	2022	2023	2024	2025
REVENUE										
Production	Nu		34,650,000	39,600,000	49,500,000	49,500,000	49,500,000	49,500,000	49,500,000	49,500,000
Total Revenue (Nu)			**34,650,000**	**39,600,000**	**49,500,000**	**49,500,000**	**49,500,000**	**49,500,000**	**49,500,000**	**49,500,000**
EXPENSES										
Limestone			11,025,000	12,600,000	15,750,000	15,750,000	15,750,000	15,750,000	15,750,000	15,750,000
Packaging			300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Transportation			472,500	540,000	675,000	675,000	675,000	675,000	675,000	675,000
Salary & wages			4,440,000	4,884,000	5,372,400	5,909,640	6,500,604	7,150,664	7,865,731	8,652,304
Administration and overheads			300,000	330,000	363,000	399,300	439,230	483,153	531,468	584,615
Utility			1,260,000	1,386,000	1,524,600	1,677,060	1,844,766	2,029,243	2,232,167	2,455,384
Total Expense			**17,797,500**	**20,040,000**	**23,985,000**	**24,711,000**	**25,509,600**	**26,388,060**	**27,354,366**	**28,417,303**
Profit EBITDA			**16,852,500**	**19,560,000**	**25,515,000**	**24,789,000**	**23,990,400**	**23,111,940**	**22,145,634**	**21,082,697**
Depreciation			4,755,000	4,755,000	4,755,000	4,755,000	4,755,000	4,755,000	4,755,000	4,755,000
Profit EBIT			**12,097,500**	**14,805,000**	**20,760,000**	**20,034,000**	**19,235,400**	**18,356,940**	**17,390,634**	**16,327,697**
Interest paid on loan			326,329	326,329	326,329	326,329	326,329	326,329	326,329	326,329
PBT			**11,771,171**	**14,478,671**	**20,433,671**	**19,707,671**	**18,909,071**	**18,030,611**	**17,064,305**	**16,001,368**
Tax			3,531,351	4,343,601	6,130,101	5,912,301	5,672,721	5,409,183	5,119,292	4,800,411
PAT			8,239,820	10,135,070	14,303,570	13,795,370	13,236,350	12,621,428	11,945,014	11,200,958
CASHFLOW										
Investment		(49,395,000)								
Net Operational Cashflow			8,239,820	10,135,070	14,303,570	13,795,370	13,236,350	12,621,428	11,945,014	11,200,958
Net Cash flow		(49,395,000)	8,239,820	10,135,070	14,303,570	13,795,370	13,236,350	12,621,428	11,945,014	11,200,958
IRR		**19%**								
Cumulative Cashflow			**8,239,820**	**18,374,889**	**32,678,459**	**46,473,829**	**59,710,179**	72,331,606	**84,276,620**	**95,477,578**

Cashflow statement of Gypsum Board and Panel

PROFIT AND LOSS STATEMENT: GYPSUM BOARDS AND PANELS											
Project Year		0	1	2	3	4	5	6	7	8	9
Calender Year	Unit		2018	2019	2020	2021	2022	2023	2024	2025	2026
REVENUE											
Production	Nu		15,750,000	18,000,000	22,500,000	22,500,000	22,500,000	22,500,000	22,500,000	22,500,000	22,500,000
Sale of Byproducts	1% of Production		157,500	180,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000
Total Revenue (Nu)			**15,907,500**	**18,180,000**	**22,725,000**	**22,725,000**	**22,725,000**	**22,725,000**	**22,725,000**	**22,725,000**	**22,725,000**
EXPENSES											
Raw Material Cost											
Semi hydrate gypsum			1,323,000	1,512,000	1,890,000	1,890,000	1,890,000	1,890,000	1,890,000	1,890,000	1,890,000
Reinforcing fibre/glass fiber			500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Chemicals and additives	Lumpsum		500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Packing boxes and labels			700,000	700,000	700,000	700,000	700,000	700,000	700,000	700,000	700,000
Transportation			110,250	126,000	157,500	157,500	157,500	157,500	157,500	157,500	157,500
Salary & wages			3,840,000	4,224,000	4,646,400	5,111,040	5,622,144	6,184,358	6,802,794	7,483,074	8,231,381
Administration and overheads			1,000,000	1,100,000	1,210,000	1,331,000	1,464,100	1,610,510	1,771,561	1,948,717	2,143,589
Utility			660,000	726,000	798,600	878,460	966,306	1,062,937	1,169,230	1,286,153	1,414,769
Total Expense			**8,633,250**	**9,388,000**	**10,402,500**	**11,068,000**	**11,800,050**	**12,605,305**	**13,491,086**	**14,465,444**	**15,537,238**
Profit EBITDA			**7,274,250**	**8,792,000**	**12,322,500**	**11,657,000**	**10,924,950**	**10,119,695**	**9,233,915**	**8,259,556**	**7,187,762**
Depreciation			1,936,000	1,936,000	1,936,000	1,936,000	1,936,000	1,936,000	1,936,000	1,936,000	1,936,000
Profit EBIT			**5,338,250**	**6,856,000**	**10,386,500**	**9,721,000**	**8,988,950**	**8,183,695**	**7,297,915**	**6,323,556**	**5,251,762**
Interest paid on loan			114,359	114,359	114,359	114,359	114,359	114,359	114,359	114,359	114,359
PBT			**5,223,891**	**6,741,641**	**10,272,141**	**9,606,641**	**8,874,591**	**8,069,336**	**7,183,556**	**6,209,197**	**5,137,403**
Tax			1,567,167	2,022,492	3,081,642	2,881,992	2,662,377	2,420,801	2,155,067	1,862,759	1,541,221
PAT			3,656,724	4,719,149	7,190,499	6,724,649	6,212,214	5,648,535	5,028,489	4,346,438	3,596,182
CASHFLOW											
Investment		(24,975,000)									
Net Operational Cashflow			3,656,724	4,719,149	7,190,499	6,724,649	6,212,214	5,648,535	5,028,489	4,346,438	3,596,182
Net Cash flow		**(24,975,000)**	**3,656,724**	**4,719,149**	**7,190,499**	**6,724,649**	**6,212,214**	**5,648,535**	**5,028,489**	**4,346,438**	**3,596,182**
IRR	**16%**										
Cumulative Cashflow			**3,656,724**	**8,375,872**	**15,566,371**	**22,291,020**	**28,503,234**	**34,151,769**	**39,180,258**	**43,526,695**	**47,122,877**

Cashflow statement of Marble, Granite and Quartzite tiles

PROFIT AND LOST STATEMENT: MARBLE, GRANITE AND QUARTZITE TILES											
Project Year		0	1	2	3	4	5	6	7	8	9
Calender Year	Unit		2018	2019	2020	2021	2022	2023	2024	2025	2026
REVENUE											
Production	Nu		3,750,000	3,750,000	3,750,000	3,750,000	3,750,000	3,750,000	3,750,000	3,750,000	3,750,000
Total Revenue (Nu)			**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**	**3,750,000**
EXPENSES											
Raw material			500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Packaging			100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Transportation			25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Salary & wages			1,152,000	1,209,600	1,270,080	1,333,584	1,400,263	1,470,276	1,543,790	1,620,980	1,702,029
Administration and overheads			35,000	36,750	38,588	40,517	42,543	44,670	46,903	49,249	51,711
Utility			132,000	138,600	145,530	152,807	160,447	168,469	176,893	185,737	195,024
Total Expense			**1,944,000**	**2,009,950**	**2,079,198**	**2,151,907**	**2,228,253**	**2,308,415**	**2,392,586**	**2,480,965**	**2,573,764**
Profit EBITDA			**1,806,000**	**1,740,050**	**1,670,803**	**1,598,093**	**1,521,747**	**1,441,585**	**1,357,414**	**1,269,035**	**1,176,236**
Depreciation			287,500	287,500	287,500	287,500	287,500	287,500	287,500	287,500	287,500
Profit EBIT			**1,518,500**	**1,452,550**	**1,383,303**	**1,310,593**	**1,234,247**	**1,154,085**	**1,069,914**	**981,535**	**888,736**
Interest paid on loan			44,000	44,000	44,000	44,000	44,000	44,000	44,000	44,000	44,000
PBT			**1,474,500**	**1,408,550**	**1,339,303**	**1,266,593**	**1,190,247**	**1,110,085**	**1,025,914**	**937,535**	**844,736**
Tax			442,350	422,565	401,791	379,978	357,074	333,025	307,774	281,260	253,421
PAT			1,032,150	985,985	937,512	886,615	833,173	777,059	718,140	656,274	591,315
CASHFLOW											
Investment		(3,615,000)									
Net Operational Cashflow			1,032,150	985,985	937,512	886,615	833,173	777,059	718,140	656,274	591,315
Net Cash flow		(3,615,000)	1,032,150	985,985	937,512	886,615	833,173	777,059	718,140	656,274	591,315
IRR		**20%**									
Cumulative Cashflow			1,032,150	2,018,135	2,955,647	3,842,262	4,675,435	5,452,494	6,170,634	6,826,908	7,418,223

Cashflow statement of Animal Feed

PROFIT AND LOST STATEMENT: ANIMAL FEED										
Project Year		0	1	2	3	4	5	6	7	8	9
Calender Year	Unit		2018	2019	2020	2021	2022	2023	2024	2025	2026
REVENUE											
Production	Nu		38,700,000	38,700,000	38,700,000	38,700,000	38,700,000	38,700,000	38,700,000	38,700,000	38,700,000
Total Revenue (Nu)			**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**	**38,700,000**
EXPENSES											
Raw material			32,364,000	32,364,000	32,364,000	32,364,000	32,364,000	32,364,000	32,364,000	32,364,000	32,364,000
Packaging			1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Transportation			270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000
Salary & wages			2,040,000	2,244,000	2,468,400	2,715,240	2,986,764	3,285,440	3,613,984	3,975,383	4,372,921
Administration and overheads			20,000	22,000	24,200	26,620	29,282	32,210	35,431	38,974	42,872
Utility			132,000	145,200	159,720	175,692	193,261	212,587	233,846	257,231	282,954
Total Expense			**35,826,000**	**36,045,200**	**36,286,320**	**36,551,552**	**36,843,307**	**37,164,238**	**37,517,262**	**37,905,588**	**38,332,747**
Profit EBITDA			**2,874,000**	**2,654,800**	**2,413,680**	**2,148,448**	**1,856,693**	**1,535,762**	**1,182,738**	**794,412**	**367,253**
Depreciation			305,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000	305,000
Profit EBIT			**2,569,000**	**2,349,800**	**2,108,680**	**1,843,448**	**1,551,693**	**1,230,762**	**877,738**	**489,412**	**62,253**
Interest paid on loan			26,000	26,000	26,000	26,000	26,000	26,000	26,000	26,000	26,000
PBT			**2,543,000**	**2,323,800**	**2,082,680**	**1,817,448**	**1,525,693**	**1,204,762**	**851,738**	**463,412**	**36,253**
Tax			762,900	697,140	624,804	545,234	457,708	361,429	255,521	139,024	10,876
PAT			1,780,100	1,626,660	1,457,876	1,272,214	1,067,985	843,333	596,217	324,388	25,377
CASHFLOW											
Investment		(3,970,000)									
Net Operational Cashflow			1,780,100	1,626,660	1,457,876	1,272,214	1,067,985	843,333	596,217	324,388	25,377
Net Cash flow		(3,970,000)	1,780,100	1,626,660	1,457,876	1,272,214	1,067,985	843,333	596,217	324,388	25,377
IRR		**31%**									
Cumulative Cashflow			1,780,100	3,406,760	4,864,636	6,136,850	7,204,835	8,048,168	8,644,385	8,968,773	8,994,151

Cashflow statement of Stone Crusher

PROFIT AND LOSS STATEMENT: STONE CRUSHERS										
Project Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Calender Year	**Unit**		2018	2019	2020	2021	2022	2023	2024	2025
REVENUE										
Production	Nu		57,600,000	76,000,000	96,000,000	96,000,000	96,000,000	96,000,000	96,000,000	96,000,000
Sale of Byproducts	1% of Production		-	-	-	-	-	-	-	-
Total Revenue (Nu)			**57,600,000**	**76,000,000**	**96,000,000**	**96,000,000**	**96,000,000**	**96,000,000**	**96,000,000**	**96,000,000**
EXPENSES										
Lumps and Fines & Quarried Materials			36,000,000	47,500,000	60,000,000	60,000,000	60,000,000	60,000,000	60,000,000	60,000,000
Raw Quarried Materials			500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Transportation			-	-	-	-	-	-	-	-
Salary & wages			3,840,000	4,224,000	4,646,400	5,111,040	5,622,144	6,184,358	6,802,794	7,483,074
Administration and overheads			520,000	572,000	629,200	692,120	761,332	837,465	921,212	1,013,333
Utility			12,060,000	13,266,000	14,592,600	16,051,860	17,657,046	19,422,751	21,365,026	23,501,528
Total Expense			**52,920,000**	**66,062,000**	**80,368,200**	**82,355,020**	**84,540,522**	**86,944,574**	**89,589,032**	**92,497,935**
Profit EBITDA			**4,680,000**	**9,938,000**	**15,631,800**	**13,644,980**	**11,459,478**	**9,055,426**	**6,410,968**	**3,502,065**
Depreciation			1,495,000	1,495,000	1,495,000	1,495,000	1,495,000	1,495,000	1,495,000	1,495,000
Profit EBIT			**3,185,000**	**8,443,000**	**14,136,800**	**12,149,980**	**9,964,478**	**7,560,426**	**4,915,968**	**2,007,065**
Interest paid on loan			114,359	114,359	114,359	114,359	114,359	114,359	114,359	114,359
PBT			**3,070,641**	**8,328,641**	**14,022,441**	**12,035,621**	**9,850,119**	**7,446,067**	**4,801,609**	**1,892,706**
Tax			921,192	2,498,592	4,206,732	3,610,686	2,955,036	2,233,820	1,440,483	567,812
PAT			2,149,449	5,830,049	9,815,709	8,424,935	6,895,083	5,212,247	3,361,127	1,324,894
CASHFLOW										
Investment		(19,940,000)								
Net Operational Cashflow			2,149,449	5,830,049	9,815,709	8,424,935	6,895,083	5,212,247	3,361,127	1,324,894
Net Cash flow		**(19,940,000)**	**2,149,449**	**5,830,049**	**9,815,709**	**8,424,935**	**6,895,083**	**5,212,247**	**3,361,127**	**1,324,894**
IRR	**21%**									
Cumulative Cashflow			**2,149,449**	**7,979,497**	**17,795,206**	**26,220,141**	**33,115,224**	**38,327,471**	**41,688,597**	**43,013,492**