

# 175

## Livelihoods

Sustainable Energy Driven Applications

7 AFFORDABLE AND  
CLEAN ENERGY



8 DECENT WORK AND  
ECONOMIC GROWTH



13 CLIMATE  
ACTION



**SELCO Foundation seeks to inspire and implement sustainable energy driven solutions that alleviate poverty. These sustainable energy driven solutions inclusive of energy efficiency and green built environments are aimed at improving quality of life and livelihoods. SELCO firmly believes that an end-user centric, demand driven approach that focuses on ecosystem building, leads to interventions that are long-term and replicable.**

**The 175 solutions in this book span across livelihood sectors and showcase sustainable energy driven solutions for varied productive use across agriculture, animal husbandry, micro businesses and textiles and crafts.**



# 175

## Livelihoods

Sustainable Energy Driven Applications



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# Executive Summary

March 2020 brought in one more crisis for humanity as a whole: Covid-19. It brought to light in very stark ways the inability of human beings to confront disasters in swift and efficient manner: thus it questioned our ability to handle a larger crisis like climate. Overtime pandemics and climate change affects the poor the most. Numerous poor families across nations have become more vulnerable to climate onslaughts. Distributed renewable energy driven, aspirational livelihoods, if implemented in a need-based, holistic and inclusive manner has proven to be a strong hope and catalyst to ensure equity for poor, very poor and abject poor communities. Moreover the livelihoods captured in this publication have proven to be strong cases for climate adaptation with the promise of contributing to future mitigation.

**Providing demand driven energy for livelihoods requires a deep understanding of that livelihood to ensure adoption, transformation and scale.**



The opportunity that sustainable and distributed energy brings for powering and em-powering value chains across agriculture, animal husbandry, textiles and crafts and micro-businesses is immense. These sectors collectively account for over 60% of India's economic activity. Each value chain, sub-sector or theme in the directory showcases the activities and solutions within those as "nodal points" or opportunities for clean energy solutions which include technology and finance. The solutions not only leverage energy efficient productive use equipment and clean energy technologies but also capture the opportunity for green building design packages. Beyond technology and finance each solution is designed for upward mobility i.e growth and expansion of farmers, rural enterprises and producer groups.

The impacts that clean and distributed energy enabled livelihoods have catalysed range from drudgery reduction, savings in time and operational costs, value addition, diversification, job creation, reduction in transaction costs for communities and end users and income increase. These however, are immediate impacts, most cases also showcase best practices towards meeting targets for local production and consumption, food security, nutrition, gender empowerment. The distributed nature of the solutions have multifold increased access. Access to services and opportunities in under-served contexts.





**The most critical impacts are that of improvement in supply chains, transaction costs, access to finance or finance inclusion, access to capac building and crucial access to schemes, policies and networks.** Most of the solutions in the directory directly meet multiple SDGs in a long term manner. Moreover, solutions and dissemination have been specifically designed and customised for marginalised populations which include persons with disabilities, transgender communities and very remote tribal populations.



**SELCO Foundation and its network of partners have till date been able to catalyse directly over 30,000 clean energy driven livelihoods across the 150+ solutions showcased in this publication.** This number is steadily rising in some states and exponentially in others, especially with the critical ecosystem of civil society, enterprises, financing institutes and government departments at district and state level. The gamut of solutions collated within this publication aims to provide awareness to stakeholders on the number and types of solutions that have created impact for livelihood enhancement via clean and distributed energy solutions.



# Agriculture

## VALUE CHAIN

Agriculture in developing countries plays a crucial role in the economic and social well-being of the population. While providing both food security and livelihoods for a large portion of the population, it often faces challenges such as limited access to technology, infrastructure, and financial resources. Smallholder farmers produce up to 80% of the food consumed in these countries. Additionally, smallholder farmers account for around 90% of all farms worldwide. Food and Agriculture Organization of the United Nations (FAO). (2018).

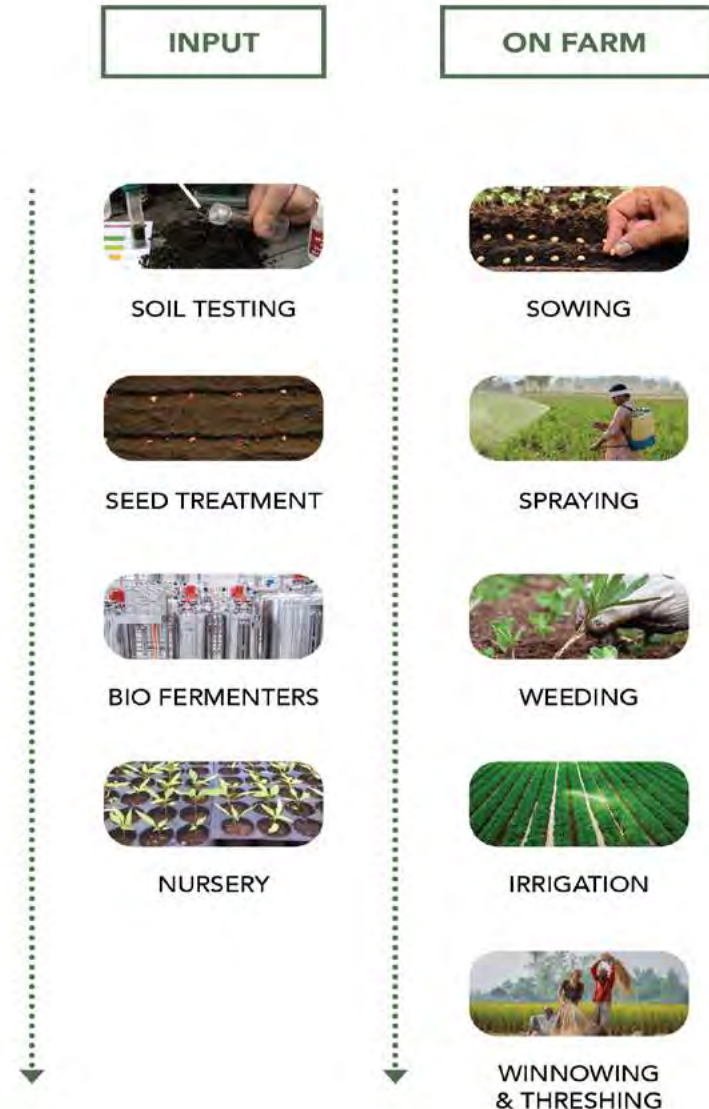
In Sub-Saharan Africa, for example, it's estimated that less than 10% of smallholder farmers use mechanised equipment, while in Asia, the figure is around 30-40%. In Latin America, the percentage of smallholder farmers using mechanised equipment is higher, around 40-50%, but still a majority of the farmers rely on manual labour and traditional tools.

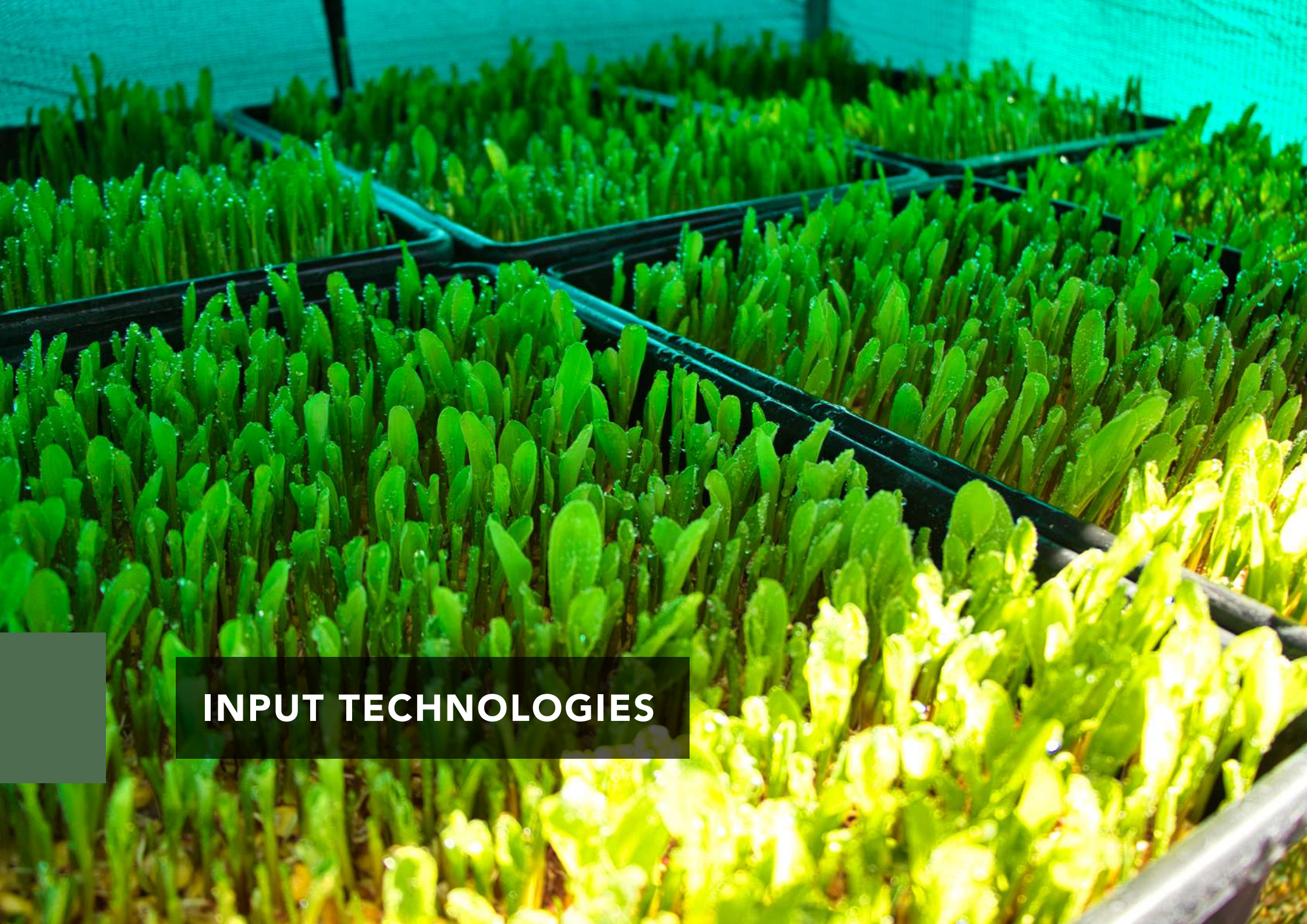
It's worth mentioning that the lack of access to energy, mechanisation services and high costs of mechanisation equipment and maintenance are among the factors that limit the adoption of mechanisation by smallholder farmers in developing countries.

Farmers in developing countries are faced with multiple challenges, including a lack of access to markets and bargaining power. There are gaps in the chain from inputs to outputs leading to low productivity, including lack of access to appropriate technological and knowledge support for cropping and on-farm production, resulting in low yields. To address these challenges, it is important to focus on the resources that farmers have and how to optimise production using these resources in order to increase their incomes and build resilience.

In the rice and paddy value chains, the optimisation of technologies across ownership types can be achieved from inputs production to processing and value addition at the farm gate.

Reference: Food and Agriculture Organization of the United Nations (FAO). (2018).





**INPUT TECHNOLOGIES**



# 1. Soil Testing Kit

The increased use of fertilisers harms soil fertility and crop health resulting in increased production costs for farmers. To promote efficient nutrient management, it is recommended to conduct soil tests before each crop cycle. Soil testing is necessary to determine the levels of nutrients in the soil and address any deficiencies through the application of manures and fertilisers. However, soil testing centres are often located at district headquarters, which can be far and difficult to access for remote and marginalised farmers. To address this, it is necessary to decentralise soil testing units to remote areas and integrate sustainable energy sources. Government departments require testing for irrigation and agri programmes, fisheries, sericulture as well.

**LACK OF ADEQUATE INFORMATION** on soil health ; deficiencies of key nutrients

**OVERUSE OF FERTILISERS AND PESTICIDES** to compensate for poor soil quality

**OVERUSE OF WATER** compounded with drought conditions or Unpredictable rainfall

## OWNERSHIP MODEL

### DISTRICT AGRICULTURE TRAINING CENTERS

Soil testing is provided as one of the many agriculture extension services provided by District level Agriculture Training Centers (DATCs) located at the district level.

### SOIL TESTING FACILITIES AT VILLAGE LEVEL

Private soil testing facilities, established with permissions and certification from government agencies, that also provide an opportunity for small-entrepreneurship at the village level.

## TECHNICAL SOLUTION

### Digital soil testing machine for Mini-lab

- **Contents:** Soil Testing Meter, Rotary Shaker, Thermal Printer, Solar Panel, Small Weight Balance, Glassware, Plasticware
- **Solar energy system:** 100 Wp x 1 Panel, 80 Ah x 1 battery, 10 A x 1 CC
- Upto 14 parameters of soil, recommends crop-specific fertiliser dose for 100 crops & prints Soil Health Card.
- Sends Soil Test Report on mobile through bluetooth, Computer connectivity optional



## IMPACT

### REDUCED COSTS FOR FARMERS

By providing a clear picture of soil health in a timely manner, reports from soil testing can be used to engage with farmers and provide recommendations on natural ways of improving the nutrients or managing the moisture content in the soil.

### IDENTIFICATION & SUPPORT OF CLIMATE VULNERABLE REGIONS

In the Indian context, soil testing also provides a mechanism to identify farmers with land that is worse off or more vulnerable to climate risks. Accordingly, government support programmes to improve soil health can be planned for these target regions. It is worth noting that lack of nutrients in soil also translate to

### IMPROVED SOIL & WATER HEALTH

By avoiding the excessive use of chemicals and instead targeting farm inputs, the soil testing service helps reduce contamination from runoff and leaching of chemicals into water and soil

### HELP FARMERS ADAPT TO CHANGING CLIMATE

Through soil testing, recommendations can be developed specifically for each geography based on the climate risk and vulnerability. Appropriate cropping patterns and agricultural practices for those regions can help provide farmers a means of adapting to changing climate.



## TECHNICAL SPECS

SEED COATING TYPE	Semi-Automatic
CAPACITY	0.7 - 1 TPH
BATCH CAPACITY	2 - 10kg (3 minutes)
MOTOR CAPACITY	2HP, 220V
CONTROL PANEL	Stator Provided (L&T)
FINISHING	Powder coating
BREAKAGE	>2% (Negotiable)

## 2. Seed Treatment Unit

Seed treatment directly impacts the yield of agriculture commodities. The treatment services are usually provided at a village information centre (VIC). The seed treatment machine can be utilised for all types of seeds except vegetables seeds (due to the size constraints).

Manual coating is **TIME-CONSUMING** and **LABOUR-INTENSIVE**.

**INCONSISTENCY:** each seed is not coated with the same amount of coating.

**SAFETY:** risk of injury from chemicals and procedures associated with manual seed coating is done by hand.

Seed coating, selected on the basis of crop type, climate and soil conditions, cost and environmental impact, is the process of applying a thin layer of material to the surface of seeds before sowing for :

### PROTECTION

From physical damage, pests, and diseases and provides added nutrients that can aid seed germination and growth.

### IMPROVING THE EASE

Of sowing and reduces need for chemical inputs post sowing

## IMPACT

### INCREASED SPEED AND EFFICIENCY OF THE COATING PROCESS

Time required for treating 200 kgs of seeds can be reduced from 24 hours to 1.5 hours post automation.

### CONSISTENCY

Automated seed coating machines can apply coatings with a high degree of consistency and accuracy, ensuring that each seed is coated with the same amount of coating.

### REDUCED LABOR COSTS

Automated seed coating can greatly reduce the labour costs associated with manual seed coating.

### REDUCED MATERIAL WASTAGE

Automated seed coating can reduce the amount of coating material wasted during the coating process, as the machines are able to apply coatings with high precision.

### FLEXIBILITY

Automated seed coating machines can be designed to handle a wide range of seed sizes and shapes and can be easily adjusted to accommodate different coatings.



### 3. Bio - Fermenter

Manual fermentation for the preparation of organic fertilisers can be **LABOUR-INTENSIVE AND TIME-CONSUMING** for poor farmers, as it often requires **CONSTANT MONITORING AND ADJUSTMENTS** to the fermentation conditions to ensure the growth of the microorganisms. Manual fermentation can also be **PRONE TO CONTAMINATION AND INCONSISTENCIES**, which can lead to low-quality or spoiled products.

#### PROBLEM STATEMENT

**MANUALLY STIRRED AND MANUFACTURED**

**LOW OUTPUT AND CAPACITY** as it is restricted to number of labour engaged with.

**DRUDGERY** involved during stirring (required every 2 hours)

**OUTPUT QUALITY** is poor due to the low and inconsistent/un-uniform oxygen integration while manual stirring

#### TECHNICAL SYSTEM

<b>Machine System</b>	AIR PUMP	150 PSI
	MOTOR	40 W, 12V DC
	FILTER	6 stage
<b>Energy System</b>	SOLAR MODULE (Wp)	60
	BATTERY (Ah)	38
	CHARGE CONTROLLER	12 V

#### OWNERSHIP MODELS

**Individual SHG FPO**

<b>Preparation of 500l of fertilizer</b>	WATER TANKS	500 L : 1 no 300 L : 1 no
	AERATOR CONTROLLER UNIT	1
	FILTERS	6
	STIRRING UNIT KIT	1

**Output:** 4 batches per month (<4000 litres)

#### IMPACT

##### INCREASED PRODUCTION CAPACITY

Total production capacity is increased from 200 litres to 1000 litres per batch.

##### BETTER NUTRIENTS & RESISTENCE

To pests to crops can be realised for 80 to 150 farmers

##### SOIL HEALTH IMPROVEMENT

From the use of organic fertilisers.

##### LIVELIHOOD OPPORTUNITY

For entrepreneurs at village level through FPO or SHG based groups





# ON FARM TECHNOLOGIES



## 4. Transplanter

Transplanting, when done manually requires 10-12 people to cover one acre one day. It is a time consuming, expensive and laborious process. This is backbreaking work that requires workers to constantly bend over to transplant the paddy seedlings.

Severe back pain and eyesight problems due to continuous bending relates to **HIGH LEVELS OF DRUDGERY.**

**LABOUR SHORTAGE** particularly in the transplanting season results in increased labour cost which adds up to the production cost.

Heavier machinery used for transplanting results in **HIGH GHG EMISSIONS AND LAND COMPACTION** cutting down the soil aeration.

Parameters	Manual Transplanting	Battery root washer transplanter	Walk behind engine transplanter
OPERATIONAL SPEED (km/hr)	0.4	1.9	2.3
POWER SOURCE	-	250 KW	Petrol engine, 3.2 KW
FIELD CAPACITY (ha/day)	0.06	0.4	1.3
TRANSPLANTING EFFICIENCY (%)	95	60	80
TIME REQUIREMENT IN HOURS	1hr 2 minutes	1hr 13 minutes	24 minutes
LABOR REQUIREMENT PER ACRE	10	3	2



## 5. Seeder

Parameters	Electric Direct Seeder
BATTERY SPECIFICATION	250 W
NO. OF ROWS	6
ROW SPACING	25 cm
OPERATIONAL SPEED (km/hr)	1
FIELD CAPACITY (ha/day)	1
SOWING EFFICIENCY (%)	90
TIME REQUIREMENT IN HOURS	30 minutes
LABOR REQUIREMENT PER ACRE	1



## 6. Sprayer

The application of pesticides is often done by the means of a sprayer. The medicine to be applied is diluted in water in predefined ratios and sprayed. The most commonly used pesticide sprayers are the back mounted machines.

### PROBLEM STATEMENT

Conventional sprayer are **HEAVY** and to be carried on back with 25 ltrs capacity

Close proximity of the applicator to the chemical spray and likelihood of **CONTAMINATION** with the pesticide

**DRUDGERY** : The tank needs to be refilled often

**POOR/UNEVEN APPLICATION** and low water pressure

### OWNERSHIP MODEL

Individual farmer model for self consumption

FPO owned community service model

### TECHNICAL SYSTEM

#### Energy System

SOLAR MODULE (Wp)	40
BATTERY	12 V, 12 A
SOLAR CONTROLLER (A)	6/10
MOTOR PUMP SET (W)	60
CHARGER	12 V, 1.7 A

#### Machine System

HOSE LENGTH	50 ft (+50 ft)
SPRAYING CAPACITY (FOR SINGLE SPRAY)	400 L
OPERATIONAL TIME (FOR SINGLE SPRAY)	3.5 - 4 hours

### IMPACT

#### CENTRALISED SPRAYERS

Are suitable for spraying any crop, easy operation & navigation, less drudgery, easy maintenance

#### TIME SAVED

In back and forth for refilling of the tank

#### EASY TO MAINTAIN AND OPERATE

the pressure control system.



Parameters	Electric Weeder	
	TRANSPLANTED RICE	DIRECT SEEDED RICE
SOIL CONDITION		
OPERATIONAL SPEED (km/hr)	2	1.8
FIELD CAPACITY (ha/day)	0.227	0.19
WEEDING EFFICIENCY (%)	92	88
DAMAGED PLANT (%)	7.2	3.8
LABOR REQUIREMENT/ ACRE	1	1

Type of Weeder	Labor Requirement/acre
MANUAL WEEDING	8
CONO WEEDEEER	1
ELECTRIC PADDY WEEDEER	1



## 7. Weeder

Weeding is one of the most **LABOUR-INTENSIVE** tasks in paddy cultivation. 12-15 people are needed to weed 1 acre of paddy in one day and this is primarily done by women.

### PROBLEM STATEMENT

The task requires the women to be bent over for long periods of time to pluck the weeds from the field. This causes a lot of **STRAIN AND REPETITIVE STRESS** on the back leading to **LONG TERM HEALTH ISSUES** over time.

Absence of efficient weeders and on farm practices are forcing farmers to adopt **CHEMICAL WEED MANAGEMENT** affecting the quality of the produce and soil.



## 8. Thresher with Winnower

Applicable for small plot farmers with poor accessibility to take large tractor operated threshers. The technology can be adapted to multiple context as it can be foot operated or motorised. 3-4 workers are involved (one preparing straw, one crushing and one collecting) in the operations. The machine is equipped with one rotating drum for threshing. Paddy and stalk will be segregated by concave siever, with different outlet for straw and paddy.

Processing Capacity: 100-150 kg/hr  
 Motor Rating : 0.5 HP

### Technology Benefit

**LOW ENERGY CONSUMPTION**

**COMPACT & LIGHTWEIGHT**

**HIGHLY AVAILABLE COMPONENTS**

**COMBINED FEATURE (THRASHER CUM WINNOWER)**

**ADAPTABLE TO SIMILAR CROPS**

### Impact on site

Can be solar powered. Decentralised technology

Mobility is very good

Production and maintenance is accessible and easy

More interesting product for farmers

Broader impact as other farmers will be interested in the machine for processing other crops

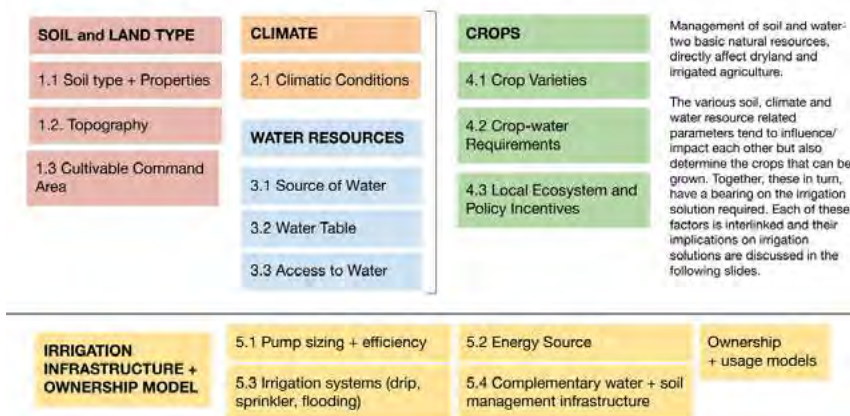


## 9. Water pump

There are more than 26 million groundwater pumps in India. Portable solar pumping systems are most conducive in specific geographic areas where **HIGH WATER TABLE** and **AVAILABILITY OF SURFACE WATER**, but **ACCESS TO WATER** for irrigation poses a challenge.

Over 67% of India's farmlands under marginal farmers have smaller landholdings. High upfront investment to access the electric pumping systems or ever increasing rental in case of fossil fuel-based pump sets make it unviable for farmers.

### Establishing the need for irrigation: Factors to be considered



## TECHNICAL SPECIFICATIONS

### Surface pumps :

- Range of capacity: 0.25 hp to 5 hp
- an draw water from farm ponds, but they can push it far uphill.

### Submersible pumps :

- Range of capacity: 0.5 hp to 10 hp
- Sometimes suitable for either deep well or surface water sources

Energy system	Solar Powered Irrigation System	Portable Solar Water Pump
<b>SOLAR MODULE</b>	300 Wp x (4 - 16)	210 Wp x 2
<b>PUMP</b>	1 HP - 5 HP	0.5 HP
<b>HEAD</b>	10 - 50 M	10 M
<b>LITRES PER HOUR</b>	16,000 - 1,10,400	3500
<b>PORTABILITY</b>		Energy cart/ tricycle/ rickshaw

## IMPACT

### REDUCED MAINTENANCE COST

Of motor by overcoming issues of low voltage, transformer problems and wire burning- reduced diesel costs.

### INCREASED CONVENIENCE FOR THE FARMER

Ability to pump water during the day rather than deal with at odd times based on energy availability

### EXPECTED INCREASE IN CROP YIELD AND INCOME

Larger area can be covered works during summer as well.



# POST HARVEST PRODUCE MANAGEMENT TECHNOLOGIES

# POST HARVEST PRODUCE MANAGEMENT

## PADDY PROCESSING

### LACK OF ACCESS

to better services at processing facilities to the community. The local facilities make a much better bargain than the farmer.

### LOW MILLING

**RECOVERY WORK** only ensures food security (minimum income) for the miller.

### HIGH RESOURCE CONSUMPTION

Large scale mills are high resource consuming, largely government supported- subsidised, and unfair to small farmers.

### POOR QUALITY OF PHP MACHINERY

is inefficient and oversized for local service needs.

### HIGH DEPENDENCE

on expensive diesel fuel is a key concern.

## OWNERSHIP MODEL

SMALL SCALE	MEDIUM SCALE	LARGE SCALE
Service based model	Service+ Production based model	Production based model
~80-100kgs	~80-100kgs	~1000 kgs
Individual Entrepreneurs Integrated huller+polisher	Individual, Social entrepreneurs, Groups and Cooperatives huller+polisher.	Groups and Cooperatives





## 10. Parboiler (Rice)

### Output: Boiled rice

The first stage of the process usually takes place one day in advance or early in the morning. The soaking takes up to 4-5 hours and is done at high temperatures to remove impurities and bring them to a certain temperature in large drums before washing the paddy multiple times and drying. This process of parboiling is done under steamed pressure above boiling point before dipping the paddy in cold water to bring it back to temperatures and consistency for the next steps of drying, milling and de-husking.

A conventional parboiler has a large combustion chamber, which has a burning rate of 25 kg /hr. After the intervention it was noted that the average burning rate has been reduced to 17 kg/hr. This has reduced the monthly expenses on firewood.

Energy Model	Parameters	Conventional	Efficient
	Grate Void Area	1393 cm <sup>2</sup>	444 cm <sup>2</sup>
	Chimney Dimensions	8" (dia) - 8" (external) X 8ft	6" (dia) - 6" (external) X 10ft

## 11. Precleaner (Rice+Millet)

### Output: Clean paddy

Paddy coming to the processing unit contains foreign materials such as straw, weed seeds, soil, and other inert materials. If these are not removed before hulling, the efficiency of the huller will be reduced. Precleaner uses vibrating sieves of different sizes to separate the mature paddy from immature grains and foreign materials.

Energy Model	Parameters	Conventional	Efficient
	Grate Void Area	1393 cm <sup>2</sup>	444 cm <sup>2</sup>
	Chimney Dimensions	8" (dia) - 8" (external) X 8ft	6" (dia) - 6" (external) X 10ft

## 12. Destoner (Rice +Millet)

### Output: Clean paddy

Same as a single drum with aspiration and oscillating sieves but has an additional special arrangement for separating stones that have the same physical dimensions as paddy. Of particular importance is the direction of flow of the paddy compared to the direction of movement of the stones.

Energy Model	Parameters	Conventional	Efficient
	Grate Void Area	1393 cm <sup>2</sup>	444 cm <sup>2</sup>
	Chimney Dimensions	8" (dia) - 8" (external) X 8ft	6" (dia) - 6" (external) X 10ft

## 13. Dehuller (Engelberg technology; Rice)

### Output: Polished rice

Engle Berg rice huller most popular and widely used across Asia. Widely used in Jharkhand and Assam. The Engelberg huller uses steel rollers to remove the husk which uses an abrasive rotating disk to first remove the husk before passing the grain to conical rollers which polish it to make white rice. The output efficiency is low with a very high percentage of broken rice as, simultaneously both the shelling and polishing is done. The technology is mostly suitable for self-consumption within the community

## 14. Dehuller (Rubber roller technology; Rice)

**Output: Brown Rice (Dehulled Rice)**  
**Byproduct: Husk/Hull**

The rubber roller huller is the most efficient hulling machine as the broken rice percentage is very less. Two Rubber Rollers of the same diameter are operated at different speeds to remove the husk from the paddy. Then the husked paddy is passed through polisher to remove the layer of bran to get polished rice



## 16. Polisher (Rice)

**Output1: White rice**  
**Output2: Bran**

Polisher is used to produce white rice by removing the bran layer and the germ from the paddy. The bran layer is removed from the kernel through either abrasive or friction polishers. The amount of bran removed is normally between 8 and 10% of the total paddy weight.



## 15. Separator (Rice)

**Output1: Brown Rice**  
**Output2: Paddy**

The output from the dehuller still contains some paddy which may reduce the efficiency of the further processes. The Separator is used to separate the brown rice (dehulled rice) from the unhulled rice (paddy) which is then fed back into the huller.



## 17. Grader (Rice)

**Output1: Optimal Head rice**  
**Output2: Oversized rice**  
**Output3: Broken rice**

Grader also called rice sifter is used to separate head rice from broken and oversized rice grains which exceeds the requirement.



**TECHNOLOGY PACKAGE 1 - SINGLE STAGE MILL**  
Engelberg/Steel roller

**13**

<b>Motor</b>	<b>Power</b>	<b>3HP</b>
	<b>Voltage</b>	<b>220V Single Phase</b>
	<b>Rated capacity</b>	<b>150kg/hr</b>
	<b>Hopper Capacity</b>	<b>10kg</b>
<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>4020 Wp</b>
	<b>Battery (Ah)</b>	<b>24000 Ah</b>
	<b>Inverter</b>	<b>8kW,10 kVA,120V</b>

**TECHNOLOGY PACKAGE 2-DUAL STAGE MILL**  
Integrated Rubber Roller and Polisher

**14+16**

<b>Motor</b>	<b>Parameter</b>	<b>Huller</b>	<b>Polisher</b>
	<b>Power</b>	<b>1.5HP</b>	<b>0.5HP</b>
	<b>Voltage</b>	<b>220V Single Phase</b>	<b>220V Single Phase</b>
	<b>Rated capacity</b>	<b>100kg/hr</b>	<b>70-100kg/hr</b>
	<b>Hopper Capacity</b>	<b>15kg</b>	<b>5kg</b>
<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>2500Wp</b>	
	<b>Battery (Ah)</b>	<b>17280 Ah</b>	
	<b>Inverter</b>	<b>6kW,7.5kVA,96 V</b>	

**TECHNOLOGY PACKAGE 3 - MINI RICE PROCESSING UNIT**  
Precleaner - Destoner - Dehuller - Separator - Polisher - Grader

**11 12 14 15 16 17**

<b>Motor</b>	<b>Parameter</b>	<b>Precleaner</b>	<b>Dehuller</b>	<b>Seperator</b>	<b>Destoner</b>	<b>Polisher</b>	<b>Grader</b>
	<b>Power</b>	<b>1HP</b>	<b>01HP</b>	<b>0.5HP</b>	<b>2HP</b>	<b>0.5HP</b>	<b>0.5HP</b>
	<b>Voltage</b>	<b>220V AC</b>	<b>220V AC</b>	<b>220V AC</b>	<b>220V AC</b>	<b>220V AC</b>	<b>220V AC</b>
	<b>Rated capacity</b>	<b>200kg/hr</b>	<b>150-180kg/hr</b>	<b>150-200kg/hr</b>	<b>200-250kg/hr</b>	<b>70-100kg/hr</b>	<b>20kg/hr</b>
	<b>Hopper Capacity</b>	<b>20kg</b>	<b>20kg</b>	<b>50kg (Double hopper)</b>	<b>20kg</b>	<b>20kg</b>	<b>20kg</b>
<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>6030 Wp</b>					
	<b>Battery (Ah)</b>	<b>24000 Ah</b>					
	<b>Inverter</b>	<b>8 kW,10 kVA,120V</b>					

*Disclaimer: Solar designs are indicative, may vary in actual*

## IMPACT

### TRANSPORTATION COSTS SAVED AND TIME SAVED

Transportation costs are now zero and time lost is minimal post intervention. Before the intervention, a bike ride to the milling centre would cost them INR 50 and local bus (low frequency bus route) would cost INR 30. They would lose out to an entire day when they had to go till the nearest milling centre.

### MORE WOMEN CAN ACCESS THE MILL

Very few own vehicles in the community. Hence it's challenging for women, especially widows, to go all the way to the nearest town and spend an entire day milling their grains.

### REDUCTION OF ELECTRICITY COST

The electricity bill has been reduced from 600 INR/month to 200/month.

### AWARENESS ON RENEWABLE ENERGY CREATED

Other community members have shown interest in the technology and have interacted with solar power for the first time. Rosy is eager to develop a market around the milled output and is planning to approach other institutions like RSETI (Rural Self Employment Training Institute) for additional support. She has also expressed interest in adding a spice grinding machine to the existing flour milling machine.

### COMMUNITY SAVINGS

The community would earlier have to travel 2-3 times a week for milling their produce spending an hour of travel each time as well as wait time of an hour or more, with a total of minimum 4 hours a week spent. Now, they are able to mill their produce as and when they require cutting out the time and travel costs completely. Due to the mill being run by one of the villagers themselves, there is trust involved which allows the community to leave their produce there and not spend time waiting.

**SOURCE OF STEADY LIVELIHOOD:** Earlier, Bondekar was relying on daily wage labour for a living which was unsteady and unsustainable. He was keen on starting something of his own which he could rely on through the year to support his family. He is now running a business of his own and earns close to INR 6,000 a month.

### ENTREPRENEURSHIP

Bondekar has taken to entrepreneurship and is interested in selling packaged milled flour and spices. However, he needs adequate support, training and awareness on market structures and dynamics before he could branch out.

### SERVICE EXTENDED TO NEARBY VILLAGES

Other villages close to Maragadidaddi which were also having to travel to Katur town are now able to access this milling service. They also save time and travel costs.



# POST HARVEST PRODUCE MANAGEMENT

## MILLET PROCESSING

### IMPROVE ENERGY RELIABILITY

India being in the developing state of energy infrastructure, the supply of reliable electricity in rural areas can transform farming, processing and value addition of millets

### ACT ON GENDER INEQUALITY

Traditionally, millets were dehulled manually by women which involves significant drudgery and time

### REDUCE CARBON FOOTPRINTS

If millets replace rice, they would slash the energy use of national cereal production by up to 12%, water use by almost a quarter, and greenhouse gas emissions by up to 13%.

### REDUCE MALNUTRITION

Decline of consumption of small millets other than finger millets in the

### STRENGTHEN GRASSROOT INFRASTRUCTURE

Decentralised small scale units can be hugely beneficial to farmers and in boosting the rural economy. Farmers could consume their own produce, sell for higher values and also use every part of the crop

### SYSTEM TYPOLOGIES

SMALL SCALE	MEDIUM SCALE	LARGE SCALE
(Processing capacity of 80 to 100 kgs per day)	(Processing capacity upto 500 kgs per day)	(Processing capacity upto 1000 kgs per day)
2 HP Pulveriser	0.5 HP Huller + 2 HP or 3 HP Integrated destoner cum grader + 2 HP Pulveriser	Precleaner + 0.5 HP Huller + 2 HP or 3 HP Integrated destoner cum grader



## 18. Precleaner (Millet)

Pre Cleaners is designed to meet the pre-cleaning requirements for all types of grain processing. It removes foreign particles such as stones, debris, immature grains, and other impurities from the input prior to processing the grain. It has metal sieves that cleans grains and removes sticks and straws. It also has an in-built blower and aspiration system.



<b>Motor</b>	<b>Processing Capacity</b>	<b>200 to 500 kg per hr</b>
	<b>Mode of operation</b>	<b>Continuous Type</b>
	<b>Overall Dimension</b>	<b>2000 mm X 900 mm X 1600 mm</b>
	<b>Power Requirement</b>	<b>1 hp, Single / Three Phase Motor Grader 0.5 hp</b>

<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>2500 Wp</b>
	<b>Battery (Ah)</b>	<b>17280 Ah</b>
	<b>Inverter</b>	<b>6 kW, 7.5 kVA, 96 V</b>

## 19. Huller (Millet)

Millet is available in unhulled or hulled form. However, it is only prepared as food after being hulled since the grain has a naturally hard, indigestible covering that is removed before it can be considered ready for consumption.



<b>Motor</b>	<b>Technology</b>	<b>Centrifugal</b>
	<b>Motor capacity</b>	<b>2 HP Huller + 1 HP Blower(Combined)</b>
	<b>Phase</b>	<b>Single Phase/Three phase</b>
	<b>Processing capacity</b>	<b>100 Kg/hr</b>

<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>4020 Wp</b>
	<b>Battery (Ah)</b>	<b>24000 Ah</b>
	<b>Inverter</b>	<b>8 kW, 10 kVA, 120 V</b>

Disclaimer: Solar designs are indicative, may vary in actual

## 20.Grader & Destoner (Millet)

Suitable for removing stones and other impurities from grains. The grains are separated based on their weight. This machine can be used for multiple grains by adjusting the air flow and the operating angle of the destoning deck.



<b>Motor</b>	<b>Motor capacity(HP)</b>	<b>2 H.P. to 5 H.P.</b>
	<b>Phase</b>	<b>1 Phase and 3 Phase</b>
	<b>Processing capacity</b>	<b>250 to 500Kg/hr</b>
<b>Energy System</b>	<b>Solar Module (Wp)</b>	<b>2500 Wp</b>
	<b>Battery (Ah)</b>	<b>17280 Ah</b>
	<b>Inverter</b>	<b>6 kW,7.5 kVA, 96 V</b>

*Disclaimer: Solar designs are indicative, may vary in actual*





## 21. Roller grader

## 22. Vibro mat grader

## 23. Round Table grader

Sorting and grading of fruits and vegetables is the process of separating and categorising produce based on size, shape, colour, and quality. The goal of sorting and grading is to ensure that only the highest quality produce is sold to consumers, and to separate produce that may not meet certain standards for size, shape, or appearance.

1. **LACK OF CONSISTENCY** in the quality of products available to consumers. Some products may be overripe or underripe, while others may be misshapen or discoloured.
2. There is no way to ensure that products meet specific **STANDARDS FOR SIZE, SHAPE, COLOUR, AND OTHER CHARACTERISTICS**. This could lead to products being rejected by retailers and wholesalers
3. It is difficult to **CONTROL PESTS AND DISEASES** that can spread from one product to another, leading to an increase in food waste.

### OWNERSHIP MODEL

#### Farm Gate Level Sorter & Grader

This type of graders will be installed at farm level by individual/group farmers. In this model, user will get freedom to sort & grade his produce at any time

The user can also allow to use this facility to others by charging nominal fees hence he can earn some extra by providing this service

#### Mobile Sorter & Grader

This type of sorter grader will be mobile & can be moved to the end users location for sorting & grading purpose.

User can be charged depending upon the quantity of produce sorted & graded. The cost benefit in this is user do not need to take his produce these facility hence saving in the transport cost. This can be rented during the peak session by owners after their activities are completed



Category	Type of Grader	Roller Grader	Screen/Vibro Mat Grader	Round Table Grader
<b>CAPACITY</b>	<b>CAPACITY PER HOUR</b>	3 hp=1-2 ton 5.5hp=4-5 ton 7.5hp=1-2 ton 9.5hp=4-5 ton	1hp=1 ton 2hp=5 ton	1hp=2 ton 2hp=5 ton
<b>OPERATIONAL PARAMETERS</b>	<b>SUITABLE FOR COMMODITIES</b>	Round fruits such as Tomato,Apple, Orange, Lemon	Potato, Onion, Garlic and other uneven fruits	Round fruits such as Tomato,Apple, Orange, Lemon
<b>ENERGY SYSTEMS</b>	<b>ENERGY CONSUMPTION</b>	2.2KW 4.1KW 5.6KW 7.1KW	0.7KW 1.5KW	0.7KW 1.5KW

**Roller grader:** Used in the sorting and grading of fruits and vegetables in series of rollers with different diameter sizes to separate produce based on their size and shape. The produce is placed on the rollers and moved through the machine, where smaller items fall through the smaller rollers and larger items continue to the next set of rollers. This process continues until the produce is sorted and graded by size.

**Screen/Vibro Mat grader :** Used in the sorting and grading of fruits and vegetables with a vibrating deck with different sized holes, also known as screens, to separate produce based on their size. The produce is placed on the deck and vibrated, where smaller items fall through the smaller holes and larger items stay on the deck. This process continues until the produce is sorted and graded by size

**Round table grader:** Used in the sorting and grading of fruits and vegetables. It consists of a circular table that rotates, with various sized openings or holes around the circumference. The produce is placed on the table and rotated, where the smaller items fall through the smaller holes and the larger items continue to the next set of holes. This process continues until the produce is sorted and graded by size.

## IMPACT

### FAIR PRICING:

For the farmers, a proper sorting and grading helps in categorising their produce between premium quality and the poor one, which helps in better price realisations.

### REDUCED FOOD WASTE:

A proper sorting helps in removing the bad quality product from the whole lot.



## TECHNOLOGIES

**Cabinet dryer:** Drying cabinets consist of an enclosed chamber where products to be dried are placed on stainless steel trays. These drying systems reduce the relative humidity allowing the moisture to evaporate quickly. Cabinet dryer is typically suitable for drying all fruits and vegetables, leafy vegetables, etc.

**Bubble dryer :** Solar bubble Dryer is one of the simplest forms of solar dryer and it is one of best efficiency due to Direct Conduction Heating, and Solar Radiation Heating. And can be used for small drying capacities of around 100 kg per day to 1000 kg per day. It is a tunnel-type dryer, designed as an alternative to open field drying. Grain is placed in the bubble and a fan circulates the warm, dry air through the tunnel to dry the grain. Ideal For Drying Grains, rice, maize, coffee, cocoa, etc

# 24. Solar Cabinet Dryer 25. Solar Bubble Dryer

The moisture content of grains remains generally higher than the desired for safe storage of grains (13-14%). Drying is the phase of the post-harvest system during which the product is rapidly dried until it reaches the "safe-moisture" level. Drying must be performed in a way that does not seriously affect their colour, flavour, texture or nutritional value. A Solar dryer is a device that dries the food substances in a controlled environment without affecting the quality of the materials. The use of solar dryers helps to eliminate the problems associated with conventional open sun drying.

Parameters	Cabinet Dryer	Bubble Dryer
<b>CAPACITY</b>	100 kg to 3000 kg	500 kg to 1000kg
<b>TEMPERATURE</b>	60 oC	60 oC
<b>TYPICAL DRYING TIME</b>	0.5 to 2 days	1 to 3 days
<b>POWER SOURCE</b>	Solar	Solar (or) Electricity
<b>SPACE</b>	Medium	Small

## OWNERSHIP MODEL

### Farm Gate

Dryers can be owned by individual farmers based on the capacity requirement. Financial support shall be provided in terms of subsidies, financial loans, etc.

### SHG/FPO

Higher capacity Dryers can be purchased by the FPO for value-added commodities.



## 26. Biomass Dryer

- The solutions are **CLEAN COOKING, ENERGY, SPACE DESIGN** interventions
- Storage of raw material and **LACK OF EFFICIENT INFRASTRUCTURE, THERMAL COMFORT AND VENTILATION** while cooking
- **FREQUENT POWER CUT ISSUES, HIGH DRUDGERY** in activities
- Lack of clean cooking solutions

### TECHNICAL SOLUTION

- The dryer dries the loaded material with the application of heat.
- In a biomass fired dryer, the firewood that is burning in the firebox is the source of indirect heat.
- There is no direct contact between the hot gases and the material that is placed on trays
- The current of air established in the dryer ensures that the moisture is taken away from the dryer.

### IMPACT

#### LONGER SHELF LIFE

The dried crops can be stored for a longer period

#### BETTER PRICE REALISATION

The commodities that are dried are utilised for value-addition products which helped farmers to increase their income.





## 27. Cold Storage

Distributed cold storages extend produce shelf life and preserve their quality. They also help in preventing glut, decreasing transportation bottlenecks during times of peak production at the farm gate, and guaranteeing the general calibre of items.

India is the second-largest producer of fruits and vegetables in the world, with a total output of 256 million MT. India loses up to 16% of its annual crop of fruits and vegetables due to **ANTIQUATED HARVESTING PRACTICES AND INADEQUATE COLD CHAIN INFRASTRUCTURE**. Food lacks access to decentralised cold storage facilities which leads to lots of wastages of the produce.

The current stage of cold storage infrastructure is **LARGE SCALE, CENTRALISED, CONSUMING A LOT OF ELECTRICITY AS WELL AS DIESEL** to provide backup during the power outages.

Farmers often have to travel long distances to access these cold storages which **INCREASES THEIR TRANSACTIONAL COSTS**.

### OWNERSHIP MODEL

#### AGGREGATOR MODEL:

- Aggregators such as FPO/FPC/SHG shall use the cold storage for storing the perishables for trading activities.
- The Cold storage can be purchased or taken on lease from the manufacturer.
- The finance support shall be made through asset financing, through grants which could be from the government or a philanthropic organisation.

#### ENTREPRENEUR MODEL:

- Entrepreneur or Individual farmer shall own the cold storage at farmgate /Mandi or Market level.
- The service model where the refrigeration service is paid according to the volume stored.
- The asset based financing support is done either through the supplier or grant from government or a philanthropic organisation.

#### DIRECT FARMER SERVICE MODEL:

- The cold storage manufacturer/supplier owns the facility and leases the space out to a retailer or a farmer for a fee.
- The service model where the refrigeration service is paid according to the volume stored

### TECHNICAL SOLUTION

The cold storage unit in off-grid operation, primarily runs on power generated from Solar Photovoltaic or Bio mass. During sunshine hours the electricity generated from solar photovoltaic is used to provide cooling through a vapour compression refrigeration cycle to cool a cold room as well as store cooling energy in a Thermal Energy Storage (TES) System. The smart control system helps in maintaining temperatures, humidity and air quality parameters precisely as per the requirements of the product



Category	Parameters	Specification
CAPACITY	STANDARD STORAGE CAPACITY RANGE	5 MT - 30 MT
OPERATIONAL PARAMETERS	TEMPERATURE RANGE	4 to 15 deg C (For Fruits and Vegetables) 0 to 10 deg C (For Fruits and Vegetables) - 5 to 5 deg C (For Fruits, Vegetables and dairy product)
	HUMIDITY RANGE	65-95%
ENERGY SYSTEMS	STORAGE CHAMBERS	Single chamber - For single storage commodities Multi chamber - For different commodities.
	SOLAR PV	5 - 6 kWp for 5MT 8 - 10 kWp for 10 MT
	THERMAL ENERGY STORAGE (TES) BACKUP CAPACITY	175 to 200 MJ for 5 MT 200 to 250 MJ for 10 MT
	TYPE OF TES	Water based : Positive temperature range PCM based: Both Positive & Negative temperature range

## IMPACT

### BETTER PRICE REALISATION:

Farmers can avoid market glut by storing the crops and can trade when market prices are higher

### BETTER MARKET LINKAGE:

Storing a high quantity of crops helps in the selling at big markets and has high bargaining power.

### TRANSPORTATION SAVINGS:

Farmers can avoid transportation of crops daily throughout the harvest sessions.

## 28. Pits & heaps

Heaps are one of the traditional methods of storing the potatoes in a heap under the shade of the tree to a maximum of 1m height and covering them with 1 foot thick agro straw for insulation

## 29. Packing Heap

Packing houses are made from natural materials that can be moistened with water. Wetting the walls and roof first thing in the morning creates conditions for evaporative cooling of a packing house that is made from straw.

## 30. Ventilation

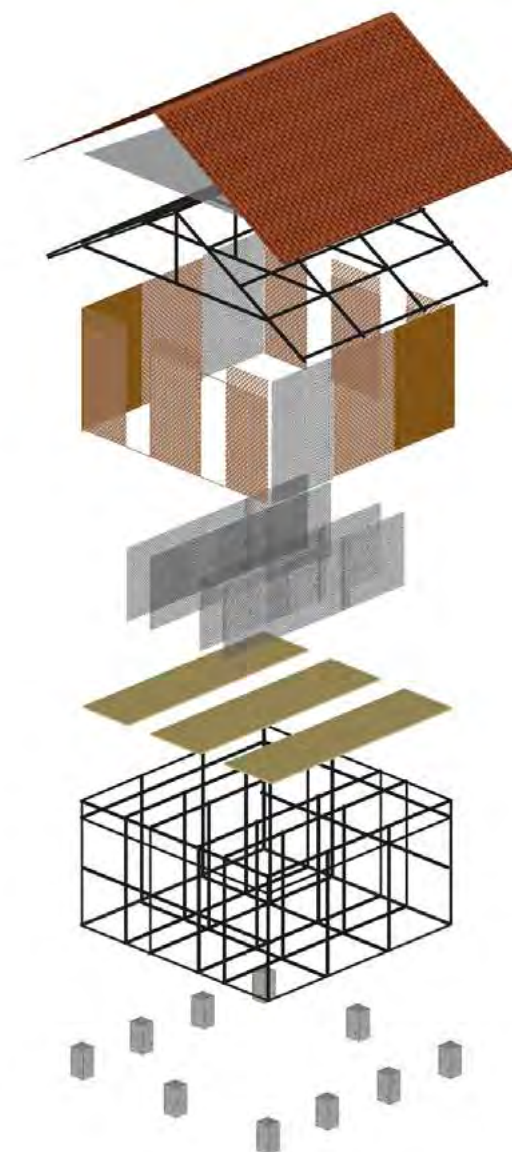
Storage structures are well ventilated or cooled using night air (relevant in locations where the difference in day and night temperature is relatively large). The storage facility should be well insulated and vents should be located at ground level. Vents can be opened at the bottom and top of the storage, and fans optionally can be used to pull cool air through the storeroom.

<b>STORAGE TIME FRAME</b>	45 days
<b>TEMPERATURE REDUCTION</b>	Approx ~ 10°C lesser than the ambient
<b>HUMIDITY</b>	50 to 90%
<b>ACCEPTABILITY</b>	The traditional methods are very cheap so are readily acceptable to farmers.

<b>STORAGE TIME FRAME</b>	3-4 months
<b>TEMPERATURE REDUCTION</b>	3 to 5 °C
<b>HUMIDITY:</b>	20 to 40 %
<b>ACCEPTABILITY:</b>	Less investment is needed on storage structures.

<b>STORAGE TIME FRAME</b>	3-4 months
<b>TEMPERATURE REDUCTION</b>	18 to 20 °C
<b>HUMIDITY:</b>	50 to 90%

## Passive Storages



Onion Storage



## 31. Potato washer & peeler Horticulture

A potato washer and peeling machine is a piece of equipment used to clean and remove the skin from potatoes. It typically consists of a washing chamber where the potatoes are agitated to remove dirt and debris, and a peeling chamber where the skin is removed through mechanical means such as abrasive brushes or blades. These machines can be found in commercial kitchens, food processing plants, and large-scale potato farms. They can greatly speed up the process of cleaning and peeling potatoes and help to ensure a consistent, high-quality product.

### TECHNICAL SPECIFICATIONS

Category	Parameters	Specification
Capacity	WASHING CAPACITY	200-250 kg/hr
Energy System	SOLAR PV CAPACITY	2 KWp
	MOTOR CAPACITY	0.75 KW, 220 V
	AUTONOMY	1 hr
Construction	TYPE	Brush Roller

### IMPACT

This technology plays an important role in processing a **HIGH QUANTITY OF PRODUCTS** in a short time with high efficiency.

**REDUCES LABOUR & DRUDGERY:** This technology reduces the labour involvement and drudgery in washing and peeling a huge load of potato before processing.



## 32. Pulp making machine Horticulture

Pulp making machine is specifically designed to process fruits and vegetables into pulp. These machines can extract the juice and separate it from the pulp, leaving a consistent and uniform pulp that is free of large chunks or seeds.

The pulp is used in a variety of applications in the food and beverage industry like juice, puree production, food additives & nutritional supplement.

### ADVANTAGES

These machines can pulp **LARGE QUANTITIES** of fruits and vegetables **QUICKLY AND EFFICIENTLY**, reducing the time and labour required to prepare them manually.

Machines can handle a **WIDE RANGE OF FRUITS AND VEGETABLES**, from soft berries to hard root vegetables, making them suitable for a **VARIETY OF APPLICATIONS**.

Processed fruit/vegetables gets **HIGHER MARKET PRICES**

Pulp is **EASIER TO TRANSPORT** compared to raw/fresh fruits & vegetables.

### TECHNICAL SPECIFICATIONS

Category	Parameters	Specification
Capacity	PROCESSING CAPACITY	Model 1: 0.2-0.5 T/h Model 2: 0.5 - 1 T/h Model 3: 1-2.5 T/h Model 4: 3-5 T/h
	SOLAR PV CAPACITY	2kW to 10 kW
Energy System	MOTOR CAPACITY	0.2-0.5 T/h: 1.5 kW 0.5 - 1 T/h: 2.2 kW 1-2.5 T/h: 4 kW 3-5 T/h: 7.5 kW
Construction	BODY MATERIAL	SS 304 (Food grade)





## 33. Fruit & Vegetable slicer Horticulture

**SAFETY CONCERNS** when slicing fruits and vegetables by hand.

**INEFFICIENCY AND INCONSISTENCY** of manual slicing, resulting in uneven slices and wasted produce.

**HIGH LABOUR COSTS** associated with manual slicing.

**DIFFICULTY** in slicing certain types of fruits and vegetables, such as hard-skinned fruits and vegetables.

**LACK OF PRECISION** in controlling the thickness of the slices.

The goal of the fruits and vegetable slicer is to overcome these issues by providing an automated, efficient, and safe solution for slicing fruits and vegetables. The machine should be able to handle a variety of produce items, allow for adjustable slice thickness, and minimise waste while reducing labour costs.

A slicing machine for fruits and vegetables is a specialised piece of equipment that is designed to quickly and efficiently slice a variety of different produce items.

The machine typically consists of two main components, including a cutting blade and a feeding mechanism.

Slicing machines for fruits and vegetables are used in a variety of settings, including commercial kitchens, food processing plants, and even at home.

They can be used to prepare fruits and vegetables for use in a variety of different applications, such as making chips, dehydrating, or as an ingredient in salads, sandwiches and more.

Category	Parameters	Specification
Capacity	PROCESSING CAPACITY	100 Kg/hr
	SOLAR PV CAPACITY	~2.5kW
Energy System	MOTOR CAPACITY	1 HP
	BODY MATERIAL	SS 304 (Food grade)



# 34. Apple peeler & Slicer Horticulture      35. Tomato blancher Horticulture

## TECHNICAL SPECIFICATIONS

Category	Parameters	Specification
Capacity	PROCESSING CAPACITY	50-60kg/h (about 8-12pcs/min)
Operational Parameters	PROCESSING APPLE DIAMETER SECTIONING	30 - 90 mm 2,4,6,8 disc
Energy System	SOLAR PV CAPACITY	2 kW
	MOTOR CAPACITY	0.5 HP
Construction	BODY MATERIAL	SS 304 (Food grade)

A blanching machine is a type of food processing equipment used to briefly submerge food in boiling water or steam in order to preserve colour, texture, and nutritional value. Blanching also helps to remove the skin of fruits and vegetables like tomatoes, Peaches etc., and can be used as a pre-treatment for freezing or canning.

The process typically only takes a few minutes, and the food is then rapidly cooled to stop the cooking process.

Category	Parameters	Specification
Capacity	PROCESSING CAPACITY	150-200 kg/batch
Energy System	POWER SOURCE	Steam
	POWER TYPE	Manual
	EFFICIENCY	75-90%
Construction	BODY MATERIAL	SS 304 (Food grade)

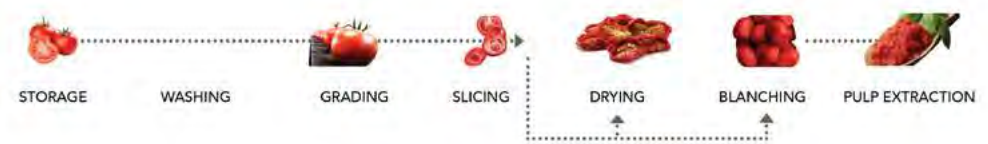
## ADVANTAGES

HIGH-SPEED OPERATION, CONSISTENCY, VERSATILITY AND UNIFORMITY

REDUCED LABOUR COSTS

INCREASED SAFETY, EASY TO MAINTAIN

IMPROVED FOOD SAFETY, WASTE REDUCTION





**PROCESS FLOW FOR VALUE ADDITION OF RAW BANANA POWDER**

1. **CLEANING** of banana / basically involves washer
2. **SLICING** of cleaned bananas – done manually through a knife - banana peeler is the most suitable. – A 0.5 HP Solar Banana Slicer
3. Sun **DRYING** – The sliced bananas needs to be sun dried that is time consuming and temperature varies as well – A Solar Dryer
4. Pulveriser – Once dried, the sliced bananas needs to **POWDERED** finely, that needs a 2 HP Pulverizer Flour Mill
5. **PACKING AND SEALING** Machine

**SYSTEM DESIGN**

Load Type	Wattage (HP)	Nos.	Hours
BANANA SLICER	1 HP	1	2
BANANA PULVERISER	2 HP	1	2

**SOLAR SYSTEM DETAILS**

<b>MAXIMUM LOAD TO BE CONNECTED</b>	<b>2.6 KWp</b>
<b>TOTAL SOLAR PANEL CAPACITY</b>	<b>2.3 KWh</b>
<b>PER DAY ENERGY REQUIREMENT</b>	<b>4.8 KWh</b>
<b>LOAD EFFICIENCY</b>	<b>80%</b>
<b>DAYS OF AUTONOMY</b>	<b>2 days</b>
<b>SUN PEAK HRS</b>	<b>5 hrs</b>
<b>SYSTEM VOLTAGE</b>	<b>96 V</b>

**36. Banana mill Horticulture**

Banana is considered to be one of the most important energy sources in the diet of people living in tropical humid regions. India is the largest producer and consumer of banana and accounts for about 33.4 per cent of the total fruit production of India.

Some products are fried chips, dehydrated banana chips, banana pulp, banana powder, green banana peel products etc. The processed banana products such as wafers/chips are gaining wide popularity in our day-to-day life.

Green banana peel contains medicinal properties and health benefits. About 2.5 percent of production is processed for 17 types of products from banana.

With increased acceptance of snack foods, there is tremendous scope of establishment of banana processing units in catchment areas for enhancing the income of the rural youth to flourish further with increased acceptance of snack foods.



## 37. Flour Mill

- Need to increase **ADDITIONAL SOURCES OF INCOME**
- **LOSS OF WORK** due to power cuts
- Need to improve the workspace and **BETTER WORKING CONDITIONS**
- The traditional processing of flour is **LABOUR INTENSIVE** and needs a lot of effort to rotate the stones.
- The fine grinding of flour is challenging in the traditional process. Lack of a flour milling service in rural areas causing people to travel **LONG DISTANCES**

### OWNERSHIP MODEL

HOME BASED

RURAL BASED

SHOP BASED

URBAN BASED

### TECHNICAL SOLUTION

A solar powered flour mill

Flour mills and spice grinding machines are used to grind the cereals, millets, and spices into a fine powder, where the flour and spice are used in our day to day life.

There are two types of flour mills, Emery stone and blade pulverizer powered by an induction motor for grinding action

SL No.	Energy Appliance	Equipment	Solar Energy System
1	FLOUR MILL/ PULVERIZER- 1 HP	1 hp flour mill AC, 5 to 8 kg per hour processing capacity. 3 Hours of operation a day. Pulverizer type	Solar Module 200 Wp x 6, Solar Battery 150 Ah x 4, Solar PCU 4 KVA, 48 V.
2	FLOUR MILL/ PULVERIZER- 2 HP	2 hp Flour mill AC, 15 to 18 kgs per hour capacity. 3 hours operation a day. Spices	Solar Module 335 Wp x 6, Solar Battery 150 Ah x 8, Solar PCU 6 KVA, 96 V.
3	FLOUR MILL/ PULVERIZER- 3 HP	3 hp flour mill AC, 20 to 25 kgs per hour capacity. 3 hours of operation a day.	Solar Module 335 Wp x 10, Solar Battery 200 Ah x 8, Solar PCU 8 KVA, 120 Vdc



## 38. Dal Mill

A dal processing unit caters to average 500 households. The system is usually integrated with a wheat processing unit.

### Energy System

<b>SOLAR MODULE (WP)</b>	<b>2500 Wp</b>
<b>BATTERY (AH)</b>	<b>1200 Ah</b>
<b>INVERTER</b>	<b>5 KVa</b>
<b>MOTOR CAPACITY (W)</b>	<b>2 HP</b>

### Motor

## IMPACT

### INCREASED PROFITS

With the integration of the flour mill with the dal mill, the centre has maximised the productive usage of the system. The processing quantities are being met year round now.

### AWARENESS ON SOLAR

Neighbouring communities are witnessing the usage of solar energy in remote contexts and have learnt of its existence, uses and applications beyond just lighting.

### COMBATTING ENERGY ISSUES

Remote regions suffer from frequent power cuts and voltage fluctuations which mean relying on diesel. With solar the unit is able to function uninterruptedly throughout the day.



SL No.	Energy Appliance	Equipment	Solar Energy System
1	OIL MILL (COLD PRESS)- 2 HP	2 hp Oil Mill AC, 10 kgs per hour capacity. 3 hours operation a day. Suits for Groundnut, Coconut, sesame, mustard seed oils.	Solar Module 335 Wp x 6, Solar Battery 150 Ah x 8, Solar PCU 6 KVA, 96 V.
2	OIL MILL (COLD PRESS)- 3 HP	3 hp Oil Mill AC, 20 kgs per hour capacity. 3 hours operation a day. Suits for Groundnut, Coconut, sesame, mustard seed oils.	Solar Module 335 Wp x 10, Solar Battery 200 Ah x 8, Solar PCU 8 KVA, 120 Vdc.

# 39. Oil Mill

Need to **INCREASE ADDITIONAL SOURCES OF INCOME**

**LOSS OF WORK** due to power cuts

**LACK OF ACCESS** to healthy processed oils in the market

Creation of cold pressed **HEALTHY COOKING OIL.**

Consumption of refined oils leads to **HEALTH HAZARDS** in the long term

## OWNERSHIP MODEL

HOME BASED

SHOP BASED

## TECHNICAL SOLUTION

A solar powered Oil mill (Oil extractor cold press)

## IMPACT

**ENERGY, WELLBEING, SAVINGS.**

Leads to **BETTER LIVING CONDITION AND GOOD HEALTH** in the long run.

**POTENTIAL FOR VALUE ADDITION** via production of by-products for e.g. chikki, peanut butter and cake etc



## 40. Chilli Pounder Mill

SL No.	Energy Appliance	Equipment	Solar Energy System
1	CHILLI POWDER MAKING MACHINE - 2 HP (PULVERIZER/MIXER/STONE TYPE)	2 hp chilli powder making machine (AC), 10 to 15 kg per hour capacity. 3 hours of operation a day. Spices	Solar Module 335 Wp x 6, Solar 150 Ah x 8, Solar PCU 6 KVA, 96 V.
2	CHILLI POUNDING MACHINE - 2 HP 4 HAMMER TYPE	2 hp pounding AC, 10 to 12 kgs per hour capacity. 3 hours of operation a day.	Solar Module: 335 Wp x 6, Solar Battery: 150 Ah x 8, Solar PCU: 6 KVA, 96 V.
3	CHILLI POUNDING MACHINE - 3 HP 4 HAMMER TYPE	3 hp chilli pounding AC, 15 to 18 kgs per hour capacity. 3 hours of operation a day	Solar Module: 335 Wp x 10; Solar Battery: 200 Ah x 10; Solar PCU 8 KVA, 120 V

### FINANCIAL MODEL

**LACK OF A MECHANISED AND ENERGY EFFICIENT** chilli pounding machine  
**OWNERSHIP OF LAND** - As the unit is on an agricultural land, cannot access a commercial metre hence the need for a dre based energy access.

**LACK OF ACCESSIBILITY TO ENERGY**

#### Solar powered Chilli Pounding machine

Training on marketing and business growth strategy in post COVID-19 scenario. This includes product photography, brand building exercise and activation of various digital platforms for business such as whatsapp, instagram and google business.



### OWNERSHIP MODEL

HOME BASED

SHOP BASED

- Financial bookends on interest rates, banks worked with, schemes broadly in narrative style.
- 40% loan component model via KVGB bank. It takes nearly 5 years in full repayment and capital asset ownership.
- Financing via Karnataka Vikas Grameena Bank

### IMPACT

ENERGY, WELLBEING, SAVINGS.

TRAINING AND CAPACITY, BUSINESS SKILL BUILDING  
 via District industries centre.

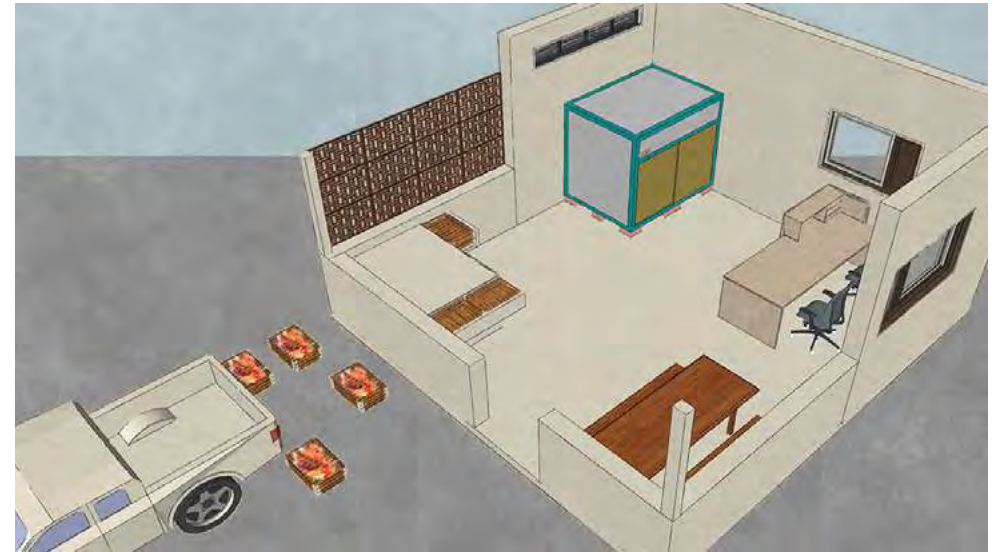
FINANCIAL INCLUSION , BANK LINKAGE.

INCREASED PRODUCTION AND OVERALL WELL- BEING

# 41. Agriculture Processing Centres

A built environment, energy optimised workspace, for agriculture processing, produce storage and value addition are critical to farmer/ entrepreneur wellbeing and productivity increase. These are achieved through designing for function through ergonomics and layout space efficiency, thermal comfort and climate controlled conditions with natural light and ventilation amplified by active task lighting and cooling applications, based on climate type, disaster and terrain.

Further with the management of food - applications for sanitation, hygiene, and where relevant, heating applications like improved and efficient cook stoves and furnaces or forges are integrated for overall improvement in quality of livelihoods. Optimally designed built infrastructure helps to optimise the flow of goods and personnel, reduce the risk of accidents and contamination, and improve overall working conditions. Additionally, a well-designed agri-processing centre can help to reduce energy and water usage, which can lead to operational cost savings and a reduction in the facility's environmental impact. Overall, investing in a well-designed built environment can help to ensure that the facility is safe, efficient, and sustainable in the long run.



Storage and Grading Centre



Common Facility Centre



Food Processing Centre



# FOOD PROCESSING



- 42. Dough Kneading
- 43. Roller Type Machine
- 44. Conveyor Belt Machine

## Roti Rolling

'Roti' is a flat round bread cooked on a griddle that forms an important part of most Indian meals. The roti making entrepreneurs engage in making different types of bread as part of their business strategy, availability of raw materials and market demand. They earn maximum income from making jowar and bajra roti which are mostly sold at marriages, community functions, hotels, dhabas, khanawalis, catering and retail shops. For an additional income to their business, a few entrepreneurs may also engage in making papad for selling it at local hotels. Women usually utilise their existing kitchens as the production

units making different kinds of rotis and the entire workflow, from kneading the dough, rolling the rotis, to cooking the rotis and then storing them, is done within the same workspace. But their business is often limited by physical capacity and entrepreneurs often complain of body pain and unmatched market demands. Also, restaurants and canteens spend enormous resources in making large numbers of rotis hampering productivity. The solar powered DC roti rolling machine increases the output multifold in such scenarios, and increases business opportunities, leading to increase in income.

### OWNERSHIP MODEL

Rent/lease      Self owned land

### TYOLOGIES

Single Entrepreneur/ SHG Group home based	Single Entrepreneur/ SHG Group Shop based/ B2B	Single Entrepreneur/ SHG Group Shop based/ B2C
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#### RISING HEAT STRESS:

Heat stress challenges the productivity and working hours by causing poor thermal comfort for the end user

#### COMPROMISED HYGIENE AND INCREASED MAINTENANCE:

The kitchen workspace surfaces are usually uneven and absorbs particles (liquid and solid) which results in time consuming tasks for cleaning and maintenance of hygiene within the workspace

#### LACK OF EFFICIENT STORAGE:

Roti rolling process requires storage of completed product as well as drying space. These are 2 key stages of production and packaging to avoid damage to products and income loss for the end user

#### AVG. MANUAL PRODUCTION PER DAY 50-100 ROTIS

#### RISING DEMAND:

As the demand for Rotis has always been on the increasing side, the need for more efficient and sustainable production methods from the local home-based enterprises is on the rise.

#### LABOUR INTENSIVE:

Traditionally the rolling of the jowar roti is done manually and involves a physical labour. The activity is performed for long hours thus causing physical strain and increased time consumed for making 1 roti

#### ENERGY GAPS:

Mechanised roti rolling machines face challenges related to erratic power cuts affecting income levels and entrepreneurs are not able to meet the demand and hesitate to take orders foreseeing failure in timely delivery.

## TECHNICAL SOLUTION

Energy Appliance	Equipment	Solar Energy System
Roti Rolling machine	0.25 HP, 24 Vdc. Capacity: 500 Roti/day	Solar Module: 40 Wpx 2 Battery: 60 Ahx2
Roti Rolling machine	0.25 HP, 24 Vdc. Capacity: 1000 Roti/day	Solar Module: 75 Wpx2 Battery: 80 Ahx2
Roti Rolling machine	0.25 HP, 24 Vdc.. Capacity: 2000 Roti/day	Solar Module: 300 Wpx1 Battery: 100 Ahx2
Roti Rolling + Atta kneading	0.25 hp + 0.25 hp Capacity: 1,000 Rotis/day	Solar Module: 300 Wp x 1 Battery: 135 Ah x 2
Roti rolling (Belt conveyor type machine + Kneader	0.25 hp + 0.25 hp Capacity: 2500 rotis/day	Solar Module: 335 Wp Battery: 135 x 2

## IMPACT

**ROLLING SPEED:** 5-6 rotis/min

**CAPACITY** of 500-1000 rotis/day  
Reduction in electricity bills

### REDUCTION IN DRUDGERY AND INCREASED PRODUCTIVITY

The solar roti rolling machines have enabled entrepreneurs, partnerships and self help groups to increase their productivity from 50-200 rotis a day to 500-1000 rotis a day. It takes about 5-15 seconds for each roti to be made, depending on the entrepreneur's experience.

### IMPROVEMENT IN INCOME

In most cases roti rolling entrepreneurs or self help groups have mentioned a seasonal spike in income which has tripled or quadrupled their income levels. At least 30% of the entrepreneurs have been able to diversify their business through the machine. Post installation of the intervention, these entrepreneurs were on an average, able to increase their daily production 2X (from 200 to 400 rotis), resulting in additional income in hand.

### EMPLOYMENT CREATION AND MARKET INNOVATION

The increased market demand has made women entrepreneurs spread awareness among other women in their communities and also employ them as additional labour.



# 45. Built Environment

Solution	Description
HOLISTIC KITCHENS	Improved workstation, ergonomics, workflow, storage and thermal comfort conditions
IMPROVED ROOFING	PUF panel roofing with turbo ventilator Panel roofing provides thermal insulation to external heat from transmitting to the indoor spaces and the turbo ventilator which not only extracts heat and smoke from the indoor spaces but also brings in natural light.
STORAGE	False ceiling using PVC board or Gypsum board In home based workspace in heat stressed regions specifically, addition of a false ceiling with air gap provides thermal insulation and improves indoor thermal comfort  Storage racks and drying space for storage of products and drying of rotis. This also reduces drudgery in terms of movement and bending down to pick up rotis



# Snack Making



## 46. Papad Making

A manual papad making machine requires more labour and involves a lot of drudgery and time.

The process of making the dough and rolling the Papad involves more human work and consumes a lot of time for the preparation.

The AC Papad presser cannot deal with erratic power cuts in rural areas and its size restricts the load capacity.

Considering these challenges, selco foundation has intervened with an efficient solar powered hydraulic papad press machine.

The increase in productivity by permanent magnet DC motors has brought a steady rise in everyday income.

### IMPACT

**DEMAND DUE TO THE MECHANISATION** of the chakli making process

**ACCESS TO STABLE SOURCE OF ENERGY**

**DIVERSIFICATION OF PRODUCTS**

**INCREASED INCOME AND ADDITIONAL CHANNEL OF INCOME**

### FINANCIAL SOLUTION

A papad making machine including solar ranges between INR 185,000 - INR 2,00,000 for hydraulic press. And the conveyor belt model costs approximately INR 2,50,000. According to the present business model assessments, a 100% loan component at 12 % interest will take 5 years to fully recover costs.

### TECHNICAL SOLUTION

#### Energy Appliance

Hydraulic papad making machine- 0.5 hp  
+Atta kneading- 0.25 hp.

Papad belt conveyor type  
Atta kneading

#### Equipment

0.5 hp, 24 V hydraulic papa machine.

Suits for Atta, millet, urad, ravi and multi papads. 250 Papad per hour capacity.

0.25 hp, 24 V Papad belt conveyor type.  
Atta kneading- 0.25 hp DC. PMDC motor retrofitted model.

Suits for Atta, millet, urad, ravi and multi papads. 600 Papad per hour capacity.

#### Solar Energy System

Solar module: 335 Wp x 2, solar battery: 150 Ah x 2, solar charge controller: 24 Vdc, 50 A.

Solar Module: 335 Wp, Solar Battery: 135 Ah x 2, Solar Charge Controller: 24 V, 50 A.



## 47.Chakli Making

## 48.Sev Bhujia Making

A manual chakli making machine requires more labour and involves a lot of drudgery and time.

The process of making the dough and making the chakli involves more labour and consumes a lot of time for the preparation.

Considering these challenges, selco foundation has intervened with an efficient solar powered automatic chakli machine with an atta kneading machine

The increase in productivity by permanent magnet DC motors has brought a steady rise in everyday income.

### TECHNICAL SOLUTION

Energy Appliance	Equipment	Solar Energy System
Chakli making machine (Fully automatic) - 0.5 hp. +Atta kneading- 0.25 hp.	0.5 hp, 230 Vac with VFD drive operated machine. Suits for Straight, round, and Muruku	Solar module: 335 Wp x 1, solar battery: 135 Ah x 2, solar PCU 1KVA, 24 Vdc.
Sev Bhujiya/Kodubale- 0.5 hp Att kneading- 0.25 hp	0.5 hp, 24 Vdc Hydraulic type machine. 8 to 10 kg per hour	Solar Module: 335 Wp x 2, Solar Battery: 150 Ah x 2, Solar Charge Controller 24 Vdc, 50 A.
Automatic chakli making machine- 1 hp	1 hp Ac machine with Automatic chakli moving + Atta kneading- 0.25 hp	200 Wp x 6 Nos, 150 Ah x 4, Solar PCU 4 KVA, 3 KW.

### OWNERSHIP MODEL

Home based  
Shop based  
Rural areas  
Urban areas

### FINANCIAL SOLUTION

A Chakli making machine including solar ranges between INR 2,00,000 - INR 2,50,000. According to the present business model assessments, a 100% loan component at 12 % interest will take 2-3 years to fully recover costs depending on the entrepreneur's capacity.

### IMPACT

The end users are able to **MEET THEIR DAY TO DAY DEMAND** due to the mechanisation of the chakli making process.

**ACCESS TO STABLE SOURCE OF ENERGY**

**DIVERSIFICATION OF PRODUCTS**

**INCREASED INCOME AND ADDITIONAL CHANNEL OF INCOME**



## 49. Pani Puri Making

A manual pani puri making machine requires more labour and involves a lot of drudgery and time.

The process of making the dough and making the puris is a labour intensive work and consumes a lot of time for the preparation

Loss of work due to irregular power cuts

Considering these challenges, selco foundation has intervened with an efficient solar powered hydraulic pani puri making machine and an atta kneading

### TECHNICAL SOLUTION

Energy Appliance	Equipment	Solar Energy System
Pani puri making machine ( belt conveyor type)- 1 hp +Atta kneading- 0.25 hp.	1 hp, 230 Vac. 1500 to 2000 pani puries per hour.	Solar module: 200 Wp x 6, solar battery: 150 Ah x 4, solar PCU 4 KVA, 48 Vdc.
Pani puri making machine (Belt conveyor type) Atta kneading	0.25 hp, 24 V Papad belt conveyor type. 1200 to 1500 pani puries per hour. Atta kneading - 0.25 hp.	Solar Module: 335 Wp, Solar Battery: 135 Ah x 2 , Solar Charge Controller: 24 V, 50 A.

### IMPACT

The end users are **ABLE TO MEET THEIR DAY TO DAY DEMAND** due to the mechanisation of the pani puri making

**INCREASED PRODUCTION AND CONNECTION TO VENDORS** for selling puris

**ACCESS TO STABLE SOURCE OF ENERGY**

**DIVERSIFICATION OF PRODUCTS**

**INCREASED INCOME AND ADDITIONAL CHANNEL OF INCOME**

### OWNERSHIP MODEL

Home based  
Shop based  
Rural areas  
Urban areas

### FINANCIAL SOLUTION

A pani puri making machine including solar ranges between INR 2,50,000 - INR 3,50,000 for conveyor belt model. According to the present business model assessments, a 100% loan component at 12 % interest will take 5 years to fully recover costs.

## 50. Built Environment



## Puffed Rice

### Solution

Holistic Built Environment

### Description

An approach to first reduce external climatic factors like heat, rainfall and winds with the design of the building envelope and then cater to the internal heat appliances with appropriate designs of ventilation systems and chimneys with exhaust. Lastly improving ergonomics, workstation design, surface finishes, and quality of natural light for ambient and tasks.





51. Stirrer : Single spindle

52. Stirrer : Four spindle

53. Blower

54. Roaster

Parboiler

CROSS  
CUTTING  
TECHNOLOGY

## OWNERSHIP MODEL

Rent/Lease  
Self owned

## TYOLOGIES

Cluster based models  
Single Entrepreneur

## FINANCIAL SOLUTION

The cost of the roaster model puffed rice machine was INR 2,10,000. The best case scenario includes a 100% loan component model leading to full repayment and capital asset ownership in 3 years.

## PROBLEM STATEMENT

**EXPOSURE TO SEVERE HEAT:** Different stages of puffing rice from production to processing and packaging includes an active heat source within the workspace that exposes workers to severe heat and drudgery. The active heat source adds to the indoor temperatures along with the rising temperatures.

**PHYSICALLY INTENSIVE WORK:** The workstation is set up ad hoc, without considering the ergonomic requirements of its user. While the processing activities itself are labour intensive, the un optimised workstation increases the physical strain on the users and reduces their performance

**EXPOSURE TO POOR INDOOR AIR QUALITY:** Smoke and dust generated within the puffed rice workspace reads between "Unhealthy" to "Hazardous" on the AQI Monitor, indicating severe challenges to health of the the end users

**IN EFFICIENT COMBUSTION RATE:** The production of Puffed rice involves partially boiling the rice paddy before it is roasted in the sand roaster. The conventional par boiler usually has a large combustion chamber, which has a burning rate of 21 kg /hr. In order to avoid unwanted heat loss and reduce the burning rate, an efficient combustion chamber is required

**TRADITIONAL AND INEFFICIENT METHODS OF COOKING** puffed rice causes slowed production. The exposure to harmful gases leads to respiratory diseases in the long term, hence the need for an energy efficient puffed rice unit.

## IMPACT

INCREASED PRODUCTION AND  
INCREMENTAL PROFITS

LEADING TO BETTER MARKET  
LINKAGES

ACCESS TO A BETTER WORKSPACE  
AND EASE AT WORKING

EFFICIENT SPACE DESIGN AND  
EXHAUST SYSTEMS CAN MAKE THE  
WORKSPACES



## TECHNICAL SOLUTION

Energy Appliance	Equipment	Solar Energy System
Puffed rice making machine: Single Spindle	DC Motor Retrofitted Model Single Stirrer 0.5 hp, 24 V  4 Hours	Solar Module 335 Wp x 2, Solar Battery 150 Ah x 2, Charge controller 24 V, 50 A
Firewood Blower	DC Motor Retrofitted Model Double shaft firewood feeder and Air blower. 0.5 hp, 24 V, 4 hours of operation.	Solar Module 335 Wp x 2, Solar Battery 150 Ah x 2, charge controller 24 V 50 A.
Puffed rice making machine: 4 Spindle Machine	DC Motor Retrofitted 4 Spindle model 1hp, 48 V 6 hours	Solar Module 250 Wp x 6, 150 Ah x 8, charge controller 48 V, 40 A
Puffed rice making machine: 4 Spindle Machine	AC Inverter based model. Motor Retrofitted 4 Spindle model 1hp, 230 Vac 4 Hours	Solar Module 335 Wp x 6, 200 Ah x 8, Solar PCU 4KVA, 48 Vdc.
Puffed rice Roaster (Boiler type)	Roaster machine- 0.5 hp, 24 V 100 Kgs per hour capacity. Suits for Puffed rice, millets, Bengal gram, pees.	Solar module 335 Wp x 2, 150 Ah x 2 Batteries, charge controller 24 V, 50 A.



# 55. Built Environment

## Solution

Improved Roofing

## Description

Thermal cool roofing solutions integrated with skylights and turbo ventilators

Furniture designs for storage and ergonomics for long time standing positions  
Function based design and workflow from peeling/ preparation to packaging with the capacity to adapt to increase in workers within the constrained space



# Chips Making





CROSS  
CUTTING  
TECHNOLOGY

## Peeler

CROSS  
CUTTING  
TECHNOLOGY

## Slicer

## 56. Oil Dryer

## 57. Chips Maker

### CHALLENGES/OPPORTUNITIES

**EXPOSURE TO SEVERE HEAT:** Different stages of puffing rice from production to processing and packaging includes

**RIISING HEAT STRESS:** Heat stress challenges the productivity and working hours by causing poor thermal comfort for the end user

**COMPROMISED HYGIENE AND INCREASED MAINTENANCE:** The kitchen workspace surfaces are usually uneven and absorbs particles (liquid and solid) which results in time consuming tasks for cleaning and maintenance of hygiene within the workspace

**LACK OF EFFICIENT STORAGE:** Chips making process requires storage of completed product as well as drying space. These are 2 key stages of production and packaging to avoid damage to products and income loss for the end user

**TIME CONSUMING AND INTENSIVE LABOUR:** Manual chip production is a time-consuming and laborious process and rural entrepreneurs are often unaware of chip slicing technology.

**IRREGULAR POWER SUPPLY:** In some cases, entrepreneurs interested in purchasing the machines lack access to energy and electric machines cannot meet demand due to irregular power supply

### IMPACT

The evaluations offer positive evidence as to the effects of the livelihood solution.

The findings from these studies show effects on a range of outcomes from **IMPROVED INCOME, TO HEALTH, BETTER SOCIO-ECONOMIC STATUS AND INCREASED PRODUCTIONS** in his business.

### OWNERSHIP MODEL

Micro (50Kg -150Kg)

Small (150Kg to 300Kg)

Medium (300Kg to 400Kg)

Potato chips and Banana chips

### FINANCIAL SOLUTION

Selco Foundation, in the year 2019, helped install a solar module and 0.5 hp DC slicer at his unit

His daily productions escalated to 100 to 150 kg of banana chips per hour and 150-200 kg potato chips per hour

Overall, he is able to manufacture more than 300 kgs in 10 hours a day

The best cases include a 100% loan model leading to full repayment in 3 years and capital ownership

## TECHNICAL SOLUTION

Type of machine	Specifications	Production capacity	Solar system
Potato slicer	0.5HP,24V,DC	150-200 Kg/hr	Solar Module: 335 Wp x 2, Battery: 200 Ah x 2, Charge controller 24 V, 50 A. 3 hrs back up
Potato peeler	0.5HP,24V,DC	150-200 Kg/hr	Solar Module: 335 Wp x 2, Battery: 200 Ah x 2, Charge controller 24 V, 50 A. 3 hrs back up
Banana chips	0.5HP,24V,DC	80 to 100 Kg/hr	Solar Module: 335 Wp x 2, Battery: 200 Ah x 2, Charge controller 24 V, 50 A. 3 hrs back up
Oil dryer	0.5HP,24V,DC	10 kg per batch/5mins	Integral part of the food processing solutions, an optional solution that can be integrated with the existing solar system





# 58. Vermicelli Making

- Need to increase additional sources of income
- Lack of a mechanised vermicelli producing unit
- Loss of work due to power cuts
- Need to improve the workspace and better working conditions

## OWNERSHIP MODEL

- Home based
- Shop based
- Rural areas
- Urban areas

## TECHNICAL SOLUTION

Type of machine	Specifications	Types	Production Capacity	Solar System
Vermicelli Machine + Atta kneader	Vermicelli machine 1 HP, 230 Vac. Atta kneader 0.25 hp	Atta, Akki, Java, Millets.	10 kg/hr (30 kg/day)	200 Wpx6 150 Ahx4. Solar PCU 4KVA 48 V.
Vermicelli Machine + Atta kneader	Vermicelli machine 2 HP, 230 Vac. Atta kneader 0.25 hp	Atta, Akki, Java, Millets	20 kg/hr (60 kg/day)	300 Wpx12 200 Ahx8. Solar PCU 6KVA 96 V.

## IMPACT

- ADDITIONAL SOURCE OF INCOME
- ACCESS TO STABLE RENEWABLE SOURCE OF ENERGY
- INCREASED PRODUCTION AND BETTER REACHABILITY TO CUSTOMERS
- BETTER STORAGE AND PRODUCT DIVERSIFICATION
- OWNERSHIP of a dre based solution unit

## FINANCIAL SOLUTION

A pilot based model to understand the feasibility and business aspect of the vermicelli machine , as it is part of the livelihood solution that also includes a roti rolling machine. Vermicelli is based on seasonal demands and hence it does not run for the entire year and acts as an additional channel of income during peak seasons. The solution package comes as roti + vermicelli combo.



## 59. Pickle Making

Pickle making at scale for individual entrepreneurs and groups can be challenging especially in the tasks of mixing pickle and drying the products in large quantities while maintaining the same taste, texture and quality. Combined with solar dryers, pickle making machines with mixer, grinders, band sealing machine, and bolting machines are ideal.

Load	Quantity
Pickle mixing machine	1
Vacuum sealing machine	1
Band Sealer	1
Bottle sealing machine	1
Mixer grinder	1

Product	Capacity	Quantity
Solar Module, 72 cells, 2 in series	Bottle sealing machine	4
Solar Lead Acid Tubular Battery, C10, 4 in series	150 Ah, 12 V	4

## 60. Packaging Appliances

Labour intensive and a manual process that is time consuming

Scope for mechanisation of the packing process

Leads to respiratory diseases in the long term

### TECHNICAL SOLUTION

Energy Appliance	Equipment	Solar Energy System
Manual Packing/sealing machine	250 Watt, 230 Vac	Solar module: 335 Wp, 100 Ah x 2, Solar PCU 800 VA.
Semi Automatic weighing machine	Weighing scale 100 grams to 2 kgs. 4 Hours, 650 Watt. energy consumption.	Solar Module: 200 Wp x 6, 150 Ah x 4, Solar PCU 4 KVA.
Semi automatic sealing machine	All sizes from 100 grams to 2 kgs. 900 Watt energy consumption.	Indicative system details for 2 to 3 hours of operation.



# 61. Millet Cafe

Sl.no	Description	Nos.
1	Refrigerator- 250 L	1
2	Refrigerator- 200 L AC for storage Chest freezer	1
3	Tea/Coffee vending machine- (60 to 80 Cups per day)	1
4	Sugarcane Juicer (Pio) - AC	1
5	Wet Grinder- 0.5 hp AC 3 kg.	1
6	Water Purifier	1
7	LED Light- AC	15
8	Ceiling Fan (Energy efficient) AC BLDC. Usha Energeia 32 W.	10

Description	Capacity	Nos.
Solar Module (72 Cells)-6S2P	335 Wp, 24 V	12
Solar Battery- 8S1P	200 Ah, 12 V	8
Glow Power Inverter GPM 5008 with MPPT Technology	6 KW, 7.5 KVA, 96 V	1





# NON TIMBER FOREST PRODUCE

## 62. Lac Pruner

Lac is a natural, biodegradable, non-toxic, odourless, tasteless, hard resin which is non-injurious to health. India is a major producer of lac, accounting for more than 50% of the total world production (as of 2015-16). In the domestic market, lac was used for making bangles, toys and in the furniture industry

### Energy System

SOLAR MODULE (Wp)

250

BATTERY (Ah)

240

### Motor

CAPACITY (W)

165

### TECHNOLOGY

Most of the lac cultivators use traditional instruments like axes for pruning purposes and this often leads to breakage or splitting of branches leading to damage of trees. Pruning has to be done in a specified time period and if not done, will lead to loss. A significant amount is spent by the lac cultivators in engaging wage seekers who are paid INR 200 - 250 per day and with labour shortage in critical harvesting season, it can affect his/her livelihood. The process of pruning is laborious and at times hazardous as cultivators have to climb trees which are very tall at times, making the task very arduous. This is compounded by the fact that in majority of instances the task of pruning is undertaken by women.

### IMPACT

There is a 41% reduction in the operational expenses, mainly wages paid to labourers- which results in savings of INR 540.

For e.g. taking an aggregate, a farmer with 60 lac trees can potentially save up to INR 16,800 annually. This being a cyclical process.

Due to the use of the pruner, the risks associated with climbing of trees that are 5-12 feet in height, are no longer present. Earlier, the lac cultivators used to climb the tree and use an axe for pruning or harvesting. This has also enabled both genders to be having an equal opportunity to perform the task.





## PEST MANAGEMENT

### 63. Rubber Tapper

Rubber tapping is the process used to collect latex from a rubber tree. The latex is harvested by slicing a groove into the bark of a rubber tree at a depth of a quarter inch with a hooked knife and peeling back the bark.

#### TECHNICAL SOLUTION

The technology introduced was designed as a replacement for the manual shaving done using a knife. No training or special skills were required to use the technology.

Percentage increase in tappers income **20%**

	Rubber tapping maching
TREES PER DAY	350-400 trees a day (depending on the skill of the tapper) v 420 trees a day (minimum)
POWER CONSUMPTION	24 watts
OPERATING VALUE	12 v

In parts of India, and across the world, farmers struggle to save their crops from animals such as elephants, monkeys and blue bulls- some responsible for destroying 60-70% of the crops in regions where they thrive in abundance. While several technologies can be used by farmers, energy is often a gap. In farmlands, where these technologies are required, specifically in or near forested regions, grid power failure or intermittent power is also a common occurrence.

**Auditory Repellents:** Are marked as either ultrasonic, sonic or biosonic calls which makes the targeted animals uneasy

**Tactile Repellents:** The principle behind this devices is they create painful or uncomfortable stimulus upon contact - Mild Electric shock

**Olfactory Repellents:** Using the general principle of odour detection to repel or stimulate olfactory mediated behaviour. -Eg. Fish Oil

**Visual Repellents:** The principle behind these devices is that usage of flashing lights or large movement of objects - is found to effectively repel wild animals like elephants, boars etc.



## 64. Snake repeller

The solar powered snake repeller device utilises ultrasonic pulses every 30 seconds that sends vibrations through the ground in a 10 feet radius. Snakes are sensitive to these lighter vibrations and are often deterred from the source. As a result, farmers can strategically place these devices within their fields (depending on size) and can completely deter snakes from entering their fields.

<b>Energy System</b>	<b>SNAKE REPELLER</b>	<b>400 - 1000 Hz</b>
	<b>SOLAR MODULE (WP)</b>	<b>4 Wp</b>
	<b>BATTERY (AH)</b>	<b>800 mAh 1.2V</b>



## 65. Monkey repeller

Market research for monkey repellents found solutions that primarily used Ultrasonic Sound Repellers. These repellents were not tested scientifically on monkeys in India; and local tests farmers showed it to be ineffective. Studies have also shown that monkeys develop immunity to ultrasonic repellents over a period of time. Thus, the solution developed looked at a combination of tactile and olfactory repellents- built to incorporate decentralised solar energy so it can be used in remote farmlands and forested areas as well.

The Ultrasonic Sound Repeller emits frequencies between 0-60 kHz to cause a mental disturbance in the monkeys. Motion sensor triggered audio sounds scare the monkeys away. Mechanisms to affect their olfactory system by the use of water force, smell and light was also added.

<b>Energy System</b>	<b>SOLAR MODULE (WP)</b>	<b>40 Wp</b>
	<b>BATTERY (AH)</b>	<b>10 Ah 14.8V</b>



## 66. Solar Fencing

Electric fencing is used to avoid damage of agricultural produce by animal attacks- It works on the presumption that a short safe pulse of electricity creates a psychological barrier, training the animals to stay away from the fence. Solar fencing is mostly seen in remote forest areas that are devoid of any power connection. The farm owners are usually not able to charge the battery due to the irregular or complete lack of power supply in such areas. They are frequently attacked by animals that in worst case scenarios can destroy an entire farmland- resulting in huge losses in the farmer's income.

### Energy System

<b>SOLAR MODULE (WP)</b>	<b>40 Wp</b>
<b>BATTERY (AH)</b>	<b>60Ah 12V</b>



## 67. Elephant Repeller

Human-elephant conflict is rising across India with human settlements expanding to the migratory path of the elephants. This conflict is a result of habitat loss, lives and fragmentation. The unintended consequences are the ever increasing loss to farmers who find themselves crossing paths with elephants, leading to loss of life and crops - resulting in loss of incomes.

The Elephant repeller light is a simple passive lighting solution placed at the periphery of a village or field to repel elephants from a safe distance. It functions by emitting flashes of bright light at irregular intervals, which mimic the reflective iris of predators seen by elephants in the night.

### Energy System

<b>LED SPECIFICATION</b>	<b>4 LEDs (1W &amp; 3W)</b>
<b>BATTERY (AH)</b>	<b>13AH, 3.7V</b>



# Animal Husbandry

# ANIMAL HUSBANDRY

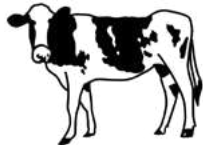
Livestock provides consequential benefits to a range of communities globally in the form of food availability, income generation, basic nutritional fulfilment, local employment creation, etc. besides acting as a form of insurance for small landholders in rural areas in incidents of crop failure.

**According to current projections the demand for livestock products is most likely to double by the year 2050**

Livestock rearing is still being practised in traditional ways especially by small and marginal rearers from developing and under-developed geographies. The major challenges are lack of mechanisation, limited technological advancements combined with poor rate of innovation, lack of access to reliable energy especially clean energy and associated infrastructure and financial resources. Mechanisation and integration of sustainable energy driven solutions across the value chain can have catalysing effects in building the resilience of farmers, expanding opportunities for increased income generation (through increased production and reduced input costs) while also supporting small scale owners in both adaptation and mitigation of climate driven vulnerabilities. Such integration of Distributed Renewable Energy at input, on-farm, post-farm and processing level can significantly improve the sector and build resilience to meet the existing externalities and global consequences that have local impacts on livelihoods and the environment.

## SECTORS

### DAIRY



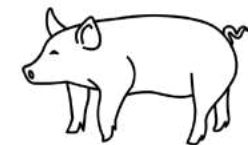
### POULTRY



### FISHERY

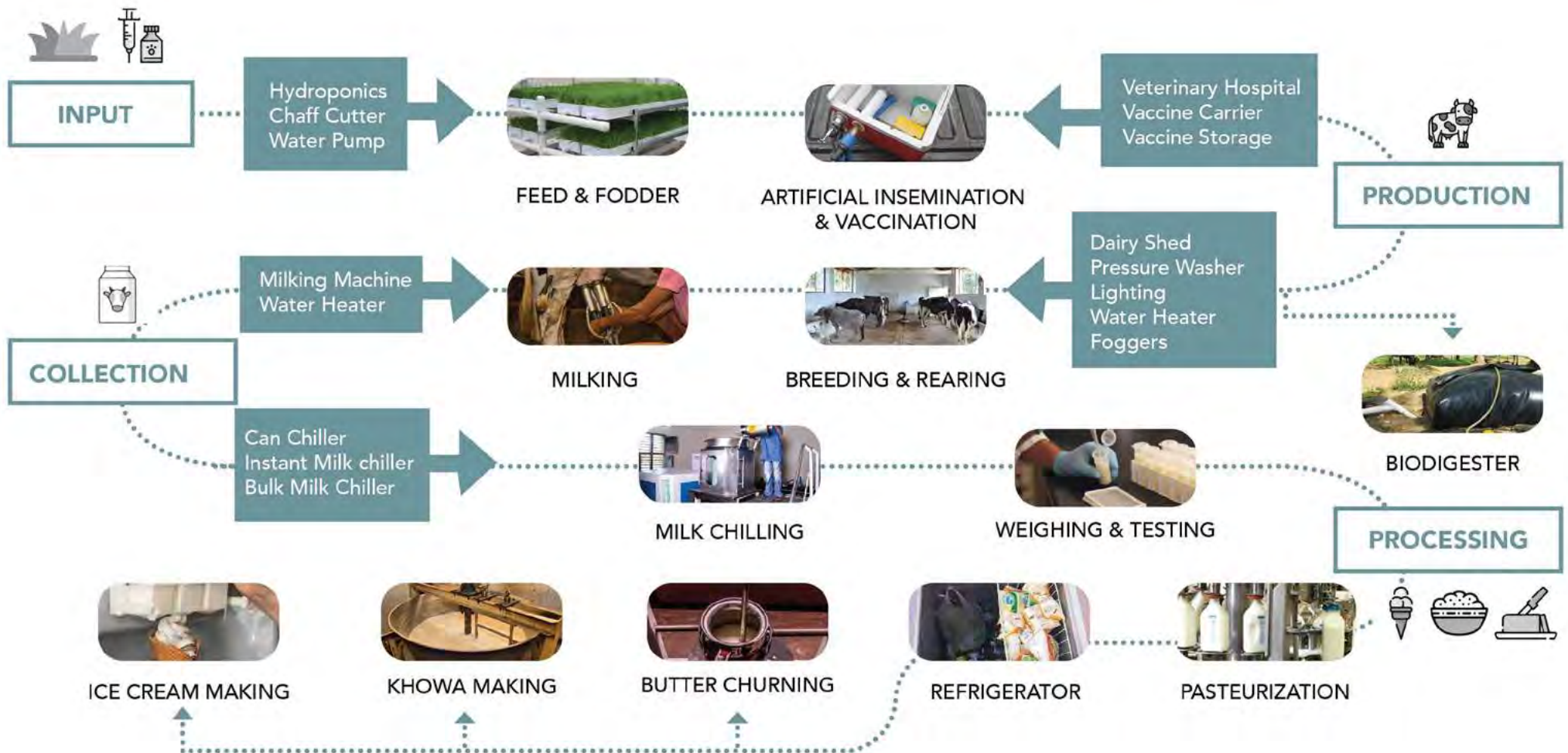


### PIGGERY



# DAIRY

Dairy farms use more energy than almost any other agricultural operation. Energy is required in the milking process, and for cooling and storing milk, heating water, lighting and ventilation. Determining the best energy efficiency and energy management opportunities for dairy farms will help reduce energy costs, enhance environmental quality and increase productivity and profitability. Energy efficiency is often an inexpensive, quick and simple way to save costs and increase income.





## 68. Input : Hydroponics

A hydroponics system is a viable method of producing fodder for dairy cattle feed. The solution promotes nutritious fodder production, thereby increasing milk production, and it also improves the quality of milk produced by increasing the content of unsaturated fat, Omega 3 fatty acids, vitamins, minerals, and carotenoids.

### HIGH INPUT COST

India continually faces a fodder crisis, jeopardizing the health and well-being of over thirty crore cattle. According to the Union Ministry of Fisheries, Animal Husbandry and Dairying, the country is facing a deficit of 23.4% in dry fodder. Such limited fodder availability leads to monumental rise in prices wherein every month dairy farmers are forced to spend more than 50% of their income in buying inputs.

### SMALLER LAND SIZE

Most of the dairy farmers own marginal land. They use this land to grow cash crops and commercial crops. Thereby they do not have sufficient land to grow fodder crops.

### CLIMATE STRESS

Climatic variabilities also have a significant impact on fodder cultivation and availability. Increasing heat stress and variable precipitation changes leading to scattered rainfall patterns, droughts and other disasters pose a challenge to procure nutritious fodder which is a critical input of the animal husbandry value chains. Similarly, in flood prone areas the fodder grown is drained in flood water wherein there is crop loss and farmers are not able to get the fresh fodder to feed the cattle.

### TECHNICAL SOLUTION

Listed below is the smallest unit which is entirely customizable based on the need and capacity of the farmers.

**Unit size:** 7 racks/levels of 4 trays each (i.e. 28 trays) Sprinkler system with timer

**Input seeds:** Typically Maize

**Input requirement:** 750gm- 1kg per tray

**Water requirements:** Roughly 7-10 liters of water per day

**Space requirements:** 13-14 sq ft floor space and height of 7 feet.

**Solar water pumping solution:** Solar panel module of 40W Battery capacity of 40Ah Diaphragm pump of about 50-60W Timer

Seed input per rack	<4kgs (4 trays)
Fodder production per rack	25 to 30 kgs* (Depends on seed type)
Operating Temperature	Up to 50 Degrees.
Power required	0.1 Units in a month (0.0034 KWH/Day)
Solar	40W Panel, 12V
Battery	40Ah Battery
Pump	12V, 40W DC Diaphragm Pump
Feed/Cattle/day	7kg/cattle/day

## FINANCIAL SOLUTION

Loans were mostly leveraged from financiers like KVGB & SKDRDP with a minimum and maximum interest rate of 9% and 14% respectively for a loan tenure of 24 months.



## IMPACT

At the level of each individual farmer, this solution brings about the following impacts

### INCREASE IN INCOME

Income increase for small and marginal farmers owning 2-4 cattle can be between INR. 23,800 (\$308) and INR. 46,000 (\$615) per annum. This is a consequence of two aspects:

### REDUCED FEED EXPENDITURE

The production of green fodder from hydroponics reduces the expenditure on externally purchased feed. Roughly this would result in savings of between INR. 7,800 (\$104) and INR. 15,000 (\$200) per annum.

### INCREASED PRODUCTION AND QUALITY OF MILK (INCREASE IN FAT PERCENTAGE)

Milk production typically increases by about 1 liter per cattle and could be upto 4 liters for each small farmer household. This means an increase in income of approximately between INR. 15,000 (\$200) and INR. 31,000 (\$415) per annum.

### SAVINGS IN TIME AND INCREASED CONVENIENCE

Growing fodder in hydroponics units requires roughly 6-7 days. This reduces the time and effort involved in accessing green fodder from common lands or irrigated lands of other farmers. As mentioned earlier, much of this benefit is seen by women who are primarily responsible for dairy farming activities within the farming household.





## IMPACT

Cutting the fodder into small pieces reduces the damage of the fodder and becomes easy to chew and digest for the animal. Green and dry feed can be given by mixing it well. It helps in **SAVING TIME** and **HUMAN RESOURCES** for cutting a large amount of chaff and **PROMOTES PRODUCTIVITY AND WELL-BEING OF THE END-USER.**

# 69. On Farm : Chaff Cutter

A Chaff cutter is either an electric driven, hand operated or engine driven mechanical device used to cut the straw or hay into small pieces to feed it to the cattle. The cutting of crop residues increases the consumption and palatability of feed, which improves animal digestion and prevents animals from rejecting any part of the food.

### AVAILABILITY OF FODDER

The availability of feed and fodder remains a major area of concern due to the huge gap between its demand and supply in the country. As per the projections, the deficit of fodder is likely to increase to 23%, 40%, and 38% respectively, by 2025.

### TIME CONSUMPTION

It is a time consuming activity which takes away most of the time that can be used for other productive purposes.

### OCCUPATIONAL HAZARDS

In the manual process, force needs to be exerted while cutting the chaff with a sharp tool. In absence of any safety measure, the static position adopted may pose occupational hazards like accidents and musculoskeletal disorders in the long run.



	THROW AWAY	FLYWHEEL	HORIZONTAL	BLOW UP
Output capacity	200-400 kg/hr	100-300 kg/hr	300-900 kg/h	2000-3000 kg/hr
Required motor	1 HP - 3 HP	0.5 HP - 1.5 HP	1 HP - 2 HP	3 HP - 5 HP
Body material	MS body	MS body	MS body	MS body
Weight	110 kg (approx)	50 kg (approx)	50 kg (approx)	150 kg (approx)
Fodder type	Bamboo, Dry Grass, Straw, Corn Stalk, Fresh Grass	Green and dry, straw	Green and dry	Green and dry



# Livestock Immunisation

## PROBLEMS + OPPORTUNITIES

### ANIMAL DISEASES

Livestock productivity is adversely affected by various animal diseases, some of them being zoonotic in nature. Occurrence of diseases causes heavy economic loss in terms of livestock health vis-a-vis production and has serious impact on export of livestock products including germplasm.

### LOW ACCESSIBILITY

Lack of regular supply of vaccines from the veterinary department as a result of remoteness of geography often results in high mortality of chicks when disease is spreading.

### ABSENCE OF CLINICS

Absence of veterinary clinics in the hilly belt and other tough terrains pose a challenge to the farmers who are not able to get vaccines and other emergency medical services for livestock on time.

## TYOLOGY



### DISTRICT LEVEL HOSPITALS

Day-to-day treatment, immunisation, vaccination, artificial insemination, surgical intervention etc. of livestock and bird are carried out by the Veterinary Assistant Surgeon



### BLOCK LEVEL DISPENSARIES

Treatment, artificial insemination, surgical intervention of livestock and poultry etc. Emphasis are given in extension activities like training of farmers, developing linkages with different financial institutions



### MOBILE CLINICS, SUB CENTRES, ARTIFICIAL INSEMINATION (AI) CLINICS

Veterinary activities like in treatment, pregnancy diagnosis, immunization (vaccination) and artificial insemination services. Demonstration and breeding farms for rearing and technologies

## IMPACT

**CONSISTENT SUPPLY** of thermostable vaccines for common diseases

**TIMELY VACCINATION AND AFFORDABLE** cost of vaccination services to remote villages and other tough terrains

Gradual **INCREASE IN THE INCOME** of the end-user due to reduction in the mortality rates of animals



## 70. Input : Vaccine Carrier

In areas with erratic power supply, effectiveness of vaccines reduces considerably even though vaccine storage is available. In such scenarios, a Solar Vaccine storage can act as an effective storage technology.

### VACCINE CARRIER

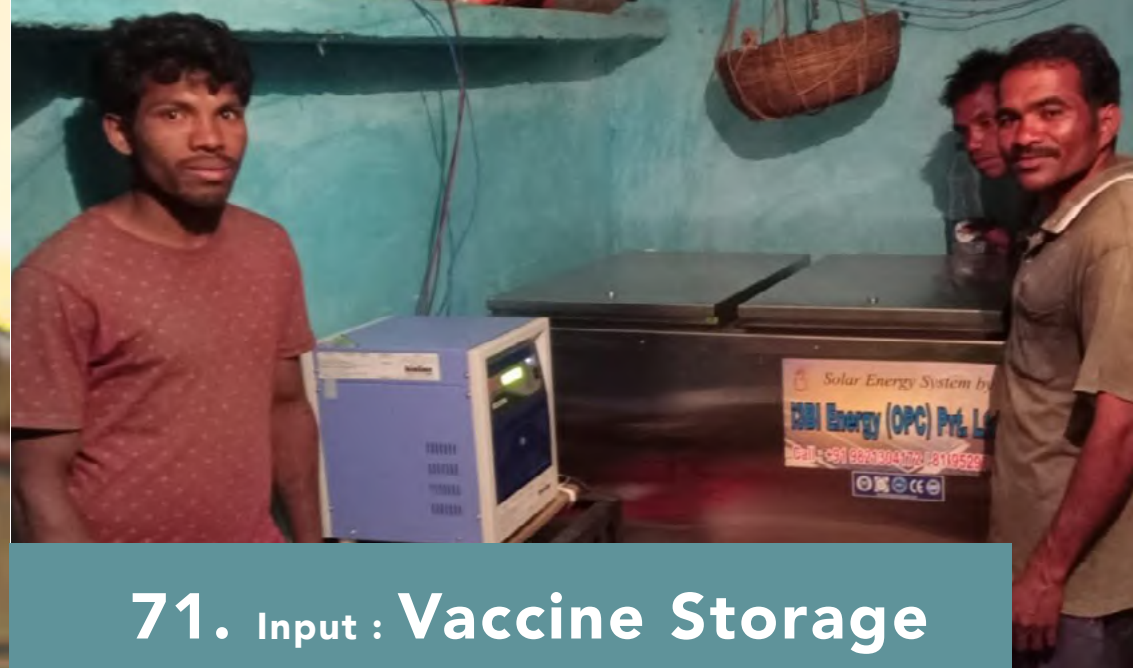
Temperature level: 4 deg C

Holdover period :12 hours  
at ambient temperature 43 deg C

Storage capacity : 2L

#### Key features

Maintains constant 4 deg C at all times  
Holdover period of 12 hours measured at  
ambient temperature of 43 deg C



## 71. Input : Vaccine Storage

Vaccine Carriers are required for transporting vaccines from healthcare facilities to locations where refrigeration is not available. The vaccine storage capacity of vaccine carriers is between 1 to 2 liters.

### VACCINE STORAGE

Storage capacity : 99 L

#### Hold over time

Can retain cooling for upto 4-5 hours at  
max in case of power disruption.  
The battery has a autonomy of 1 day





## Integrated Dairy Shed

72. On Farm : Dairy Shed

73. On Farm : Pressure Washer

74. On Farm : Water Heater

For efficient management of cattle, a thermally comfortable and efficient shed for housing cattle is critical. Poor planning and design can result in increased operational costs to the dairy farmer. Conditions of heat stress, congestion and access to feed and water can negatively affect yield and quality of milk. Housed alongside the cows will be the feed and water dispensers, appliances for milking, cleaning and sanitation as well as for comfort i.e. lighting and fans or cooling application depending on climate type.

The interventions are true for both open/ loose housing type and closed barn style cattle sheds. Closed sheds are preferable in regions of high heat stress, lack of available land for grazing and urban or peri-urban regions

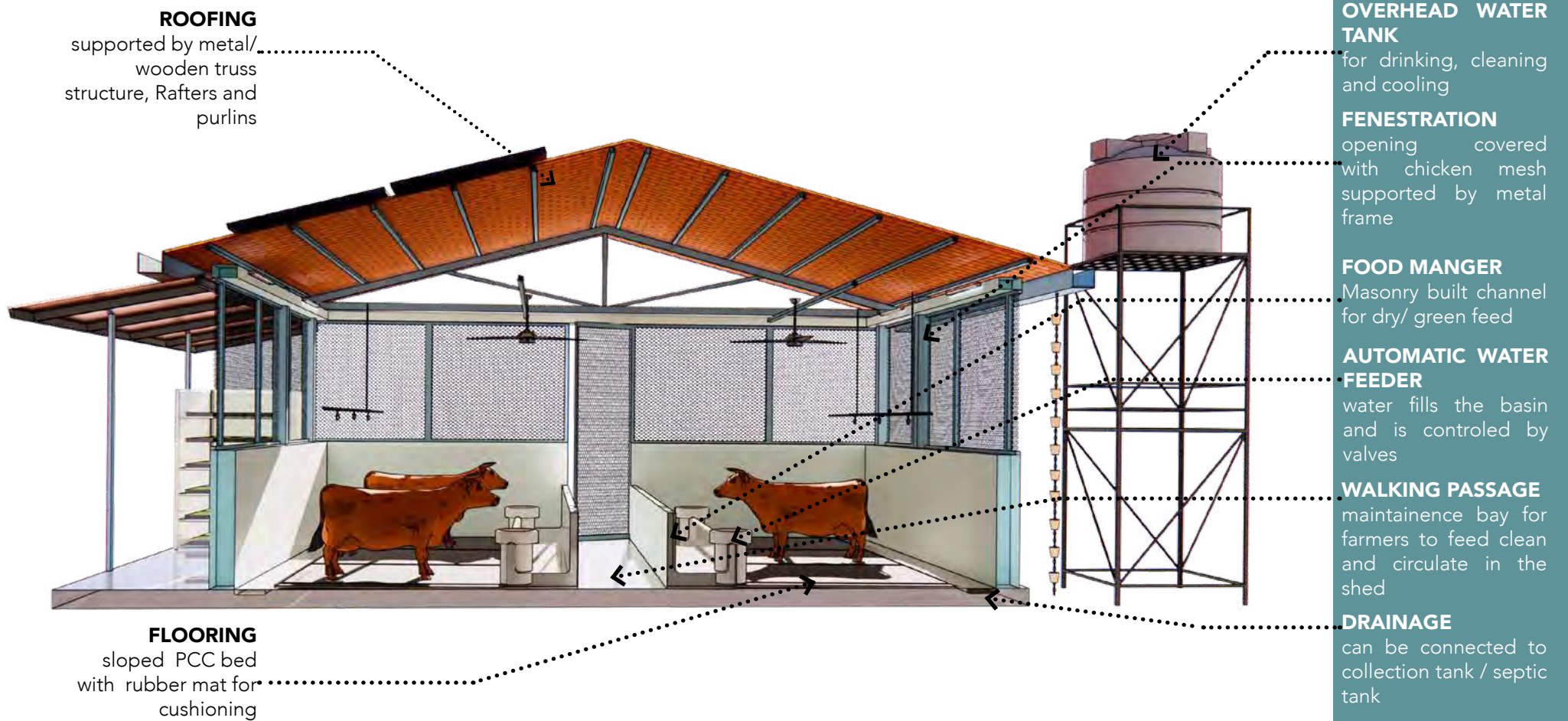
- Behavioural restrictions associated with the use of tie-stall systems
- Heat stress affects cattle : Extreme heat stress, reduces feed intake of cattle by 8-12%. Thus, reducing the milk yield, milk fat and solids which in turn affects the income of the farmer.
  - Reduction in fertility & calving rates
  - Low milk components: Milk Yield reduces up to 20% during summers.
  - Susceptibility to infection

Existing dairy sheds are **haphazardly and unscientifically** built with the use of heat trapping building materials like tin sheet and asbestos which are in constant need of replacement due to climate related damages.

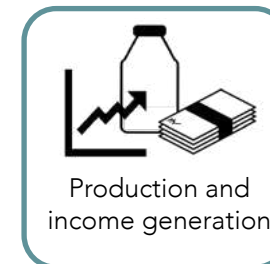
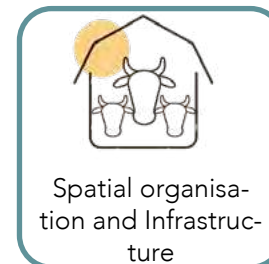
Overcrowding is a common mistake seen in shed management. This leads to concentration of gases like Methane and Carbon Dioxide that adds to increased internal temperature and reduced indoor air quality.

Most dairy sheds have a low clear height of 6 feet, which contributes to the increase in indoor temperature.

## BUILT ENVIRONMENT SOLUTION



## KEY FOCUS ON



# Integrated Dairy Shed

	End user profile	Type of shed	Management services	Energy Services
1.	1-5 cows - most 50% of cows	Attached to the house	Manual water feeder / Automatic OHT motorized Septic tank Pressure washer water heater	Lights and fans Milking machine Single cluster
2.	Upto 10 cows (Hybrid/cross-breed) -70% milching cow	Closed/Free range (Head to head Tail to tail) Storage	Manual water feeder / Automatic feeder OHT motorized Silage tank Septic tank Pressure washer water heater Foggers	Lights and fans Milking machine- Single cluster Hydroponics - 24 to 32 trays
3.	Upto 20 cows (Hybrid/cross-breed) -70% milching cow	Closed/Free range (Head to head/ Tail to tail) Milking area Storage	Manual water feeder / Automatic water feeder OHT motorized Silage tank Septic tank Biogas Pressure washer	Lights and fans Milking machine Double cluster Hydroponics - 48 to 64 trays

**LIGHTING**  
solar powered  
street lights

**ACTIVE COOLING AND VENTILATION**  
Ceiling mounted or wall mounted fans can work for both closed and open type of shed





**LIGHTING**

Solar powered lighting can be used for both closed and open type of sheds

**ACTIVE COOLING**

Solar powered fogger system can be connected to sensors for automatic misting

**HYDROPONICS**

feed system with solar powered fogger system



# 75. On Farm : Foggers

Temperature is a critical element in dairy farming, as it can influence animal health and milk production. Higher temperatures cause heat stress in the cattle, increasing respiration rate and decreasing reproduction and milk production rates. It is convenient as well as economical to keep the animals cool by bathing them in a pond or a lake allowing them to stay there for at least four hours a day. However, availability and proximity to such water resources is a major challenge.

## TECHNICAL SOLUTION

Number of foggers	16
Pump wattage	90 PSI (pound/inch <sup>2</sup> )
Type of sensor	Digital cyclic timer
Temperature difference	4-5 celcius
Components availability	Long term, every component easily available except nozzles (only from them)
Solar panel and Battery	80W , 12V 20Ah, Li-ion 12Vdc

## IMPACT

**PRODUCTIVITY:** Helps in boosting the productivity of the livestock and the overall animal husbandry sector

**MAINTENANCE :** Overcomes the problem of high maintenance and running costs of diesel pumps and grid electricity



## 76. On Farm : Biodigester

### ACCESS TO FIREWOOD

Lack of access to quality firewood aggravated during disasters and inadequate quantities of firewood affect women disproportionately, increasing their opportunity costs.

### ANIMAL MANURE

Among all the sources of waste, those that generate the most amounts of biogas are from animal manure due to their high load of methane-generating (methanogenic) bacteria.

### PRODUCTIVITY

The cow dung easily available in the dairy farms can be used as raw material for the production of the biogas. The biogas produced can be used for making khova sweets on site in the dairy farm. Also, the biogas generated can be used for cooking and other applications in the dairy farm.

### TECHNICAL SOLUTION

A typical individual biodigester unit includes

- Prefabricated biogas digester or reactor with its ancillary components
- Cookstove/burner
- Biofertilizer tank for collection of slurry for agricultural impact manufacturing

### IMPACT

#### ECONOMICAL SAVINGS

The solution is economical compared to other higher cost sources like grid and diesel

#### REDUCED ENVIRONMENTAL BURDEN

It is environmentally friendly as it helps in reducing the load of waste destined for collection sites or garbage dumps, thereby reducing the amount of leachate produced

#### HIGH PERFORMANCE ENERGY

It has good potential as an energy generator and has high performance in multiple processes that demand energy

#### MULTI-TERRAIN SOLUTION

The system can be implemented in regions that have difficulty accessing or procuring conventional modes of energy and can effectively reduce their long term energy costs.





## 77. On Farm : Milking Machine

An efficient milking machine designed with a DC motor powered by solar system has successfully reduced the time involved in milking by 50% over when performed manually. Additionally, it also leads to hygienic milk collection and reduces the labour cost involved as the need to hire people to milk is eliminated.

### **DRUDGERY**

An efficient milking machine designed with a DC motor powered by solar system has successfully reduced the time involved in milking by 50% over when performed manually. Additionally, it also leads to hygienic milk collection and reduces the labour cost involved as the need to hire people to milk is eliminated.

### **LABOUR SHORTAGE**

There is also an acute shortage of skilled labour to perform the activity of milking. Employment of unskilled labour negatively impacts the milk collection while employing skilled labour is cost intensive as they demand high pay. Such scarcity of skilled worker poses a challenge to the livelihood of the dairy farmer.

### **ISSUE WITH CURRENT SOLUTION**

Though there are electric milking machines in the market, lack of access to grid electricity and associated fluctuation can easily damage the conventional milking machines. Also, the existing machines are high power consuming with around 0.5 hp to over 5 hp which can also have detrimental effects on the health of the cattle.

## FINANCIAL SOLUTION

Loans were mostly leveraged from financiers like KVGB & SKDRDP with a minimum and maximum interest rate of 9% and 14% respectively for a loan tenure of 36 months.

## IMPACT

### **FASTER MILKING TIME AND REDUCED LABOUR NEED**

Reduction in the milking time and lesser dependency on labour for milking. This was verified through a socio economic study conducted by SELCO foundation, wherein 92% of the respondents mentioned significant reduction in milking time

### **EFFICIENT MACHINERY WITH LOW POWER CONSUMPTION**

### **INCREASE IN PRODUCTIVITY & INCOME**

### **REDUCTION OF PHYSICAL DRUDGERY**

### **AFFORDABLE, RELIABLE, ENERGY EFFICIENT SOLUTION**

## TECHNICAL SOLUTION



**MICRO FARMS**



**SMALL FARMS**



**MEDIUM FARMS**



**LARGE FARMS**

SCALE	MICRO FARMS	SMALL FARMS	MEDIUM FARMS	LARGE FARMS
<b>MACHINE TYPE</b>	Mini milking machine, Portable trolley milking machine, Nano milking machine & Single bucket milking machine	Single can milking machine, single bucket & double bucket milking machine	These are centralised milking machines with single bucket and single cluster with liners.	These are centralised milking machines with double buckets & double clusters with liners.
<b>BUCKETS</b>	Single bucket	Single and double bucket milking machine	Single bucket	Double bucket
<b>PRODUCTIVITY</b>	Upto 7-8 Cows/ hour	Upto 15 Cows/ hour	Approx 8-10 Cows/ hour	Approx. 12- 25 Cows/ hour
<b>KEY FEATURES</b>	<ul style="list-style-type: none"> <li>• Easy to Install</li> <li>• Easy to Operate</li> <li>• Minimum maintenance</li> <li>• Designed in India</li> <li>• Available in Mobile Type, High Hygiene Standards</li> <li>• Both options are available AC/DC.</li> <li>• Single cow milked at a time</li> </ul>	<ul style="list-style-type: none"> <li>• Easy to Install</li> <li>• Easy to Operate</li> <li>• Minimum maintenance</li> <li>• Designed in India</li> <li>• Economical</li> <li>• Available in Mobile Type, High Hygiene Standards</li> <li>• Two cows milked at a time</li> <li>• Both options are available AC/DC.</li> </ul>	<ul style="list-style-type: none"> <li>• For dairy farms with more number of cows.</li> <li>• Milking is comparatively faster.</li> <li>• This is combo solution i.e both milking machine &amp; sprayer is driven by one motor(1 Hp)</li> <li>• 25L SS tank- 1nos.</li> </ul>	<ul style="list-style-type: none"> <li>• Two cows can be milked at a time,</li> <li>• Double bucket milking machine, with 25L SS tank 2nos.</li> <li>• Driven by a 1.5Hp, 48Vdc motor.</li> <li>• Combo solution with Sprayer and milking machine driven by common motor.</li> </ul>

## MILK PARLOR

A milking parlor is part of a building where cows are milked on a dairy farm. Cows are brought to the milking parlor to be milked and are returned to a feeding and/or resting area.

Cows may also be milked in their housing area using bucket milkers or a pipeline milking system.

Power Consumption : 1 HP  
 Type : 4 Cluster  
 Processing capacity : 10 min per cow



## 78. Collection : Can Chiller

The Can Chiller shall be used for cooling the raw milk after milking in order to conserve the quality of milk and check the growth of microorganisms. It is intended for daily collection of milk.

### INADEQUATE SOLUTIONS

Small entrepreneur are facing losses due to inadequate refrigeration and poor storage

### SMALL SCALE SOLUTIONS

Currently all the milk chillers are of higher capacity and also out of reach of small scale farmers.

### HIGH MAINTENANCE

Current available BMC are very difficult to maintain and are of higher operational expenses. Additionally there is a lack of technology awareness among the dairy farmers.

## IMPACT

### SOLUTIONS AT SOURCE

It is essential to improve the quality of milk. One key factor affecting quality is the time between milking and the first chilling. Milk being a highly perishable product needs to be chilled to  $\sim 4^{\circ}\text{C}$  at the earliest to arrest bacterial growth and retain its quality. The innovative and affordable instant milk chiller makes it possible to chill milk at source - thereby reducing spoilage, retaining quality, increasing shelf life and thereby increasing the income of dairy farmers.

### REDUCED PRODUCTION COST

It has reduced production cost as it works without generator during power outage backup for hours.

## TECHNICAL SOLUTION

Capacity	4 cans per day (40 litres each)
Temperature at the end of the chilling cycle	4 deg C
Duration of Chilling Cycle	3 hrs
Rechilling to maintain the temperature	3 hrs for each milking
Power supply	230 V, Single Phase AC
Power Requirement	1200 W
Refrigerant	R - 404 A



## 79. Collection : Instant Milk Chiller

Instant milk chiller (IMC) reduces milk temperature instantly avoiding milk quality deterioration and bacterial growth.

### **LACK OF STORAGE**

Small farmers and entrepreneurs lack storage facilities which gets compounded by the unreliable supply of electricity. Such lack of electricity hampers expansion and diversification of business across this value chain.

### **USAGE OF MULTIPLE REFRIGERATORS**

With the help of their neighbors, farmers stored milk produced in multiple refrigerators to prevent spoilage and reduce losses.

### **TECHNICAL SOLUTION**

A typical individual unit includes  
Prefabricated biogas digester or reactor with its ancillary components :  
Cookstove/burner  
Biofertilizer tank for collection of slurry for agricultural impact manufacturing

### **IMPACT**

#### **REDUCED SPOILAGE**

The solution has served the entire camel herder community who reported tremendous reduction in spoilage of milk collected at the milk collection centers.

#### **INTEGRATING CAMEL HUSBANDRY**

This has led to an increase in the income of the camel herder community in the region. This has also helped them to sustainably integrate camel husbandry with the modern economy and enhance their livelihood options.

#### **IMPROVED MBRT RESULTS**

The instant milk chilling solution at collection centers/sources becomes essential to lead better Methylene Blue Reduction Test (MBRT) results.



**IMPACT**

**SHORTER COOLING TIME**

This enables milk collected from farmers to be cooled in a relatively shorter period of time, as opposed to the prolonged period taken in conventional bulk coolers

**IMPROVED QUALITY**

Milk cooled in this manner is of higher quality, and helps the end user to fetch premium prices. Reduction in likelihood of milk spoilage is ensured

**80. Collection : Bulk Milk Chiller**

Bulk milk chillers are used for collecting milk at community level. Bulk milk chiller cools milk from 35 C to 4 C. It also ensures that the milk remains within the desired temperature (4degC) till the milk tank arrives for bulk collection.

**NEED FOR QUICK COOLING**

Milk must be chilled to 4 deg C or less within 3.5 hours of milking. However, lack of speedy milk collection is a challenge in remote areas.

**UNRELIABLE SOLUTIONS**

Primary problems with existing traditional milk coolers include unstable cooling rates, slow rate of milk cooling and heavy dependence on grid

**UNCLEAN FUELS**

The traditional systems also rely on diesel generators in absence of a grid which increases cost of cooling. For instance, the milk cooling cost on diesel is typically 1 – 2 INR/L as compared to 0.15 – 0.2 INR/L with grid electricity.

**DIESEL USAGE**

The pilferage of diesel, maintenance after every 500 hours of run time and environmental pollution are other few challenges associated with diesel generators.

**TECHNICAL SOLUTION**



**BULK MILK CHILLER**

Storage Capacity  
1000 L | 2000 L

Power consumption  
1.7 kW | 3.4 kW

Recharging time  
6 - 7 hours



**INSTANT BULK MILK CHILLER**

Capacity : 200 L

Details  
100L per batch  
0.75 TR, 1 kW (approx.)



## 81. Collection : Weighing + Milk Testing

### LACK OF ACCESS TO SOLUTIONS

Since a large number of milk procurement centers are located in the interior rural parts of the country, they face erratic power supply; in the lack of which they are unable to test the quality and other parameters of the produce obtained.

### LOSS OF INCOME

Absence of solution, causing delay in procuring the milk resulting at times in quality of milk getting deteriorated and thus resulting in income loss.

### IMPACT

#### SAVINGS & INCREASED INCOME

Savings through reduced power bills due to reduced dependency on grid power - thus resulting in substantial savings in operational costs - and boosting the income of the members.

#### IMPROVED QUALITY CHECK

Supports in ensuring accuracy in measuring quantity and fat content of milk and in obtaining fair payments by the farmers. It also supports indirectly in reducing the quality variations among the sellers.

#### REDUCED CARBON FOOTPRINT

The intervention also significantly reduces the carbon footprint with the shift from using fossil fuels to generate power

### TECHNICAL SOLUTION

- DC powered with lower ratings of 40W and 6W for weighing & testing machines respectively
- The designed solution gives autonomy of 3 hours/ day.

Solar module	100 (Wp)
--------------	----------

Battery	1320 (Ah)
---------	-----------

Charge controller	15 A, 12 V
-------------------	------------

Capacity	85 W
----------	------

Backup hours	3 hrs
--------------	-------



## 82. Processing : Butter Churner

Butter is one of the most important value-added dairy products. India is the largest producer of butter with annual production of 5035 million tones. Out of the total production of milk in India, 1% is converted into butter.

Even though a lot of potential exists, the traditional dairy product preparation is labour intensive and the quality of finished products are highly variable in terms of physical, chemical, microbiological and sensory properties, so there is an urgent need to produce uniform and high-quality products.

A butter churner is a device used to convert cream into butter. This is done through a mechanical process, frequently via a pole inserted through the lid of the churn, or via a crank used to turn a rotating device inside the churn.

An efficient solar powered agitator was developed which is aimed to be versatile, user friendly, ergonomic and aspirational especially for rural unelectrified households. In a larger context, this device can also be a means of livelihood generation. For this solution, an old DC fan motor was used to churn the butter and this innovation was born out of a need to have a low cost locally manufacturable solar powered kitchen appliance that would be useful in remote regions of the country where grid supply is erratic or non-existent.



### TECHNICAL SOLUTION

14W DC motor was used which was more efficient than the available AC motor driven butter churner in the market.

The presence of the switch on/off button gives flexibility in operations.



## CHALLENGES + OPPORTUNITIES

**EXPOSURE TO SEVERE HEAT:** Different stages of Khova processing includes an active heat source within the workspace that exposes workers to severe heat and drudgery. The active heat source adds to the indoor temperatures along with the rising temperatures.

**PHYSICAL STRAIN DUE TO INEFFICIENT WORKSTATION ERGONOMICS:** The workstation is set up ad hoc, without considering the ergonomic requirements of its user. While the processing activities itself are labour intensive, the un optimised workstation increases the physical strain on the users and reduces their performance

**EXPOSURE TO POOR INDOOR AIR QUALITY:** Smoke and dust generated within the Khova making workspace reads between "Unhealthy" to "Hazardous" on the AQI Monitor, indicating severe challenges to health of the the end users

**LACK OF EFFICIENT STORAGE:** Khova making which involves milk, requires adequate storage to avoid damage of products and income loss for the end user

**COMPROMISED HYGIENE AND INCREASED MAINTENANCE:** The kitchen workspace surfaces are usually uneven and absorbs particles (liquid and solid) which results in time consuming tasks for cleaning and maintenance of hygiene within the workspace

**LABOUR INTENSIVE AND PRONE TO EASY DAMAGE:** The process of Khova making is physically taxing as it requires stirring the milk continuously which leads to severe body pains and joint pain in the long run. And if the stirring is not done continuously, there is reduction in the blend and quality of the Khova reduces.

**LONG WORKING HOURS** (more than 9 hours per day) makes the activity severely drudgery ridden and the production rate is limited

# 83. Processing : Khova Machine

Khova or mawa is dried evaporated milk solids and forms the base for almost all sweets. Both khova making and pedah making requires constant stirring attention which can be a drudgerous task. Solar powered motor to stir the milk continuously, helps reduce the drudgery and improves the quality of Khova.

### OWNERSHIP MODELS

- Rent/ Lease
- Self owned

### TYPOLOGIES

- Cluster based models
- Single Entrepreneur



## TECHNICAL SOLUTION

- DC powered with lower ratings of 40W and 6W for weighing & testing machines respectively
- The designed solution gives autonomy of 3 hours/day.

### 110 L LPG Gas mode

0.5 hp, 24 V

Per batch capacity: 30-35L/batch

### 110 L biowaste model with blower

0.5 hp, 24 V & 30 W blower

Per batch capacity: 30L/batch

### 180 L LPG Gas model

0.75 hp, 24 V

Per batch capacity: 50L/batch

### 180 L biowaste model with blower

0.75 hp, 24 V & 50 W Blower

Per batch capacity: 40-50L/ batch

### 110 L khova machine

Solar Module (72 cells)

2 x 300 Wp, 24 V

Solar battery

2 x 200 Ah, 12 V

Charge Controller

30 A, 24 V

### 180 L khova machine

Solar Module (72 Cells)-

1 in series 3 in parallel

3 x 335 Wp, 24 V

Solar Battery

4 x 135 Ah, 12 V

Hybrid Solar Charge Controller

50 A, 24 V

## FINANCIAL MODELS

Loans were mostly leveraged from financiers with a minimum and maximum interest rate of 9% and 11.5% respectively for a loan tenure of 36 and 48 months respectively. Schemes provided can be for transition to solar energy or for set up of new micro businesses. Under MSME (Ministry of Micro, Small & Medium Enterprises). The maximum loan amount under the scheme which can be availed by an individual or as a firm engaged in MSME activity. The loan period is for 60 months and with an interest rate of 11%.

Some Government schemes under which suitable loans can be availed are: the Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) and the Prime Minister Employment Generation Program (PMEGP)

## IMPACT

**IMPROVED WELL-BEING:** Mechanization has led to reduction in the physical strain involved and has the potential to eliminate other associated occupational hazards.

**REDUCED PRODUCTION TIME :** Production time reduced by half due to mechanisation and better workspace. This Adds 2 more productive hours during afternoons

### REDUCED DEPENDENCY ON GRID:

Dependency on grid supply hampered the khova production due to its erratic and unreliable supply. This was replaced by a solar powered khova machine, post which the production process is uninterrupted even in the rainy season when power cuts are most frequent.

**BUSINESS EXPANSION:** The intervention facilitates product diversification and expansion of business thereby creating backward and forward linkages and generating more sources of income.

### REDUCED LABOUR REQUIREMENTS:

Number of labour required have reduced, which has reduced labour cost for the end user. Number of labour hours earlier required have drastically reduced. They now work for <6 hrs per day.

**IMPROVED WELL-BEING:** Mechanization has led to reduction in the physical strain involved and has the potential to eliminate other associated occupational hazards

Further Khova can be used to make ice cream and other milk based sweet products

# 84. Processing : Khowa Built Environment

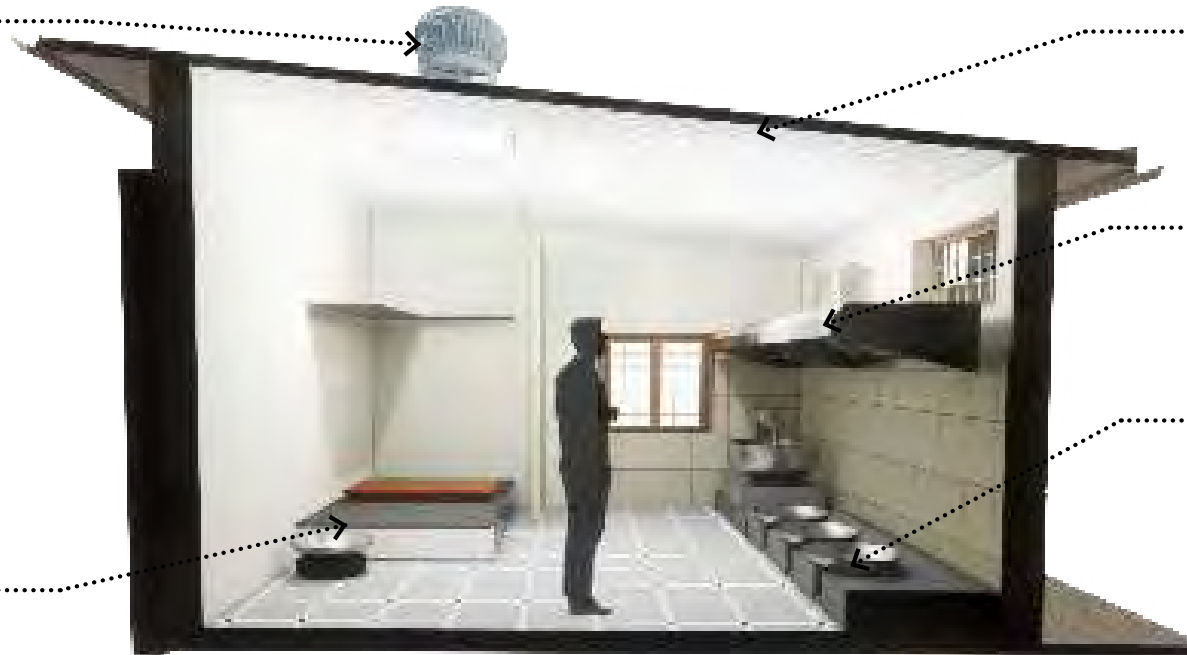
**TURBO VENTILATOR**  
ventilation and natural light system to bring better outflow of hot air

**ROOFING**  
Roofing materials that improves the thermal comfort of the space supported by metal frame

**EXHAUST**  
Solar powered hood for extracting heat from the cook stove

**EFFICIENT CHULAHS**  
Chulahs customised for the particular vessel used in the workspace to save on fuel and uniform heating

**SPAITAL DESIGN**  
ergonomics, workspace standards and better storage



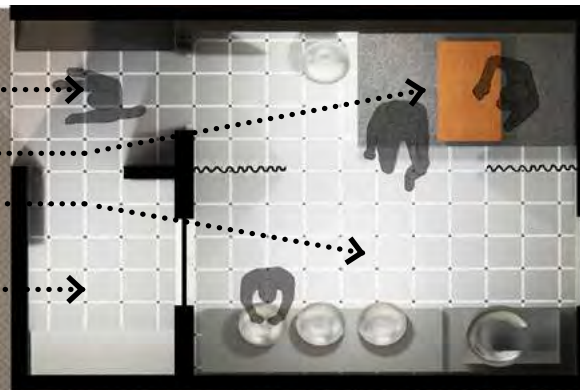
SECTIONAL ELEVATION

**ENTRANCE TO THE WORKSPACE**

**PREP AREA**

**COOKING AREA**

**STORAGE**



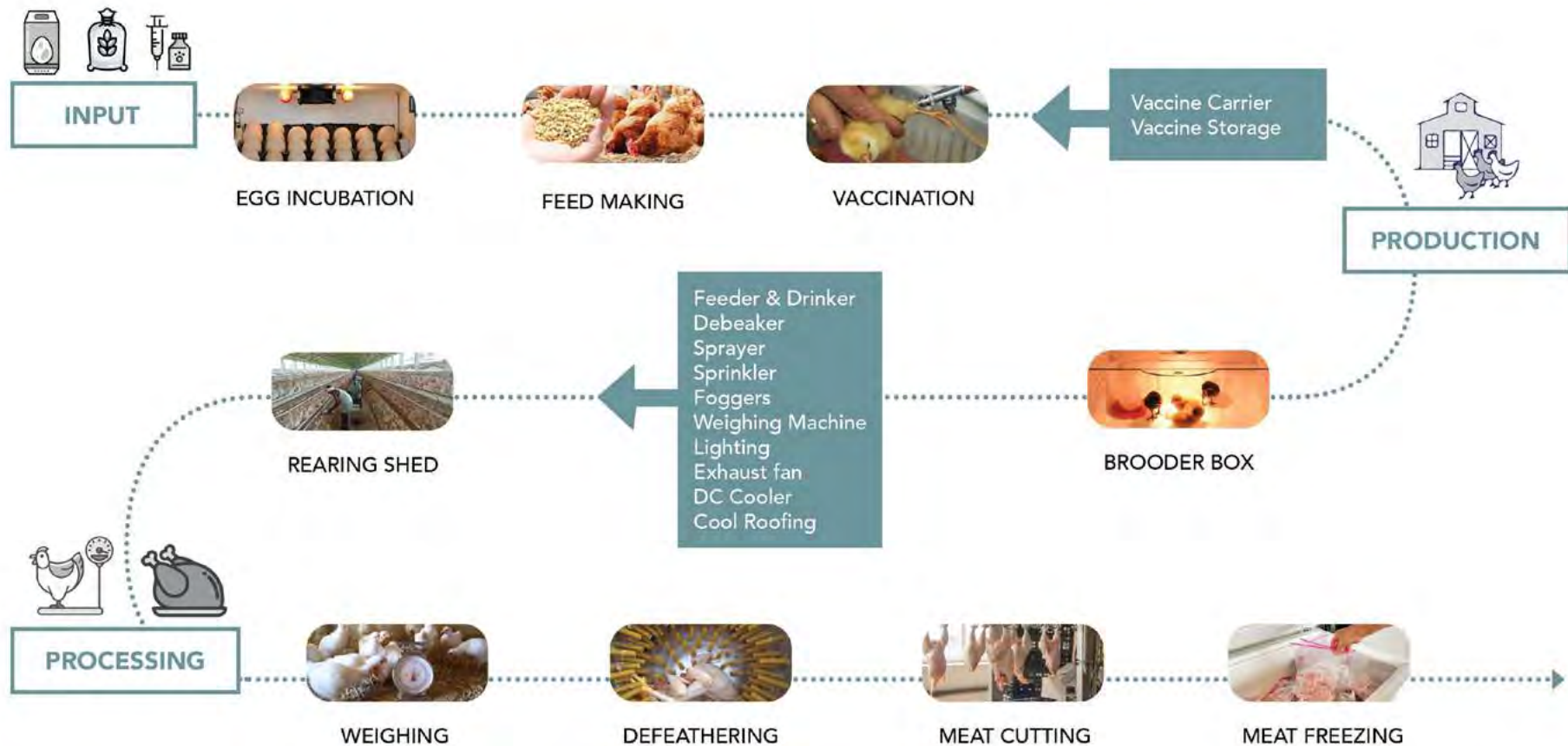
KEY PLAN



VIEW

# POULTRY

The poultry sector in India has undergone a paradigm shift in structure and operation from a mere backyard activity into a major commercial agriculture based industry over a period of four decades from around 1980 to 2017. Small scale backyard farmers usually occupy a small amount of land and depend on makeshift solutions. When compared to large scale poultry companies, small scale farmers tend to use decentralised solutions and methods which require more time, manual drudgery and labour costs. Additionally these farmers find themselves at a disadvantage because of the high cost of feed and transportation, expensive vaccines, veterinary care services, the nonavailability of credit and lack of supporting marketing outreach and infrastructure





## IMPACT

### INCOME ENHANCEMENT

It will lead to direct income enhancement for the entrepreneur/end-user from Day old chicken (DOC) production

### ENSURES SUPPLY QUALITY

Will ensure continuous supply of quality Day old chicks (DOC) to the locality and help revive backyard poultry of indigenous local birds.

### REVITALISE MARKET

This would help to revitalise the market for indigenous poultry bird production and meat demand thereby strengthening local food security..

# 85. Input : Egg Incubator

A significant rural population continues to practise backyard poultry as a supplementary source of income. This economic activity is also collectively taken up by the community who often breed indigenous varieties that fetch higher prices. Among those breeds certain indigenous breeds like the Indian Breed of Black Chickens do not sit long enough on its eggs for hatching, highlighting the need for an incubator. While the rate of hatching in traditional methods is about 40-60%, it increases to about 90% with the use of an egg incubator.

**UNRELIABLE AND POOR QUALITY OF POWER SUPPLY** in rural areas compromise the efficiency of the incubation system leading to **INCOMPLETE HATCHING PERIOD, LOSS OF EGGS, AND HENCE INCOME**. The solar-powered egg incubation device overcomes the problem of uneven heat distribution thereby ensuring better hatching rate.

## TECHNICAL SOLUTION

DETAILS	100 EGG	200 EGG	300 EGG	500 EGG	1000 EGG
IMAGE					
TYPE	Fully automatic	Fully automatic	Fully automatic	Fully automatic	Fully automatic
WARRANTY	1 Year	1 Year	1 Year	1 Year	1 Year
WATTAGE	140 W	140 W	180 W	280 W	460 W

# Input : Vaccine Cold Storage



CROSS CUTTING TECHNOLOGY

Solar system for 500 egg incubators

Solar Module : 3 x 250 Wp, 24 V  
 Solar Battery : 2 x 180Ah, 12 V  
 Solar Power Conditioning unit (PWM) : 1kVA, 24V

# Input : Vaccine carrier



CROSS CUTTING TECHNOLOGY



## 86. On Farm : Backyard Poultry Shed

Backyard/ free range poultry farming is characterised by rearing native chicken in small numbers (10-15) by each household in the backyards under free range system. This being a popular livelihood in rural areas it is also significant in contributing to the rural economy. The birds are allowed for foraging during the day time while at night they are provided with shelter, made of locally available low cost materials. These are usually reared in smaller numbers as there is no appropriate coop/infrastructure present for a large number of birds.

### INCREASED MORTALITY:

While rearing indigenous birds in small ad hoc shelters, they are more prone to predator attacks (rodents and snakes) and challenges due to extreme monsoons which increases the mortality rate among the birds

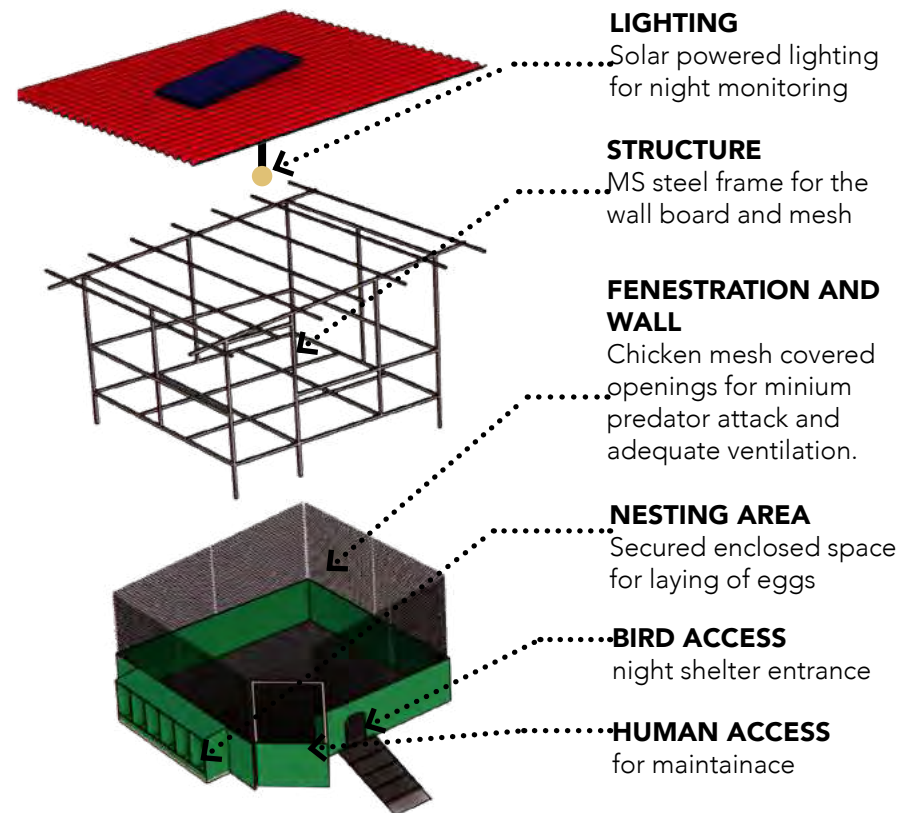
### REDUCED EGG PRODUCTION

Hens are attacked/ disturbed by other birds while laying which results in increased number of egg breakage as well as reduced egg production

### INCREASED MAINTENANCE TIME AND RECURRING COSTS:

Maintaining the coop/ shelter is often labour intensive and often incurs recurring costs in frequent replacement of metal roofing and wall sheets

## TECHNICAL SOLUTION



## IMPACT

**WEIGHT GAIN** in birds can be observed due to better shelter and pace management as reported by the farmers

**DECREASED MORTALITY** due to predator attacks or rainfall

Better **EGG PRODUCTION** and egg yield can be observed

**EASIER MAINTENANCE**



## 87. Commercial Poultry Shed for Broiler, Layer Integrated Sheds and Cool Roofing Solution

Cold stress and heat stress are experienced differently by the poultry birds. Certain behavioural changes due to the cold stress include huddling, while that for heat stress include panting and loss of appetite. However, both result in weight loss and lower FCR, directly affecting the income of poultry farmers.

The type of poultry sheds vary between broiler/ breeder shed/ hatchery unit/ grower shed, etc. which accommodate multiple stages of rearing with varying operations and requirements. And these sheds are mostly locally made with unburnt brick or mesh covering and tin or asbestos roofing. The openings of closed sheds are often covered with tarpaulin sheets due to its lower costs.

Some heat/ cold stress symptoms in poultry birds lead to lowered FCR, weight loss and increased mortality. Hence, the productivity indicators include:

**Average FCR:** 1.5 - 1.6

**Mortality rate:** Maximum 0.8%

**Bird weight:** Big bird - 2kg, Small bird - 1kg

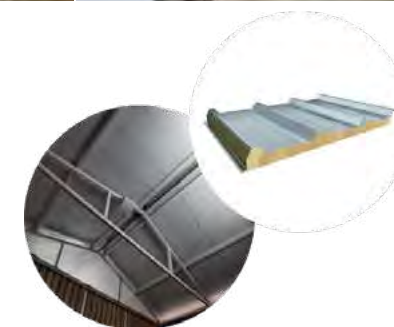
Since poultry birds are largely affected with cold stress or heat stress corresponding to the seasonal changes, there are some seasonal practices adopted by the farmers like avoiding rearing during winters.

### RECURRING COSTS AND DRUDGERY

Those who cannot afford active cooling and heating techniques adopt passive methods like use of curtains, gunny bags, jute false ceiling, thatch over roof (rural), etc. which along with increasing drudgery, also increases recurring costs in frequent replacement of materials.

### INCREASED EXPENDITURE FOR FARMERS

Multiple cooling and heating techniques, both active and passive, are used by farmers. Some active cooling techniques include evaporative and plain coolers, foggers, fans, etc. which results in increased expenditure for the farmers.



**PUF panel** of 50mm thickness with bubble wrap sheet of 12mm thickness for insulation



**White colour coated PPGI sheet** with **bubble wrap sheet** of 12mm thickness for insulation

## INTEGRATED SHED FOR POULTRY

### ROOFING

roofing solution that improves the thermal comfort of the space supported on truss frame

### ACTIVE COOLING

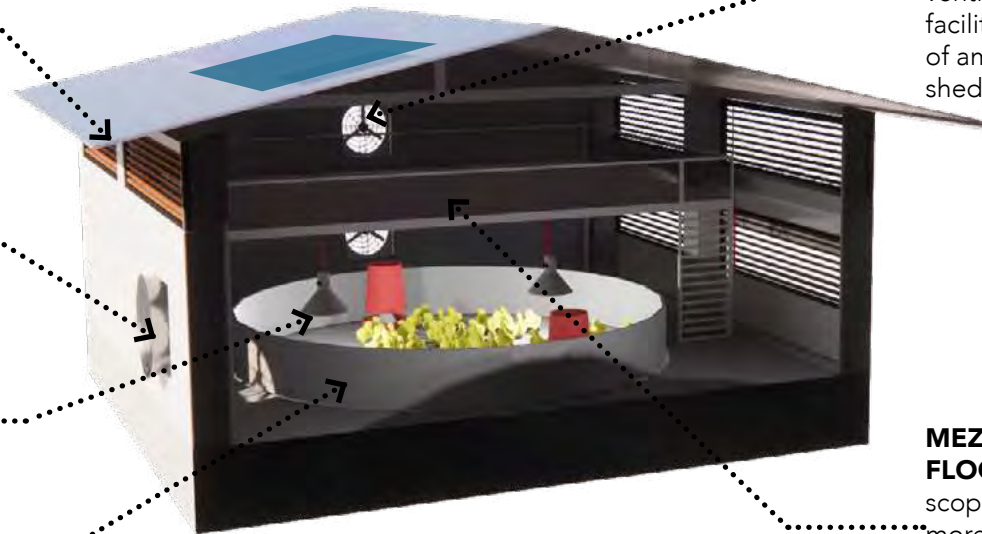
Solar powered DC coolers that works on the principle of evaporative cooling

### BROODER

Solar powered lighting for chick brooding

### BROODING ENCLOSURE

for controlling the area for circulation of the birds



### EXHAUST FAN

Solar powered ventilation system facilitating in removal of ammonia from the shed

### MEZZANINE FLOOR

scope for rearing more number of birds on a smaller footprint

## IMPACT

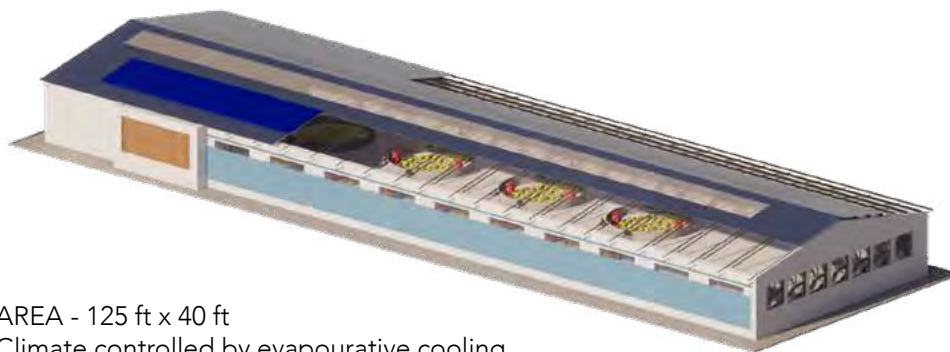
**TEMPERATURE:** Optimised indoor temperatures up to 2 to 3 deg celcius

**FCR:** Optimised FCR between 1.5 - 1.6

**MORTALITY:** Reduced mortality rate within 0.8% limit

**WEIGHT:** Improved bird weight between 1 to 2 kg

## CLIMATE CONTROLLED POULTRY SHED (5000 birds)



AREA - 125 ft x 40 ft

Climate controlled by evaporative cooling method with the help of automation through sensors (Mechanical fans + Cellulose panel)

## CLIMATE CONTROLLED POULTRY SHED (500 birds)



AREA - 40 ft x 15 ft

Climate controlled by evaporative cooling method with the help of DC coolers (addition : ventilators and exhaust fans)



## 88. Lighting

Lighting is important for Layer poultry. These Layer Poultry sheds are open sided and natural day light enters the shed throughout the day. However, the chickens are sensitive to changes in the duration of light. Similarly, the feed consumption is also dependent on lighting and its intensity. They need 14 to 15 hrs of lighting which includes 6-8 hrs of daylight. This combination of light and darkness is provided to maintain the standard weight of the chicken i.e close to 1.5Kgs, which must be maintained to get good production of eggs.

Lighting patterns for broilers are designed to stimulate and control feed intake. As an environmental factor, light is composed of three elements: intensity, duration, and wavelength. The intensity of light affects the behavior of broilers. Lighting duration is largely dependent upon the age of chickens involved and type of housing in use. Colour of light dictated by wavelength exerts variable effects on poultry performance. Darkness is as important to the growth and health of broilers as light. Layer poultry sheds need more lumens of lighting compared to a broiler rearing sheds.

Type of Poultry	Age (weeks)	Minimum light level (lux)	Photoperiod (hr/day)
Broilers	0-0.5	30-50	24
	0.5-1.5	30-50	23
	1.5-market	5	18-20
Breeders	0-3	30-50	14
	4-20	30-50	8
	20-64	30-50	15
Layers	0-6	10-30	15
	6-18	5-10	8
	18-80	5-10	15

### TECHNICAL SOLUTION

LED Lighting (5W *3)	Broiler chicken for approx 450 to 600 birds covering an area of 500 sq ft
LED Lighting (7W *4)	Layer birds for 500 birds covering an area of 800 sqft
Solar Module (36 Cells) and battery	1 x 75 Wp, 12 V 1 x 75 Ah, 12 V
Solar Charge Controller	1 x 10 A, 12 V
DC LED Light	2 x 5 W, 12 V

### IMPACT

**ENERGY :** It is a sustainable solution for the farmers who are dependent upon erratic power supply and non durable battery operated lighting products

**FCR :** Improved FCR help the farmer to earn more income from very low input costs

**MANAGEMENT :** This solution ensures animal have an environment that is conducive for their growth and living, while also ensuring ideal feeding patterns that helps in maintaining the optimal body weight of flock

**EGG PRODUCTION :** The solution helps in reducing the losses in egg production rate and enhances the income of poultry rearer





## 89. Brooder Box

Brooders help poultry chicks to undergo development of internal organs that they aren't naturally equipped to handle. They need an ambient temperature of around 35 degree celsius for two weeks, that needs to be artificially maintained as feather features are under development. Ventilation for proper airflow and removal of ammonia is important for their health.

### CHALLENGES OF FUEL

Small farmers (with flock size around 400-500) use tin container **coal/wood based heating systems**, sometimes gas brooders, and one bulb for lighting which are not safe as there is a risk of chicks spilling charcoal if not observed closely.

### LIGHTING NEEDS

**Continuous light** is required for accelerated feeding, which enables them to consume more and hence grow faster which is not ensured in absence of brooder box

### MORTALITY RATE

Gas brooder causes **mortality** of chicks if not closely observed when the gas cylinder becomes empty. Monitoring the whole process is challenging with conventional methods. Additionally, gases from charcoal brooder are harmful due to improper combustion.

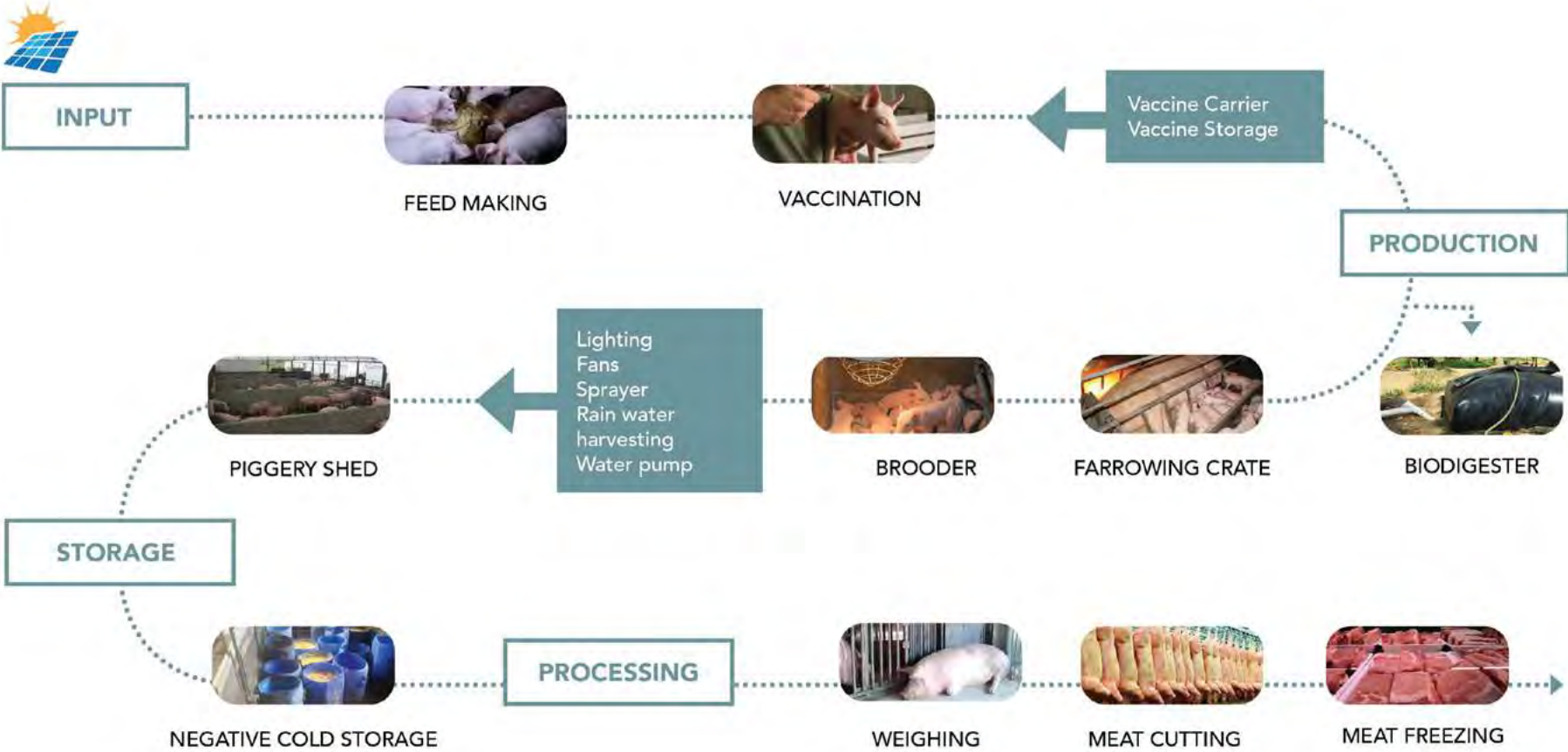
### IMPACT

This will **LOWER MORTALITY OF BIRDS** in the rearing process as this stage plays a vital role in internal organ development. If the required temperature of 35 deg C is maintained throughout brooding, mortality of 4-5% can be minimised in later stages.

It will also **REDUCE THE OPERATING EXPENDITURE** of the current brooding techniques widely followed by the end users.



# PIGGERY





Input : **Chaff Cutter**

CROSS  
CUTTING  
TECHNOLOGY

## 90. Production : **Farrowing Crate**

Pig farrowing crates are barred metal crates within a pen where pregnant sows are placed shortly before giving birth. Farrowing crates prevent the sows from turning around and only allow them to move a little forwards and backwards.

Alongside the farrowing crate, within the pen, there is an area called a "creep" that the sow's piglets can move into. This is often heated to attract the piglets away from lying next to the sow. The piglets are still able to reach the sow's teats to suckle but when they are in the creep, she is prevented from being able to interact with them

### **RISK OF INJURY**

After giving birth to piglets, there is a possibility that the sow will crush them. A fully-grown sow can weigh around 300kg, a piglet, on the other hand, weighs just one to two kgs. So, if the sow accidentally steps or even lies down on one of her newly born piglets, she can injure or even kill them.

The bars of the farrowing crate are placed so that the piglets can escape underneath them when the sow stands up and lies down, reducing the risk of them being harmed.

### **TECHNICAL SOLUTION**

Size:2.2m\*1.8m,  
Pipe:Dia 33.3×2.5mm;  
Galvanized.Sow feed trough:20L  
SS material; Nipple drinker for sow;  
piglet drinking bowl;  
IR light heating lamp with cover for piglets  
Concrete Slatted floor

### **IMPACT**

#### **ECONOMICAL**

Farrowing crates make for a more economical way of keeping farrowing sows indoors since they take up less space than farrowing pens that allow sows to move freely during and after giving birth.

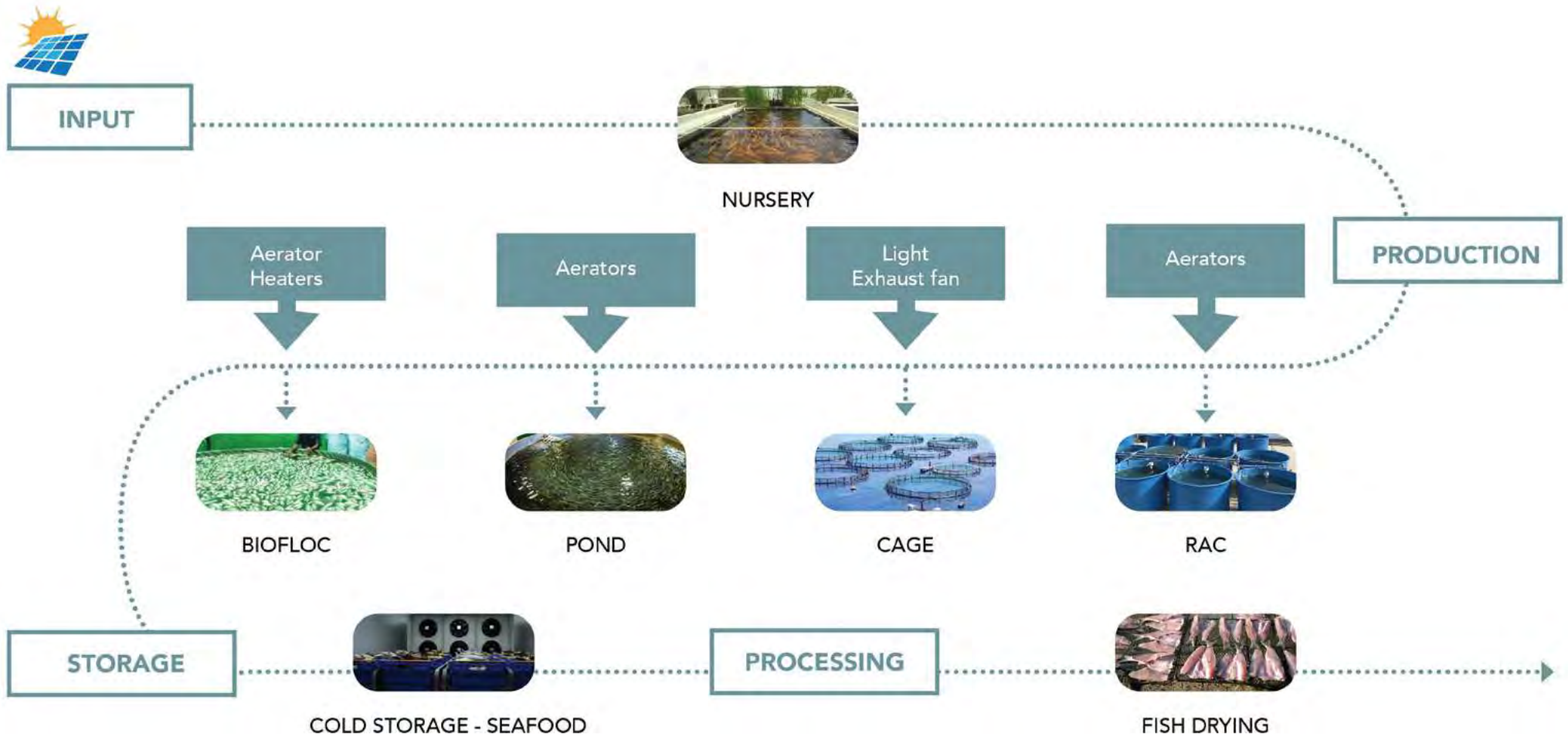
#### **REDUCED FEAR OF INJURY**

It is also easier for farmers to look after the sows without fear of being injured by a mother protecting her young

#### **REDUCED PIGLET MORTALITY**

Farrowing crates are also thought to reduce the possibility of accidental piglet mortality and hence increase production and economic return, though this is not always the case.

# FISHERY





**IMPACT**

**REDUCED MORTALITY**

Reduces the mortality rate of fishes by providing better aeration

**IMPROVED GROWTH**

Improves the growth rate of the fishes by ensuring proper functioning of natural ecosystem underwater

**INCREASED INCOME**

Increase in income of practitioners of fishery by increasing yields and saving on operation costs

# 91. Production : Fish Aerators

Aerators are mechanical devices used for aeration, or mixing air with another substance, such as soil or water. These devices are used to add oxygen to the water, they are essential for the survival of the fishes in the created ecosystems and enable productivity. An artificial aeration helps to keep the natural ecosystem alive in these artificially created ponds or fish tanks (Bio Floc).

**INEFFICIENT MANUAL PRACTICES**

For Aeration, farmers are using old manual practices like rotating the fishing net creating movement in the pond surface. This method does not have a huge impact on the production.

**RELIANT ON ELECTRICITY**

Solutions available in the market for Aeration are powered by electricity, which is not suitable in off grid areas and using a diesel engine of 2 hp has a huge running cost of Rs. 5000 on an average per month

**TECHNICAL SOLUTION**



**BIO FLOC**

**POND**

**Type**

Solar powered with battery  
Bubble type aeration

Solar powered with battery  
Paddle type aeration

**Weight**

13.6 kgs

120 kgs

**Power Consumption**

25W

350 W- Propellor,  
200W-aerator



## 92. Production : Cage Fishing

### **INEFFICIENT MANUAL PRACTICES**

Because cage culture takes place in the middle of a reservoir, there is no electricity to maintain and monitor inputs, which makes its implementation difficult

### **RELIANT ON ELECTRICITY**

There is also an attached risk of fish theft during evenings and at night, which can pose major losses for the practitioner

### **IMPACT**

#### **REDUCED MORTALITY**

The exhaust fan cools the feed, extending its shelf life thereby improving quality and yield

#### **IMPROVED GROWTH**

Fish can consume insects attracted by light



# Micro Business

In today's world when multiple businesses are piloting and restructuring their approach, ways of operations, space and interactions, linkages etc one needs to closely look at and support the micro and small enterprises and Re-imagine the "new normal" for micro businesses, who are the backbone of our economy, to be able to do the same. Economic setbacks from COVID-19 crisis and increased unemployment rates will need dedicated responses. Micro Businesses contribute in boosting the local economy, creating local employment, and making decentralised services available. Sustainable energy led Micro businesses can promote balanced local regional development of any country in a decentralised and sustainable manner. The solutions further create opportunity for marginalised and vulnerable communities focusing on businesses with less than INR 20 Lakh (USD 2500) annual turnover, with individual or group ownership (less than 10 members) and comprising businesses in retail, service, production and manufacturing.





# RETAIL & SERVICES

The entrepreneurs in the retail and service industry are reliant on building their livelihood and income based on the quality of services, hygiene conditions and comfort provided to their customers. The factors that affect such workspaces include:

## **BRANDING ELEMENTS:**

The image and quality associated with the space is a crucial factor in building brand awareness in such a service based industry.

## **UNINTERRUPTED POWER SUPPLY AND ENERGY EFFICIENCY OF APPLIANCES:**

While all such services require basic lighting facilities either as task lighting or general lighting, some of the businesses are directly dependent on energy based appliances like refrigerators, trimmers, printers, etc. Active ventilation in heat stressed regions becomes very crucial in undertaking livelihood activities.

## **ACCESS TO DURABLE BUILDING MATERIALS:**

Broken roof sheets, tin construction, and unendurable materials expose the entrepreneurs to theft, heat stress, and water leakages through the varying seasons.

## **HYGIENE SETTING AND AESTHETICS**

The hygiene and the aesthetics of the space directly impact the customer base in such a service based industry. Design elements such as efficient storage options to store their products, cleaner service area for the customer to feel comfortable, play an important role in getting in the required footfall. In the summer months, due to a lack of storage facilities, some of the products become unusable under high temperatures



# PROVISION STORES

## LIMITED OPPORTUNITY TO DIVERSIFY PRODUCTS / SERVICES :

Ad-hoc setting up of small scale general stores called “the petty shops” does not allow for diversification of the services and products. In rural areas especially, certain services like printing, xerox are limited. Diversification would provide an opportunity for the entrepreneur as well as the whole local community

## STORAGE AND RACKING :

Storage and Racking: Need for optimised customer interface with products to improve customer footfall and increase sales and income for the entrepreneur. An efficient storage system would also avoid chances of damage to products.

## IRREGULAR POWER SUPPLY

Irregular power supply interrupts business as well as opportunities to diversify with other services

## OPPORTUNITY TO DIVERSIFY

Opportunity to diversify and increase additional sources of income

## OWNERSHIP TYPES

RENT / LEASED

SELF OWNED

## TYOLOGIES

SHOP BASED  
HOME BASED  
PORTABLE  
MOBILE

RURAL  
SEMI - URBAN  
URBAN

## TECHNICAL SOLUTION NARRATIVE

### BUILT ENVIRONMENT ELEMENTS FOR 100 SQ FT UP TO 300 SQ FT

For a petty shop intervention, the solution mix varies widely depending on the entrepreneur's income capacities and enterprising nature. The solution mix is usually installed successively to reduce the capital burden and phase out the solutions. The solution mix includes a printer, xerox machine, refrigerator, lamination services among others.

#### SHOP FRONT ELEMENTS

Basic external branding elements to improve customer footfall: Signage with LED, graphics and shop front display and designs

#### FIT OUT INTERIORS

Ergonomically designed workspace with Storage and display racking for optimised customer interface with products and display lighting

#### FLEXIBLE MODULAR FURNITURE

For customer and entrepreneur comfort and wellbeing. Provides opportunity to diversify products/ services over years of running a shop



## 93. Refrigeration : Refrigerator

REFRIGERATOR- 100 L	100 LITRE, 65 W, 12 VDC. + LIGHT 10 W. (NOT SUITABLE FOR ICE CREAMS, AND NE THE DESIGNS MAY VARY)	150 WP X 2 NOS, 200 AH X 1 NO'S
REFRIGERATOR- 100 L	100 LITRE, 95 W, 12 VDC LIGHT 10 W	150 WP X 3 NO'S, 200 AH X 2 NO'S
REFRIGERATOR- 150 L	150 LITRE, 95 W, 12 VDC LIGHT 10 W	150 WP X 3 NO'S, 200 AH X 2 NO'S
REFRIGERATOR- 200 L	200 LITRE, 95 W, 12 VDC LIGHT 10 W	150 WP X 3 NO'S, 200 AH X 2 NO'S
REFRIGERATOR- 250 L	250 LITRE, 185 W, 24 VDC LIGHT 10 W.	250 WP X 3 NO'S, 150 AH X 4 NO'S
REFRIGERATOR- 350 L	350 LITRE, 185 W, 24 VDC LIGHT 10 W	250 WP X 3 NO'S, 200 AH X 4 NO'S
REFRIGERATOR 200L + JUICE MIXER + SUGARCANE MACHINE PRINTING	COMBINATION OF ESEVA CENTRE + JUICE SHOP	250 WP X 6, 200 AH X 8, SOLAR PCU 4 KW, 5 KVA, 96 VDC.

\* INDICATIVE DETAILS

### TYOLOGIES

DAIRY COOLER	BOTTLE COOLER	MEAT STORAGE
1 TO 11°C	5 TO 8°C	2 TO 4°C
MILK, ICE CREAMS ETC.	COOL DRINKS, WATER ETC.	FISH, PRAWNS, MEAT, ETC.
VACCINE SAVER	FRESH FRUITS & FRUIT PULPS	
2 TO 8°C	-10 TO 0°C	
VACCINES, MEDICINES, ETC.	FRUIT PULPS, ICE ETC.	



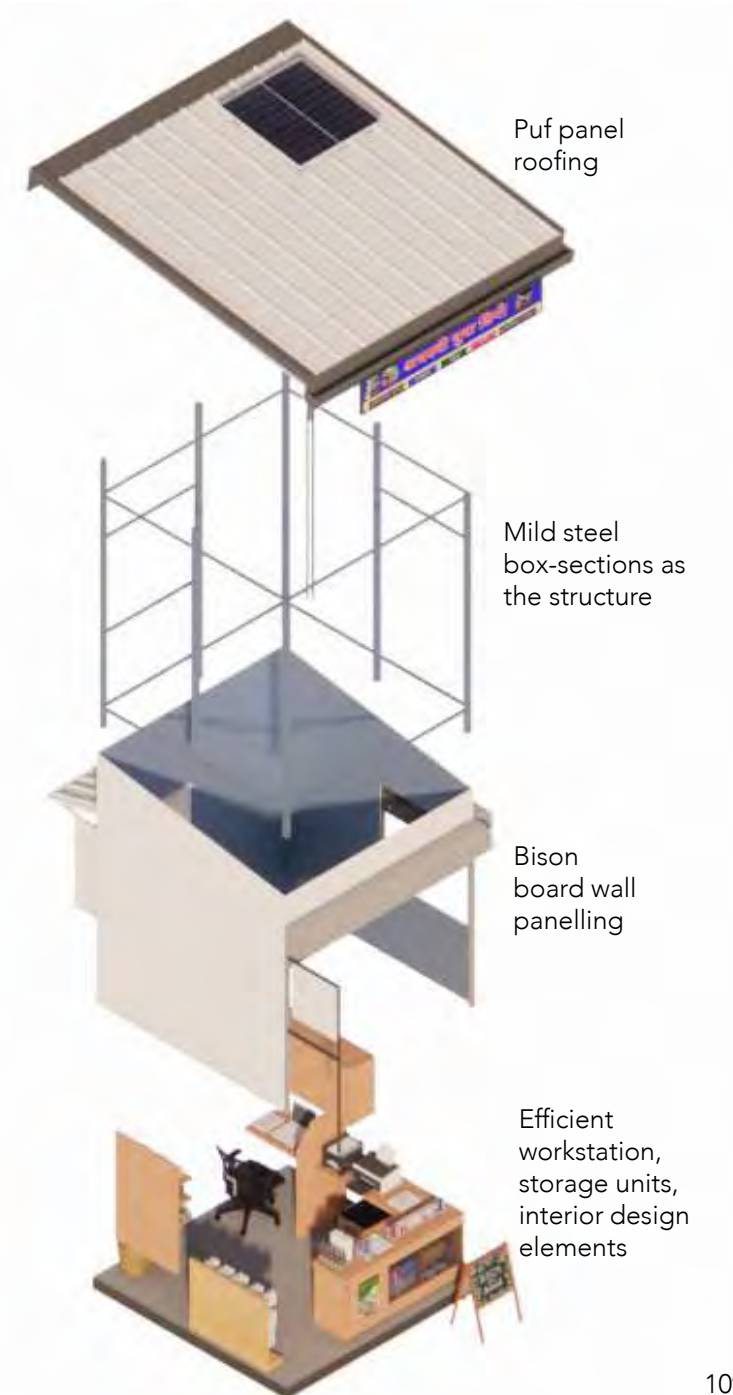
## 94. Printer and Copier

## 95. Digital Service Centre

ENERGY APPLIANCE	EQUIPMENT	SOLAR SYSTEM DETAILS
PRINTER/XEROX	EX: EPSON 3256, EPSON L380, EPSON ECOTANK L3110, CANON PIXMA, CANON (G2010/ G3010), HP (DESKJET GT 5810/ 5820).	OPTION: 100 PAGES A DAY 40 WP PANEL, 20 AH BATTERY, 150 W 12 V MICRO INVERTER OPTION: 200 PAGES A DAY 40 WP PANEL, 40 AH BATTERY, 150 W 12 V MICRO INVERTER
PRINTER + LIGHT + FAN	EPSON PRINTER 10 W LIGHT PEDESTAL FAN 18 W.	60 WP, 60 AH BATTERY, CHARGE CONTROLLER 12 V, 10 A. MICRO INVERTER 150 WATT.
PRINTER+LAPTOP+ CAMERA+LIGHTING	LAPTOP, CANON CAMERA, PRINTER	150 WP X 2 NOS, CHARGE CONTROLLER 12 V 30 A, MICRO INVERTER 150 W.
LAPTOP/PC, PRINTER/XEROX/ INTERNET MODEM, LAMINATION, BIOMETRIC, CAMERA, LIGHTING	E- SEVA CENTRE (GRAM ONE MODEL)	335 WP X 4, 150 AH X 4, 2.5 KVA, 48 VDC.

# 96. Built Environment : Digital Shop

Shop Front elements	Basic external branding elements to improve customer footfall: Signage with LED, graphics and shop front display and designs
Fit out interiors	Ergonomically designed workspace with Storage and display racking for optimised customer interface with products and display lighting
Flexible modular furniture	For customer and entrepreneur comfort and wellbeing. Provides opportunity to diversify products/ services over years of running a shop





## 97. Juice Shops : Sugarcane Juicer

## 98. Juice Shops : Sweet Lime Juicer

ENERGY AND EFFICIENT APPLIANCES	DESCRIPTION	SOLAR SYSTEM DETAILS
SWEET LIME JUICER- 0.25 HP, 24 V. + LIGHT	0.25 HP, 24 V	300 WP, 100 AH X 2, CHARGE CONTROLLER 24 V, 30 A.
SUGARCANE JUICER: PRODUCTION CAPACITY : 100 GLASSES/DAY. . + LIGHT	0.5 HP, 230 VAC SUGAR-CANE MACHINE	300 WP, 100 AH X 2 BATTERIES, SOLAR PCU 1.5 KVA, 24 VDC.
SUGARCANE JUICER:PRODUCTION CAPACITY : 200 GLASSES/DAY. . + LIGHT	0.5 HP, 230 VAC MACHINE	400 WP, 135 AH X 2 BATTERIES, SOLAR PCU 2KVA, 24 VDC.
SUGARCANE JUICER:+ REFRIGERATOR- 100 L. + LIGHT PRODUCTION CAPACITY : 200 GLASSES/DAY.	SUGARCANE MACHINE 0.5 HP, 230 VAC MACHINE , 200 L CAPACITY REFRIGERATOR.	990 WP, 180 AH X 4 BATTERIES, SOLAR PCU 2.5 KVA, 48 VDC.
REFRIGERATOR + JUICE MIXER + SUGARCANE MACHINE.. + LIGHT	JUICE SHOP: REFRIGERATOR 200 L + MIXTER+ SUGARCANE MACHINE - 0.5 HP.	250 WP X 6, 200 AH X 8, SOLAR PCU 4 KW, 5 KVA, 96 VDC.W

Before intervention : Low productivity (50-100 glasses/day)  
 After intervention : High productivity (150 to 200 glasses/day)

## 99. Built Environment: Juice Shop

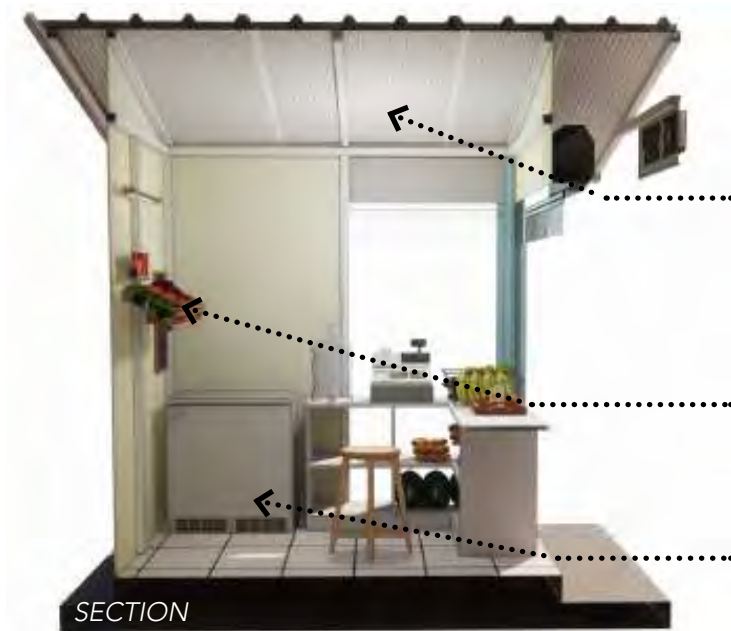


**Lack of brand visibility:** For a service based unit like a juice shop, unique shop front with signage, graphics and display become key in improving the brand visibility of the unit, thus increasing customer footfall

**Time consuming and increased drudgery:** Sugarcane juice vendors who use manually operated juice extractor are required to perform continuous laborious activity, which not only causes physical strain but also increases the time taken for each glass of juice.

**High energy bills:** Diesel and grid operated machines used as juice extractors use 1 HP- 2 HP motors which are energy inefficient as well as increases the energy bills for the vendor

**Need for Efficient Appliances:** A fridge to allow cooling and increase of product shelf life



**STRUCTURE**  
Pre fabricated structure supporting materials that improve the thermal comfort

**SPATIAL DESIGN**  
efficient design with adequate storage

**COLD STORAGE**  
Refridgerator to keep fruits and other commodities fresh



Shop front of the juice shop with the wet space towards one side and the dry service area towards the shop front.



An elevation of the juice shop along with a print shop at the DC office in Trichy, Tamilnadu.



# 100. Built Environment: Vegetable

## Lack of an ergonomic workspace

A service counters are often not ergonomically flexible and comfortable that make it easy for the shop setting.

## Compromised hygiene and increased maintenance

The surfaces in the vegetable shop are usually absorbs particles (liquid and solid) which results in time consuming tasks for cleaning and maintenance for hygiene within the workspace

## Lack of Brand Visibility

Local small scale hotels/ eateries in rural and semi urban require support channels to set their services apart and for increasing the customer footfall. This will allow them to diversify and expand their business

## Heat Stress

Along with the rising external temperatures, there is also an active heat source as part of the workstation which increases the indoor temperatures.

## Lack of refrigeration and storage

Due to the compromised shelf life the entrepreneur is often forced to sell his goods at a lower price and cater to the local demands.

## BUILT ENVIRONMENT ELEMENTS

### Shop Front elements

Unique shop fronts with signage, graphics, front display

### Fit out interiors

Efficient workstation, storage units, interior design elements

### Basic interiors (portable model)

Finishing for walls, flooring and surfaces

### Basic NLV elements

Windows, ventilators and other openings

### Improved Roofing

Improved roofing materials to reduce transmission of external heat to indoors and improve indoor thermal comfort





An interior view of the vegetable shop model. The shop here consists of a service counter with drawers on one side and storage rack that becomes the display on the other side.



An Exterior view of the shop front. The extended counter and the storage racks placed towards the outside allow easy transaction during the purchase.

(Barbershop)

- 101. Barber Shop
- 102. Trimmer
- 103. Salon
- 104. Steamer
- 105. Hair Dryer
- 106. Waxing Equipment

**Need for Task lighting**

Task lighting is critical for barbers to work efficiently. Lack of irregular and improperly placed lighting can affect quality of the services provided

**Lack of Functional Interiors**

Aesthetics, storage and ergonomic workspaces that appeals to the customers as well as provides optimised storage spaces and allows easy workflow

**Rising temperatures**

Heat stress challenges the productivity and working hours by causing poor thermal comfort for the barber as well as his customers and affect products

**Lack of Brand Visibility**

Local small scale barbers in rural and semi urban regions lose their customer base to branded barber/salon chains set up in the urban centres. Barbers lack the required support channels to set their service apart.

**Irregular power supply**

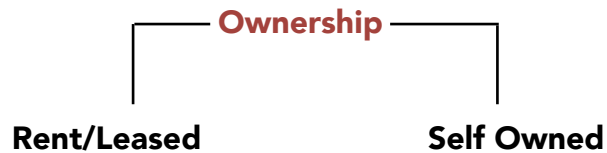
interrupts productive work hours of barbers since primary services like hair cutting and trimming require uninterrupted energy to power appliances like trimmer, hair dryers and especially task lights which are critical for barbers to work with.

**Limited access to Durable Building**

Materials Broken roof sheets, tin construction, and unendurable materials expose the barbers to theft, heat stress, and water leakages through the varying seasons.

**Time consuming**

Manual cutting and trimming takes a longer time. Thus implicating a need for power run trimmers.



**TYOLOGIES**

**Workspace Areas**

**Services and facilities (list)**

100 sq ft

Hair cutting and trimming, shaving, hair dyeing, oil massage

100 to 200 sq ft

Hair cutting and trimming, shaving, hair dyeing, oil massage and facials

200 to 600 sq ft

Hair cutting and trimming, shaving, hair dyeing, oil massage, facials, hair colouring, full body massage

## SOLUTIONS

### Solar Energy system

to allow self sufficiency in energy access as well as transformation into a renewable source of energy. This allows an uninterrupted power supply

### Shopfront elements

such as signage, display area, building facades are important tools that help individual barbers in regions that lack the required support channels to set their service apart.

### Efficient Appliance

Trimmer to reduce the time per service by allowing 40-50 services per day.

### Interior finishing

that ensures not only aesthetics that builds more attraction for the customers but also provides a more ergonomic workspace for the barbers along with ample storage spaces

### Optimised Envelopes

allow better indoor thermal comfort as well as prevents water leakage during monsoon upon proper installation.

## TECHNICAL SPECIFICATIONS

### Energy efficient appliances

#### Trimmers + Light (Barbershop)

### Description

Trimmer 10 W (40-50 services/day)  
2 LED Lights, 10 W.  
1 DC Fan.

### Solar system Details

100 Wp, 12 Vdc.  
Battery - 100 Ah  
Charge Controller with in-built micro-inverter - 12V- 150 W

#### Trimmer, Steamer, Hair dryer, curling iron , straightener) + Light Fan. (Beauty parlour)

Trimmer 10 W,  
steamer- 1500W, Hair dryer- 2000 W, Straightener- 1500 W. Waxing: 300 W. AC machiners.

335 Wp x 6, 200 Ah x 8,  
Solar PCU 4 KW, 5 KVA,  
96 Vdc.



Steamer



Trimmer



Straightner



Hair Dryer



Waxing Equipment

## BUILT ENVIRONMENT ELEMENTS

### Shop Front elements

Unique shop fronts with signage, graphics, front display



### Fit out interiors

Efficient workstation, storage units, interior design elements



### Basic interiors

Finishing for walls, flooring and surfaces



### Basic NLV elements

Windows, ventilators and other openings



### Improved Roofing

Improved roofing materials to reduce transmission of external heat to indoors and improve indoor thermal comfort



## SOLUTION PACKAGES

Package type	Description
<b>Energy + Shop front</b>	This is the basic model provided to ensure optimised and efficient energy use and basic external branding elements to improve customer footfall
<b>Fit out Interiors + Energy + Shop Front</b>	1 + efficient workstation, storage units and interior design elements
<b>Optimising Thermal Comfort + Fit out Interiors + Energy + Shop Front</b>	2 + Improved roofing materials to reduce transmission of external heat to indoors and improve indoor thermal comfort
<b>End to end package</b>	Energy Optimised and sustainable energy driven Barber shop and salon that is Futuristic and Aspirational

## IMPACT

- 2x Income increase, based on a 2x footfall increase
- Reduction of indoor temperatures and humidity to up to 4 degrees celsius
- Dependency on grid electricity has been either completely eliminated or halved
- Time per service has halved where manual trimming is replaced with mechanised trimming
- Other co-benefits like: asset ownership, financial inclusion, improved socio economic conditions, improved overall quality of livelihood can be achieved
- Development of a brand name for the barbershop adds to the aspirational goals of the barbers





## Blacksmithy

107. Blower

108. Powerhammer

109. Angle Grinder

110. Blacksmith Workspace

### Lack of an ergonomic workspace

Workstation designed for a comfortable sitting position and allows an easy workflow, with appropriate storage as well as passive methods for smoke extraction becomes important to ensure more productive hours of work

### Heat Stress

Along with the rising external temperatures, there is also an active heat source as part of the workstation which increases the indoor temperatures.

### Drudgery

Traditional Manual methods for blowing and hammering leading to physical strains in the long run.

### Time consuming and high labour costs

Labour intensive thus leading to high labour costs

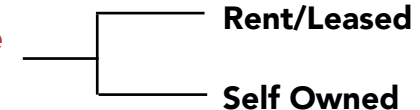
### Irregular power supply

interrupts productive work hours for blacksmiths who use electric powered blowers

### Risk to health

Inhalation of smoke and particulate matter for prolonged hours causes respiratory issues

**Workspace Ownership**



## SOLUTION PACKAGES



### Energy appliance

### Equipment

### Solar system Details

### Description

#### Blacksmithy Blower- 15 W

15 W, 12 V. 5 mm thickness material

Solar Module - 40Wp, 12V, Lead acid battery - 20Ah at 12Vdc

Solar powered blower which speeds up the blowing process and provides temperature control for fabrication

#### Blacksmithy Blower- 30 W

30 W, 12 V. 5 mm thickness material

Solar Module - 100Wp, 12V, Lead acid battery - 120Ah at 12Vdc



#### Power hammer +Black Smith Blower

25 Kg Power hammer, 2 hp, 230 Vac

Solar Module - 335 Wp x 12 Nos, Lead acid battery - 200Ah x 8, 7.5 KVA, 6KW Solar PCU.

Solar powered solution which automates the hammering process. Best suited for all blacksmiths facing physical strain. Suitable for larger instruments as compared to smaller repairs



#### Angle grinder

Modified DC Angle grinder- 0.5 hp, 24 Vdc

335 x 2 Nos, 200 Ah x 2, Charge controller 24 V, 60 A.

For stone polishing, Tool sharpening, grinding purposes.

### Workspace Typologies

Street based portable  
Shop based/  
home based

Rural areas/  
Semi urban areas/  
Urban areas



## BUILT ENVIRONMENT ELEMENTS

### Ergonomic workstation

Workstation designed for a comfortable sitting position at an appropriate height, with placement of all units required for the activity within the ergonomic work circle allows an easy workflow

### Storage Units

Store rooms with shutters and coal storage canister placed within the ergonomic work circle

### Efficient workflow layout

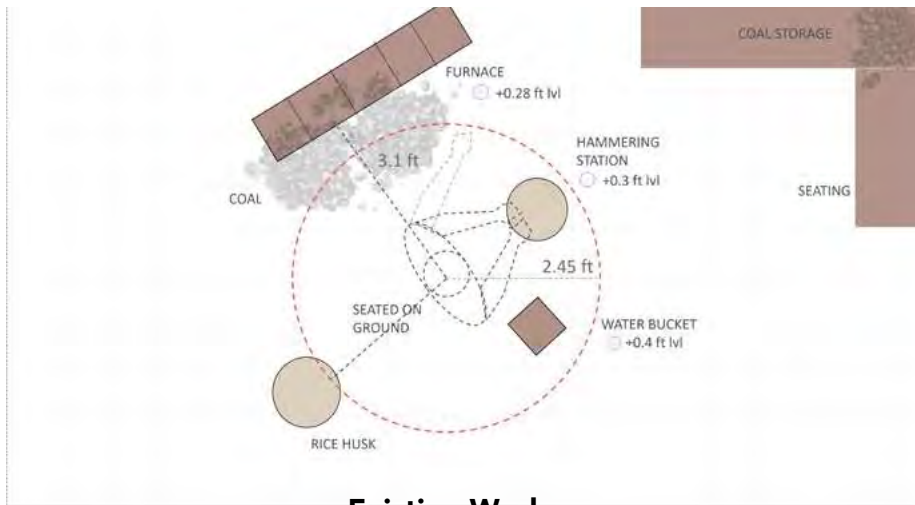
Ergonomics and efficient workflow for seating and standing work

### Natural lighting and ventilation

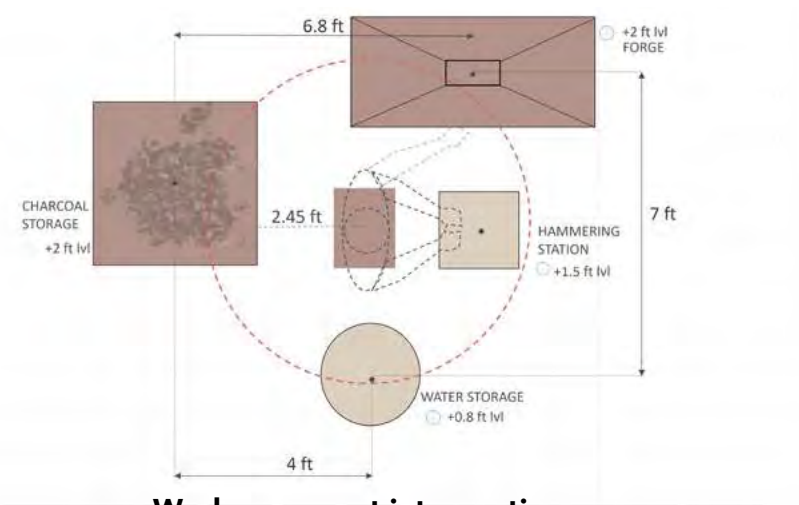
Insulated and raised cool roofing and turbo ventilators, windows and adjustable apertures.

### Forge

Passive designed chimney and forge for efficient combustion and smoke extraction



Existing Workspace



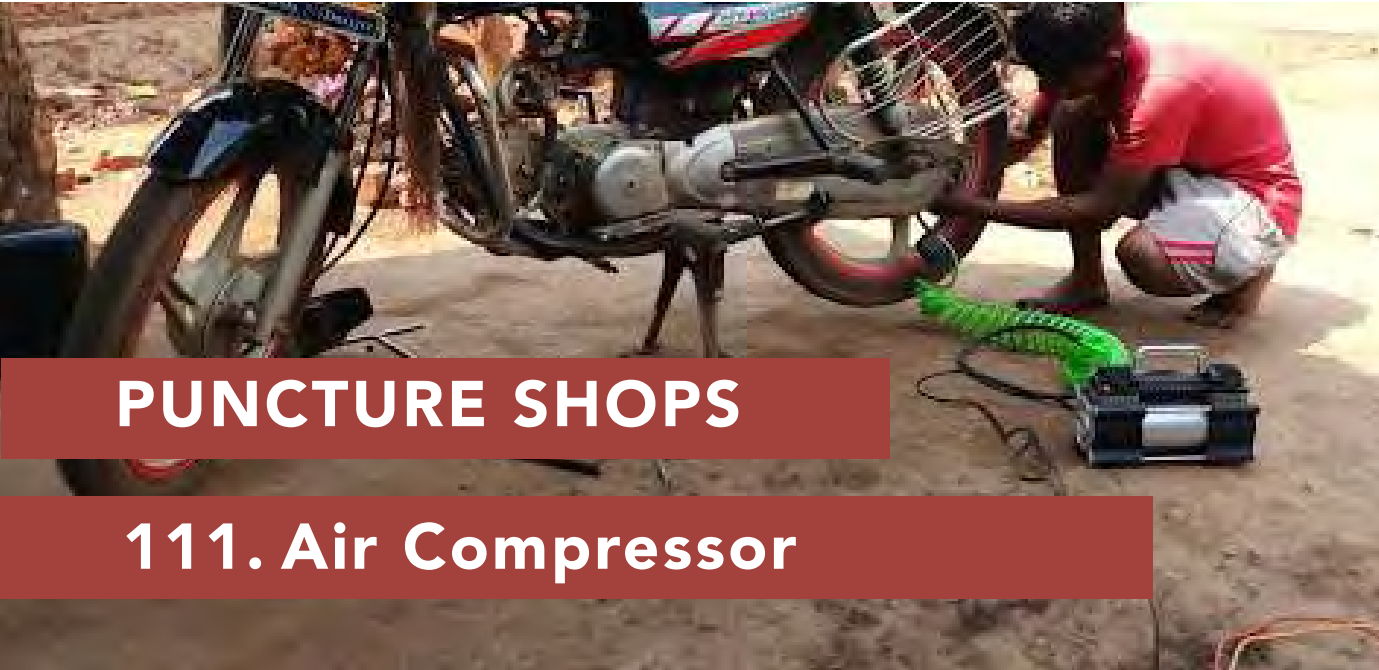
Workspace post intervention





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The solarised  
blacksmith workshop at  
Kolar, Karnataka



# PUNCTURE SHOPS

## 111. Air Compressor

Garages that are off grid, need both **ENERGY ACCESS AND MECHANISATION OF PROCESSES**

Most mechanics need to carry back their equipments home in the **ABSENCE OF A SAFE WORKSPACE**

ENERGY APPLIANCE	EQUIPMENT	SOLAR SYSTEM DETAILS
MINI AIR COMPRESSOR - 0.25 HP. 12 VDC.	MINI PORTABLE AIR COMPRESSOR - 200 W, 12 V	150 WP X 1, 200 AH X 1, CHARGE CONTROLLER 12 V, 50 A.
AIR COMPRESSOR 0.5 HP + SOLAR LIGHTING	DC AIR COMPRESSOR - 0.5 HP, SUITS FOR BIKES, CARS. 10 W LIGHT X 2	300 WP, 150 AH X 2, CHARGE CONTROLLER 24 VDC, 50 A.
AIR COMPRESSOR - 0.5 HP.+ LIGHTING	AC AIR COMPRESSOR - 0.5 HP, 230 VAC. SUITS FOR BIKES, CARS. 10 W LIGHT X 2. 35 LITRE TANK CAPACITY.	335 WP X 2, 200 AH X 2, SOLAR PCU 2.5 KVA.
AIR COMPRESSOR - 1 HP.+ LIGHTING	AC AIR COMPRESSOR - 1 HP, 230 VAC. SUITS FOR BIKES, 65 LITRE TANK CAPACITY. CARS, LORRY. 20 W LIGHT X 2	200 WP X 6, 150 AH X 4, SOLAR PCU 4 KVA, 3 KW.
AIR COMPRESSOR - 2 HP.+ LIGHTING	AC AIR COMPRESSOR - 0.5 HP, 230 VAC. SUITS FOR BIKES, CARS, LORRY, TRACTORS, JEEPS. 20 W LIGHT X 2, 95 LITRE TANK CAPACITY.	335 WP X 6, 200 AH X 8, SOLAR PCU 6 KVA, 5 KW.

## 112. Built Environment : Puncture Shop



(Hotels and Eateries)

113. Kitchen with Seating Area

114. Kitchen with Shop Front

115. Catering | Cloud Kitchens

**Lack of an ergonomic workspace**

Workstation designed for a comfortable sitting position and allows an easy workflow, with appropriate storage as well as passive methods for smoke extraction becomes important to ensure more productive hours of work

**Heat Stress**

Along with the rising external temperatures, there is also an active heat source as part of the workstation which increases the indoor temperatures.

**Compromised hygiene and increased maintenance:**

The kitchen workspace surfaces are usually uneven and absorbs particles (liquid and solid) which results in time consuming tasks for cleaning and maintenance of hygiene within the workspace

**Lack of refrigeration and storage**

due to which the entrepreneur is unable to cater to the local demands of ice cream, cool drinks etc. and is forced to sell at a lower price.

**Lack of Brand Visibility**

Local small scale hotels/ eateries in rural and semi urban require support channels to set their services apart and for increasing the customer footfall. This will allow them to diversify and expand their business

**Ownership models**

**Kitchens with seating areas**

Teashop kitchen model with kitchen, seating and shopfront



**Kitchen with shop front**

Bakery kitchen model with kitchen and shop front sales



**Catering or cloud kitchens**

Hotel Kitchen model with efficient workspace layout



**TYOLOGIES**

## Hotel Kitchen (cookstove+Refrigerator+BE)



The floorplan of the Kitchen workspace model. The Kitchen here has been divided into cooking area and service area with a back entry for loading raw materials.



An Interior view of the Kitchen workspace. stainless steel has been here as it remains more durable and cleanable.





### Tea shop (cookstove+tea burner+Refrigerator+BE)



The floor plan of the Teashop workspace model. The floor plan here consists of the cooking zone, service zone and customer cone. The tea counter is placed towards the entrance to add value to the shop front to increase the footfall.

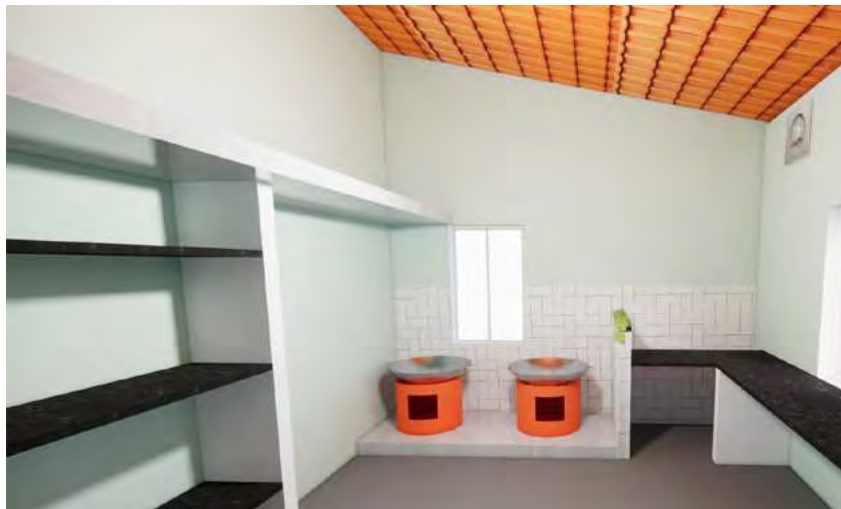


The structure consists of pre-fabricated metal box sections, Bison board walls and puf panel roofing system. A brighter color palette has been maintained through the design.

### Hotel Kitchen (cookstove+Refrigerator+BE)



Teashop kitchen model with kitchen, seating and shopfront



Teashop kitchen model with kitchen, seating and shopfront





(Hotels and Eateries)

# Refrigerator 116. Wet grinder



CROSS  
CUTTING  
TECHNOLOGY

## SOLUTION PACKAGES

Energy Appliances	Equipment	Solar system Details
<b>Refrigerator + Wet grinder + Lighting + Fans. (Hotels, ex trans kitchens)</b>	Refrigerator- 200 L, 230 Vac Wet grinder- 2 hp, 230 V. 60 Kg/hour. 20 W light 230 Vac, AC Fan	335 Wp x 12 Nos, Lead acid battery - 200Ah x 8, 7.5 KVA, 6KW Solar PCU.
<b>Wet Grinder + Lighting, Fan (Hotels, and Individual and SHG)</b>	60 Kg/per hour, 2 hp, 230 Vac Instant wet grinder	335 Wp x 6 Nos, Lead acid battery - 180 Ah x 8, 6 KVA, 5 KW Solar PCU.

*\*Indicative costs Only*

## 117. Fuel Efficient stove

A versatile stove can cook all kinds of food and meet needs of roasting, boiling and frying. It is designed in a range of sizes to cook meals, fry chips etc. It is ideal for big and small street food vendors, institutions, canteens, messes for sweet and snack makers especially in small towns and peri urban areas. They are designed for flat bottom vessels and frying pans with diameters from 40 cms to 99 cms. Fuel saving of 40% over conventional stoves and so reduces cooking cost.



## Biomass-fired oven

Bakery products like biscuits and cakes are becoming popular in villages. The biomass-fired oven offers low baking cost and uniform temperature for all baking trays. Batch size is 90 biscuits each of 16 gms. The baking time is 10 mins and the biomass burning rate is 3 kg / hr. Efficient tava stoves saves 40 kg of fuel every day when utilised for an average of 8 hours.



# VENDING

## 118. Cotton Candy Maker

**LACK OF ACCESS TO ENERGY**

**LOSS OF WORK DUE TO IRREGULAR POWER SUPPLY**

**SCOPE FOR ADDITIONAL SOURCES OF INCOME BY DIVERSIFYING SERVICES**

An inverter system with a lockable battery box, will help him minimise labour time and optimise production

ENERGY APPLIANCE	EQUIPMENT	SOLAR SYSTEM DETAILS
COTTON CANDY MAKING MACHINE	1800 W, 2 MINS FOR ONE SUGAR CANDY.	SOLAR MODULE: 335 X 6 NO, 150 AH X 8, SOLAR PCU 5 KVA, 4 KW.
CORN GRILL BLOWER LIGHT + FAN ( ONE PORTABLE UNIT)	BLOWER FAN 10 W, LIGHT 5 WATT.	SOLAR MODULE: 20 WP, 12 V. SOLAR BATTERY: POLIFEPO4 BATTERY WITH 5 W LIGHT
POPCORN MAKING	2000 WATT ENERGY CONSUMPTION, 230 VAC. 0.25 KG/BATCH.	335 WP X 6 NOS, 150 AH X 8, SOLAR PCU -6 KVA, 5 KW, 96 V.

## 119. Corn Grill Fan

**LOSS OF WORK DUE TO IRREGULAR POWER SUPPLY**

**LACK OF ACCESS TO ENERGY ON A MOBILE CART**

**SCOPE FOR ADDITIONAL SOURCES OF INCOME BY DIVERSIFYING SERVICES**

An inverter system with a lockable battery box will help him minimise labour time, and optimise production

## 120. Popcorn Maker

**LOSS OF WORK DUE TO IRREGULAR POWER SUPPLY**

**LACK OF ACCESS TO ENERGY ON A MOBILE CART**

**SCOPE FOR ADDITIONAL SOURCES OF INCOME BY DIVERSIFYING SERVICES**

An inverter system with a lockable battery box will help him minimise labour time, and optimise production

## Pani Puri

CROSS  
CUTTING  
TECHNOLOGY



## Mobility

# 121. Scooter Shops 122. Autorickshaw Shops

### Livelihood

Scope to Create Income Generating Livelihood via a portable Cart Vehicle

### Flexibility

Willingnes to have a Mobile to enable Flexibility (Eg Printing Unit)

### Secondary Income source

Willingness to add secondary sources of income.

### Access to Energy

Lack of Access to Energy for mobile Units

ENERGY APPLIANCE	EQUIPMENT	SOLAR SYSTEM DETAILS
MOBILE PUSH CART ( VEGETABLE CART)	LIGHTING 10 W + WEIGHING SCALE + MOBILE CHARGING.	75 WP, 60 AH BATTERY, CHARGE CONTROLLER 12 V 10 A WITH MICRO INVERTER- 150 W.
MOBILE PRINTING SERVICE (ON SCOOTER)	SCOOTY, PRINTER - 15 W- 100 PAGES PER DAY, LIGHTING- 10 W, SOLAR BATTERY	SOLAR MODULE: 40 WP, 30 AH SMF BATTERY. MICRO INVERTER- 150 W, 12 VDC/230 VAC.
MOBILE SNACK MAKING UNIT (THREE WHEELER AUTO)	LIGHTING+ REFRIGERATOR- 100 LITRE	SOLAR MODULE: 150 WP X 3, 30 AH SMF BATTERY. MICRO INVERTER- 150 W, 12 VDC/230 VAC.
MOBILE EATERY ( FOOD AND SNACKS)	LIGHTING 10 W X 3 NOS	75 WP, 60 AH BATTERY, CHARGE CONTROLLER 12 V 10 A
MOBILE JUICE MAKING (ON THREE WHEEL AUTO)	SUGARCANE JUICE MACHINE- 0.5 HP, 230 VAC. 100 GLASSES PER DAY 2 - LIGHTING 10 W, 230 VAC	SOLAR MODULE: 200 WP X 2,SOLAR SMF BATTERIES: 135 AH X 2, 2.5 KVA SOLAR PCU.



## TYOLOGIES

1. PHYSICALLY DISABLED ENTREPRENEURS
2. MARGINALISED COMMUNITIES
3. INDIVIDUAL ENTREPRENEURS
4. HOME BASED
5. COMMERCIAL SPACE BASED  
MOBILE EATERIES OR SERVICE PROVIDERS

# MANUFACTURING & PRODUCTION

Manufacturing and production businesses can play a crucial role in the development of poor communities post-COVID-19. The key features for adaptation are including the measures to design the built spaces for external heat, weather conditions and combining the same with efficient applications, improved heat application and workstation designs to improve wellbeing and productivity levels for the production and manufacturing lines for various individual entrepreneurs and groups.



## 123. Rope Making

### LACK OF OPTIMISED STORAGE

Efficient use of space with optimised storage can allow careful storage of final products

### LACK OF OPTIMISED ERGONOMICS

It enables the end users to increase their productive hours by ensuring comfort

### PHYSICAL STRAIN AND HIGH LABOUR COSTS

Using traditional Ratts for spinning coir yarn involves more of physical drudgery and additional labour requirement

### IMPACT

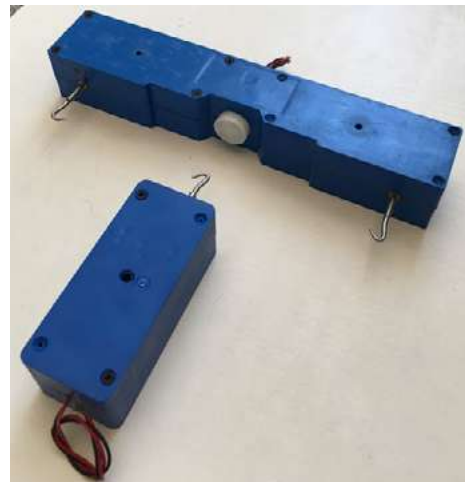
**REDUCED DRUDGERY:** All the users have positively acknowledged that intervention has made a difference in terms of reduced physical effort.

**REDUCED EXPENDITURE:** When compared to earlier situations, users have seen tangible savings in terms of the wages that they had to pay earlier for labour. This has added to the user's overall earnings.

**INCREASED PRODUCTIVITY:** Solar rope making machine, increases the productivity in terms of labour as well as in terms of volume of output produced.

**REDUCED INJURIES:** Users have witnessed a decrease in workplace mishaps since the adoption of the machine

### TECHNICAL SOLUTION



Coir Rope making (Electronic Ratt) to make 15 feet coir fibre ropes. 10 W. Two hooks model.

Solar system: 75 Wp, 60 Ah battery, charge controller 12 V, 10 A. 8 hours operation.

Rope making 0.5 hp, 24 V- 4 hooks model suits for 100 feet ropes (Coir, plastic, sisal, fibre types)

300 Wp x 2, 200 Ah x 2, Charge controller with wireless remote regulator 50 A, 24 V. 4 hours back up

Suits for 100 feet length 4 yarm ropes of coir, plastic, sisal, old sarees



**Pottery Unit :**  
**Blunger**  
**Jigger Jolly**  
**Pugmill**  
**Pottery Wheel**  
**Kiln**  
**Walk-in Kiln**

Pottery is one of the oldest traditional livelihoods in India, and thrives as both an art form and a means to create functional items. The craft has been practised and passed on over generations with the form constantly evolving. In the last decade, the industry has been introduced to technological interventions aimed towards reducing drudgery. However, lack of access to information, lack of markets, absence of reliable sources of energy and easy financing holds back the community from completely switching to modernisation.

## CHALLENGES + OPPORTUNITIES

### **HEAT STRESS AND EXTREME RAINFALL**

Along with rising external temperatures, there is also an active heat source as part of the workstation which increases the indoor temperatures. Furthermore with rains - drying of pots and productivity is dramatically reduced in monsoon months

### **LACK OF AN ERGONOMIC WORKSPACE**

Workstation designed for a comfortable sitting position and allows an easy workflow, with appropriate storage as well as passive methods for smoke extraction becomes important to ensure more productive hours of work

### **LOW PRODUCTIVITY AND PHYSICAL DRUDGERY**

The productivity of the pots or any other products associated to the wheel is very low as it takes a lot of time to make any product in a manual wheel and the work comes to a stand still in case of power cuts while using an electric wheel.

### **TIME CONSUMING AND INCREASED DRUDGERY**

A manual pottery wheel requires labour and involves a lot of drudgery and time.

### **IRREGULAR POWER SUPPLY**

The mechanised electric AC pottery wheel not only increases electricity consumption and the subsequent energy bills for the potters but is also inefficient in rural areas where power supply is irregular.

### **LIMITED LOAD CAPACITY**

The pottery wheel size that is commonly used by potters especially in the rural areas limits the loan capacity



## 124. Blunger



## 125. Jigger Jolly



## 126. Pug mill

### TECHNICAL SOLUTION

Power Consumption	180 W
Energy Requirement	180 Wh (1 hour)
Solar Module	300 Wp
Battery	100 Ah @12 V x 2.
Charge Controller With Speed Regulator	24 V, 30 A.
Blunger Size	100 Litres.
Processing Rate	500 KGS/Hr.
Water Clay Ratio	1:1

Power Consumption	1500 W
Energy Requirement	1500 Wh (1 Hour)
Pug Mill Capacity	1.5/2 Hp, 230 Vac.
Production Rate	700 Kgs/Hour.
Solar Configuration	Customized

Jigger jolly machine	0.25 hp, 24 V dc
Panel	335 wp, 100 x 2 Battery, CR 24 V, 30 A

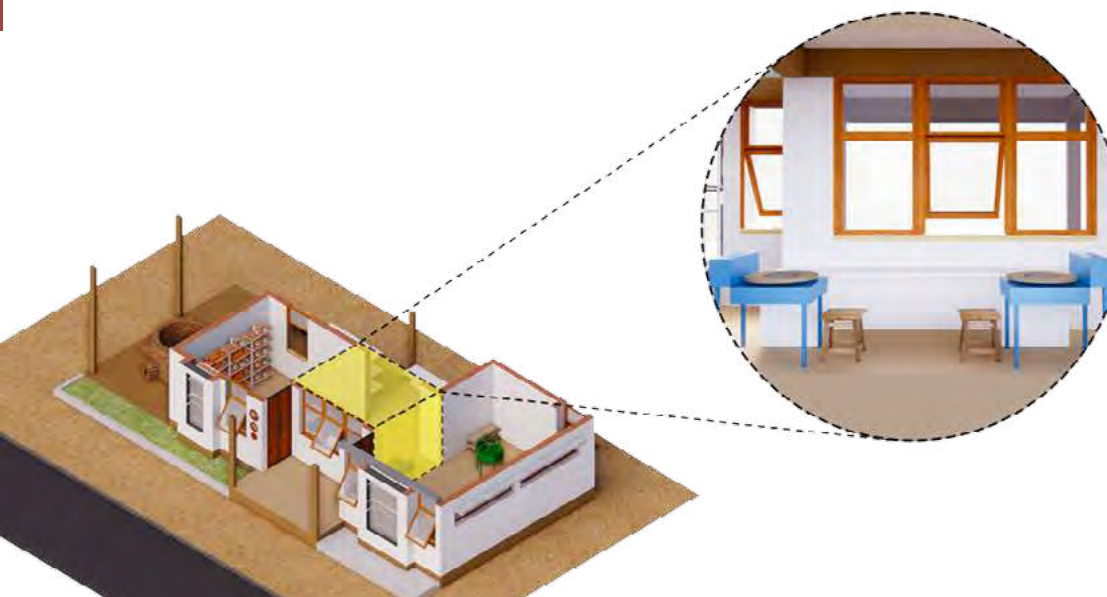


1	Passive built environment elements for natural lighting and ventilation	Roofing material, windows, skylights to improve the natural quality of the workspace
2	Ergonomic workstation	Workstation designed for a comfortable sitting position at an appropriate height, with placement of all units required for the activity within the ergonomic work circle allows an easy workflow. Along with task light positioning to avoid shadow cast due to task light.
3	Storage units	Storage racks with shutter to allow efficient and secure storage of raw materials and final products



## 127. Pottery Wheel

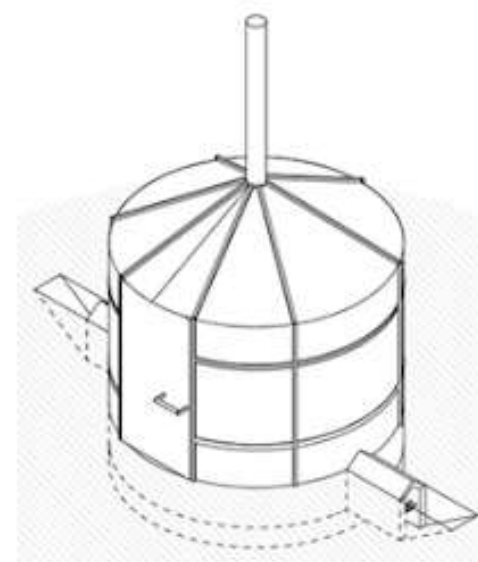
A modified, efficient, high quality and safe potter's wheel with a speed controller for easy operation has been designed. The wheel has also been designed with a more efficient PMDC (Permanent Magnet DC) motor to reduce the overall cost of solar powering the wheel. This simple solution allows for a transformational change in the way potters have been operating traditionally.



	DC Pottery wheel- 0.25 hp	DC Pottery wheel- 0.5 hp
POWER CONSUMPTION	180 Watts	380 Watts
ENERGY REQUIREMENT	720 Wh (4 hours)	1520 Wh
SOLAR MODULE	300 Wp	300 Wp x 2
BATTERY	100 Ah @12 V x 2.	200 Ah @12 V x 2
CHARGE CONTROLLER WITH SPEED REGULATOR	24 V, 30 A.	24 V, 40 A.
WHEEL SIZE	14"/16"/18" INCH	14"/16"/18" inch wheels
MAXIMUM CLAY WIGHT	25kgs to 30 kgs.	30 to 60 kgs.



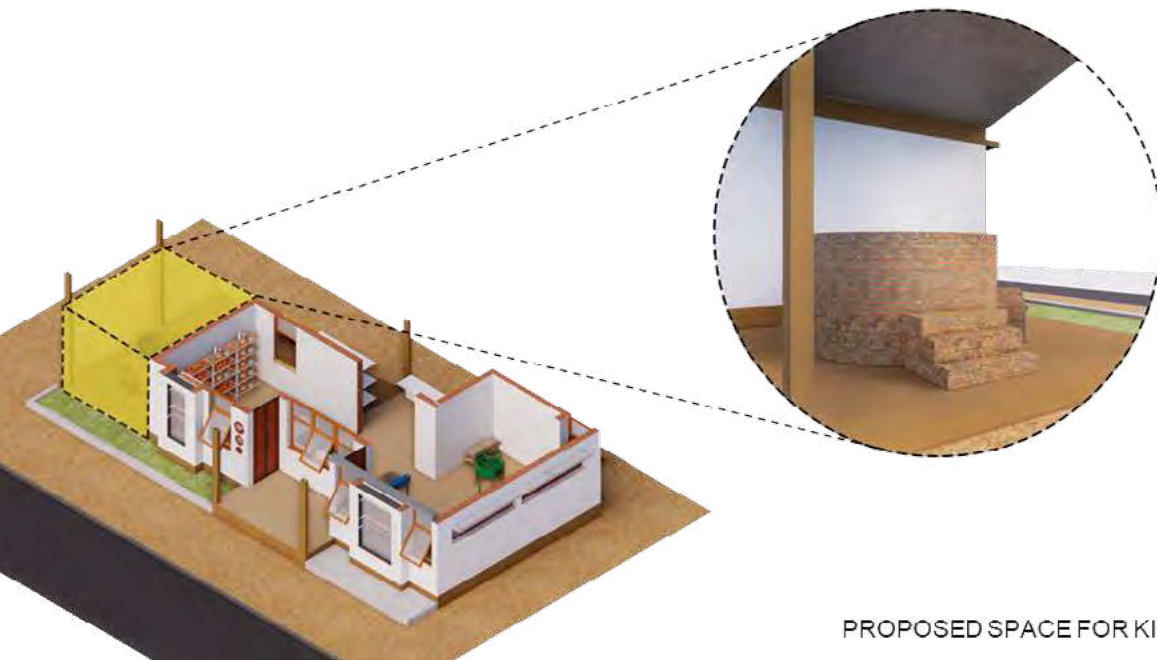
## 128. Solar Kiln



## 129. Walk-in Kiln

### TECHNICAL SOLUTION

Inner wall	5.5 FT
Outer wall	7.58 FT
Wall thickness	1 FT
Height	5 FT
Fire pit length	2.5 FT
Fire pit height	2 FT
Steps	2.5 FT
No of article can be fired	300 TO 400 pieces (Medium))



PROPOSED SPACE FOR KILN

# 130. Pottery Shed - 1

## TYPOLOGIES OF OWNERSHIP

- Home based
- Shop based in commercial space
- Small production units
- Bigger production units with diversified products

## TECHNICAL SOLUTION

The workspace for pottery production includes spaces for storage mud, kneading and preparing the clay, making of articles, storage for drying in shade and sun, burning of articles and storing of finished articles. In certain cases, a training or demonstration area is included and displays of shopfront can be included for customer facing sites. Kilns can be housed within and outside the shed and workspaces can be designed to maintain comfort conditions for work.



# 131. Pottery Shed - 2

## IMPACT

Increase in number of working hours and working days (monsoon) resulting in 20-30% **INCREASE IN PRODUCTION**

**AMBIENT TEMPERATURE REDUCTION** to a comfortable range of 26 deg C to 32 deg C

**REDUCED EXPENSES** on maintenance due to reduction in repairing costs

**REDUCTION IN DRUDGERY** and time required for production due to mechanisation

Separate storage space for a longer period resulting in **LESS WAITING PERIOD**.

Efficient cook stoves help in **REDUCING FUEL CONSUMPTION** by ~40%

**INCOME INCREASE BY 100%** during peak days

**PRODUCT DIVERSIFICATION** a possibility with potential to supply to larger markets in nearby peri or urban areas



## CHALLENGES + OPPORTUNITIES

### DRUDGERY AND LONG WORKING HOURS

The process of paper plate making is physically intensive and is highly labour intensive. Paper plate production without efficient mechanisation is tedious and time consuming with workers involved in the process for long hours and are subjected to odd work timings.

### EXPOSURE TO OCCUPATIONAL HAZARDS

The workers in the sector work without access to appropriate protective gear which exposes them to workplace accidents and can cause major loss of livelihood. Similarly, they are also exposed to heat, smoke and dust in the workplace which can have major long term health implications.

### IRREGULAR POWER SUPPLY

Power cuts and high energy consumption of existing machinery used produces hindrance for the entrepreneur in achieving his/her maximum potential.

# 132. Paper Plate Making

## OWNERSHIP MODELS

**CLUSTER BASED MODELS**

**SINGLE ENTREPRENEUR**

## FINANCIAL SOLUTION

The financial bookends of a paper plate making unit include a loan repayment in 1.5 years at 25% loan component. The overall cost of a paper plate making unit is INR. 4,50,000

## IMPACT

**INCREASE IN PRODUCTION**

**INCREASE IN INCOME**

**TIME REDUCTION DUE TO MECHANISATION**

## ENERGY APPLIANCE

**Paper plate making machine (Hydraulic)**

**Paper plate making machine (Hydraulic)**

**Paper plate making machine (Hydraulic)**

**Paper plate making machine (Automatic)**

## EQUIPMENT

1 hp, 230 Vac. 300 Plates per hour. Single Die.

2 hp, 230 Vac, 500 plates per hour. Single die

2 hp, 230 Vac, 800-1000 plates per hour. Double die

3 hp, 230 Vac, 1000-1500 plates per hour. Single die

## SOLAR SYSTEM DETAILS

Solar Module: 200 Wp x 6  
Battery: 150 Ah x 8  
Solar PCU 4 KVA, 3 KW, 96 Vdc.

Solar Module: 335 Wp x 6  
Battery: 200 Ah x 8  
Solar PCU 6 KVA, 5 KW, 96 Vdc.

Solar Module: 335 Wp x 6  
Battery: 200 Ah x 8  
Solar PCU 6 KVA, 5 KW, 96 Vdc.

Solar Module: 335 Wp x 10  
Battery: 200 Ah x 10  
Solar PCU 8 KW, 10 KVA, 120 Vdc.

# 133. Agarbatti Maker

## LOW PRODUCTIVITY

Currently, the sector is highly manual which results in low production rates per worker. There is a need to strengthen the machine manufacturing capability of the sector at a competitive cost.

## EMPLOYMENT CREATION

There is a demand amongst the community members for the business, however, due to manual processes the vision gets limited. There is a need to install Agarbatti making machines for selected typologies of end users to create sustainable employment. Such a mechanisation loan will also cater to the need for a self-reliant collective unit for Agarbatti making business.



## IRREGULAR POWER SUPPLY

Power cuts and high energy consumption of existing machine based units gives rise to major hindrance for the entrepreneur in achieving his/her maximum potential.

## TECHNICAL SOLUTION

Type of machine	Specifications	Production capacity
Agarbatti making machine	1 HP, 230 Vac. Single phase.	300 strikes/min, 10kg/hr.
Wet & Dry powder mixer	0.5 HP, 24 V, DC	5 kg/5 min

	
200 Wp x 6 Nos (1200 Wp, 24 Vdc)	150 Ah x 4 Nos Solar PCU Inverter technology. 4KVA, 48 V
	Variable frequency drive operated

## IMPACT

### INCREASE IN INCOME

Mechanization of this business can significantly improve production rates and incomes. In case of an average manual unit, the total income through sale of raw sticks is Rs.18250/- and overall profit is Rs 2625/-. Post mechanisation, the gross profit may reach to roughly around Rs 4000 to Rs. 5000.

### INCREASE IN PRODUCTIVITY

The automatic agarbatti machine can increase the production capacity of raw sticks and also increase the usage hours of the machine. Phenomenally this energy-based solution will help in the achievement of self-reliance with sustainable livelihood for rural women.

# Carpentry

- 134. Planer
- 135. Power Drill
- 136. Wood Lathe Machine



## IMPACT

### PRODUCTION EFFICIENCY INCREASED

The carpenters and artistic craft makers reported a decrease in time taken to craft various products. This has helped them in meeting the orders on time, resulting in satisfaction of the customer, as well as confidence in the carpenter to take up larger orders.

### PRODUCT QUALITY IMPROVED

In case of finer carvings, in some cases, neatness in the work can be achieved by even the lesser skilled carpenters- adding value and increasing the scope for design.

### IRREGULAR POWER SUPPLY

Carpentry involves the usage of power driven equipment- but due to off-grid situations or unreliable power in the rural areas, carpenters often face difficulty in completing the order in time. Power cuts and high energy consumption of existing machine based units gives rise to major hindrance for the entrepreneur in achieving his/her maximum potential.

### DRUDGERY

Carpentry is a labour-intensive process that has many successive steps. When performed in absence of relevant and effective machines, the process becomes highly drudgery-ridden, requiring increased time to make each product. Combined with this, the off-grid situation makes the carpentry work drudgery intensive.

## TECHNICAL SOLUTION

### SIDE PLANER

Smoothing as well as removing rough edges

### POWER DRILL

Making holes and driving screws

### WOOD LATHE MACHINE

Shaping of wood material

## OWNERSHIP MODELS

### SMALL SCALE CARPENTER

Products manufactured includes Chairs, tables, beds, sofa sets. doors, windows etc. and the market is usually local villagers

### SKILLED CARPENTER FOR DECORATIVE PIECES

Products manufactured includes Artist costumes, beads, gift items etc. and the market include Artist costumes, beads, gift items etc.

### Energy System

Solar Module : 1000 Wp  
 Battery : 8640 Ah  
 SPCU : 1.6 kW 2kVA 24 V

### Motor

Capacity 370 + 1000 + 300 + 520



## 137. Stone Polisher

In many historic locations of India decorations with ornate carvings or sculptures of deities, animals and humans etc. This art form called stone sculpting or stone carving still continues on, however, a number of issues means that it is slowly fading out of practise.

### LACK OF RELEVANT TECHNOLOGIES

Stone polishers continue to use outdated technologies and manual methods which can be inefficient and cause low productivity.

### LOW QUALITY OF PRODUCT

Often the stone quality finish is not on par with what could be accomplished with stone polishing tools because of which local craftsmen cannot command higher price points.

### OWNERSHIP MODELS

**Small scale artisans**

**Skilled artisans for decorative pieces**

### IMPACT

#### INCREASED PRODUCTIVITY

The employment of stone polishing tools ensures that the work is performed at a faster pace and leads to shorter time spans in completing final products.

#### IMPROVED QUALITY

Neatness in the work can be achieved which ensures greater quality of the product adding value and increasing the scope for availing better consumer traction.

#### ENHANCED INCOMES

Due to improved productivity and quality of end product, the entrepreneur develops better potential to earn additional income, thereby creating a sustainable business environment.

### TECHNICAL SOLUTION

This solution involves repurposing the existing angle grinders used by blacksmiths. The design involves solar powering of a selected angle grinder with stone specific polishing pads and blades. The angle grinders are lithium ion battery-run for versatility and are solar charged. This allows the end users to complete their work at a much faster pace and achieve a better finish which could be marketed at a higher price.

#### ANGLE GRINDER + LIGHTING

Modified DC Angle grinder  
0.5 hp, 24 Vdc. 10 W light.

335 x 2 Nos, 200 Ah x 2,  
Charge controller 24 V, 60 A.

For stone polishing, Tool sharpening,  
grinding purposes.

#### Energy System

Solar Module : 75 Wp  
Batter 960 Ah  
SPCU 500 VA 12V  
Charge Controller 24A 12v

#### Motor

Capacity 54W 18V  
Inbuilt Battery 3Ah / 5Ah Li ion (2)  
RPM 8500  
Backup hours 1



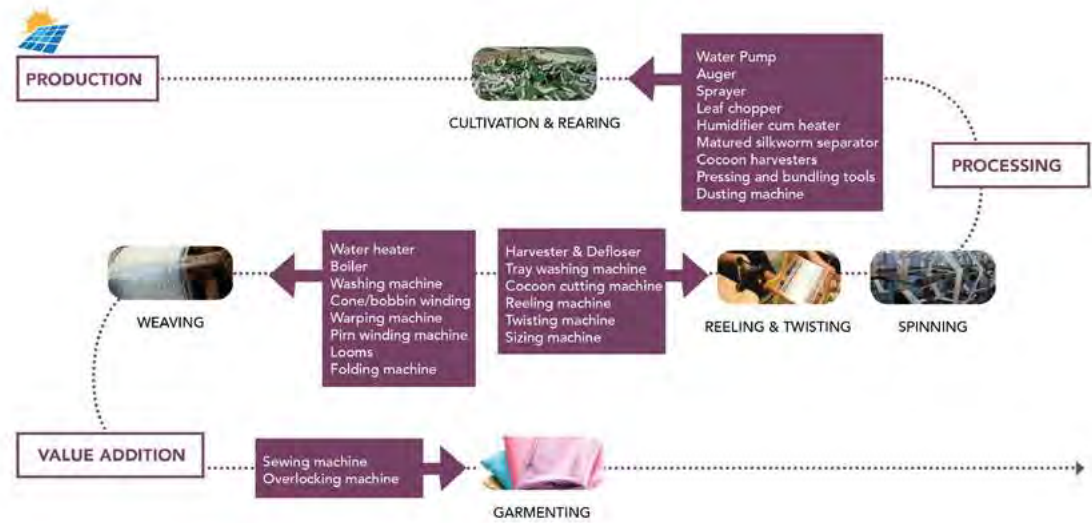
# Textiles & Crafts



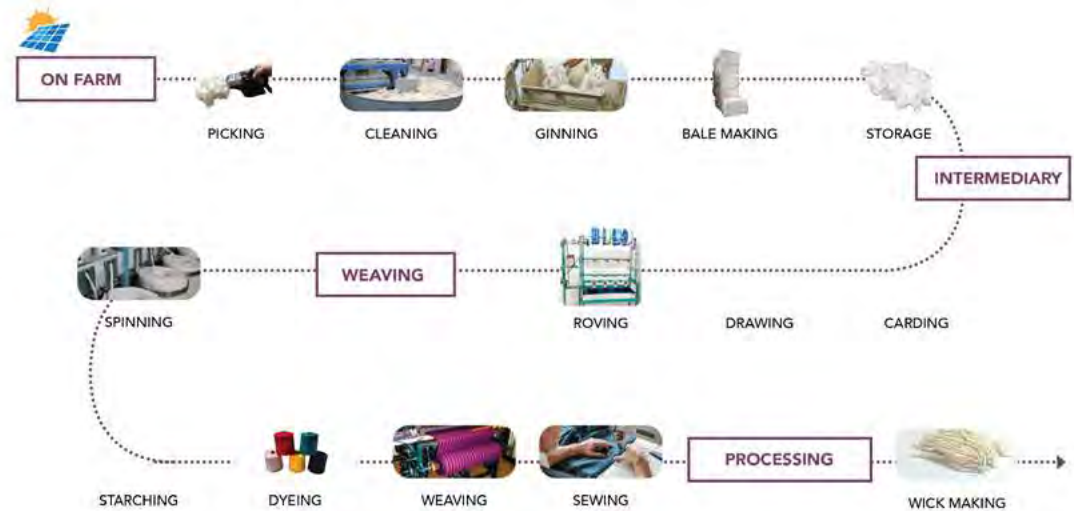
Textile and craft industry plays a vital role in the economic development of the country. It represents the cultural value and richness of Indian heritage and tradition. Although, the Indian textile & handicrafts industry is the largest employment generator after agriculture, yet the industry is highly labour intensive and has limited access to relevant technology and innovation especially in rural and remote areas where mostly women and weaker sections of the society are involved in the trade.

Introduction of modern machines powered through Decentralised Renewable Energy (DRE) can revitalise the industry by expanding opportunities in the rural areas, where most people struggle to secure proper jobs and agriculture is prone to failure owing to weather vagaries. Mechanisation can become a boon for artisans and entrepreneurs by increasing scope for income generation while also developing their potential to adapt and mitigate any major climate driven vulnerabilities that the sector is likely to face. Integration of solar based livelihood solutions at various stages of production can have a transformative effect on the sector and build resilient livelihoods that are equipped to meet the increasing demand of the global market in a cleaner and greener manner.

### SILK VALUE CHAIN



### COTTON VALUE CHAIN



## CROSS CUTTING APPLICATIONS

### 138. Yarn Winding Machine

Motor Type: AC  
Capacity: 0.25 HP  
Backup Hours: 3

335 Wp, 135 Ah Battery, 2KVA Solar PCU

### 139. Beam Winding/ Warping Machine

Motor Type: DC  
Capacity: 0.25 HP  
Backup Hours: 8 operations.

335 wP, 100 Ah x 2, CR 24 Vdc, 30 A.

### 140. Green Looms

Motor Type: BLDC  
Capacity (W): 850  
RPM: 3000  
Backup Hours: 8

Solar Module (Wp): 400  
Battery (Ah): 3840  
Charge Controller: 20A 48V



## CHALLENGES AND OPPORTUNITIES

### PRODUCTIVITY-

The handloom production is not enough for the weaver to earn enough and be sustainable in the long run. The solar loom helps double the productivity

### EFFICIENCY -

The time and energy required to complete one weaving cycle is more than the solar looms as the 4 limb movement of the solar looms is synchronised.

## KEY CHARACTERISTICS

A **solar power efficient loom** that operates that operates in the power range of 50W - 370W

**Cost ranges** from 1.5L to 2L inclusive of the system and solar cost

Solar looms **reduces the weaving time** by 50% and improves productivity as compared to handlooms

Pre-designed or retrofitted to existing looms with a **short learning curve**



## 141. Conventional Power loom

Usual speed (picks per minute)	Usual fabric width	Per day production	Design settings for multi color	Power consumption	Suitable application	Solar Energy details.
120	Upto 72 inch	~35 metres	Manual Set Jacquard/ Dobby	~750 Watt	Single weaver up to 35m/day	200 Wp x 6, 150 Ah x 4, Solar PCU 4 KVA, 3 KW.

## 142. Efficient Power loom

Usual speed (picks per minute)	Usual fabric width	Per day production	Design settings for multi color	Power consumption	Suitable application	Solar Energy details.
100	Upto 72 inch	~30 metres	Manual Set Jacquard/ Dobby	~150- 380 Watt	Single weaver upto 30m/day	Solar module 335 Wp x 2, 150 Ah x 2, Charge controller 24 Vdc, 50 A



# 143. Rapier Loom

Usual speed (picks per minute)	Usual fabric width	Per day production	Design settings for multi color	Power consumption	Suitable application	Solar Energy details.
450	Upto 120 inch	~135 metres	Electronic Jacquard/Dobby	~ 2000 Watts	Cluster of weavers upto 135m/day	335 Wp x 6, 180 Ah x 8, Solar PCU 6 KVA, 5 KW





## IMPACT

**INCREASED PRODUCTION:**

Integration of ergonomic workstation along with passive built environment leads to better working condition, work organisation thereby increasing productivity and saving time

**LESS LABORIOUS:**

Mechanization of the stitching process combined with better working condition reduces drudgery and makes the task easier

**ADDED FLEXIBILITY DUE TO ACCESS TO ENERGY:**

Round the clock access to energy gives the end user the desired flexibility to work according to market demand and seasonal patterns

**NO LOSS OF WORK DUE TO POWER CUTS:**

Poor power supply conditions often restrict work timings leading to loss of productive hours, which gets completely eliminated with the solution as it ensures reliable power supply to cater to customers and the market demand.

# 144. Sewing Machines

## CHALLENGES + OPPORTUNITIES

**LACK OF BRAND VISIBILITY:** Local and small scale tailors lack the required support channels to set their services apart through more customer facing and appealing elements for brand visibility

**LACK OF OPTIMISED ERGONOMICS:** It enables the end users to increase their productive hours by ensuring comfort

**LACK OF OPTIMISED STORAGE AND DISPLAY:** Efficient use of space with optimised storage along with display can allow careful storage of final products along with provision for better customer interface

**TIME CONSUMING:** Manual sewing machines require high manual labour thus leading to low productivity per day

**IRREGULAR POWER SUPPLY:** Entrepreneurs in the tailoring industry who want to switch from manual to motorised machines are severely impacted by irregular power supply. Tailoring also requires appropriate task lighting for comfortable working conditions

**HIGH ELECTRICITY CONSUMPTION AND ENERGY BILLS:** Electric sewing machines have a higher energy consumption and increases the monthly energy bills

## OWNERSHIP MODEL

Rent/Lease  
Self owned

## TYOLOGIES

Individual Shop based/ home based  
Production groups  
Rural areas/ Semi urban areas/ Urban areas



## TECHNOLOGICAL SOLUTION SPECIFICATIONS

Type	Solar Module	Solar Battery	Charge Regulator	Operational hours	Motor
Straight stitch sewing machine	60Wp (12V)	60Ah (12V)	10A, 12V	4-8 hours	PDMC Motor (with pedal, pulley and belt): 60W, 12V, 3000rpm
High speed sewing machine	60Wp	110Ah (12V)	800VA	8 hours	PDMC Motor: 80W x 1 unit
Per day production	~ 6 metres	~15 metres	~35 metres	~30 metres	~135 metres
Industrial sewing machine	250Wp (24V)	80Ah (12V) x 2	800VA, 24V	8 hours	0.5 hp High speed universal AC motor with VFD operated: 230W, 1440rpm

# 145. Tailoring Shop

Shop Front elements	Basic external branding elements to improve customer footfall: Signage with LED, graphics and display rack
Storage Units	Storage racks with shutter to allow efficient and secure storage of raw materials and final products
Ergonomic workstation	Workstation designed for a comfortable sitting position at an appropriate height, with placement of all units required for the activity within the ergonomic work circle allows an easy workflow. Along with task light positioning to avoid shadow cast due to task light
Passive built environment elements for natural lighting and ventilation	Roofing material: False ceiling with PVC or gypsum board



COMMON FACILITIES TAILORING CENTER



BASIC TAILORING UNIT



TAILORING UNIT WITH WAITING AREA



MULTIPLE TAILORING STATIONS WITH CHANGING ROOMS



# Cotton

- 146. Cotton Picking Machine
- 147. Cotton Wick and Bud Making

- 148. Ginning Machine
- 149. Solar Charkha



Technology	Specifications	Solar Design
<b>Solar powered hand held cotton picking machine</b>	Motor Type: DC Motor Capacity (W):11 RPM: 54 Backup Hours: 6	Solar Module (Wp): 15 Battery (Ah): 84
<b>Cotton Wick and Bud making</b>	AC Motor with belt conveyor type- 90 Watt, 230 Vac.	150 Wp, 80 Ah x 1, Micro in-verter- 150 Watt, 12 V and 230 Vac output.
<b>Ginning Machine</b>	Motor Type: AC Induction 1 phase Capacity :1 HP RPM: 1440 Backup Hours: 3	Solar Module (Wp): 1200 Battery (Ah): 7200 SPCU (kW): 2 kW 48V
<b>Solar Charkha</b>	Motor Type: PMDC Capacity (W): 80 RPM: 1500 Backup Hours: 8	Solar Module (Wp): 250 Battery (Ah): 1920 Charge Controller: 20A 24V

COTTON PICKING MACHINE



GINNING MACHINE



SOLAR CHARKHA

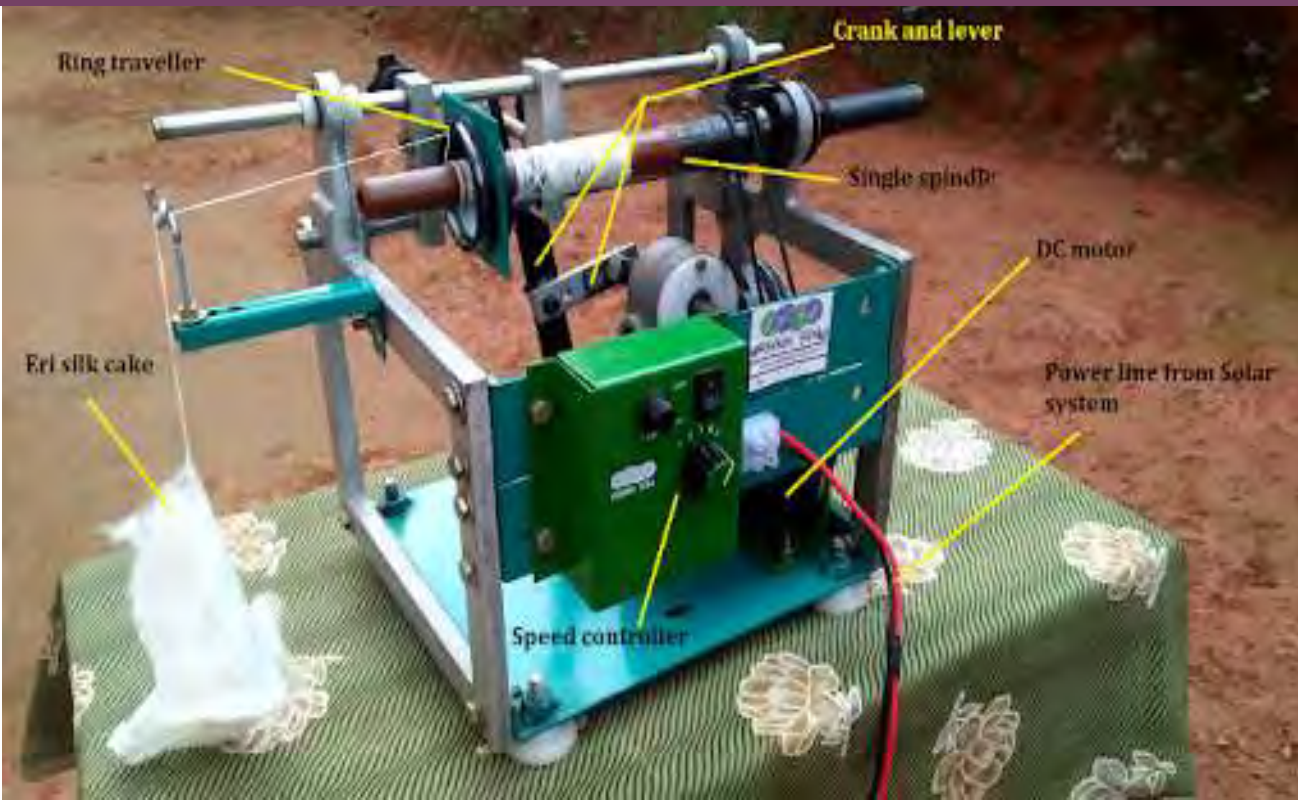


COTTON WICK AND BUD MAKING





# 150. Spinning Machine



Sl. No	Particular	Value
1	Type of motor	Single spindle machine with one DC motor.
2	Motor load	15 W
3	Driving mechanism	Crank and lever
4	Twisting rate control	Speed controller is fitted to control the twisting rate.
5	Feed rate control	No feed rate control mechanism
6	Productivity rate (in 8 hours per day of usage)	220 gram
7	Cost (in INR) without GST	7700

# 151. Re-reeling Machine

It helps in **Reeling the yarn into the hank form**, which makes it market ready in a faster, efficient and higher quality manner

It **saves out on a lot of time and effort** of the reeler, which can be utilised to do more reeling to earn more.

It has the potential to save half a day a week, and help the reeler to **earn an additional income** of approximately Rs. 400-500 per week.

Type of the machine	Buniyaad/Unnati//Silky Spinning	Sokalika, Spinning (different model)	Retrofitting Reeling machine-	Re-reeling machine
Type of Yarn Suitable	Tassar, Muga, and Mulberry.	Muga silk Weft yarn	Tassar, Muga, and Mulberry.	Tassar, Muga.
Type of activity	Reeling	Reeling	Reeling	Reeling and Twisting
Production (Manual Vs Machine)	1:4	1:4	1:4	1:6
Power consumption	20 to 30 Watt, 12 V	20 to 30 Watt, 12 V	60 W, 12 V	150 W, 24 V
Motor technology	PMDC Motor	PMDC Motor	PMDC Motor	PMDC Motor
Solar configuration	100 W Panel, 12 V, 80 Ah, Charge controller 24 V, 15 A.	100 W Panel, 12 V, 80 Ah, Charge controller 24 V, 15 A.	150 W Panel, 120 Ah. Charge controller 24 V, 15 A.	300 Wp, 100 A x 2, Charge controller 24 V, 15 A.



# 152. Silk Rearing

## CHALLENGES + OPPORTUNITIES

The quality and the quantity of produce that comes from the cocoon can be adversely affected if optimal environmental conditions like temperature, humidity, ventilation, illumination, etc. are not maintained. For instance, **light is required so that it helps the caterpillars to feed properly and also help the rearers in supplying leaves at night.**

Fans are required to maintain the temperature during cocoon formation. Therefore, the **lack of adequate and reliable electricity can negatively impact cocoon cultivation** and result in huge losses for the entrepreneur.

## TYOLOGIES

### CENTRAL EXCLUSIVE REARING HOUSE:

A combination of passive built environment along with provision of backyard host plant cultivation and sufficient energy and water resources can support such rearing houses.

### HOME BASED REARING HOUSE:

Currently conducted in an unorganised manner and has scope of improving the rearing places with proper lighting, ventilation and shelves and workspace.

# Sabai Grass Craft

153. Cutting Machine

154. (Dyeing) - Solar Water Heater

155. Cone Winding Machine

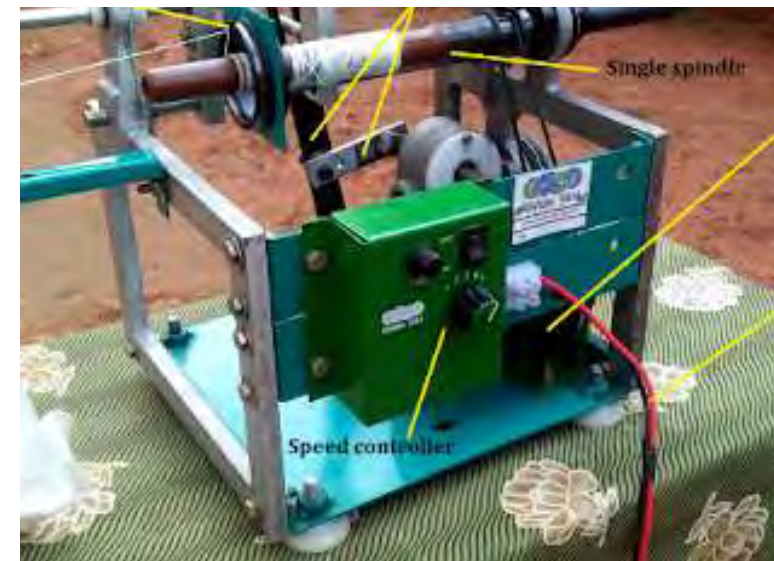
156. Warping Machine

157. Weaving

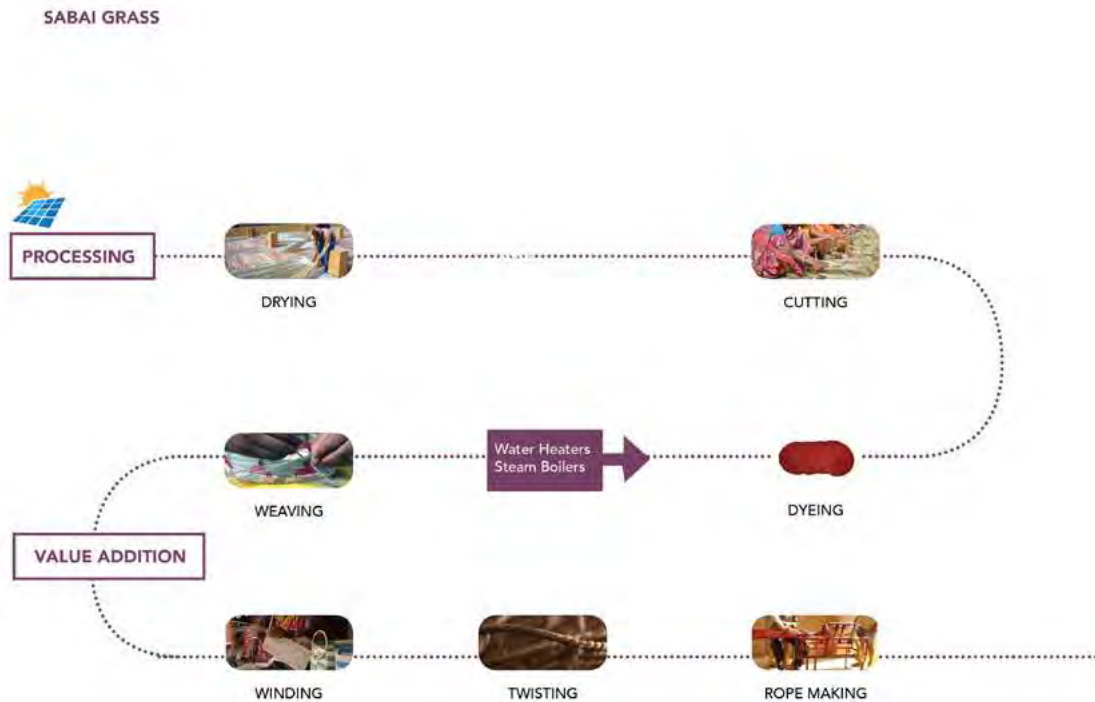
158. Electric Water Drier



JACQUARD LOOM, WEAVING



CONE WINDING MACHINE





CUTTING MACHINE



WARPING MACHINE

Technology	Specifications	Solar Design
<b>Cutting</b>	1 hp, 230 Vac	Solar Module 200 Wp x 6, Solar Battery: 150 Ah x 4, Solar PCU 4 KVA, 3 KW.
<b>Solar water heaters</b>	500 Litres per day	500 Litre solar water heater
<b>Cone Winding</b>	0.5 HP AC	Solar Module 335 Wp x 2, Solar Battery: 150 Ah x 2, Solar PCU 2 KVA, 1.4 KW.
<b>Warping</b>	0.5 HP AC	Solar Module 335 Wp x 2, Solar Battery: 150 Ah x 2, Solar PCU 2 KVA, 1.4 KW.
<b>Weaving</b>	0.5 hp DC 24 Vdc	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar charge controller 24 V, 30 A.
<b>Electric water Drier</b>	3000 W, 100 Litres boiler model for dying	Solar systems for electric heaters are not recommended since the system capacity is huge and not efficient to use the heaters. Partial heating the solar water heaters are being used up to 60 degree temperature.
<b>Grass Rope making</b>	0.5 hp DC 24 Vdc	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar charge controller 24 V, 30 A

# Banana Fiber Craft

159. Splitting/Cutting Machine

160. Extractor

161. Shredder

162. Spinning Machine

163. Warping Machine

164. Weaving Machine

165. Cone Winding Machine

Machine

166. Cup Making



BANANA BARK CUP MAKING MACHINE



BOBBIN SPOOL WINDING MACHINE FOR WARPING



SPINNING



WEAVING



CUTTING/SPLITTING MA-



ROPE MAKING



<b>Production Process</b>	<b>Specifications</b>	<b>Solar Design</b>
<b>Splitting/Cutting</b>	Splitting machine- 2 hp AC 230 Vac.	Solar Module 335 Wp x 6, Solar Battery: 150 Ah x 8, Solar PCU 6 KVA, 5 KW, 96 V.
<b>Extractor</b>	Extractor machine- 2 hp AC 230 Vac	Solar Module 335 Wp x 6, Solar Battery: 150 Ah x 8, Solar PCU 6 KVA, 5 KW, 96 V.
<b>Shredding</b>	Extractor machine- 1 hp AC 230 Vac.	Solar Module 200 Wp x 6 , Solar Battery: 150 Ah x 4, Solar PCU 4 KVA, 3 KW, 48 V
<b>Spinning</b>	0.5 hp AC 230 Vac	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar PCU 2.5 KVA, 24 Vdc.
<b>Warping</b>	0.5 hp AC 230 Vac	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar PCU 2.5 KVA, 24 Vdc.
<b>Weaving</b>	0.5 hp AC 230 Vac	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar PCU 2.5 KVA, 24 Vdc.
<b>Cone winding</b>	0.5 hp AC 230 Vac	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar PCU 2.5 KVA, 24 Vdc
<b>Banana Cup Making</b>	2 hp, 230 Vac.	Solar Module 335 Wp x 6, Solar Battery: 200 Ah x 8, Solar PCU 6 KVA, 5 KW, 96 Vdc.
<b>Rope making</b>	Fibre Rope can be done 100 feet, 4 yarn type- 0.5 hp DC Motor.	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Solar charge controller 24 V, 50 A. Wireless speed regulator.
	Straight stitch- 60 Watt, 12 Vdc.	Solar Module 60 Wp, Solar Battery: 60 Ah, Solar charge controller 24 V, 10 A.
<b>Stitching</b>	Industrial- 0.5 hp, 230 Vac	250 Wp x 2, 150 AH X 2, 2.5 KVA, 24 Vdc.
	Zigzag/Embroidery 0.5 hp, 230Vac	250 Wp x 2, 150 AH X 2, 2.5 KVA, 24 Vdc.

# Bamboo Fiber Craft

- 167. Cutting machine
- 168. Splitting Machine
- 169. Slicing Machine
- 170. Round Stick Making
- 171. Bamboo Polisher
- 172. Grinder



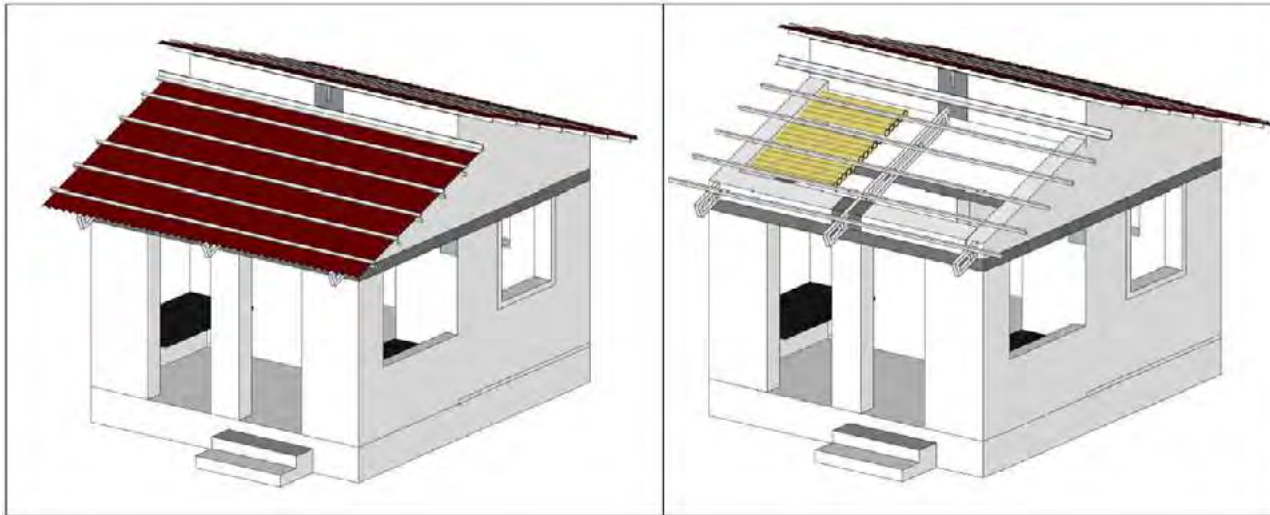
Technology	Specifications	Solar Design
<b>Cutting machine</b>	2 hp cutting machine, AC 230 Vac	Solar Module 335 Wp x 6, Solar Battery: 180 Ah x 8, Solar PCU 6KVA, 5 KW.
<b>Splitting machine</b>	1 hp, 230 Vac	Solar Module 200 Wp x 6, Solar Battery: 150 Ah x 4, Solar PCU 4KVA, 3 KW.
<b>Slicing machine</b>	1.5 hp, 230 Vac	Solar Module 335 Wp x 6, Solar Battery: 180 Ah x 8, Solar PCU 6KVA, 5 KW.
<b>Round stick making</b>	1.5 hp, 230 Vac	Solar Module 335 Wp x 6, Solar Battery: 180 Ah x 8, Solar PCU 6KVA, 5 KW
<b>Bamboo polisher</b>	1.5 hp, 230 Vac	Solar Module 335 Wp x 6, Solar Battery: 180 Ah x 8, Solar PCU 6KVA, 5 KW.
<b>Grinding</b>	Angle Grinder + Brush Cutter- 0.5 hp, 24 Vdc or AC	Solar Module 335 Wp x 2, Solar Battery: 200 Ah x 2, Charge controller 24 V, 50 A.
<b>Solar water heating</b>	100 to 500 litre solar water heaters	500 Litre solar water heaters for dyeing and cleaning.

# Dhokra Casting

173. Workspaces

174. Wax Electric Heating Mantle

175. Polishing and Grinding Machine



Mould Preparations Kneading clay	Uses Black Soil / Termite soil and Rice Husk	1 day
The basic mould form	Uses the above-mixed clay to make the basic shape and then uses river mud to make it smoother. It is left to dry in the sun for 3 to 4 days.	3-4 day
Wax Preparation, Wire making, and Coiling of wax threads onto the basic mould.	Uses the Mixture of Beeswax, and calcium hydroxide coal tar and kneads the same into fine wax. Then the wax is pressed into long strings. The wax strings are then used to create the design on the basic mould.	1 day
First Clay Coat: Coating mud over Wax Design	The wax design figure is dipped into the mixture of white clay and jute fibres twice while sun drying in between.	2 day

Fixing the Closed core and Second Clay coat: Cover mould

The Dipped wax design is then covered with another thick layer of termite mud mixed with jute fibre and sand.

2 day



Funnelling and spruce

The cover form is provided with a funnel and spruce which will help flow molten brass into the mould.

2 day



Final Moulding

Pieces of brass metal are added to the funnel and then covered with some more termite sand and kept for drying.

2 day



Casting

The final mould is then placed upside down in the Kiln or Furnace for 2 hours, and once it is taken out it is rotated to let the molten brass flow into the form.

1 day



Demoulding and Polishing

The mould is broken and then it is polished for the final product.

1 day



PUG Mill

### Pugmill

Mixing, Moisturizing removing  
2 HP, AC

Solar Design: 230 Vac, 335 Wp x 6 No,  
Solar battery: 180 Ah x 8,  
Solar PCU 6 KVA, 5 KW, 96 Vdc.



### Polishing and grinding machine 2 hp, 230 Vac, single phase

Solar Design: 335 Wp x 6 No, Solar  
battery: 180 Ah x 8, Solar PCU 6 KVA,  
5 KW, 96 Vdc.



Blunger

### Blunge 0.5 hp ACr- Cleaning the clay and filtering.

Solar Design: Blunger 0.5 hp, 230 Vac.  
335 Wp x 6 No, Solar battery: 180 Ah  
x 8, Solar PCU 6 KVA, 5 KW, 96 Vdc.



### Electric eater for Wax melting: Mica Heater

Not recommended for solar

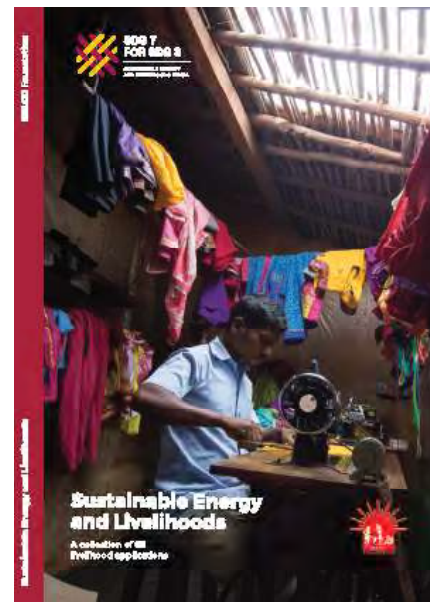


### Heating Mantle

Not recommended for solar

# Additional Resources

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# Conclusion

Millions of people across the globe lack access to respectful livelihood opportunities. Inability to avail these keeps them in perpetual poverty, or at risk of falling into poverty. Availability of reliable energy is one of the key reasons for the poor not able to avail services and opportunities that give them the confidence to build on their livelihoods, improve their productivity and well-being. Additionally, in recent times, climate related stresses and disasters have made the lives of the poor uncertain, and their livelihoods more drudgery driven and unviable. All of this results in loss of confidence on skills, income, critical assets and debt.

As shown in this document, sustainable energy has the potential to transform the lives and livelihoods of vulnerable populations. The solutions showcased here are designed and deployed in a need centric manner, by studying value chains, sectors, activities, role of stakeholders, as well as transaction costs for the marginalised populations in order to access these roles and opportunities in the value chains. Using sustainable energy as a catalyst, solutions showcased here present low hanging fruits that countries and practitioners can adopt and scale for improved livelihoods for adaptation and mitigation to climate change.



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