FLOUR MILL

SECTOR: AGRI-PROCESSING

MODEL BANKABLE DOCUMENT

SELCO FOUNDATION

NABARD

TABLE OF CONTENT

1. INTRODUCTION

In India cereals constitute the lion's share of agricultural production accounting for 50% of the area under crops. The cereals are mostly consumed as staples after simple cooking procedures and in some cases moderate primary processing of the product to remove the husk is indispensable. Traditionally, this processing service is obtained from local millers but consumers are increasingly purchasing milled grains, often in packaged and branded forms. The transformation of the grains of cereals involves intense processes like cleaning, drying, soaking, germinating, milling, de-vegetating and mixing with other ingredients like milk. In a limited way cereals can also be amenable for further value addition into nutritious, consumer friendly or attractive food. Wheat, apart from its direct consumption in households after domestic transformation to items like chapatti and puri is widely known to be an ingredient for commercially processed bread and other bakery and confectionery items.

India is the second largest producer of wheat, after China. The total area under the crop is about 29.8 million hectares in the country. The production of wheat in the country has increased from 94.88 million MT in 2011-12 to an all time record high of 99.70 million tonne in the 2017-18 crop year (July-June). The major increase in the productivity of wheat has been observed in the states of Uttar Pradesh (the largest Wheat producing state of India), followed by Punjab, Haryana and Madhya Pradesh.[1]

The first task post harvest of wheat is pretty simple: cut the heads from the top of the wheat plants and then thresh them to remove the grains from the rest of the head, called chaff. The grains are divided from additional plant fragments, cleaned and taken to a mill, where any separation of bran, endosperm and germ takes place.

From a primary data collected during the year 2012 -13 from 160 wheat growers from two major wheat producing districts i.e. Hoshangabad & Vidisha of Central Narmada Valley and Vindhyan Plateau Agro climatic regions of Madhya Pradesh, respectively. It is observed from the data that the harvest losses was found more in mid varieties (2.84 kg/q) as compared to early varieties (2.79kg/q) of wheat. The quantity loss during threshing and winnowing was 0.34kg/q. The average loss during transportation was found to be 0.21 kg/q and found more in tractor trolley (0.23 kg/q) as compared to the bullock-cart (0.19 kg/q) mode of transportation. The quantity lost during storage of grains was found to be maximum in rodents as compared to fungus. There were remarkable post harvest losses occurred in different stages of wheat production and the majority of respondents have lack of technical knowhow about post harvest technology. For this reason, efforts should be made for

[1] https://farmer.gov.in/M_cropstaticswheat.aspx

capacity building by providing training and technical advice to post-harvest handling, storage practice, drying and proper use of insecticides that can significantly reduce these losses.[2]

Post Harvest loss of wheat	
Process	Quantity loss
Threshing and Winnowing	4%
Transportation	2%
Storage of grains	59%
Harvest	30%
Handling	5%

The postharvest losses can be reduced to half with the use of available technology viz., timely harvest, use of proper harvesting and threshing equipment, safe storage, prophylactic and curative measures to check infestation.

2. NEED FOR SOLUTION

Flour Mill is used in regions where wheat grains are produced. In most of the rural areas, electricity is available only for 5 to 6 hours per day in a single phase. Three phase power is available only in the night for 2 to 3 hrs. For this reason, sometimes workers are forced to run the machine at night time (11:00 pm to 3 a.m). During an emergency or when there is peak demand, workers sometimes have to rely on alternate sources such as diesel generators which is more expensive than the grid electricity itself. The available grid voltage is very low (from 150V to 180V) usually; some of the other machines cannot be used at the same time due to the low voltage thus making it difficult for them to reach their production targets.

2.1 Types of flour mill

Flour mill is a machine which transforms the grains into their flour (ie, the powdered form which can be consumed by humans). Mainly the flour mills are classified into two types

1. The mill which has stones to crush
2. The mill which has grinding blades to crush

The first type of the mill uses Emery stones to crush the wheat, bajra or corn and make it into the flour and these types of flour mills

[2] https://www.researchgate.net/publication/310365472_EXTENT_OF_POST-HARVEST_LOSSES_IN_DIFFERENT_STAGES_OF_WHEAT_PRODUCTION_IN_MADHYA_PRADESH

are used most widely. In the second type of flour mill the grinding blades are used to make the flour.

Flour mill with Emery stones

Flour mill with grinding blades

These machines don't require foundation for installation. Generally, as per observation the flour mill uses stone to crush the wheat, bajra or corn to grind into flour. When it comes to the flour mill with grinding blades, it is used only for domestic purpose and these types of flour mills are not used widely.

Advantages and Disadvantages of Emery Stone flour mill

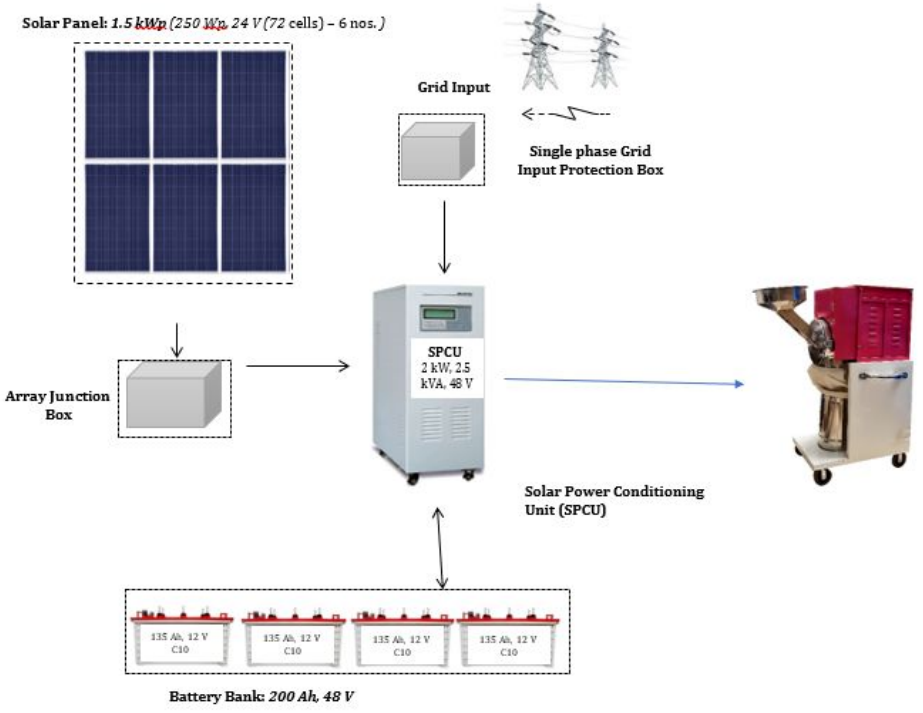
Advantages	Disadvantages
Wheat or bajra, which is grinded tastes much better than the blade flour mill.	Maintenance is required such as, the dressing* has to be done for emery stone after 45 days.
The main advantage is that the vitamins are retained in the stone flour mill. The heat produced while grinding the wheat is very less. The vitamins gets lost when there is heat.	The emery stones should be changed after 12 or 14 months

*Dressing means after grinding continuously the emery stones grooves get flattened, so in order to make those grooves and make it work efficiently the dressing tool is used and the procedure is known as Dressing.

Advantages and Disadvantages of Pulverizer

Advantages	Disadvantages
The performance of blade flour mill is same as the stone flour mill	The taste of the flour is not that good as the stone flour mill
While grinding the grains, much heat is produced that results in vitamin loss	Not used widely
No maintenance required	Blades have to be changed, after they get worn down.

3. SCHEMATIC DESIGN



4. TECHNICAL SPECIFICATION

The design for both flour mill and Solar Design (2HP, single phase—3Hours + hybrid system)

Sl.No.	Products	Capacity	Qty
1	Solar Module (72 Cells) - 5 in Series	250 Wp, 24 V	10
2	Solar Battery	150 Ah, 12 V	8
3	MMS (New, Virdis, Coimbatore)	250 Wp, 1M	10
4	Glowpower GPM4008 with MPPT Technology	**4 kW (5 kVA), 96 V**	1
5	Cables red+black (M-B)	6 sq.mm.	30
6	Cables red+black (M-M)	4 sq.mm.	40
7	Cables red+black (B-B)	10 sq.mm.	12
8	Earthing Cable	10 sq.mm.	20
9	Grid Input Protection Box (Greensol)	With SPD & MCB	1
10	Battery Rack (Hakke Industries, Bangalore)	150 Ah X 8 Nos (2 Racks of 4 Batteries)	1
11	AJB with MCB & SPD (Greensol)	2 IN, 1 OUT	1
12	Double pole MCB (Load side)	16 A, 230 Vac	1
13	Earthing Kit		2
14	Consumables		1

5. KEY FEATURE OF PULVERIZER

The frequent maintenance requirement for grinding is the major disadvantage. This is done away with the introduction of flour pulveriser. The 2 in 1 pulveriser can be used to grind both grains as well as spices. There are 2 feeds - the front feed is used to feed spices (Chilli, turmeric, pepper etc) and get the ground output (need to be followed twice) and the back feed is used for grains (Wheat, jowar, millet etc) and will get the fine ground flour at the output.

There are different types of sieves in pulveriser. Depending on fineness of output, the sieve can be replaced accordingly. The degree of the output can vary from fine powder to broken granular grains.

Advantages:

- The machine is maintenance free and does not require any lubrication on a weekly basis.
- After using the machine for 45 minutes the machine needs to be switched off for 5 minutes.

6. INSTALLATION

6.1 Flour Mill

- **Emery stone Flour mill**
  - The emery stones need to be dressed, before setting up the machine(dressing means to grinding the grooves, dressing results in efficient grinding)
  - The motor is aligned in a proper manner by connecting the V-belt between Driver and driven pulley.
- **Pulverizer**
  - To grind the grains, the feed is from behind the grinding chamber, and for spices the feed is from the front inlet.
  - The spices like turmeric and pepper needs to ground twice by using 2 meshes - first feed through the big mesh and followed by a second feed through a fine mesh.
  - After the use of the machine, the mesh needs to be cleaned properly and kept.

6.2. Module:

- While unboxing module to install two people should care handle module instead of one person.
- Identify shadow-free location on roof top for installation and clean the area. Mark points to place RCC (Reinforced Cement Concrete) on the floor.
- Depending upon geography and type of roof it will be decided whether MMS has to be customized or not.
- If needed with the help of local fabricators it has to be made possible.
- Identify south with the help of magnetic compass and mount the panel facing South.
- Please maintain the optimum tilt angle of the solar panel so as to maintain the efficiency and increase the life of the panels.
- Depending upon the type of footing Roof mounting and ground mounting, configuration of tilting angle in particular angle- Summer Tilt and winter tilt
- The type of footing will depend on the type and angle of roof for rooftop mounting. In case of ground mounting, it depends on the type of soil.
- Isolated footings are most commonly used footings for Reinforced cement concrete column because it is simple and most economical.
- Combined footing: the aim is to get uniform pressure distribution under the footing.
- Earthing of panels: in order to protect the entire solar system and people using it has to be connected to earth.
- Panels are interconnected such that the voltage of the system is achieved. They are connected to the Array Junction Box by MC4 Connectors. Panels are interconnected such that the voltage of the system is achieved.

6.3. Batteries:

- For ventilation holes are made in the rack to give space for air to pass through.
- Batteries should not stacked one above the other.
- Keep polarities of all the batteries adjacent to each other on the same side.
- Batteries should be stored in a cool, dry and shaded area free from sunlight.
- Best room temperature for storing batteries is 20°C.
- In DC systems, while making connections, always connect negative wire first and then positive wire.
- While disconnecting, disconnect positive wire first and then negative wire. This is for safety reasons and to avoid sparks at the battery terminals while doing connections
- Keep air safety distance between batteries of at least 20mm.
- Use wire lugs at battery terminals to avoid loose connections.
- Do not use grease on battery lugs as it has a high melting point and is a bad conductor of electricity. Use petroleum gel instead.
- Lugs should be dry and should not be hot. Lugs get hot due to loose connections, improper wire size or poor quality of lugs
- Always keep top of batteries clean and keep the lids sealed to avoid contamination by dust.
- To measure battery voltage, first disconnect electric load and solar input
- To get more accurate current readings, connect ammeter in series to the battery and load.
- Battery Connections: Do the battery interconnections such that the system voltage is achieved. Keep them well in the battery box.

7. MAINTENANCE

7.1. Flour Mill

- **Emery Stone Flour Mill**
  - The lubrication will be done at all the bearing points and on a weekly basis the lubrication needs to be done.
  - After half an hour of operation the mill need to be given spare time of 5 to 10 minutes, as it is a single phase motor, needs some time to cool down - to avoid burning of winding in motor.
  - Dressings of emery stone should be done within 45 days if usage is more than 50kg/day.
- **Pulverizer**
  - The Pulverizer should be cleaned thoroughly cleaned.
  - The mesh needs to be removed and cleaned on a daily basis.

7.2. Module:

- Clean the panels at least once a month.
- Do not displace the panels from the mounting structure.
- Tilt angle has to be checked.
- Check if there is any deformation in the panels.
- Check if there are any wire/ wires directly exposed to sunlight.
- Do not drop, allow objects to fall on, stand or step on solar modules.
- Do not walk, lean, sit or rest heavy objects on solar panels.
- Prevent the direct contact of the positive and negative terminals of Panels.
- Solar modules have a protective glass front. Broken solar module glass is an electrical safety hazard (electric shock and fire). These modules cannot be repaired and must be replaced.

7.3. Battery:

- Check the acid level in the battery at regular intervals. Fill with distilled water if the acid level is low.
- Do not overuse the system.
- Apply Petroleum Gel on both terminals of the battery.
- Prevent the direct contact of the positive and negative terminals of batteries.
- Batteries store a large amount of energy. Never short circuit the external contacts of battery under any circumstances

8. SAFETY

8.1. Emery stone Mill Machine:

- After grinding, the grinding chamber should be cleaned thoroughly as it may reduce the grinding efficiency.
- The grains to be milled should be properly dried before input to the mill. The moisture content in the grains avoid proper

8.2. Module:

- If wiring line voltage is higher than 70 Volts it will be Hazardous.
- Wear insulated safety gloves, industrial shoes while working on the system
- Do not touch the panels junction box during day time, as DC voltage is always present when solar modules are exposed to sunlight
- MCB has to be turned off in solar combiner box of the Solar Array before you work on them.
- Always check positive or negative polarity of any wire with multimeter before connecting it to any device
- Do not leave any wire open, it can touch other terminals causing short-circuit.

8.3. Battery:

- Provide a ventilation in the battery room for the hydrogen gasses generated to move out.

- Do not allow water to drip or splash on the battery.
- Avoid children touching the charge controller.
- No Smoking warning sign has to be hanged if needed outside.
- Wear safety glasses for protecting the eyes from the acid.
- If acid comes in contact with eyes, wash for 15 minutes and report to a doctor immediately
- If acid comes in contact with skin or clothing, rinse off for several minutes and try not to spread the electrolyte. Report to a medic/doctor after rinsing

9. TROUBLESHOOTING

9.1. Flour Mill Machine

Problem	Possible Causes	Corrective Action
Grinding efficiency is reduced	check for stuck grains on the groove	The grains should be removed either using brush or manually.
Grinding noise is coming	adjustment spring is damaged	Needs to be replaced

9.2. Module :

- Disconnect the fuse
- Cover solar modules with thick blanket or cardboard
- Check the interconnection polarity between the modules
- Check the bypass and reverse blocking diodes for correct polarity
- Check for any loose connection
- Replace the fuse.
- Uncover the solar modules
- Check the output voltage of individual modules using clamp meter /Multimeter
- Check the output voltage of solar array at terminal blocks.

9.3. Battery:

- Check specific gravity of the battery if the specific gravity is low then send it
- Check the terminal voltage after the load is disconnected from the battery terminal.
- Remove corrosion on the terminal posts
- Use self-leveling filler that automatically fills the battery to a predetermined level.
- While topping take care not to splash from the cell opening

10. COST & ECONOMICS

Methodology: The cost economics based on the service demand translating to profits per month which is required to service the EMI cost of acquisition of the system. The business case in based on service model for a new entrepreneur where flour is brought in by nearby individual customers.

The cost and economic of rice huller business is based on the following assumptions:

- Cost of System (includes solar component): Rs 1,70,000/-
- Interest rate is fixed at an average of 12%
- Payment tenure translate to 60 monthly EMIs
- Based on the calculation, the EMI cost coming to Rs 3782
- No. of working day considered: 25 days
- No. of working hours: 8 hours
- The entrepreneur avails loan amount of Rs 1,70,000 for both capex and opex.

Approximate revenue per year

Flour grinding	kg/hour	7
Working hours	hours/day	8
Working days	days/month	25
Market price of wheat flour	Per Kg	5
Total Selling Revenue	Per year	84,000

Approximate expenses per year

CAPEX	
Items	One-time cost
Flour Mill	16,000 ₹
Solar system	154,000 ₹
Total	1,70,000 ₹

EMI Calculation

EMI	
LOAN AMOUNT	1,70,000 ₹
RATE OF INTEREST PER ANNUM	12.00%
RATE OF INTEREST PER MONTH	1%
TENURE IN MONTH	60
EMI	3,782 ₹

Expected increasing profit from Solar flour mill machine

EMI cost	Rp/year	45,384 ₹
Total selling revenue	Per Year	84,000 ₹
Total operating income (Profit)	Per Year	₹ 38,616
	Per Month	₹ 3218

The intervention is expected to increase the entrepreneurs income by Rs 38,616 on a yearly basis.

11. CASE STUDY

a) Kondu Bodekar - Margadidaddi

Kondu Bodekar, in his 40s, is part of the Gowli community, the cattle herders, and is today settled at Margadidaddi, Mundgod. He primarily is a daily wage labourer and today is the only individual managing the flour and chilli milling business in his community.

Marga didaddi is an extremely remote forest area situated in Munadagod, a panchayat town in Uttara Kannada district in the Indian state of Karnataka. There are about 25 households residing in this community, many of whom have settled here since more than 50 years. They all have mud houses that they have constructed themselves. Among them, only 2-3 people own land cultivating rice, arecanut, maize, while the rest of the community engages in daily labour work at other peoples farms in nearby communities. Only these 2-3 households cultivate crops like arecanut, maize so that they can sell at the market. They usually get ration from the nearest town for rice, jowar, chilly

(10-15kg) which they get once a month from the market. Their food habits include simple meal of *jowar* and *akki roti*, rice and *sambhar*. Also very few, 5-6 households, may grow vegetables for self consumption. Only 4 out of 25 households has the power grid metre, and they face power cut issues on an average of 1-2 hours and during rainy season face power cuts of more than 4-5 hours. Today 95% of households have solar and some may take illegal grid connection, even with the solar present.

For technical details: The flour machine is a 1 hp single phase system that can mill 8kg of grain per hour. It is a 3 hour hybrid system - meaning a combination of both grid and solar. The solar system comprises of 6 panels - 250W and 4 batteries - 150 Ah.

Due to the remoteness and lack of technology know-how, Kondu Bodekar may not be sure of his age and estimates weights of quantities milled with traditional methods. Currently the milled product is used only for self consumption. Post installing the solar powered grinding machine, he is able to approximately mill 5 kg/day (worst) -10 kg/day (best), and are yet to experience any kind of season but estimate a supply of about 10-15 kg/day of milled output. As summer is the season of chillies, they are hoping to have more demand of grinding chillies. They hardly celebrate festivals, and the only ones they celebrate is Dussehra, Diwali where simple sweets out of rice are made - which does not need any milling activity. And during the rainy season, crops get wet and people do not prefer milling.

For servicing: The energy enterprise branch offers any type of service regarding the machine and solar within 24 hours of the service request.
Utilisation: He utilises the machine for 1-2 hours, and has only run on solar.

<u>Packaging, storage and distribution</u>
He usually does not have to store the milled product, but if he has then it has not been for more than a week. In order to collect the food grains, they go to the market once a week or once in 15 days and buy approximately 10-15 kgs. There is no market developed and hence no packaging or distribution involved. He has noticed that if the milled product is kept for more than a week, insects can destroy the produce and hence they mill and immediately give it to the end user or atleast within a week max.

<u>Market and costs</u>
The nearest town is the Katur market which is 5 km away. Some of the villagers may go by bike and many others may choose to walk - taking 30mins to reach the market. He is open to selling packed items to the market but needs adequate support, training and awareness on market structures and dynamics. Cost of inputs bought from the market: They buy the grains - jowar and rice and masala and spices at 5 INR/kg, and chilly at 10 INR/kg while they sell the milled rice or chilly at 6 INR/kg.

<u>Finance</u>
There is a public sector bank - Vijaya bank in the nearest town, Katur. These are the loan details:

Total cost of the machine - 1,70,000 INR

Entrepreneur contribution - 42,500 INR

Loan structure
The loan was provided as mudra shishu loan which does not need any collateral.
EMI - 1000 INR/month
ROI - 10%
Tenure - 3-5 years

12. IMPACT

Effort	Pre intervention, they had to spend a day as they would have to walk for 30mins and then stand in a queue. The process gets further delayed when there are power cuts. They usually go every wednesday to the market so they used to sit and clean the grain in the mill area and get the milling done- making it an extremely inconvenient activity.
Income	He now gets an additional income of 700-800 INR/month.
Influence	There has been a gradual change that has come into the community as they have started appreciating the relevance of technology and feeling proud that their village now has their own milling point. Other nearby villages have also shown interest to get their graisn milled at this centre.