

LANCASTER UNIVERSITY, MANAGEMENT SCHOOL 2019

ECONOMIC VALORISATION OF BAMBOO IN ARUNACHAL PRADESH?



Group 6 under the supervision of Pr.Salomon Darwin

Students in Master of Corporate Development within Lancaster University. We did this work with the Smart village movement launched and developed by the team of Pr. Salomon of Berkeley University. The smart village movement aim to transform villages in India by making them advance in terms of technology and connected to global markets.



ECONOMIC VALORISATION OF BAMBOO IN ARUNACHAL PRADESH?

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OUR PROJECT

In every industry the demand for plant-based/carbon-neutral ingredients is rising in the western markets to promote a sustainable planet. Our business case recommends Arunachal farmers to produce high-quality-high margin bamboo-based charcoal with Himalayan branding to meet the global demand. This Fast-Moving Consumer Goods market will bring in much needed investment while generating local jobs and improving international exports for the state.

1. Demand.

Our Buyers, Miyabi, Mr Blanc, etc. are prepared to purchase 250 tons/year of our product at market price, which generates \$360 000 revenue/year. The market for activated charcoal, currently valued at USD 2.8 billion, is predicted to grow by 13% annually. In addition, the demand for activated charcoal made from a plant-based raw material is rapidly increasing, while the coal-sourced activated charcoal market is dying down to improve the carbon footprint.

2. Investment.

Miyabi Inc., a Japanese commercial bamboo charcoal water filter company, is keen on investing in this venture. The firm wants to grow by establishing an entity in India. The initial capital investment required is USD 26 000 to set up a small factory that transforms 4 tons of bamboo into 1 ton of charcoal daily. A total of two industrial heaters, one charcoal grinder and a packaging machine will be required. Total cost of raw material per day is \$203.00. More factories can be set up as the demand grows.

3. Revenue.

Our projected sales for 1st year are estimated to be \$360, 000 from the sale of 250 tons of charcoal. This will yield \$79,500 in net profit. The villagers are paid a monthly salary, which is approximately two times the average wage of a farmer in Arunachal Pradesh.

4. Operations.

Our operations consist of 7 steps: Procurement - Drying- Cutting - Heating - Grinding - Packaging - Exporting. This will directly create 15-20 local jobs, 10 of which will be lumberjacks. The venture requires 150 hectares of land to be rented on yearly basis to not encounter deforestation issues. Our operating expenses are projected to be \$219,700/year that represents income for the local economy.

5. Supply Chain Management (Distribution).

The factory will be set up in Kinekibo. Truckwale will be transporting our finished product to the warehouse. Our customers will collect the package product from our warehouse in Itanagar and ship it through their transportation firm.

6. Marketing.

The marketing of the product is then done by our customers, mentioned in the Demand section. The “Himalayan Charcoal” brand is already being used by companies such as The Body Shop. The same brand can be utilized by our customers.

7. Socio-Economic Impact.

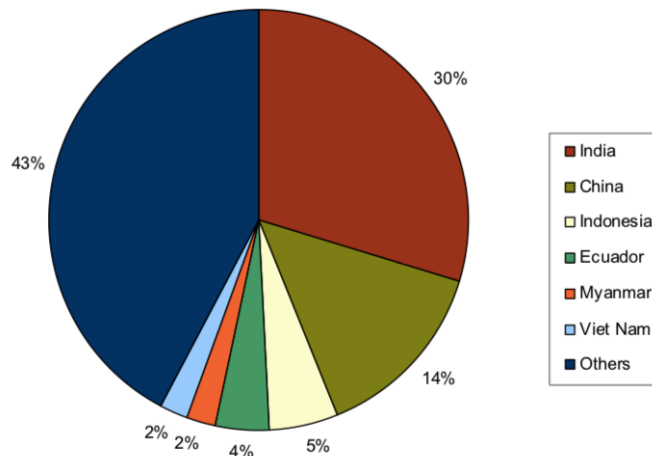
Initially, the project will directly create 15-20 jobs. This includes both production workers and administrative personnel. This project has a very high potential of scaling up throughout Arunachal Pradesh. As per our financial forecast, in the first year itself, the project will net a profit of \$79 500.

Thus, creating employment within the state and improving the state’s GDP. Currently, we have a capacity of producing 1 ton of bamboo charcoal by using 2 industrial heaters. Taking into consideration the availability of bamboo in the state, the production capacity can increase up to 10 tons a day by adding 18 more industrial heaters, 10 more charcoal grinders and 10 more packaging machines gradually. This will then have a huge economic impact on the state while improving the global carbon footprint.

THE MARKET

Bamboo: an unexploited resource

30% of the global bamboo resource is located in India, making it the country with the largest amount of bamboo in the world.

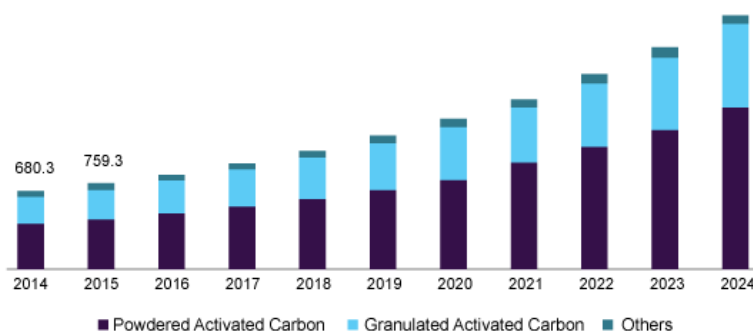


However, India still imports 50% of the bamboo that is used within the country, due to its inefficiency in procuring the bamboo that is domestically present. The imported bamboo mostly originates from China, which only has 14% of the global bamboo recourse. 9.2% of the Indian bamboo resource is found in Arunachal Pradesh.

While the governments of other countries, such as China and Vietnam, have already in the infrastructure and organisations required to efficiently utilise this resource for various industries. India has only started investing in this resource recently, making it a latecomer to the bamboo market. This makes having a unique opportunity more important, in order to not have to directly compete with established companies that offer the same product.

Demand and Market Analysis

The demand for activated charcoal is growing at a rate of 7% annually. In the US the growth is almost twice the global rate, currently at an astounding 13% annual growth rate.



The market value as of 2017 is USD 2.84 billion, while the demand was 1.9 million tons.

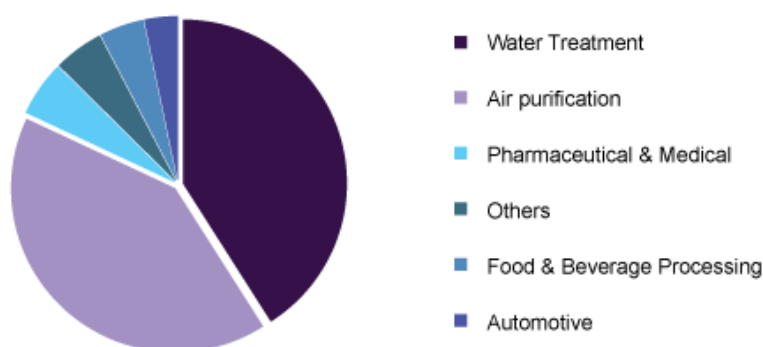
Currently the demand is increasing faster than the current producers can supply, which is making the market price of this product increase. Another trend that characterises this market is the influence that the push towards environmental sustainability is having in the industry.

Traditionally activated charcoal is made through coal carbonisation. Environmental protection legislation pushed by governments and NGOs, as well as smarter consumers that are more and more concerned with the effect that air and water pollution have on their health, are facing companies to switch to a more sustainable supply source. Some of the new alternatives that have emerged are:

- Wood
- Bamboo
- Coconut Shells
- Olive Pits
- Nut Shells

Although wood is a better source than coal — a finite source that is becoming more and more scarce — it is still not truly environmentally friendly. Compared to bamboo, which has a 5 year full growth cycle, most trees average at 40 years. Additionally, using trees contributes to global deforestation — an issue that bamboo does not have if handled properly.

It's highly absorptive properties make activated charcoal have many uses, represented in the graph below:



Other uses include, but are not limited to:

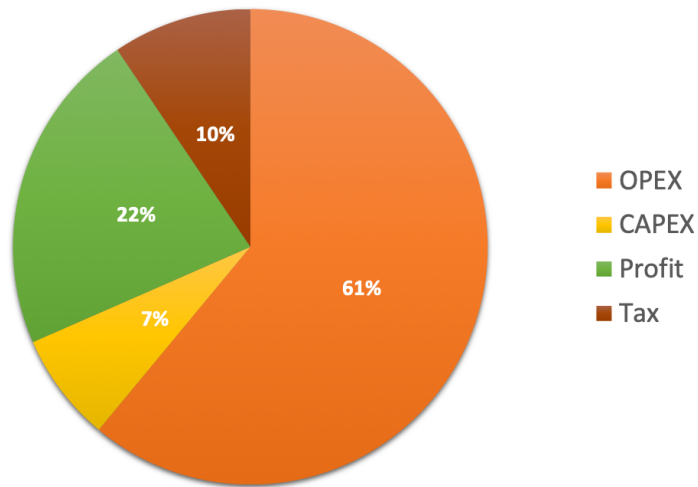
- Dietary supplements
- Cosmetics (face masks, toners, etc.)
- FMCG: toothpaste, shampoo, etc.
- Food

Revenue

The market price for this product ranges from 1300 to 1700 USD/ton. With a factory capacity of 1 ton per day, the annual revenue that this venture generates is USD 360'000. With the current market price, the revenue will increase proportionally to the tons added, i.e. 1 ton/day = USD 360'000.

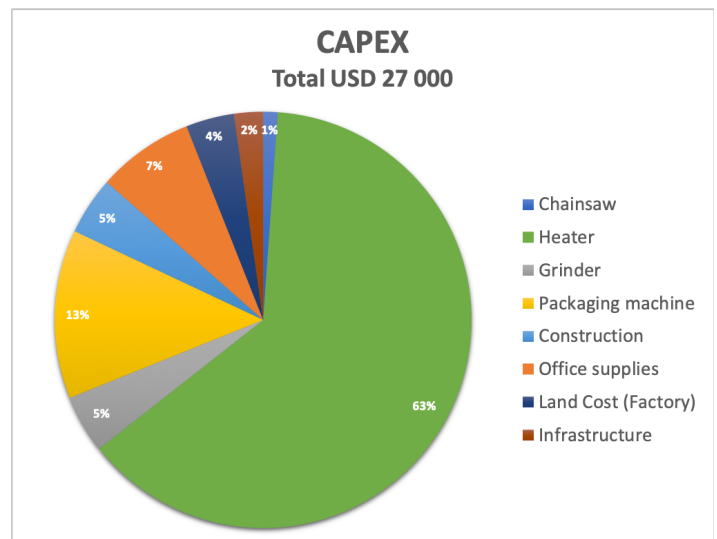
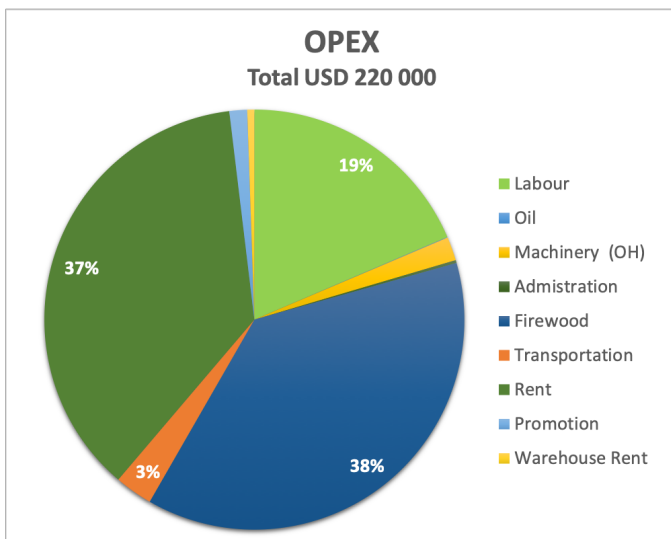
Revenue Split

Total 360'000 USD



The profit is approximately USD80'000 and USD34'000 is already going to the government through tax revenue.

The OPEX and CAPEX are represented by the graphs below:



Branding and Marketing

Customers will be able to utilise the Himalayan Charcoal brand in their products. The Himalayan brand promotes features such as freshness, purity and cleanliness, all of which perfectly match with what our product does.

Other companies are already using the Himalayan Charcoal brand (mostly home-use water filters and cosmetics), as well as Bamboo Charcoal (mostly used for toothbrushes and toothpaste), to market their products. These use cases prove that the brand is successful in marketing a product.

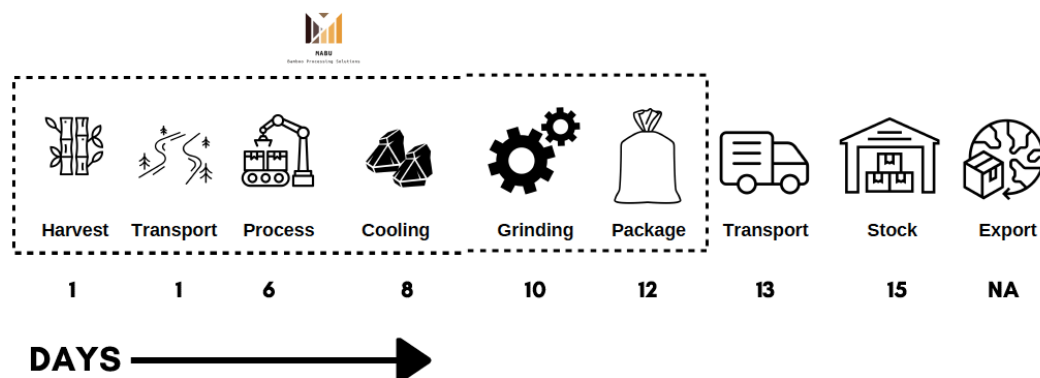


The companies that are already using these brads are:

- The Body Shop
- Mr Blanc
- Chagrin Valley: Soap & Salve Company
- Unifect
- Glamglow

FROM A TO Z

For an overview of the process, our operation consists of seven major steps, namely: Procurement - Drying- Cutting - Heating - Grinding - Packaging - Exporting.



Procurement refers to the process of obtaining something. The operations will require raw bamboo canes from the farmers on a daily basis. Four tons bamboo is required to produce a total of one ton of activated bamboo charcoal. The bamboo will be harvested by the farmers and transported to Kinekibo village region. The pre-processing supply chain consists of labours transporting the bamboo from the farms on the Brahmaputra river.

This village is close to the river and an ideal project location. The next step would be to dry the bamboo and get it down to the required moisture content level (less than 10%). This will be done at the warehouses near the plant. Once the bamboo is partly dried, it needs to be cut down into smaller shoots so that it is ready to be heated and transformed into the activated bamboo charcoal. Once the industrial heater reaches the optimal temperature, the bamboo shoots are put in and it takes about 8-10 hours for the carbonisation process.

Then the container is left to cool down for approximately 5-6 days i.e, 120-144 hours. Next, the carbonised bamboo shoots are transferred to the grinding machine to obtain the activated charcoal powder form. This product is then packaged with the help of a packaging machine and is ready to be exported. The post-processing supply chain consists of the transportation of activated bamboo charcoal powder in trucks from Kinekibo village to Itanagar, the capital of Arunachal Pradesh. The customers can easily collect the charcoal from there as they already have a well established global supply chain network.

HARVEST

The Bamboo:

Bamboo belongs to the plants and flower family, specifically monocotyledonous. It belongs to the sub-family of the Bambusiadeae. Bamboo is considered to be a grass, just like rice, palm and reed. Bamboo is mainly grown in warm and wet areas in Asia, South America, Africa and Oceania. However, it is a resistant grass which can grow in almost any climate. Most of the commercialised bamboo today came from natural forests. There are more than 90 bamboo variants and approximately 1300 different species depending on their size, color and shape. Any flora or fauna specie is identified by analysing the flower. However, the flowering is irregular for bamboo and thus, the specie is identified by analysing the stalk, leaf and the outer layer that protects the bamboo shoots.

A main characteristic of the bamboo it is the speed of its growth. Depending on the species, a bamboo can grow on an average, 10 to 50 centimetres per day during the growth period. Bamboo as the woody planted could be harvest during most of the year. However, to allow the sustainability of the forest and ecosystem it is highly recommended to avoid the bamboo shoots emergence period.

The Exploitation:

By dividing the crop cycle in four we highlight all sides of the growing process.

Education phase:

As previously mentioned, bamboo is already being exploited in existing forests. The farmers and lumberjacks lack the required education and need to be trained on how and more importantly, when to buck the bamboo canes. Hence, it is vital to provide training to all the lumberjacks associated with this project. This training can only be provided by an experienced lumberjack. This will be more of an interaction guide composed of few scheme which will explain the bamboo shoot sizes, the optimal height and the ideal time to buck the grass with the chain chainsaw (See APPENDIX).

Furthermore, our sustainable approach of the subject pushed us to contact a couple of NGOs and experts specialised in bamboo exploitation. Patrice Lamballe and Aurélie Vogel are two French researcher belonging to the GRET a french development organisation. However, the

analysis of the exploitation impact on the ecosystem and the sustainability of the forest has to be done on the basis of a 5 year period. This analysis is based on different data such as the number of plants per hectares, the number of bamboo shoots per plant, the other plants growing near the bamboos, ground analysis and others criteria which enable analysts to evaluate the situation of the forest.

To do this analysis, the “World Bamboo” is an organisation that works for promoting and exploiting bamboo in a sustainable manner. The “INBAR” is an organisation that works to use Bamboo and Rattan as a growth tool in emerging areas. Initially, an audit of the potential zone will have to be conducted along with the World Bamboo, NBM (National Bamboo Mission) and the INBAR (International Bamboo and Rattan Organisation). These three organisations are the specialised and recognised organisations in the bamboo industry. This collaboration aim is to evaluate the sustainable ways of the forest exploitation and also educate the lumberjacks to improve their method to the harvest. In one of the research papers based on a project in north Vietnam, INBAR sent an expert on the field for the first week of the bamboo exploitation to educate the farmers and to collect data. The above mentioned organisations have teams which are specialised in similar projects who ensure a sustainable exploitation of resources.

Pre-harvest phase

As mentioned above, the bamboo is a grass but is exploitable as the woody plant. Thus, it does not need any pre-harvest process as other fruits or vegetables require. During the non-harvest time, lumberjack and some of the manufacture employee will cut wood in order to create a sufficient stock of fire wood for the heater. However, during the off season, the main bamboo business can be complemented with a groundnut exploitation business. Such a combination could enrich the diversity of the exploitation and on the long term to create a sustainable ecosystem.

Growth & Management Phase:

Time required from growth to maturity for the bamboo (see below) is around 5 years. The project needs 150 hectares to enable a sustainable cycle between the harvest and the growth of bamboo. During these period 10 lumjack will work on the harvest of bamboo and its transportation to the processing unit.

Post-Harvest Phase:

The post and pre-harvest in the bamboo crop cycle is the same thing. Both represent the four months (May to August) when bamboo shoots grow. During this period the lumberjack will cut firewood, plant groundnut and prepare everything for the next harvest. On mid and long term groundnut will create an additional revenue for the company.

EXPLOITATION PROCESS

As mentioned previously, bamboo will be harvested for 8 months of the year to allow a sustainable management of resources.

January – February	March – April	May – June	July – August	September – October	November - December
Favourable harvesting time	Tolerable harvest if required	No harvest (Emergence of new shoots)	No harvest (Growth of new shoots)	Tolerable harvest if required	Favourable harvesting time

During the four other months the lumberjack will be preparing for the next harvest season, plant groundnut in the forest in a perspective of complementary revenues and they will also prepare firewood that is required for the industrial heater. The project will employ 11 lumberjacks to cut the bamboo and transport it to the manufacture. In the morning lumberjacks will go to the forest to cut bamboo. The tools used by the lumberjack, are mainly chainsaws this chainsaw will need to be refilled every day. Using a “Stihl Cast Iron Chain Saw MS-170” is highly recommended taking into consideration the quality/price ratio. Mid-day, the lumberjacks will transport the bamboo from the forests to the processing plant through the river. The process of transporting bamboo via river is a famous and old practice which is being used currently in the state. This mode of transportation is inexpensive and way more eco-friendly as compared to the trucks. A larger amount of bamboo can also be transported using the “raft” method. The project will require 150 hectares of bamboo forests in order to operate and procure 4 tonnes of bamboo daily. This area can be used in rotation which will in turn create a sustainable exploitation process overall.

Transport distance (km)	Travel time (days)
10	1
40	2
70	3

	Bamboo
Diameter 1,5 from the ground (mm)	105 to 115
Circumference 1,5 from the ground (cm)	> 34
Tall utilisable (m)	9,8
Average weight/meters (kg)	3,32

TRANSFORMATION PROCESS

The transformation process from bamboo to activated bamboo charcoal particles is not a very complicated one. The entire operations can be broken down into seven major steps:

Procurement: In this process the raw material (Bamboo) will be obtained from the bamboo farms and transported to the manufacturers. Approximately 10 lumberjacks will be employed who will be responsible for plantation of bamboo, bunking of the crop and transporting it to the project site. A total of 4 tonnes of bamboo will be required on a daily basis. The bamboo will be harvested by the farmers and transported to Kinekibo village region. The pre-processing supply chain consists of labours transporting the bamboo from the farms on the Brahmaputra river. This village is close to the river and an ideal project location.

This is a very cost effective and efficient method that is commonly used in the Northeast Indian regions. This supply chain method is a very environmental friendly method as well as there is no carbon footprint in this step.

Drying: Drying is natural process in which the bamboo will have to be stored so that it loses the excess moisture content and is ready to be used as a raw material for carbonization. This step usually takes about 48-90 hours (2-4 days) depending on the weather. This is a very important process as if bamboo canes with a high moisture content (>15%) are used, they will end up getting burned. Hence, resulting in the carbonization process to prolong. Additionally, due to the high moisture content, the heat will not be spread across the bamboo shoots evenly and might result in the shoots getting cracked. This degrades the quality of the bamboo charcoal produced.

Cutting: Due to bamboo's low thermal conductivity, longer pieces will take a long period of time to heat up and thus slow down the entire carbonization process. Also, as the bamboo needs to be put in the heaters, it has to be cut down into smaller pieces. The recommended size of bamboo canes for the heater is 10cm X 40cm. Any size smaller than this dimension is also acceptable.

Heating: This is the process of raising the temperature inside the container is known as heating. Firewood is added on a daily basis to keep the fire going which turns the bamboo into activated bamboo charcoal. Once the feeding is complete, the intake gets sealed once again and is not opened until one batch of bamboo has undergone carbonization. The firewood feeding will depend on the temperature. The feeding is stopped if the temperature escalates too quickly and it difficult to control. If the operates are unable to control the temperate, the bamboo might crack and not get carbonized. Once the temperature reaches 250-260 degree mark the bamboo will start to decompose rapidly. Around the 450-500 degree mark, the refining stage of the process will start. In this stage, the bamboo's hardness will be enhanced. Some more firewood is added to increase the temperate and achieve the 950-1000 degree mark. At this temperature, the carbonization process takes place. The workers are trained to determine the carbonization process progress by the smell and the colour of the smoke. When the process starts, the smoke will show white colour complimented with a lot of steam. Soon the smoke turns slightly yellow and emits a a tar smell. Finally, at the end of the carbonization process, the smoke colour turns bluish.

After the carbonization process, it is vital to keep the container sealed and let the carbonized bamboo to cool down. The cooling process depends on weather but generally takes about 120 to 144 hours (5-6 days). If the container is opened during the cooling process, the output can easily get oxidized thus losing its effectiveness. When the container has a temperature lower than 50 degrees, it is the ideal time to take out the activated bamboo charcoal. The project will require two industrial heaters with a capacity to produce 500 kgs of output each on a daily basis. In order to produce 1 ton of activated bamboo charcoal, 4 tonnes of raw material (bamboo with desired moisture level) will be required.

Grinding: The bamboo charcoal is then put into the grinding machine to transform the activated bamboo charcoal canes into activated charcoal bamboo powder. This is an important step in the operation cycle as most of our customers need the activated charcoal in a powder (finer particles) form. The grinding machine has a capacity of grinding 300 kg of activated charcoal bamboo canes.

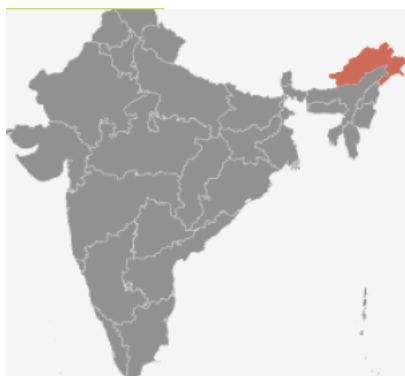
Packaging: The packaging of the product is done immediately after the grinding process. The two machines will be connected with a conveyer belt and one employee will be needed to manually feed the empty bags to the packaging machine. The packaging machine has multiple capacities and can depend as per the customer's requirement. There are five most common bag sizes (10kgs, 25kgs, 50kgs, 75kgs and 100kgs). Both the grinding and the packaging are continuous processes.

Exporting: After the activated bamboo charcoal powder is packaged, it will be sent to Itanagar, the capital of Arunachal Pradesh. The post processing supply chain of transporting the activated charcoal powder bags from Kinekibo to Itanagar will be outsourced to the transportation company, Truckwaale. They are a transportation company with expertise in these kinds of industrial jobs. The output will be then stored in the warehouse in Itanagar. This is done so that our customers can easily get them collected from the warehouse. As we are a B2B business, our customers will be the companies that use activated charcoal as a raw material for their products such as water filters, air filters, tooth pastes, face masks etcetera. As the customers already have a well established supply chain network all over the globe, it would be easier for them to collect the charcoal powder from Itanagar. They will save up on the freight costs and make the whole process more effective.

GEOGRAPHICAL LOCATION

Arunachal Pradesh is north east state of India, is one of the 29 states of India. Arunachal Pradesh is a part of the seven sisters and shares its borders the states of Assam and Nagaland to the south and shares international borders with Bhutan and Myanmar. Itanagar is the capital of the state. As four tonnes of bamboo is required for this project on a daily basis, the optimal site for this project would be near a water body (running downstream) and also with bamboo forests at a comfortably reachable distance. Hence, the village of Kinekibo village (village code: 263994) was finalised.

Kinekibo village is located in Jengging Tehsil of Upper Siang district in Arunachal Pradesh, India. This small village is situated at the banks of river Brahmaputra and has dense bamboo forests on both sides of the river in a 2-5 kms radius. The river has a downstream flow and can be used to transport the bamboo canes from the forests to the manufacturing site by the lumberjacks. Kinekibo is approximately 13-14 hours away from the state capital, Itanagar by road.



PART OF SEVEN
SISTERS



CAPITAL:
ITANAGAR



KINEKIBO AND
RIVER

IMPACTS OF OUR PROJECT

Business Perspective:

From a business point of view, this is a very lucrative project. This is because we add value by processing the bamboo that we buy from the cultivators and then sell it to firms that use activated bamboo charcoal. Thus, creating a win-win situation for all the stakeholders. As Arunachal Pradesh has a lot of bamboo, the resource is not being used to its optimal level. Studies show that approximately 70-80 percent of bamboo resource in Arunachal Pradesh goes waste and the rest is used for activities such as paper production, manufacturing of furniture and other building materials. Hence, the government has also taken incentives to promote the use of bamboo and bamboo products (Northeast Window, 2017).

Villagers who cultivate bamboo sell it in the nearby open markets and in most cases do not get fair price that they deserve. This is usually because there is no or minimal value addition in this transaction. The bamboo is used locally for various activities such as manufacturing houses and furniture.

However, as we will be exporting the bamboo after adding value (process bamboo in the industrial heaters to convert it to activated bamboo charcoal), we can pay the cultivators a fair amount. Demand for bamboo and bamboo related products in the APAC (Asia- Pacific) region are growing notably both in terms of value and volume. APAC is projected to create an increment of opportunity close to US \$5000 million between 2017 and 2027 (Future Market Insights, n.d). In addition to the rise in demand in the APAC regions, bamboo's demand in the European countries is on a rise due to the proven health benefits. Some of the major health benefits are assist kidney function, natural water filter, teeth whitening and oral health, skin care, deodorant etc.

Thus, there is a very high scope to export activated bamboo charcoal in the APAC and the European regions. For our customers (the companies that manufacture products using the activated bamboo charcoal), we add value by lowering the cost of their raw material by exploiting the economies of scale. With the ample amount of bamboo resource that is present in Arunachal Pradesh, the government support and the relatively low cost of labor in the state there is no reason for the project to fail.

To conclude, it is advisable to monetise on the growing global demand of bamboo and bamboo related products (Appendix “ Impact of our project”). In the long term, our vision is to provide an easy way to enable people in the rural areas to access clean water through the use of activated bamboo charcoal water filters.

Villagers Perspective:

The smart village movement is built on the principle of empowering villagers to take ownership of their environment in order to better their lives in a socio-economically sustainable way. The launch of this venture will do just that. The central objective of our project is to create value for the people in the villages in Arunachal Pradesh through a business model that is unique to the region, but has been proven to work in the global market.

All the requirements and goals we set for the project are rooted in creating a business model that will benefit the villager first. Through the creation of an ecosystem centred on the human aspect and improving their welfare, all other stakeholders — government, university and businesses — can profit, resulting in a stronger triple helix.

Through the establishment of this venture the villager benefits in many ways. The creation of employment opportunities is the key element through which the villagers benefit from this venture. When selecting a business opportunity to exploit the bamboo resource a great emphasis was put on making a choice that will not require high-skilled workers. This was done to ensure that the villagers in the area would be the ones to benefit from the created jobs.

Directly, the venture creates jobs as/in:

- Lumberjacks: harvesting the bamboo and preparing it for transport.
- Forest maintenance: planting and ensuring an efficient growth of the bamboo.
- Transporters: transporting the raw material to the processing facility.
- Factory workers: workers that will take part in the cutting, drying, cooling and packaging of the product. Once they get a better feel of the business, the workers will also be trained in building and nurturing customer relations.

Throughout all the positions the villagers will be trained and educated on the entire ecosystem created, so they can reap the full benefits. The business model is very labour intensive, so as the business grows, more and more people will be needed in the

workforce. Later on, with the establishment of a brand, positions for a high skilled human resource will be available. This attracts talent that will be essential in the development of the area. Active bamboo charcoal has many uses in addition to being used for a water filter. This creates the opportunity of many different types of businesses entering the ecosystem. By having more companies establish themselves in the region indirectly creates more employment opportunities.

Additionally, the diverse nature of activated charcoal creates opportunities for entrepreneurial behaviour; new businesses that use activated bamboo charcoal can be established by the villagers in the region.

In the long-term the charcoal will also be supplied to the rural areas in India, and other developing or underdeveloped countries. As of now, having clean water is still a big problem for many countries. The properties of active charcoal allow it to be a simple, cheap, yet effective, solution for “at-home water treatment”. A portion of the revenue gained will be used to fund this step in the development of the business. This step solidifies the focus on increasing the living standard and villager empowerment.

Additionally, this also benefits the government, by substantially cutting costs in healthcare.

Government Perspective:

In one of the last plan of Arunachal Pradesh government (PEACE, PROGRESS AND PROSPERITY IN THE NORTH EASTERN REGION: VISION 2020), bamboo represents the major proportion of the agricultural part. For several legitimate reasons, bamboo is represented on thousands of hectares of land and most of it is not exploited, or not even reachable. To develop an ecosystem around by launched of complementary industries which allows synergies and value creation for the stakeholders (villagers, government...) is one of the government goals. The project will impact the government of Arunachal Pradesh in five different ways: Firstly, the bamboo transformation in activated charcoal will have an impact on employment. From lumberjacks to the final transporters, it will employ initially approximately a hundred persons. More on the long term with similar or complementary businesses and our project growth, the bamboo industries could become a major employer in Arunachal Pradesh. This employment, paid for by the revenue generated from export, will contribute to increase the wealth and the commercial balance of Arunachal Pradesh.

Secondly, fed by the need of transport between the manufacture and the main transport axes, this project will step by step contribute in the improvement of infrastructures, e.g. concrete roads, which will first reduce the “distance” between rural and urban areas, and secondly it will increase the attractiveness of rural areas which was hitherto isolated. More it will allow other local companies which, due to the lack of appropriate supply chain couldn’t export beyond their small perimeter.

Thirdly, the empowerment of the people by creating a fruitful channel for one of the most present assets of this state. By designing a new supply chain which aims to create value through bamboo our project permit the launch of similar projects in Arunachal Pradesh and, also in the other Indian states.

Fourthly, through the taxes the government will harvest the result of this project. By paying the VAT, corporate taxes, income taxes etc. the government of Arunachal Pradesh will benefit from the launch of this project and the positive externality of it.

Fifthly, moreover it will reduce the contamination of water and and the health and economic issues that arise due to it. By reducing the water’s intoxication level, our project will contribute to the reduction for the government health expenses. “The smart village movement” could be considered as a potential goal for government to break the rural isolation which maintains the poverty and unemployment, our project through the study of a potential process and supply chain brought opportunities which have to be developed. Both initiative and empowerment are the factors which will back up the government policies and enable a future for rural areas.

DETAILS

Ressources:

Below you will found the detailed costs for the harvest and the first transportation.

TOTAL cost Per Year for the Harvest and Transport	USD
lumberjack	23,400
Material	600
OIL	475
TOTAL	24475

Ressources Availability	Unit	kg
Bambou exploitable (5y) per hectare per year	500	8.5
Quantity need per day		4
Quantity need per year		880
hectars needed	120	
price of one hectare of forest in A.P.		
price of one hectare of forest in A.P. (rent/month)		

Labor cost Per Year for the Harvest and Transport	Number	cost of one salary	USD
lumberjack	11	2000	22

Labor cost Per Year	Number	cost of one salary	USD
employee	8	2400	19,200
Manager	1	4200	4200
Total	9		23,400

Total Hours needed per day	hours
Pre-heater process	14
heater process	8
package process	15
Back office	15
Management	8
total	60

Number of employee needed	Hours per week	lumberjack needed
lumberjack	40	
Needed	432	11

Material cost	Unit	USD	USD per Week
Chainsaw	1	100	
quantity needed	6	600	
oil for one unit per day	0.5L	0.4	2.4
1 year depreciation chainsaw (6)			600

human cost of the harvest	Unit	KG	hours
Production a lumberjack per day (8 -1h break)	40		7
number of Lumberjack for Quantity need per day	6		42

Hours of works needed per day	Harvest	river Transport	total
hours of works	42	30	
total			72

transport time	Km	Unit of bamboo	KG	Hours
Preparing the transportation	0			1
on the river	5	50	850	4
from the river to the manufacture	0.5	50	850	1
total for 4 T		240	4000	30

Transformation:

Details cost of plant and machinery:

The cost of plant & machinery is estimated at USD\$ 16,900 including transportation and installation charges. The installed production capacity is 0.5 Ton x 2 per cycle i.e. per day.

Item	Unit price (USD)	Quantity	Amount (USD)	Specification	Electricity Usage (Per hour)
Zhengzhou Wanqi Mechanical Equipment Co Ltd	\$8,440	2 units	\$16,900	Model No. : THL 4 Output: 500kg/ 8hrs Carbonizing time: 8hours	2.5 kw * 2 = 5 kw
Charcoal Grinder	\$1,200	1 unit	\$1,200	Wanqi 500: 300kg/hr	7.5 kw
Charcoal Sawdust Packaging Machine	\$3,500	1 unit	\$3,500	LG-PD	4 kw
Total			\$21,600		16.5 kw

Based on the processing capacity of 1 Ton per day, 4 Ton of bamboo and 2 ton of firewood and 16.5kW of electricity per hour, so, 148.5kW is required per day.

Security deposit for the electricity in India (Single Shift): Rs. 2448, i.e USD \$35.

Tariff (Rs/kW): Rs. 3.50 per kW, i.e USD \$ 0.05/kw.

We have employed farmers to cultivate the bamboo required. Explained further later in the report.

The cost per ton for the firewood is Rs. 7000 i.e. USD\$98.5

Total cost of raw material per day is:

Particular	Price (USD)	Requirement	Total raw material cost per day
Electricity (per hour)	0.05	16.5 * 8	\$6.6
Firewood	98.5/ ton	2	\$197
Total			\$203.6

Number of employee needed	Hours per week	lumberjack needed
Employee	40	
Needed	360	9

Arunachal Pradesh electricity costs:

<http://www.arunachalpower.org.in/pdf/Tariff%20orders/2018%2006%2015%20Tariff%20Order%20FY%202018-19.pdf>

Heater: https://www.alibaba.com/product-detail/Activated-Carbon-Making-Machine-Wood-Charcoal_60528835419.html

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FINANCIAL DETAILS:

Item/Stage	Unit	Amount	Item/Stage	Unit	Amount
Harvest & Transport (PHASE 1)			Processing (PHASE 2)		
Chainsaw cost	USD	50	Labour cost	USD/person/month	200
Chainsaw	integer	6			
Oil	USD/L	1	Labour	integer	9
Oil needed per day	L	1			
Bamboo resource	ton/ha/year	9	Heater	USD	8,440
Quantity	tons/day	4	Grinder	USD	1,200
Forest rent***	USD/month	6,750	Packaging machine	USD	3,500
Labour cost	USD/person	200	Electric cost	USD/day	7
Labour	integer	8	Firewood	USD/day	197
Labour productivity	tons/hour/person		Price raw charcoal	USD/ton	1,500
			Price powdered charco	USD/ton	1,700
			Average charcoal price	USD/ton	1,500 **
			Machinery OPEX	percentage	15%

NOTES:	
Most costs are rounded.	
Labour is averaged per worker.	
Overhead for machines includes electricity and other maintenance.	
*Estimated at 10% of the initial cost per year.	
**Weighted average of the type of product sold.	
*** For the acerage needed	
Transportation Truckwaale	
Administration includes banking, office supplies, etc.	

Revenues						
Item	Unit	Total	Month 1	Month 2	Month 3	
Raw Charcoal	USD					
Powdered Charcoal	USD					
Total (average)	USD	360,000	45,000	45,000	45,000	

Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
45,000	45,000	45,000	45,000	45,000				

Cost/Month			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Item	Unit	Total						
CAPEX								
Chainsaw	USD	300	300					
Heater	USD	16,880	16,880					
Grinder	USD	1,200	1,200					
Packaging machine	USD	3,500	3,500					
Construction	USD	1,200	1,200					
Office supplies	USD	2,000	2,000					
Land Cost (Factory)	USD	1,000	1,000					
Infrastructure	USD	600	600					
Total	USD	26,680						
OPEX								
Labour	USD	40,800	3,400	3,400	3,400	3,400	3,400	3,400
Oil	USD	84	12	12	12	12	12	12
Machinery (OH)	USD	4,002	334	334	334	334	334	334
Administration	USD	480	40	40	40	40	40	40
Firewood	USD	82,740	11,820	11,820	11,820	11,820	11,820	11,820
Transportation	USD	6,400	800	800	800	800	800	800
Rent	USD	81,000	6,750	6,750	6,750	6,750	6,750	6,750
Promotion	USD	3,000	200	500	500	200	200	200
Warehouse Rent	USD	1,200	100	100	100	100	100	100
Total	USD	219,706	23,156	23,156	23,156	23,156	23,156	23,156
Profit before tax	USD	113,614						
Profit after tax		79,530						

Cost/Month	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Item						
CAPEX						
Chainsaw						
Heater						
Grinder						
Packaging machine						
Construction						
Office supplies						
Land Cost (Factory)						
Infrastructure						
Total						
OPEX						
Labour	3,400	3,400	3,400	3,400	3,400	3,400
Oil	12					
Machinery (OH)	334	334	334	334	334	334
Administration	40	40	40	40	40	40
Firewood	11,820					
Transportation	800	800				
Rent	6,750	6,750	6,750	6,750	6,750	6,750
Promotion	200	200	200	200	200	200
Warehouse Rent	100	100	100	100	100	100
Total	23,156					
Profit before tax						
Profit after tax						

Item/Stage	Unit	Amount	Item/Stage	Unit	Amount
Harvest & Transport			Processing		
Chainsaw	USD	50	Labour cost	USD/person/day	
Oil	USD/L	0.8	Labour	integer	9
Bamboo resource	ton/ha/year	8.5			
Quantity	tons/day	4	Heater	USD	8440
Forest rent	USD/month	6750	Grinder	USD	1200
Labour cost	USD/person/day		Packaging machine ?	USD	3500
Labour	integer		Electric cost	USD/day	6.6
Labour productivity	tons/hour/person		Firewood	USD/day	197

IMPACTS OF OUR PROJECT

Reference for the BUSINESS PERSPECTIVE :

- Arunachal Pradesh: An Important Position among the Bamboo Bearing States. (2017, October 07). Retrieved from <http://www.thenortheastwindow.com/2017/10/arunachal-pradesh-important-position-among-bamboo-bearing-states/>
- Bamboos Market: APAC Projected to be the Most Attractive Regional Market During the Forecast Period: Global Industry Analysis 2012-2016 and Opportunity Assessment 2017-2027. (n.d.). Retrieved from <https://www.futuremarketinsights.com/reports/bamboos-market>
- Huizen, J. (n.d.). Activated bamboo charcoal: 8 uses and what the science says. Retrieved from <https://www.medicalnewstoday.com/articles/322609.php>

OTHER

APPENDICES:

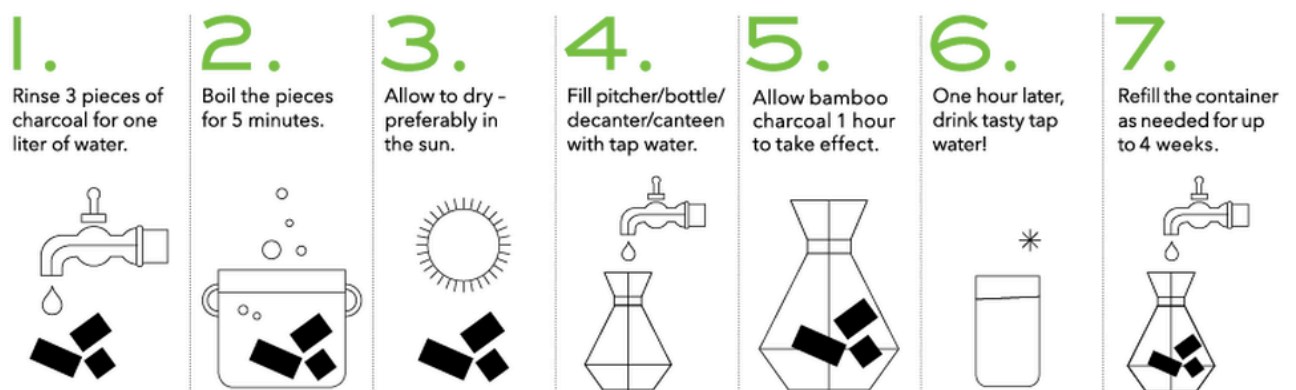
Appendix A: Black + Blum charcoal water filter.

The image below creates a visualisation of how the charcoal water filter works.

- Lasts 6 months
- Uses binchotan (wood) charcoal. Works similarly to bamboo charcoal, however it is less sustainable because trees need more time to grow.



Appendix B: How to use Bamboo Charcoal as water filter filters



Bamboos market :



Different sources:

- How to create value through bamboo, different ways. (French)
(http://www.laboress-afrique.org/ressources/assets/docP/Document_N0225.pdf)
- “A review of low cost alternative of water treatment in rural area”, potential use of our charcoal in rural area.
(https://www.researchgate.net/publication/272089418_A_review_of_low_cost_alternative_of_water_treatment_in_rural_area)
- “Bamboo charcoal as a natural Water Filter - An indigenous rural application”, an indian perspective
(<https://www.indiawaterportal.org/articles/bamboo-charcoal-natural-water-filter-indigenous-rural-application>)
- “Production of activated carbon from bamboo scaffolding waste—process design, evaluation and sensitivity analysis”
(<https://www.sciencedirect.com/science/article/pii/S1385894705001051>)
- Todays potential water filters for heavy metals: “A review on economically adsorbents on heavy metals removal in water and wastewater”

(<https://link.springer.com/article/10.1007/s11157-013-9330-2>)

- “Modification of bamboo-based activated carbon using microwave radiation and its effects on the adsorption of methylene blue”

(<https://www.sciencedirect.com/science/article/pii/S0169433209017346>)

- “Arsenic Removal from Water by Iron-Modified Bamboo Charcoal”

(<https://link.springer.com/article/10.1007/s11270-011-0921-7>)

- Existing projects of the INBAR involving Bamboo charcoal:

(<https://www.inbar.int/?s=charcoal>)

- Potential hitters on Alibaba:

(<https://french.alibaba.com/product-detail/Activated-Carbon-Making-Machine-Wood-Charcoal-60528835419.html?spm=a2700.galleryofferlist.normalList.341.79c07d21mFZW4y>)

(https://french.alibaba.com/product-detail/continuously-type-jute-stick-charcoal-furnace-charcoal-powder-making-machine-60627379354.html?spm=a2700.md_fr_FR.maylikeexp.5.70c5131cSHXWyR)

- **“Adsorption of dyes from aqueous solutions on activated charcoal”**

(<https://www.sciencedirect.com/science/article/pii/S0304389406006376>)

- “Adsorption of chromium from aqueous solution by activated alumina and activated charcoal”

(<https://www.sciencedirect.com/science/article/pii/S0960852406001325>)

- “Activated charcoal filter layer for gas masks”

(<https://patentimages.storage.googleapis.com/bc/3b/6e/37d82da71fb71d/US4992084.pdf>)

- “Efficiency of Moso Bamboo Charcoal and Activated Carbon for Adsorbing Radioactive Iodine”

(<https://onlinelibrary.wiley.com/doi/full/10.1002/clen.201000012>)

- PRODUCTION, CHARACTERIZATION, AND APPLICATIONS OF ACTIVATED CARBON

(<https://pdfs.semanticscholar.org/4d8c/b2cbc834c17949fd5e24ffb46d864cd84a15.pdf>)

- **“Bamboo-based activated carbon for supercapacitor applications”**

(<https://www.sciencedirect.com/science/article/pii/S1567173914002983>)

- **Company producing activated carbon in India with coconuts :**

(<http://rajcarbon.com/index.html>)

Appendix E: Business Model

What is the customer segment – pain points?

The usage of active bamboo charcoal products all over the world is increasing in products such as water filters, face mask, toothpastes and many more. The companies producing these products usually charge a premium from their customers due to the lack of availability of active bamboo charcoal products globally. Hence, as we will be producing active bamboo charcoal, our customer segment will initially be **the companies producing bamboo charcoal related products**.

What is your value proposition – pain relievers?

As there is plenty of bamboo present in Arunachal Pradesh, with the use of economies of scale, we can convert the bamboo into bamboo charcoal at a very low cost. We can pass on this benefit to our customers, thus adding value by making their raw materials (active bamboo charcoal) at a lower cost.

Sustainability is also an issue for all companies currently using Binchotan (tree) charcoal. Supplying them with charcoal that is produced from a grass will solve this pain point.

How do you maintain relationship to keep the value fresh?

Keeping a close relationship with our customers through constant communication.

How to you distribute the value you create to your customers?

Customers will either take care of the distribution themselves or we will be utilising the services of transport companies that can handle large-volume shipping (Ex: amazon). There are also possibilities of creating synergies with other groups' supply chains. Leveraging economies of scale and scope in this instance will lower the costs for every product.

What resources do you need to create the value?

In order to create the value (providing cheaper bamboo charcoal), we will mainly need access to the bamboo dominant regions in Arunachal Pradesh. Also, we will need the government's aid in terms of the required permissions and funds to set up an industrial heater that would produce active bamboo charcoal.

What activities you will do that will contribute to your value proposition?

Producing active bamboo charcoal at a cheaper rate than the competitors and extensively marketing it globally. Partnering with companies producing bamboo charcoal related products and establish long term professional relationships. Hiring influencers and bloggers to promote the bamboo charcoal related products to create awareness.

Who are your partners that will enhance your value proposition – save costs and lower your risks

The Arunachal Pradesh State Government's approval enhance the value proposition as the project will then have the government's support. Additionally, an investment from a company that produces bamboo charcoal products will ensure that the bamboo charcoal that we produce will have at least one assured buyer.

(We have already contacted companies that are interested to expand their activities in carbon-active charcoal water filtration in India.

How do you capture the value you create? How do you make money? What is your revenue streams and what are your costs?

Capture the value: Exporting the bamboo charcoal to countries that use bamboo charcoal products and are willing to pay a premium for these products.

Make money: As we plan to sell the bamboo charcoal at a cheaper price than the competitors, we need to focus on volumes...

Revenue Streams: Proceeds from the sale of bamboo charcoal products worldwide.

Costs: Buying bamboo from the local community and the operational costs of the industrial heater.

Comparison to Biosand Filters

While the Biosand Filter is a form of water filtration, it is not a water disinfectant. We looked into the Canadian company that is producing Biosand Filters and in their website they state that this filter can only be used as one step in water purification - after which the water has to be further purified through other technologies such as chlorine, solar (UV), boiling, etc.

(<https://www.cawst.org/services/expertise/biosand-filter/more-information>)

This technology is currently being used in Cambodia. So far the research on it has had mixed results. In addition, the Biosand Filter has no effect whatsoever on arsenic. (<https://www.clearcambodia.org/home/household-water-filter-program/>)

In conclusion, activated charcoal and biosand are very different technologies that have a different effect on water.

Some of the other uses for active bamboo charcoal currently being used by companies (Face wash, Soap, Shampoo, Natural water filter, , Teeth whitening and oral health, Skin care, Deodorant, Insect Bite treatment , Air Purification , Reduces High, Colestrol)

The Many Uses of Bamboo Charcoal. (n.d.). Retrieved from <http://bamboohabitat.com/the-many-uses-of-bamboo-charcoal/>

What Can Bamboo Charcoal Do for Your Skin? (n.d.). Retrieved from <https://www.birchbox.com/guide/article/what-can-bamboo-charcoal-do-for-your-skin>

All-Natural Black Powder – Naturally Improve Cholesterol, Acne, Yellow Teeth, and 7 More. (n.d.). Retrieved from <https://www.foodmatters.com/article/10-activated-charcoal-benefits-and-uses>

Huizen, J. (n.d.). Activated bamboo charcoal: 8 uses and what the science says. Retrieved from <https://www.medicalnewstoday.com/articles/322609.php>

Explanation of not taking the biomass or combustible charcoal (biocoal) route.

Our goal for the project was to create a business model that would be sustainable in the long term and that would provide economic growth and empowerment to the villagers themselves. Considering the focus on creating a long-term opportunity we made the decision not to pursue bio-coal due to a few reasons:

- There are many solutions available to produce energy in an easier and much more sustainable way.
- Locally creating energy and injecting it into the grid is a delicate process that usually involves a tendering process. Competing with large corporations on this front was a major downside.
- Many companies (including ones in the neighbouring state, Assam) are already using bamboo for energy purposes. This would make us very late entrants into the market.
 - As of now there is an MoU signed with a company to use a portion of the bamboo in AP to produce biomass in the plant in Assam, however we are not able to find out what is stopping them from following through. As this issue has already been discussed between the two state governments, any further research provided by us would not add much value and it wouldn't provide any innovative ideas.
 - Producing paper from bamboo has a similar issue.

Machine details



Overview

Quick Details

Condition:	New	Type:	Air Flow
Application:	Making Charcoal	Place of Origin:	Henan, China (Mainland)
Brand Name:	Songling Tengda	Model Number:	QHL-4
Effective Volume:	8CBM, 9m3	Dimension(L*W*H):	2.1*2.3*1.9m
Weight:	4500kg	Voltage:	380V
Power(W):	1.5kw	Certification:	CE ISO
Raw material:	wood, branches, coconut shell, bamboo etc.	Capacity:	can be customized
Fuel:	Gas or wood	Advantage:	Continuous Working
Cooling time:	8-9 Hours	Installation:	Technician's Guidance
Carbonization time:	6-8 Hours	Carbonization type:	Flowing
Usage:	Briquette Carbonization Furnace	Warranty:	1 Year
After-sales Service ... Engineers available to service machinery overseas			

Grinder: https://www.alibaba.com/product-detail/Durable-Coconut-Charcoal-Grinding-Mill-Best_60545051185.html?spm=a2700.7724838.2017115.1.b7f17e8ewPYKVj

Quick Details

Condition:	New	Type:	Hammer Crusher
Application:	Grinding Coal	Motor Type:	Stepper Motor
Capacity(t/h):	0.5	Place of Origin:	Henan, China (Mainland)
Brand Name:	Wanqi	Dimension(L*W*H):	3x3x2 stere
Weight:	500 KG	Certification:	CE ISO9001
Warranty:	1 Year	After-sales Service ...	Online support, Field installation, commissioning and training...
Quality:	Excellent	Installation:	Under Engineer's Guidance
Blade Quantity:	4	Blade Length:	100 mm
End Product:	Charcoal Powder, Coal Powder	Dim Diameter:	180*200 mm
Fineness:	80-100 mesh	Speed:	2600 r/h
Name:	Charcoal Grinding Mill		

Model	400
Disc Diameter (mm)	400
Blade Quantity	4
Blade Length (mm)	80
Dim Diameter (mm)	140×200
Fineness (mesh)	80-100
Speed (r/h)	2700
Capacity (kg/h)	300
Powder (Kw)	5.5
Weight (kg)	300

WANQI MACHINE





PackagingMachine: https://www.alibaba.com/product-detail/Longer-Machinery-Charcoal-Sawdust-Packing-Rice_62008493263.html?spm=a2700.7724838.2017115.98.455d2e0cTAildP



Specifications

Type: Multi-Function Packaging Machine
Function: Filling, Sealing, Packing, Packaging
Automatic Grade: Automatic
Voltage: 220 V/380 V
Brand Name: LONGER
Certification: CE ISO9001
Product name: Charcoal Sawdust Packing Rice Packaging Machine Sale
Packing range: 0.2-100 Kg
Division difference: 2 g-20 g

Condition: New, New
Packaging Type: Bags, Film, Pouch
Driven Type: Electric
Place of Origin: Henan, China (Mainland)
Dimension(L*W*H): 2960*730*775 mm
After-sales Service ... Video technical support, Online support
Packing speed: 300-500 bags/h
Packing error: 0.1%FS
Feeding way: Belt feeding