Sustainable Energy Access and the Rice Value Chain

Implementations, Solutions and Learnings from an Ecosystems Perspective

SELCO FOUNDATION

JULY 2020

Good Energies FOUNDATION

1 NO POVERTY

2 ZERO HUNGER

7 AFFORDABLE AND CLEAN ENERGY

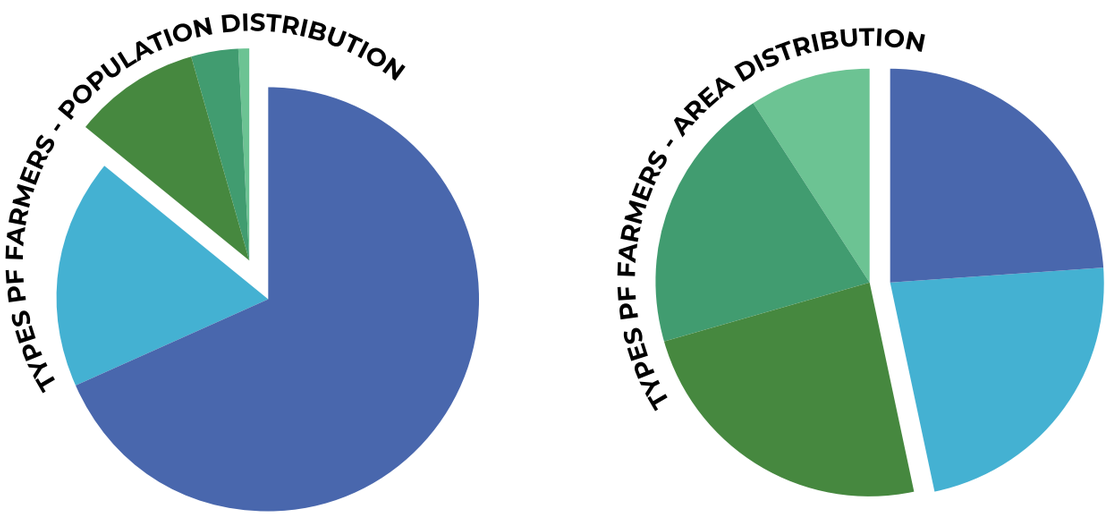
8 DECENT WORK AND ECONOMIC GROWTH

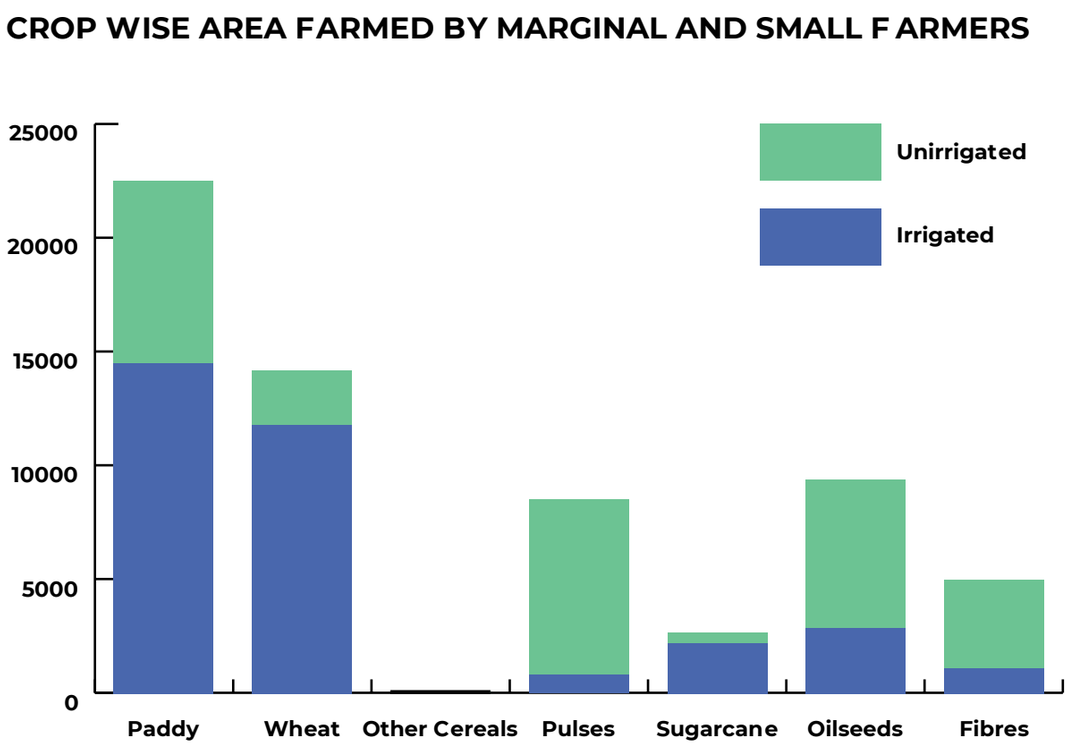
Table of Contents

Problems in the Rice Value Chain

Most Indian farmers have marginal land holdings, with relatively small quantities of individual farm yield

Small and marginal farmers with less than two hectares of land account for 86.2% of all farmers in India, but own just 47.3% of the crop area, according to the 10th agriculture census 2015-16.



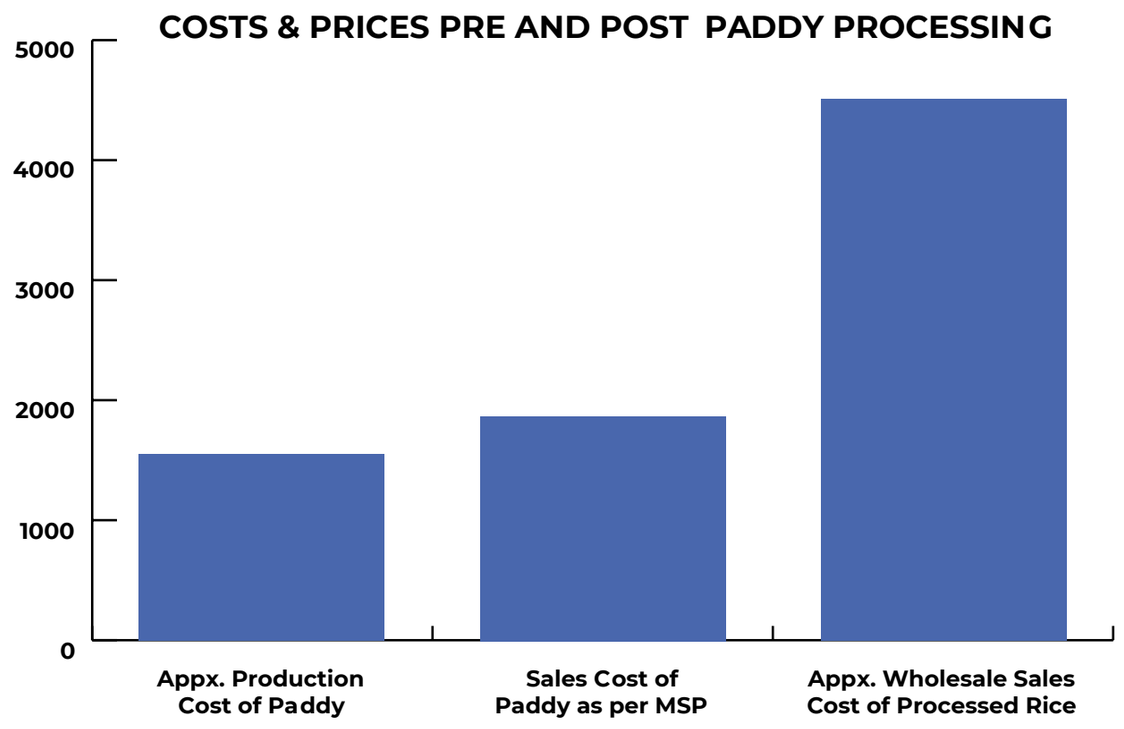


Marginal farmers engage in paddy production as a form of sustenance

Cereals, particularly paddy is a preferred crop among marginal and small farmers as per the report on Agricultural Statistics at a Glance - 2014. This trend towards food crops (Cereals and Pulses) is that a considerable portion of the yield would be consumed by the farmer and his/her family. The high incidence of unirrigated paddy, is characterised by rain fed paddy crops which also coincides with the annual return of migrating paddy farmers from major cities.

Value capture in the rice value chain is higher in its downstream activities

As seen on the graph on the right the difference between the cost of production of paddy and final sale of paddy is not very high - most of which is what the farmer would receive as his/her share of the value. Post this, the value of paddy would increase by 2x-3x by processing alone. Moreover, the main by product of rice, husk and bran are at times as valuable as the rice it-self.



Rice Farming Regions of India

Vulnerable Rice Farming Communities

THE NEW INDIAN EXPRESS

Link to article

No grains in the pot, no money in the pocket, Karnataka farmers face uncertain times

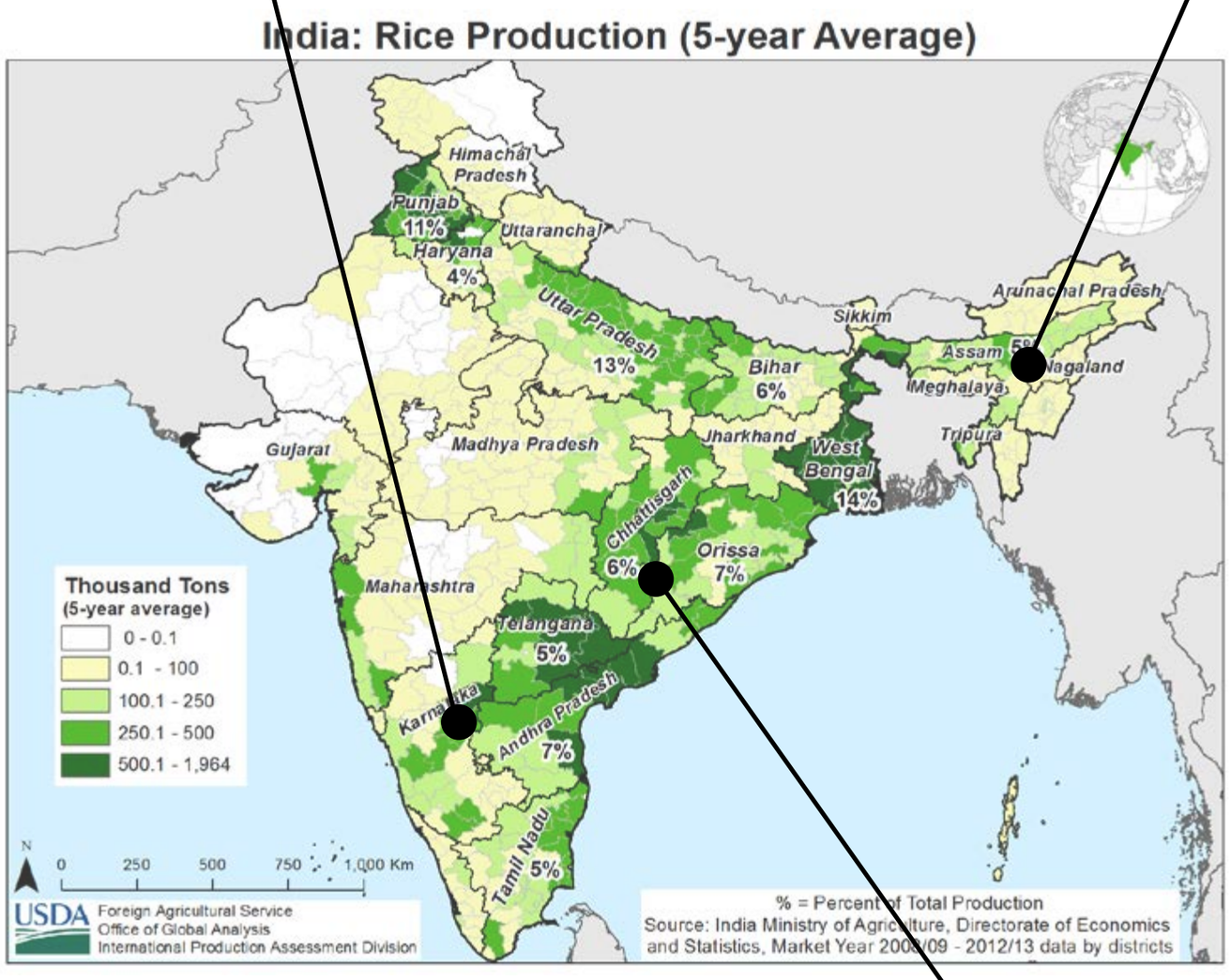
Small farmer Nagaraju from Raichur, who cultivates paddy, is waiting for the economy to pick up before purchasing seeds for his next crop.

Science THE WIRE

Link to article

Why do Indigenous Communities Continue to Practice Shifting Cultivation?

24/06/2020



Vulnerable, paddy growing communities exist largely across the country. India is the second largest grower of rice in the world. Major rice belts in India are in the southern peninsula, east cost, hilly, forested areas regions in the east and north east as well as the flood plains of the north east and plains of the north. The woes of marginal farmers are largely common. In the north east for example, paddy farming is carried out using indigenous sustainable methods which are often misunderstood; whereas in Odisha, a high yield output does not ensure ample food for farming communities; Similarly in Karnataka, acute water shortages have rendered traditional flood paddy farming impossible, with more areas discontinuing paddy farming every year.

The Indian EXPRESS

Link to article

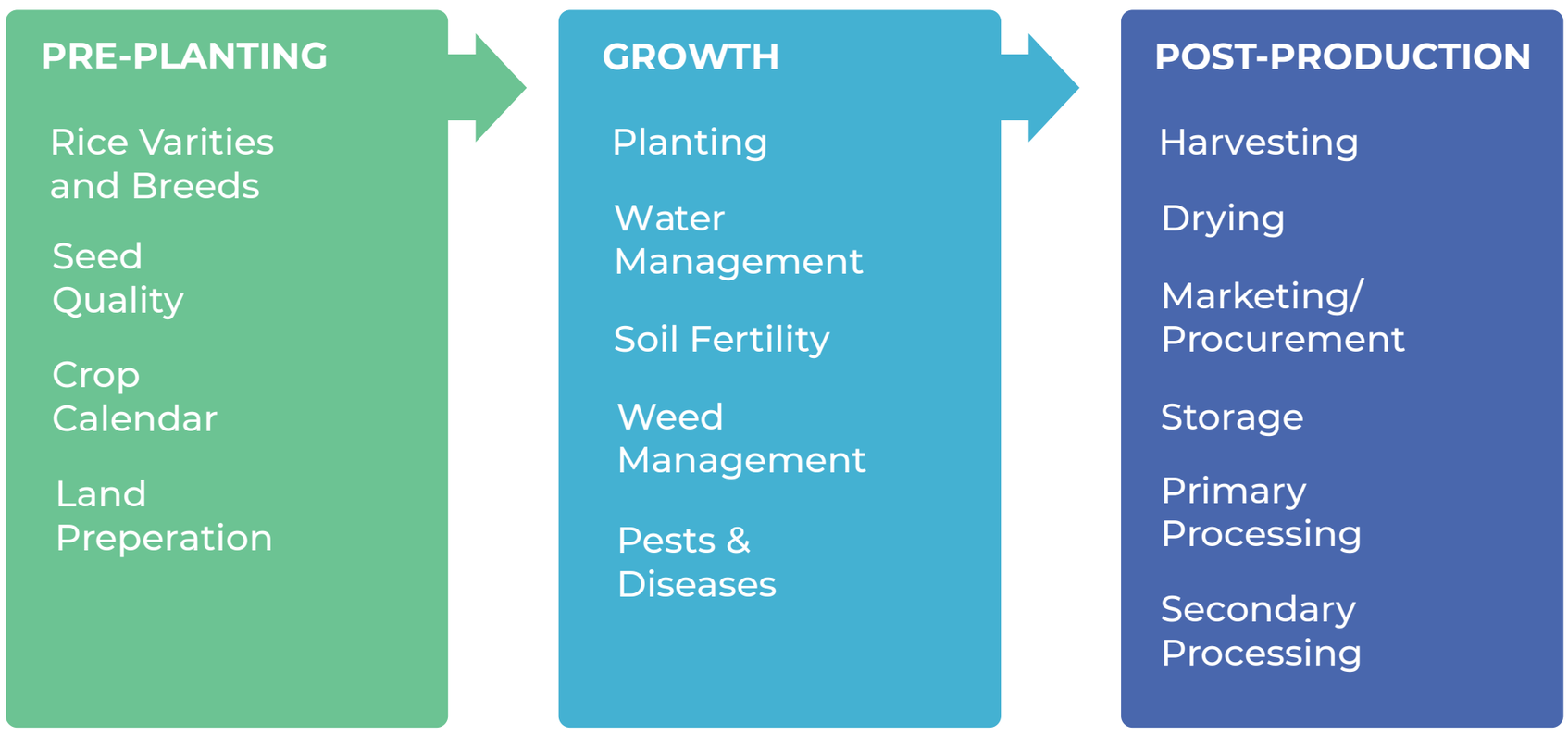
Decoding Poverty: Nabarangpur produces enough rice for itself and more

Nabarangpur has 73 rice mills that can together process 2 lt of paddy annually.

Value chain Mapping of Rice
Key Learnings

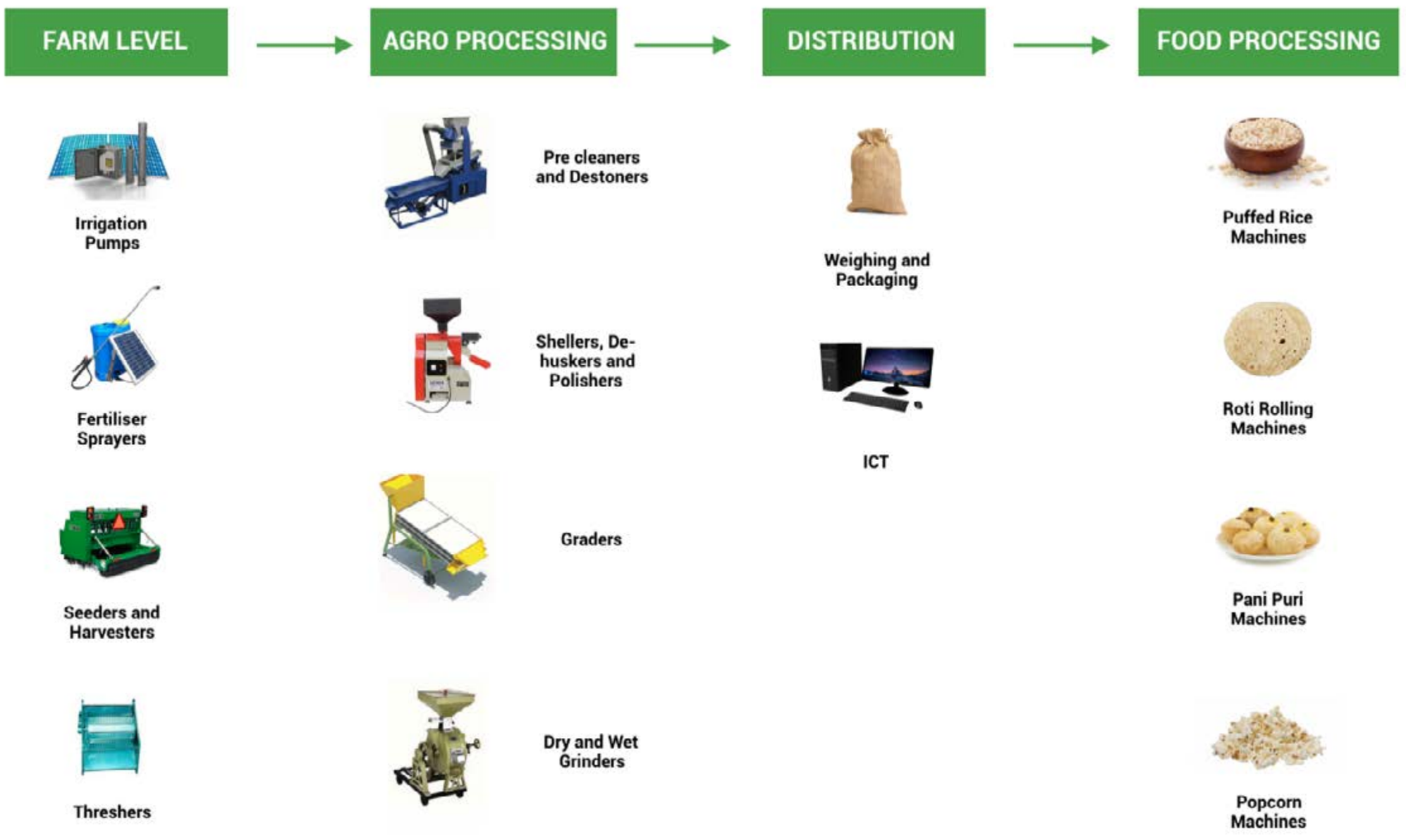
The value chain from paddy to rice is a long one, involving a number of processes and stages

The journey from farm to table for the paddy crop is similar to other cereal crops. Farmer woes in the pre-planting stage are heavy, with capital borrowed for pre-planting activities is largely sourced from private providers or even stakeholders like millers and merchants - lower down the value chain. Labor requirements are heavy in the growth stage with most farmers adopting transplanting methods of growing paddy. The last stage is one of high value addition where the price of grain and by products exponentially increases.



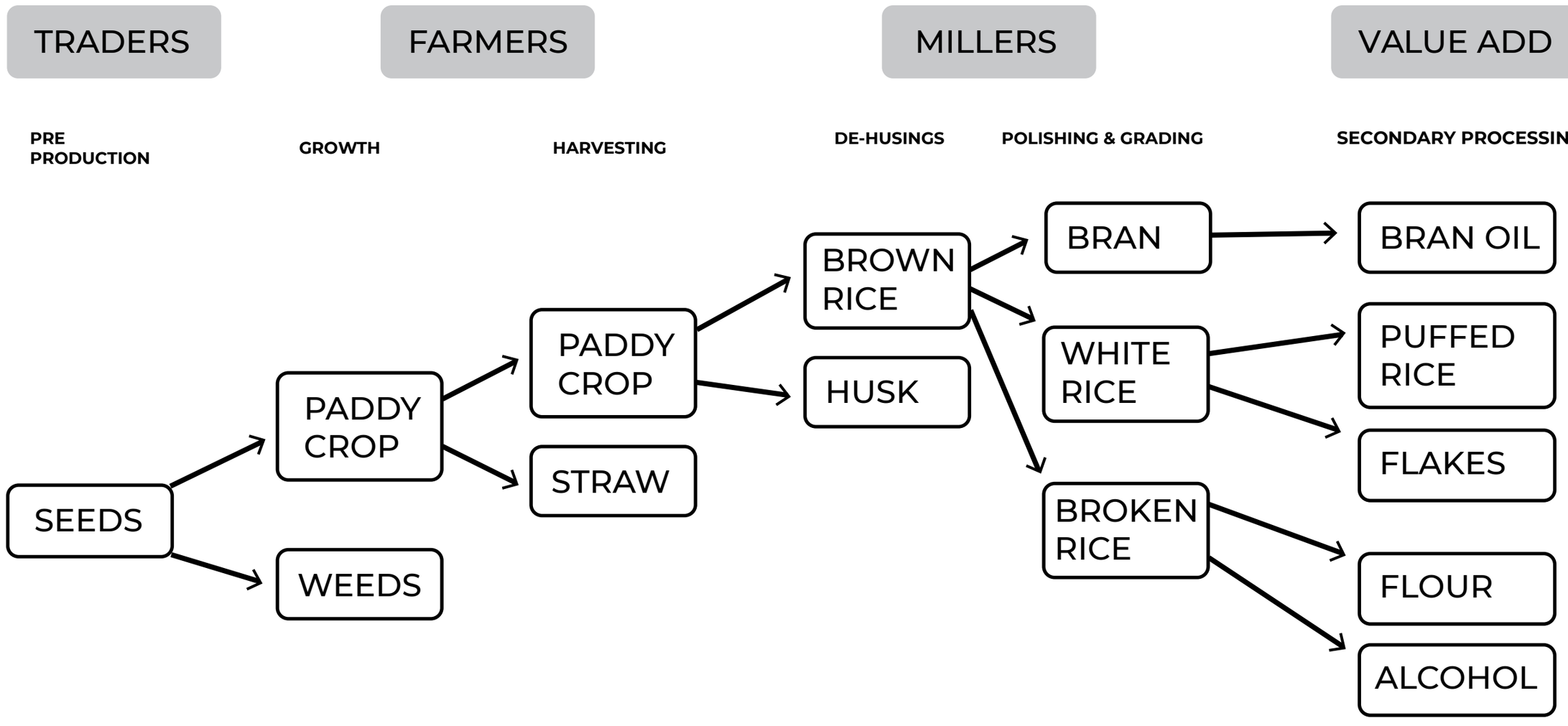
Sustainable Energy, Technologies and Infrastructure as assets have a major role to play across the rice value chain

Many technologies can be identified for appropriate stages. These machines range from individual use machines to more number of rice farmers or groups/clusters. The machines identified are similar in nature to those required for other major cereals like Wheat , Millets, Maize with contextual changes in some cases.



Product Mix for various stakeholders in the rice value chain

Further to the parts of the value chain, key stakeholders and product mix at various stages is described below. As on can see, key products with high value lie with the miller.



Models in the primary rice value chain - Buyer Driven, Facilitator Driven, Producer Driven

Today, there are a few models including traditional models, government driven models and new emerging models are all simultaneously practiced. Out of these, traditional models are most exploitative of farmer's interests with millers and traders taking the largest share of the value gained. In government driven models like government institution based procurement, many drawbacks and effects of slow processes, as well as continued dependency on other aspects of traditional models prevents greater uptake and value generation for the farmer. In the new emerging models category, lack of adequate enabling factors prevents communities from taking up such disruptive models or successfully seeing them through.

Traditional/Buyer Driven Model

- Farmers role is limited to paddy production and rely on traders for further linkages
- Power is highly centralised towards millers
- Post harvest management is controlled by the APMC Act.

Government/Facilitator Driven Model

- Government replaces private traders and procures paddy directly from farmers.
- Provides MSP to farmers but is slow to release funds
- Ensures National Food Supply and Reserves
- Relies on traditional channels for milling

Emerging/Producer Driven Model

- Producer or groups of marginalised producers act as entrepreneurs.
- Provides higher autonomy and high market returns for producers.
- Farmers have higher bargaining power when working with traders and can also diversify products as per local needs.
- Requires an enabling ecosystem - if missing can cause risk

Key aspects of the rice value chain are highly centralised. Decentralising such highly centralised aspects would require a 'scaling down' approach - across key functions of technology, financing, ownership as well as markets and linkages.

DISTRICT
1,000,000 quintals

→

BLOCK
50000 quintals

→

CLUSTER
5000 quintals

→

VILLAGE
500 quintals

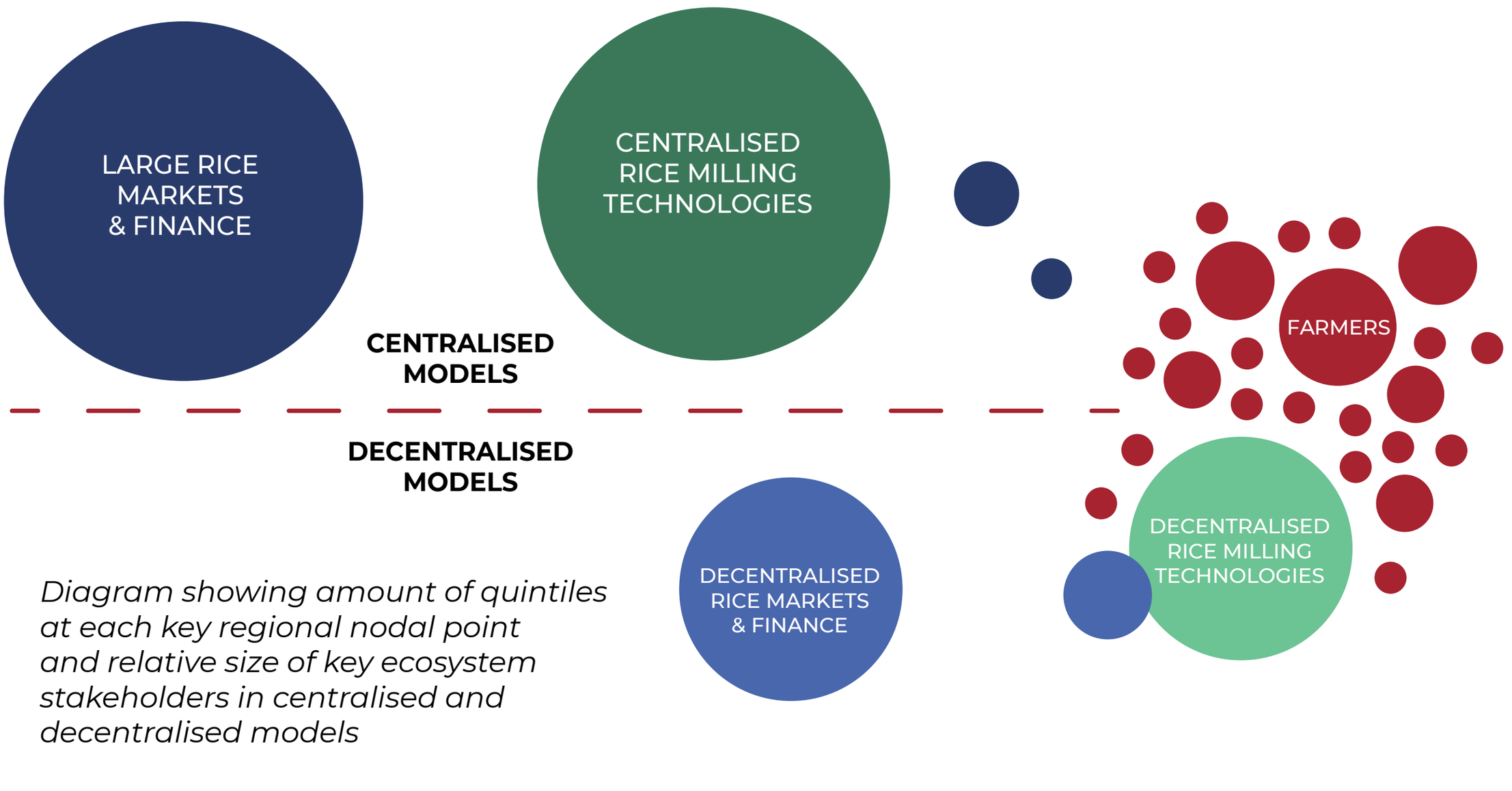
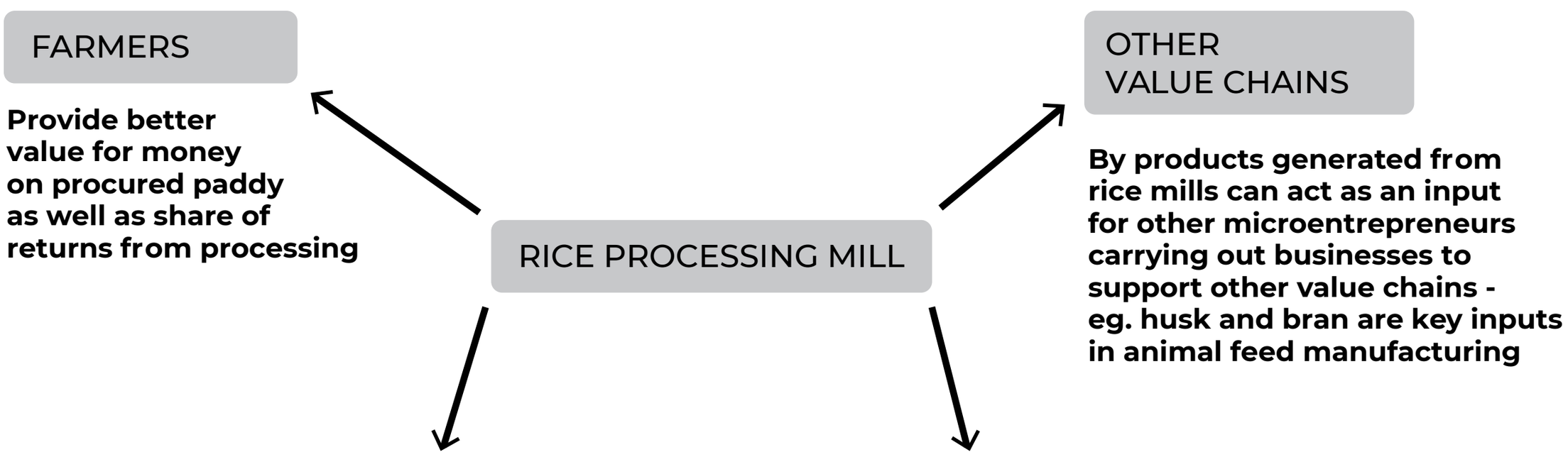
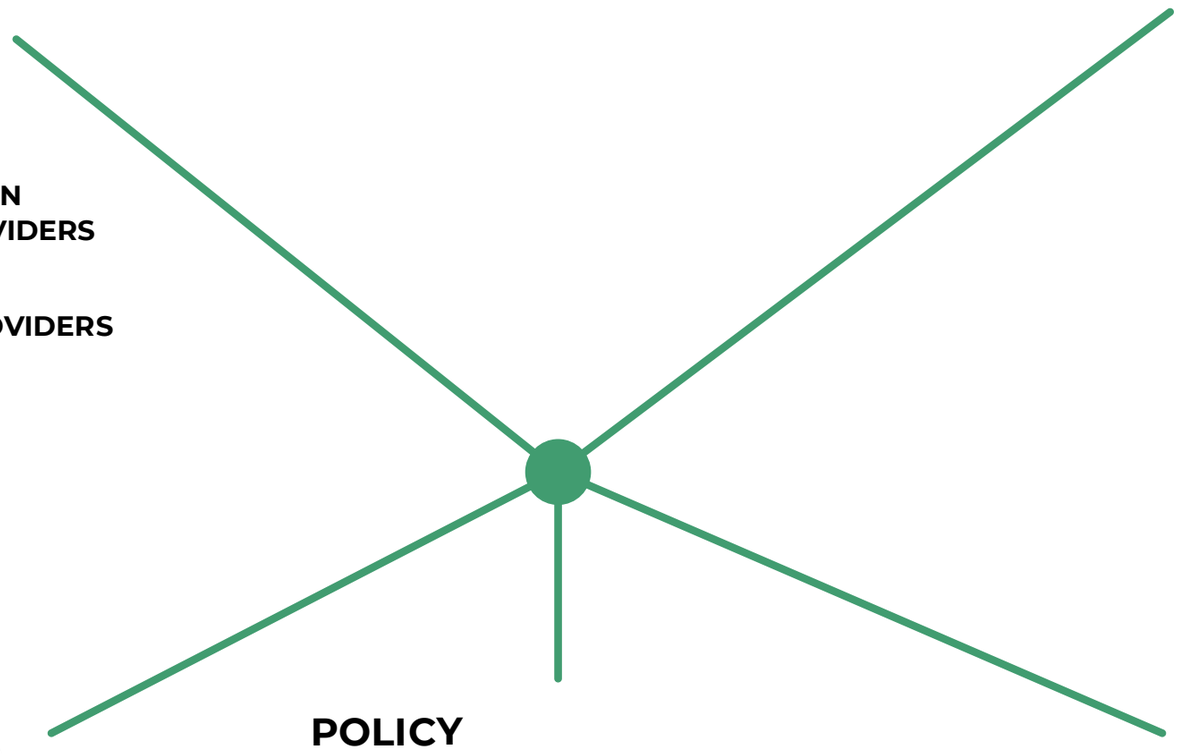


Diagram showing amount of quintiles at each key regional nodal point and relative size of key ecosystem stakeholders in centralised and decentralised models

Key aspects of the rice value chain when decentralised can have multiple positive repercussions, across its input and output linkages within its value chain but also in other value chains.



Ecosystem Stakeholders in the Rice Value Chain



TECHNOLOGY & INFRASTRUCTURE

TECH. BENCHMARKIN G

ON FARM PADDY PRODUCTION TECH ASSET AND INFRA PR OVIDERS

OFF FARM RICE PROCESSING TECH ASSETS AND INFRA PR OVIDERS

SKILL & CAPACITY BUILDING

STATE AGRICULTURE & HORTICULTURE UNIVERSITIES

ITIs AND OTHER EDUCATIONAL INSTITUTES

SOCIAL ENTERPRISES

NON PROFIT ORGANISATIONS

GOVT. INSTITUTES & AGRI EXTENTION CENTRES

FINANCIAL LINKAGES

COMMERCIAL & RURAL BANKS

MFIs - NBFCs AND TRUSTS

ENTERPRISE IN VESTORS

POLICY

CENTRAL, STATE, DISTRICT ADMINISTRATION & GOVERNMENT

FOOD & CIVIL SUPPLIE S

ECONOMIC & FINANCE

SCIENCE & TECHNOL OGY

AGRICULTURE

RENEWABLE ENERGY

MARKETS & LINKAGES

SEED CERTIFIC ATION

INPUT SUPPLY - GOVT. & PVT.

FARMERS

SHGs & FARMER GROUPS

FARMER PRODUCER COMPANY

GOVT. AGRI MARKETING INSTIT UTIONS

PRIVATE MILLERS, STORAGE, WAREHOUSING

PRIVATE TRADERS/NE TWORK

Sittilingi Organic Farmers Assiciation

USERS, MARKETS & LINKAGES

NGO

DISTRICT LEVEL

TAMIL NADU

INNOVATION PARTNERS

Formation of SOFA (Sittilingi Organic Farmers Association), an association of farmers currently practicing organic methods, and is in the process of receiving organic certification from the government. Currently, there about 200 farmers who are registered, of whom, half have got ‘organic certification’ from the Govt. of Tamil Nadu.

COMMUNITY/ USER CO-ORDINATION

ACTIVE R&D ENGAGEMENT

Alto Precision

TECHNOLOGY & INFRASTRUCTURE

OFF FARM RICE PROCESSING TECH ASSETS AND INFRA PROVIDERS

PAN INDIA

INNOVATION & REPLICATION PARTNERS

ACTIVE R&D ENGAGEMENT

INNOVATION/ REPLICATION AND SCALE ADVOCACY

Harsha Trust

USERS, MARKETS & LINKAGES

NGO | STATE LEVEL | ODISHA

INNOVATION & REPLICATION PARTNERS

Harsha Trsut has operated in Odisha since 2002. By the year 2018 they worked with more than 87871 families to enhance their income by at least 50% of their existing incomes. Their vision is to eliminate hunger and malnutrition in the most backward districts of the state and be actively supported by the community, other NGO partners, government and corporations. Their idea is to place small women farmers who produce our food at the forefront. They provide platforms for communities which will address myriad dimensions of rural livelihood , starting from organizing women into SHGs and subsequently village organizations. They have 10 Farmer Producer Organizations which help in aggregation of products and thus fetching better prices for both ends of the value chain.

http://www.harshatrust.org/

COMMUNITY/USER CO-ORDINATION

ACTIVE R&D ENGAGEMENT

INNOVATION/ REPLICATION AND SCALE ADVOCACY

Evangelical Social Action Forum (ESAF)

USERS, MARKETS & LINKAGES

FINANCIAL LINKAGES

SMALL FINANCE BANK

NGO | STATE LEVEL | ODISHA

INNOVATION & REPLICATION PARTNERS

1. ESAF Small Finance Bank is an Indian small finance bank providing banking services and small loans to the under banked. ESAF started its operations as an NGO in 1992 as Evangelical Social Action Forum
https://www.esafbank.com

2. As an Agri-Cooperative, ESAF is actively participating in all agri and allied technical exhibitions through which a platform is given to its members to showcase their produces.

http://esafcooperative.in/page/agri-initiatives

COMMUNITY/USER CO-ORDINATION

ACTIVE R&D ENGAGEMENT

INNOVATION/ REPLICATION AND SCALE ADVOCACY

NABARD

FINANCIAL LINKAGES | POLICY

GOVT. INSTITUTION | PAN INDIA

REPLICATION PARTNERS

Promote sustainable and equitable agriculture and rural development through participative financial and non-financial interventions, innovations, technology and institutional development for securing prosperity

https://www.nabard.org/

INNOVATION/ REPLICATION AND SCALE ADVOCACY

India Foundation for Humanistic Development (IFHD)

USERS, MARKETS & LINKAGES

NGO | STATE LEVEL | ODISHA

COMMUNITY/USER CO-ORDINATION

ACTIVE R&D ENGAGEMENT

INNOVATION/ REPLICATION AND SCALE ADVOCACY

INNOVATION & REPLICATION PARTNERS

The India Foundation for Humanistic Development [IFHD] is a Sec 25 (now 8) not-for-profit foundation with Sec 12 A and 80 G exemptions. Guided by humanist values, IFHD's mission is to contribute to a just, free and equitable society in which all people, regardless of gender, caste, ethnicity or other identities, have equal access to opportunities and resources, and actively participate in decision-making processes that determine their lives and their future. By investing in transformative development interventions and collaborating with individuals, civil society organisations, the private sector and the government, IFHD aims to enable social change – in both rural and urban areas. IFHD is committed to the marginalised, and seeks to create lasting improvements in their lives. IFHD trusts in the creativity and agency of people and its core values are quality, cooperation and innovation. - **http://ifhd.in/**

Seven Sisters Development Assistance (SeSTA)

USERS, MARKETS & LINKAGES

NGO | STATE LEVEL | ASSAM

INNOVATION PARTNERS

SeSTA collectivizes women to form Self Help Groups (SHGs), builds their capabilities and strengthens livelihood systems to alleviate mass poverty in far flung villages of Northeast India. - **https://www.sesta.org/**

COMMUNITY/USER CO-ORDINATION

USERS, MARKETS & LINKAGES

INDO-GLOBAL SOCIAL SERVICE SOCIETY (IGSSS)

VRUTTI

RASHTRIYA GRAMIN VIKAS NIDHI (RGVN)

UKHRUL DISTRICT WOMENS INSTITUTION OF MANIPUR

LIFE EDUCATION AND DEVELOPMENT SUPPORT (LEADS)

PRADAN

VANASIRI RURAL DEVELOPMENT SOCIETY (VRDS)

SAURAMANDALA

MOREGAON MAHILA MEHFIL

FINANCIAL LINKAGES

STATE BANK OF INDIA

BRAMARAMBA BANK

KARNATAKA VIKAS GRAMIN BANK

SYNDICATE BANK

NABFINS

POLICY

WOMEN & CHILD CARE DEPARTMENT OF KARNATAKA

MEGHALAYA, ODISHA, MADHYA PRADESH, KARNATAKA STATE RURAL LIVELIHOOD MISSION

NABARD

UDUPI DISTRICT ADMIN

TECHNOLOGY & INFRASTRUCTURE

VISHRA AGRO

LOCAL MANUFACTURERS

SKILL & CAPACITY BUILDING

INSPIRE FOUNDATION

DISTRICT AGRICULTURE TRAINING CENTRES & KRISHI VIGYAN KENDRAS IN SELECTED DISTRICTS

Scalable Solutions and Models for Rice Processing

CONTEXT

A vast number of paddy farmers in India are Marginal and Small Farmers. Such farmers grow paddy in small quantities. With a constant need of cash flow, such communities utilise various strategies in the way they sell their rice. A portion of these farmers, who have built savings, other sources of income sell most of their produce to government procurement agencies at the applicable Minimum Sales Price. However, a large number of marginal and small farmers do not have the ability to hold their stock which government funds are released in exchange for procured paddy - which is usually 3 or more months after procurement. Hence, such farmers continue to sell most of their paddy to local merchants - usually members of the same locality with higher social capital and business networks. All farmers however, retain a portion of their paddy. This is done for two reasons - a) Sale of paddy in weekly markets at a later time, usually at lower prices but with immediate payment; b) Self Consumption by the family. The latter is milled at local rice mills which are located in the same or a neighbouring village owned by families usually with more financial security. These machines, are of local make, and in most cases of inferior quality with unusually high motor capacities, much higher than what is needed for the quantities processed. This also causes increased, unnecessary energy expenditures. Such mills are also in most cases affected by power cuts and breakdowns or would be completely off-grid - forcing either regular shutdowns or the use of diesel run systems.

There are two key challenges addressed in this context - that of better addressing milling needs for local consumption, especially for remote communities; to offer a way for marginal and small farmers to make higher returns of their produced paddy. Hence, highlighted in this document are two solutions to address the needs respectively. The solutions are:

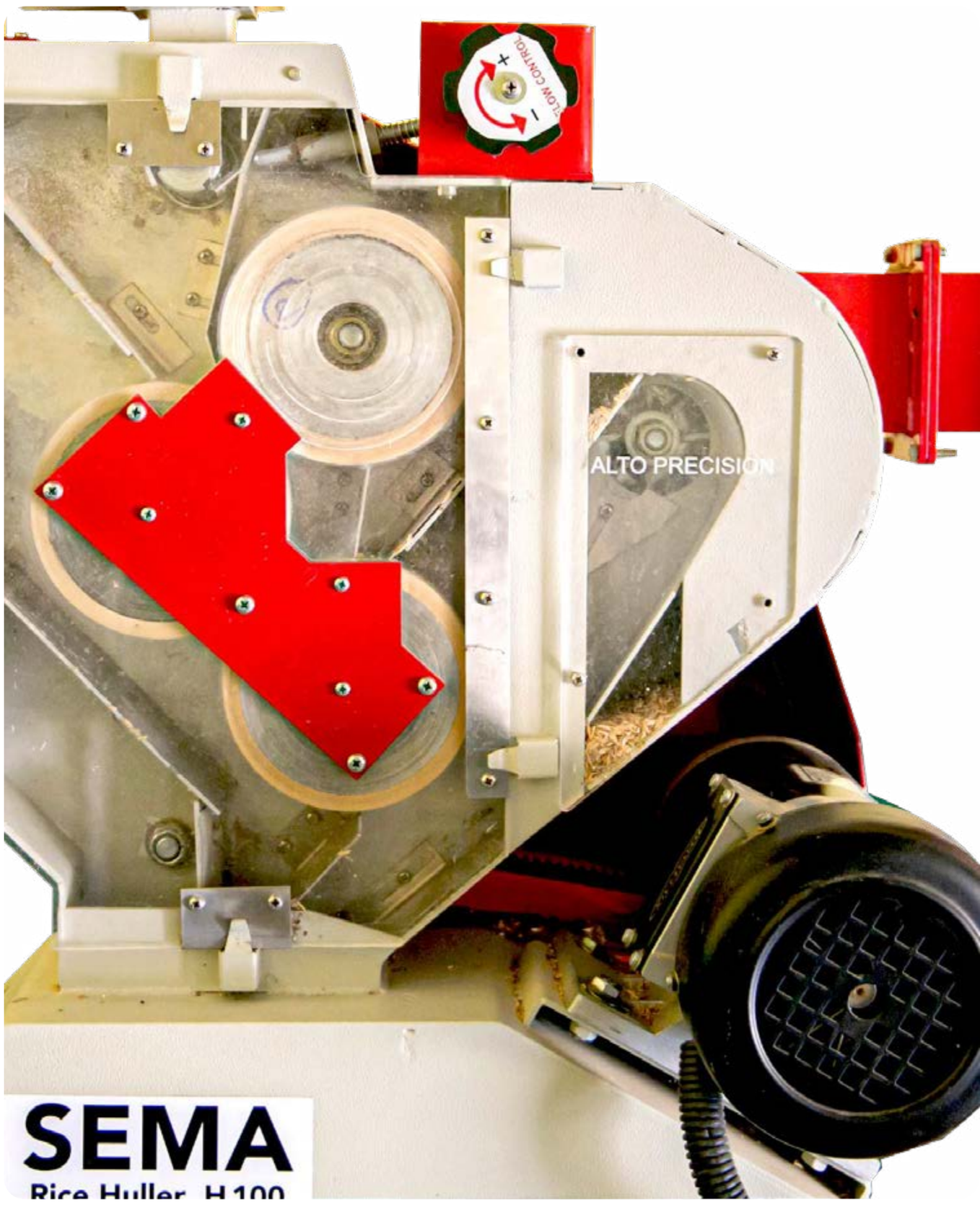
1. **Paddy Primary Processing Service for Local Rice Consumption**

2. **Medium to Large Scale Paddy Aggregation, Primary Processing and Marketing - Focus on Local/ Niche Rice Varieties**

Integrated Energy Efficient Rice Mills for Decentralised Rice Processing

Energy efficient solar powered rice de-husking and polishing machines were developed in partnership with ALTO Precision to cater to lower volume & high output quality needs for usage at village or cluster levels. These machines were made such that they would be:

- Easy to use and of high efficiency
- Adjustable for different varieties or breeds of rice
- Adjustable such that varying levels of polishing (Brown Rice, Semi Polished Rice, White Rice) could be achieved as per the user/community requirements.



Rice Huller

50%
Energy Savings

The rice huller improves the output efficiency to 95% from 80-85% of the locally available machine.

Rice Polisher

25%
Energy Savings

Polishes 45-70 kgs of rice every hour depending on the polishing rate (1%, 5%, 14%)

Rice Mill (Separator + Huller + Polisher + Grader)

68.5%
Energy Savings

Processes 150 kgs/hour of rice - semi automatic and 350 kgs/hour of rice - fully automatic

Rice Huller + Polisher

Energy Generation -
Solar Panel Capacity Needed

Inefficient
300 Wp x 24

Efficient
300 Wp x 12

Energy Storage -
Battery Capacity Needed

Inefficient
200 Ah x 16

Efficient
200 Ah x 8

1 Paddy Primary Processing Service for Local Rice Consumption

CHALLENGE

Current rice processing services are not fully accessible at the last mile. This is particularly important for tribal/forest dwelling/remote communities where villages may be more widely scattered with distances wide and transportation option limited, and costs high.

EXAMPLE - LANJIGARH BLOCK, KALAHANDI, ODISHA

NUMBER OF HOUSEHOLDS IN LANJIGARH	**11269**
NUMBER OF RICE MILLS IDENTIFIED IN LANJIGARH	**35**
NUMBER OF VILLAGES WITHOUT RICE MILLS/TOTAL NUMBER OF VILLAGES	**194/222**
ESTD. NUMBER OF PEOPLE TRAVELLING OUT OF VILLAGES FOR RICE MILLING SERVICES (AVERAGE NO. OF HOUSEHOLDS/ VILLAGE*NUMBER OF VILLAGES WITHOUT RICE MILLS)	**9847**

TOTAL UTILISED CAPACITY/ MINIMUM CAPACITY AVAILABLE PER DAY ACROSS 87 RICE MILLS SURVEYED IN 2 BLOCKS - @500KG/DAY/MILL

UTILISED	47%	TOTAL
20350 kg		**43500**

Most current rice milling machines used are inefficient and over the required capacity. These business are not profitable at low volumes and the machines are under-utilised.

The entrepreneurs largely rely on incomes from rice husk and bran recovered as a by product of paddy processing. Gains from this sale of husk and bran are completely lost by the farmer.

AVERAGE BYPRODUCT GENERATED ACROSS 87 RICE MILLS SURVEYED	AMOUNT EARNED ON AVERAGE BY SALES OF BY PRODUCTS (HUSK+BRAN+BROKEN RICE)
235 kg Per Month	**INR 3300**

COST FOR EVERY 1 KG OF PADDY MILLED BY A FARMER	RESULTANT WORTH OF RICE RECEIVED BY FARMER (@50% HULLING EFFICIENCY)	% OF POTENTIAL INCOME LOST FOR EVERY 1 KG OF PADDY PROCESSED
INR 15	**INR 14** 500g/1kg of Paddy	**48.27%**

NO. OF RICE MILLS USING DIESEL AS AN ENERGY SOURCE	**70/87**
AVG. MONTHLY RECURRING COST OF DIESEL FOR THE MILLER	**INR 1853**
TOTAL DIESEL CONSUMED ACROSS 87 RICE MILLS PER MONTH	**127,000 Liters**

Machines used are of extremely high capacity, often many times over the required volume. These large machines force entrepreneurs to incur high diesel, electricity which negatively impacts their cash flow/viability.

*Data Based on Survey Conducted by SELCO Foundation with 87 Rice Mills in 2 Blocks of Kalahandi District in Odisha - Thuamul Rampur and Lanjigarh

OPPORTUNITY

Rice Processing services for remote communities can be decentralised to the very last mile, at the individual village level to achieve multiple benefits:

Husk and Bran are valuable income source and by product of processed rice can be made locally available for further use at local level as a component of animal feed or sold in larger quantities to external markets.

Having rice milling services available at the last mile would greatly help save on transportation and transaction costs incurred on traveling to more centralised mills

A larger group of individuals can be employed to operate and maintain the local rice mill. As entrepreneurial skills develop and with further collective action - aggregation, production and marketing capacities can be further built as additional entrepreneurial ventures for higher collective returns.

TECHNOLOGY SOLUTION LEARNINGS

Additional Machinery for Value Addition, for Auxiliary Income Sources as per Local Needs

The value added products of rice, as well as the further processing of by products of rice are both additional viable businesses. Here, additional machines eg. Husk Grinders would need to be considered.

Local Service Network and Easy Availability of Spare Parts

For communities which are very remote, future technical difficulties and trouble shooting would greatly hamper productivity. Here, effective risk management would be needed to be considered and mitigated.

OWNERSHIP AND OPERATIONS LEARNINGS

Village Level Self Help Group Owned Rice Mills

Self Help Groups (SHGs) promoted by the Rural Livelihood Mission or NGOs can serve as an entry to point to identify entrepreneurs. SHGs, usually comprising of 10 women each can set up village level units serving approximately 50 households.

Village Level Entrepreneur Owned Rice Mills

In areas where group building practices may be lower, as well with less remote communities, individual entrepreneur led Rice Milling Units can be utlised.

FINANCIAL SOLUTION LEARNINGS

Rice mills in remote areas require long term asset financing and higher upfront capital subsidies due to lower volumes of business. Appropriate business models can be created as per local needs keeping in mind current and future volumes.

As shown in the figure alongside, appropriate loan models with upfront capital subsidies and Differed Rates of Interest can be utilised.

COST ECONOMICS OF RICE MILLING SERVICE FOR REMOTE/TRIBAL COMMUNITIES - SOLUTION WITH SCOPE FOR EXPANSION

TOTAL APPX. COST OF RICE MILLING UNIT (500 kg/Day)	INR 600,000
TOTAL CAPITAL SUBSIDY AMOUNT (@75% ON TOTAL)	INR 450,000
LOAN AMOUNT	INR 150,000
MONTHLY INSTALLMENT AMOUNT AT 4% INTEREST FOR 5 YEARS	INR 2762
TOTAL POTENTIAL INCOME (AT 50 KG OF MILLING PER DAY AND INR 3 PER KG MILLING COST)	INR 4500

CASE STUDY

LATEHAR, JHARKHAND

Village Level Self Help Group Owned Rice Mill

Kurokala village in Mahuadanr Block, Latehar district is a remote village with Santhal communities residing there. They are all small and marginal farmers who grow rice for one season and practice horticulture farming as well. The rice grown by these farmers are Black Jeera Rice and normal varieties of rice which they consume and sell. 300 households cultivate paddy in this cluster of Mahuadanr block with each household producing about 15-20 bags of paddy (10 quintiles) per season. They keep enough paddy aside for self consumption and sell the rest.

Life Education and Development Support (LEADS) is an organization based in Jharkhand that works in the districts of Khunti, Hazaribagh, Laterhar, Ghumla etc to promote livelihoods of communities. They also work in urban areas with their base located in Ranchi. Within the livelihoods work, they focus on agriculture and natural resource promotion, animal husbandry for sustainable livelihoods and more. They have members grouped in SHGs across the districts, some of which are driven by women participation and leadership.

In Latehar and Ghumla districts alone, they have 1600 members who practice rice cultivation. These farmers live in very remote forested regions and are predominantly belonging to tribal communities.

INPUTS, OUTPUTS AND MARKETS

Kisan Mahila Mandal is a women based SHG with 20 members who decided to take up the decentralized solar powered rice mill intervention as they observed the need for hulling of rice and polishing there. The nearest rice mill is in a town about 10 km away which is centralized in nature. A small building infrastructure was set up with the help of the Jharkhand Livelihood Mission and the equipment, energy components were provided by SELCO Foundation in May, 2019. Multiple training sessions were conducted by SELCO Foundation staff for the women members. The women operate the machines, handle packaging, accounts, registers, maintenance etc.

PRE-INTERVENTION

Earlier in Latehar, there was no decentralized rice milling solution or service available. People had to go 10 km to a centralized solution to get the service. Adopting this decentralized approach the SHG is much closer to their dream target of producing 20 packets x 20 kgs per day with processes including rice procurement, hulling, polishing & packing.

SOLUTION

The huller and polisher are two separate components with the huller processing 60 kg per hour and the polisher cleaning 50 kg per hour. With the machines running for 6 hours, they can mill 3 quintiles of produce per day.

The decentralized mill is being run as a service model where they sell their produce through 4 middlemen who they have developed linkages with. Due to not having their own transportation, they sell to the middle men who come regularly and pick up the milled produce as well as paddy from the farmers. The middle men take the produce to markets in nearby towns like Daltonganj.

MACHINES INCLUDED

Rice Huller, Polisher, Separator, Grader | **3.5 hp**

SOLAR ENERGY UNIT

3.2 kWp, 1600 Ah with 48V LVD

PADDY MILLED PER DAY

2.5 quintal

MILLING CHARGES

INR 2/kg

EARNINGS PER MONTH

INR 12,500

COVID IMPACT AND LEARNINGS

The lockdown has also had repercussions in Latehar district with establishments having to close down. This includes the oil mill, flour mill and the rice mill which people from the town and villages nearby would access. With this access being cut off, villagers from nearby villages of 5-6 kilometer radius started to come to the SHG run solar powered mill as they heard of it from the middlemen. The SHG started to mill and polish the produce charging town folk INR 5 per kg and FPO members INR 2 per kg, as opposed to the usual rate of INR 3 per kg. The mill has been running for an additional 3 hours per day milling 150 kg of paddy to rice per day. Due to this, the SHG has been making profits even during the lockdown. People accessing this mill have been expressing that they prefer this as they have reduced time and expenses as the centralized mill in town would charge them INR 2 per kg but would not return the husk. Whereas, the SHG members have been returning the husk to the customers along with their hulled rice. The husk has many uses for the farmers in the form of mixing it with manure to make biofuel, using it as fuel to keep the pots going which they use to make alcohol and laying poultry farms with this base to revoke ammonia. This husk is usually sold for INR 50-70 per bag for fuel used to make alcohol and INR 30-40 for the poultry shed with each bag weighing 20 kg. The decentralized rice mill generates 60% rice and 40% husk of the paddy being fed. The solar powering has been very useful during the lockdown as the region suffers heavy load shedding and frequent power cuts. If diesel were to be used as a backup fuel, they would take 2 days to procure diesel during the time of lockdown which would have hampered their service and production.

IMPACT, LEARNINGS AND WAY FORWARD

Income and profit: Even during the lockdown, due to the unit being located in a remote region, the SHG members remained unaffected and were allowed to operate through it. This brought in more customers, increasing their income and turning in profits.

Additional customer base: Due to the mills in the town being shut down as a result of the lockdown, people from nearby villages and towns started to use this service to mill their produce. At least 100 people recently accessing this mill have expressed to the SHG members that they will only come to their center henceforth even post lockdown as it is more economical, convenient and time saving.

Food security: Farmers and communities from nearby villages and from Kuro Kala have been able to process their stored paddy to rice which is giving them food security in a time where access to essentials has been difficult.

Awareness on solar: A lot of the visiting communities are seeing solar energy for the first time and have learnt of its existence, uses and applications beyond just lighting.

Combating energy issues: The remote region suffers a lot of power cuts, frequent load shedding and voltage dips which would have required the SHG to rely on diesel, if it weren't for solar. It takes 2 days to procure a batch of diesel and in the time of lockdown, it would have taken longer with additional permissions required to be able to access it, causing hindrances in their service.

Need for an integrated model: Due to increased orders which will continue post the lockdown, the SHG requires a higher capacity machine which can process 6 quintiles per day. A preferred solution would be an integrated model with the huller and polisher in the same unit. SELCO Foundation will provide the solution to the SHG post the lockdown period.

CASE STUDY

UDUPI, KARNATAKA

Village Level Entrepreneur Owned Rice Mill

Haliberu village is situated near Kolluru, Kundapura Taluk, Udupi District. This village is 75 km away from district headquarters. This village has 71 households. All 71 households are involved in agriculture. Major crops of this village are Arecanut, Cashew, and Paddy. All families involved in paddy farming. Each farmer/family grows 10 to 15 quintal paddy in 1 to 3 acre land per year which is close to 78 tons per year. Most of the paddy is used for the self-consumption of each family and very few farmers are selling paddy to local contacts or market.

PRE-INTERVENTION

All farmers are taking paddy to the rice mill which is located 4 to 5 km away from the village. This is the present practice of paddy hulling in this village. Rice mills charge Rs.3/- per kg rice. Road access to the villages is very poor, because of this transportation is very Difficult in this village. After seeing this opportunity, the potential of doing solar-powered rice Huller in this village was identified and found Mr. Anand a micro-entrepreneur in this village.

ENTREPRENEUR SELECTED

Mr. Anand is a farmer from Haliberu village, Kolluru. He is involved in agriculture for the past 15 years. He has 1.5 acre of paddy farming land, 1-acre areca nut farm, and 5 cashew trees. In this he is growing around 15 quintal paddy per year, 3 to 4 quintal Arecanut and around 50 Kg cashew. Along with agriculture, he is also running rickshaw. This is his secondary income source. In his family, a total of 7 members include 5 adults and 2 children. Along with him, his family member is going for agri-labor work. On an average monthly family income is approximately Rs.15000/- to Rs.20000/-.

SOLUTION

A solar-powered rice huller and polisher was installed on this site in Aug 2019. The Entrepreneur is working on the rice mill. Slowly villagers have come to know about the solar-powered rice mill project installed in the village and they are coming to hull their paddy to Mr. Anand. Since it is new for them they are comparing and trying both hulling methods. As of now, the entrepreneur is able to hull around 200 kg to 400kg per week. As per him, he is earning INR 1200 per week. And this is because of offseason most of the farmer had done hulling and sold paddy. Now paddy is coming for hulling which they have kept for family consumption.

PADDY MILLED PER WEEK

400 Kg

MILLING CHARGES

INR 3/kg

EARNINGS PER MONTH

INR 4800

2 Medium to Large Scale Paddy Aggregation, Primary Processing and Marketing - Focus on Local/Organic/Niche Rice Varieties

CHALLENGE

In current, traditional models of paddy cultivation and marketing, farmers are at the losing end. While they are meagerly compensated for the cost of Paddy, bigger players in the supply chain benefit largely - like millers who keep the bulk of the share from by product generation; smaller traders who provide immediate cash against distress paddy sales in local markets; and large distributors who make profits from the large volumes of paddy handled, either through private markets or the government PDS.

For a small farmer group to effectively compete with a well established system, and make profits, it would require it to deal with large volumes of paddy, aggregated via procurement from a large number of marginal farmers - a feat which may require a great deal of effort and co-ordination.

However, this scenario is not true for all variants of paddy. Special or niche local varieties of rice - like black rice, aromatic rice varieties, jeera rice, etc. offer returns at a much higher rate as compared to the most common rice varieties, at low volumes, post primary processing. Moreover, a focus on quality of processing is needed here, which is not always fulfilled by local mills. The same scenario holds true for organic varieties of rice - where organic rice would often get mixed with regular varieties of rice in large centralised mills, causing huge losses to farmers.

	COST OF PADDY	COST OF RICE
REGULAR RICE	**10-15**	**20-30**
BLACK RICE	**100**	**200**

Such varieties are used more often locally, thus further shortening supply chains and aiding profitability. Such varieties are also better suited to local climates and further aid ecological sustainability.

Source: International Journal of Managing Value and Supply Chains (IJMVSC) Vol. 6, No. 1, March 2015

OPPORTUNITY

Quality and Energy Efficient Rice Processing solutions for clusters of farmers and a range of rice varieties can have multiple benefits:

Marginal and small farmers, in conjunction with Farmer Producer Organisations can greatly increase their individual incomes with FPO's generating profits from sales of processed rice. This is further boosted with engaging in production and marketing of local varieties

Shortened supply chains, saving on multiple transport costs - transfer to procurement zone, transfer to warehousing, transfer to miller, transport to storage and distribution

TECHNOLOGY SOLUTION LEARNINGS

Quality improving machine add ons to Integrated Energy Efficient Rice Mills for Decentralised Rice Processing

To effectively be able to process and market quality rice, supplementary machinery like graders and pre cleaners are needed, usage of which cannot be avoided since production would be done at a large scale and manual processes would take time.

Need for complimenting & efficient storage and machine housing infrastructure solutions

Such units would not only be milling in large quantities but would also store a large amount of procured, un processed paddy as well as processed rice. Ample and efficient space for working activities and storage would need to be thus considered.

OWNERSHIP AND OPERATIONS LEARNINGS

Village/Cluster Level SHG/ Farmer Producer Company Owned, Service and Production Hybrid Models

Such systems could be owned by groups but would need ready markets to sell processed rice.

Village/Cluster Level SHG/FPO Owned Production Models Linked to Public Dist. Systems

These units would need to have pre-defined market linkages with Govt. Procurement and Food Supply Services and follow required guidelines, standards and processes.

CASE STUDY

NABHRANGPUR, ODISHA

Cluster Level, FPO Owned Paddy Processing Service and Production Hybrid Model

There are many FPOs in and around Odisha that engage in different types of processing - rice, millet, chilly, turmeric and dal. One among them is Danteswari women producer CO.LTD, an agri producer - a rice processing Farmer Producer Organisation (FPO) under Harsha Trust initiative, that operates in the Kosagumada block of Nowrangpur district, Odisha.

INPUTS, OUTPUTS AND MARKETS

The FPO is a collective consisting of 520 farmers. Among the 520 members, 53 have been elected as board members who take various decisions related to the functioning of an FPO. The FPO is responsible to supply the material for cultivation - including seed, fertilizer and also training on product harvesting and marketing of the products. The paddy being hulled are of various types - aromatic and black jeera rice. Even today, 20% of paddy is still manually hulled because of the distance and transportation issues.

Barter System and Emergence of Middlemen:
A common transaction method in the region was barter system- a traditional practice where farmers would barter part of their harvested produce with other commodities. A form of this practice has been adapted by saahukaars (middlemen) who procure paddy from farmers for x amount and return them milled rice of the same amount. This practice also applies for cotton, millets and other pulses which farmers sell. The milled produce given to them is often of poor
Quality, and sometimes the produce given is of lower rate. Middle men capture the markets in this manner and have turned the traditional barter system into an exploitative business practice. Hence, the setting up of the SHGs and FPOs with decentralized milling systems were critical in this region.

Procurement Model: The milling center has been operational since December 2018 which is run by the production staff, mill operator and a night watch. Their procurement policy is that they procure the paddy from the member farmers at the same rates which are offered by the block level government centres. However, the additional benefit is that at the end of the year, the profit is redistributed to the member farmers in the form of dividends. The procurement of paddy happens twice a year, right after the harvesting period. Since the storage facility isn't sufficient for all the paddy to be stored, there is a rotational system in place - where some SHGs give their produce and some store it at home all of whom are given payment in advance for their quantity of produce. Once the first batch has been milled and stored, the second batch is brought in. Another system in place is that farmers write letters to the FPO stating the quantity that they require for self consumption and the quantity they would like to sell. Deducting the processing charge, the amount is paid in advance and the rest is maintained in their registers.

Input Supply: The FPO also supports the farmers with technical support, awareness of new scientific techniques for productivity enhancement and cropping practices, input supplies like seeds, irrigation,fertilizers etc which makes it more compelling for the farmers to sell to the FPO as opposed to the market.

Processing: The stored paddy is processed daily in batches, packed and sold to the vendors using their mini truck which they invested in for both marketing and procurement. The members pay a processing fee of INR 2 per kg. With the mill being established locally, time and money spent on traveling to towns has also been saved.

Marketing: The main towns around the village are Nabarangpur, Joypur and Papadahandi. The FPO board of directors, vendors, government representatives conducted a meeting for formulating the marketing plan before the mill was established. Through this local team, linkages with surrounding vendors were formed who were responsible for micro-selling. This was taken into consideration before the technology capacity and energy system design was done.

PRE-INTERVENTION

The Kosagumada block is an off-grid area and the primary occupation of all households is farming and are engaged in other agri related livelihoods. There are about 20,000 households in this block, all of whom are involved in cultivation and having an average of half to 2 acres of farming land. The major crop that is cultivated by all households especially in the rainy season is paddy, 20% is dal and another 20% would be vegetables for self consumption purposes only. Those having 1 - 2 acre of land use 40% of their crops for consumption and the rest goes to the market, whereas those with half acre of land use their entire produce for self consumption purpose. Suppose 1 acre of paddy cultivation is done, it gives 20 bags of paddy, 1 bag being 50-60 kg of paddy - amongst which 10 bags are kept for self as a counter act for food security issues and 10 bags given to the nearest FPO.

SOLUTION

The rice mill consists of a machine that hulls and polishes rice. It is a 5 hp machine that can hull to produce 2 quintiles or 200 kg of rice per hour. It is a 5 hours system.
Post installation of the solar powered rice huller and polisher in May 2018, the paddy cultivated by the villagers now goes entirely to the FPO, which is then hulled and sold by the FPO in the market. The villagers choose the FPO over the market as they are paid INR 2 more than the market price for paddy. Milling for self consumption is only by those villagers who are closer to the block, say 10-12 kms, while those who are at a distance may just mill locally. On a daily basis, 700 kg (6-7 quintal) of rice is milled in the FPO, so 25 days*700kg = 17,500 kg is milled in a month.

The procurement of paddy by the FPO from the villagers is standard across the year so there is no seasonal effect on the output being milled and produced for the market. Thus, paddy has to be usually stored by the FPO across the year and processed according to the capacities of the machine and demand of the market. The market for the processed rice has yet to scale and mature as the demand, quality checks and market linkage and players are yet being explored and innovated upon. Mukti solar, a clean energy last mile enterprise, and an incubatee of SELCO Foundation, offers any type of service regarding the machine and solar if any service request is received. The FPO utilises the machine for 4-5 hours, and operates it only in the day time.

PACKAGING, STORAGE, DISTRIBUTION AN TRANSPORT

As the FPO has to store the paddy over the year, it ensures adequate storage space. It has allocated a big space, a house of 1000 sq ft, and uses gunny bags to store them. The paddy is usually stored not more than a period of one and a half month. The rice hulled is packed in 13
Cotton bags and sold to the market within a weeks time. The FPO has a 6-wheeler truck for facilitating the input-output mechanism - which includes collection - where paddy is collected from the villagers at a 30-35 km radius and distribution - where the polished rice is sold to the nearest market 25-30 km away. They also take the required steps to prevent damage to the crop and infestations. This can include adopting traditional methods and using the adequate materials for flooring, walls, etc.

The nearest market is 25-30 km away. There are no market fluctuations experienced yet as a standard output is processed and sold in the market. The state government has an agency, Odisha Rural Development and Marketing Society(ORMAS), that helps establish market linkages and provides training and support. Cost of inputs bought from the market: The FPO pays the villagers INR 1000 per quintal for paddy and sells the rice as ration for INR 10/kg and in the market for INR 12/KG. A separate space is used for running the machine and measures are taken to ensure the hygiene and safety inside the room. As the temperature is usually really high, ventilation and temperature control needs

IMPACT

1. Zero fuel costs for the machine to run.
2. Reduction in drudgery involved in labor intensive manual rice hulling process.
3. Very low maintenance with ease of operation results in long machinery life.
4. Decentralized models can be a one-time investment at the community level but benefiting in the long run.
5. Areas with limited accessibility such as hilly terrains, rural areas can have their own hullers thus reducing the transportation cost.
6. Farmers can keep the byproducts (husk).
7. This innovation has given scope for production of brown rice at domestic level at low cost, cottage scaled value addition business for farmers.

CASE STUDY

KRISHNAGIRI, TAMIL NADU

Cluster Level FPO Owned Brown Rice Production Model

Srimadhi Farmers Producer Company, located at Kaveripattinam in Krishnagiri district in Tamil Nadu. The company was established in 2015 and since then promoted by ESAF. There are 500 farmer members in the FPC. Out of them 300 are paddy farmers. Because, Paddy is a major crop in Kaveripattinam area but farmers are getting very low income from their cultivation.

INPUTS, OUTPUTS AND MARKETS

The goal of the Srimadhi Farmers Producer Company is to collect the marginalized farmers and increase their productivity by adapting new farming techniques and produce new value added products to increase their income and improve their standard of living. Initially they were practicing inorganic methods and they gradually started adapting the organic practices.

PRE INTERVENTION

For value addition products, Srimadhi FPO wanted to start with unpolished rice production to address the health issues. Since there was a voltage problem in their area, the FPC was planned to utilize the sustainable energy resources. So, with the help of ESAF they contacted SELCO Foundation to install the Solar Powered Rice Huller.

SOLUTION

A rice huller and polisher were installed in Kaveripattinam for Samridhi FPO. Until now they have processed 1 Ton unpolished rice/ semi polished rice and sold them to local, Krishnagiri and Salem regions. They want to set up full small scale rice mill and oil mill which is in the process. They are having the potential and space to process 100 tons. They are gradually increasing their production and market linkages in neighbouring regions.

BUSINESS MODEL

Weekly Calculation	
Paddy Price	20
Rice Market Price	50
Net Profit PKG	30
Processing PW in Qtl	2
Paddy Cost PW	4000
Net Income PW	10000
Expenses PW	800
Net Profit PW	5200
Processed till date	
Paddy(In ton)	1
Total Cost for Paddy	20000
Net Income	50000
Expenses(Includes Labour, Transportation)	4000
Net Profit	26000

Scalable Solution for Rice Value Addition - Small and Medium Scale Puffed Rice Making

CONTEXT

Puffed rice is a type of puffed grain made from rice, and is usually made by heating rice kernels under high pressure in the presence of fire. Puffed rice is also served as a popular street food in India. In Bangladesh, Pakistan, Thailand & Burma, this is used for breakfast & with tea/coffee. Also these countries make various types of puffed rice based food. Small and Medium scaled puffed-rice factories located in India have been identified as a potential livelihood opportunity where one can help to improve working conditions and critically, reduce energy usage. In most puffed rice mills, machines are either manual or those which have been retrofitted with motors for automation - using 1hp to 3hp motors which are not energy efficient considering the use case. Puffed rice mill energy demands can be greatly reduced by reducing the size of motors used in the machinery. More over, lack of productivity caused by usage of DG sets in quick intervals with multiple stops in work can be greatly addressed with a clean and reliable source of energy.

In the context of tribal areas of India and some selected regions, particularly puffed rice is one of the preferable snacks for elders and children as it is easy to eat. This has over the years provided the opportunity for not only medium scale mills to be set up but also home based puffed rice making units run primarily by women. However the mills are few in number, inefficient whereas manual processes are drudgery prone and provide very little productivity. For example, in Thuamul Rampur block in the Kalahandi district of Odisha there is only one puffed rice mill at the block headquarters. Most community members get puffed rice from their neighbouring households who makes puffed rice manually as well as from local traders who buy from the more centralised mills and sell door to door in remote pockets and villages. Considering the low productivity, it is not currently possible for local, manual puffed rice makers to meet the demand of local traders. There is potential for further improving the productivity of such mills where local people and local traders would further benefit.

In this context, the first solution addressed by SELCO Foundation was to work with existing rice mills, to study the energy gaps and potential benefits caused by energy efficiency - which has been further explored in the document. The second context of helping puffed rice businesses start from scratch, or convert small home based puffed rice making entrepreneurs to slightly larger scale business with a packaged solution. This second solution is being implemented going forward by the Foundation with such home based entrepreneurs and small local traders.

Retrofitted, Solar Powered Solutions for Small/Medium Scale Puffed Rice Factories

CHALLENGE

In many puffed rice mills heat is generated by burning rubber tyres which generates toxic smoke, which is bad for the environment and the people working in the environment. Most areas are affected by regular power cuts and at these times a diesel generator is used to power the machinery. Moreover, motors used in automated mills are usually over capacity and take up too much energy.

OPPORTUNITY

Motors used in puffed rice machines can be downsized and thereafter solar powered to save on expenditure on electricity as well on diesel which is used everyday in case of power cuts. This would greatly improve the profitability of puffed rice enterprises.

TECHNOLOGY SOLUTION LEARNINGS

Improving machine efficiency and savings on recurring diesel costs

Motors used in puffed rice factories are of overcapacity and depend on diesel heavily as a fuel source. Replacement of such inefficient AC Motor with DC more efficient motors has provided a substantial amount of savings where power cuts are high.

Improving productivity due to energy reliability

In areas where power cut hours are lower in number, diesel costs incurred may not be substantially high. Here however, power outages would still occur frequently but for short duration causing not only lack of productivity, as DG sets would be required to be turned on/off but also directly in terms of cost considering that firewood used to provide heat in the processes would be considerably wasted over the short durations of frequent power cuts.

FINANCIAL SOLUTION LEARNINGS

Retrofitted Solar Powered DC solutions directly effect financials of the business and generate enough income through which system costs can be paid for, specifically in areas where power cuts are rampant and in-turn diesel costs high.

CASE STUDY

KOPPAL, KARNATAKA

Individual Owned Puffed Rice Retrofit DC Motor and Solar Energy Solution

Annur Sab resides in a village called Chiluvarige of Koppal District. While puffed rice production involving his entire family is his day job, he also does electrical work on the sidelines. Nearby shops are his customers. It gives him a considerable income, helping him managing the needs of his family. Puffed rice production begins at 4 in the morning which keeps the family occupied for 4 to 5 hrs a day.

PRE INTERVENTION

In Spite of adopting partial mechanisation, erratic power cuts had taken a toll on the production. Using a diesel generator was an inevitable solution. He had to spend approximately ₹600 every week for an alternative source of energy.

SOLUTION

Addressing the situation, steps were taken to optimise the solution by replacing a 1 hp AC motor by a 0.5 hp DC motor. A DC solution of 300 Wp panel with 150 Ah battery bank capacity was given to run the machine for their needs.

IMPACT

This actually cut down the operational cost resulting in an increased profit margin. The production of puffed rice continued without any hindrance, along with saving the money spent on diesel. The sound less environment due to not using a generator has eventually turned the production process into a peaceful journey. After intervention he is saving diesel cost Rs 880/month as well as increased Productivity by 20%

CASE STUDY

BALASORE, ODISHA

Individual Owned Puffed Rice Unit Solar Energy Solution

Ranjan Panda is a retuning migrant from Balasore, Odisha. He worked in Gujarat State for a period of 10 years as a labour migrant worker and thereafter returned to Balasore to set up his own business. Here after seeking support a local mentor helped him set up his own puffed rice unit.

PRE INTERVENTION

Although he was happy with starting his own business, constant electricity power outages and high costs of diesel prevented him from reaching his full potential. He manufactured 4 quintiles (400 kg) of puffed rice everyday and spent over INR 200 on diesel expenditures every day. Moreover, constant voltage fluctuations caused due to power outages made him very weary of the safety of his new machine. With a rise and drop in voltage his machines motor would be burnt which would immensely hurt his business. He had thus even purchased a voltmeter to track the incoming voltage and take necessary precautions.

SOLUTION

To address this situation a solar energy generation and storage unit was installed at Ranjan Panda’s Puffed Rice Mill. This greatly helped him in saving not only on recurring diesel expenditures but also helped him increase his productivity as a whole with the more reliable energy source.

Implementation Learnings and Way Forward

1. The two working models for rice milling - one for servicing of rice milling needs of local paddy farming communities, and the other of procuring and, processing and marketing local/aromatic/organic varieties of rice can be effectively scaled.

For the first solution, a blanketing approach in conjunction with state and district administration as well as appropriate livelihood missions could be carried out to make village level rice milling services available particularly in remote villages. As heavy upfront capital subsidies would be required for communities to be able to start businesses, having governmental or large philanthropic support would be critical. For the second solution, a more focused approach could be taken on those areas where ecosystems for organic rice, local rice varieties and special varieties are to some extent existing or can be easily developed. This would help generate enough working models where communities who haven t adopted this so far can be replicated through cross learning. Here tie ups with both government run as well as private training institutions linked to successful model programs would be critical.

2. As the by-products generated via rice milling are extremely valuable, more innovation can be carried out to utilise these by-products effectively, by further developing complementary enterprises as a buyer of such by products.

Husk, Bran, Bran Oil and Broken Rice are all valuable inputs can be utilised in a number of other products like animal feed, cooking oil, biscuit manufacturing, alcohol making, and so on. Such enterprises and their technology needs would be further studied specific to areas where rice mills have been implemented. A mapping exercise will be carried out to ascertain the number of such enterprises and their variations across rice typologies in the country.

3. As the farmers in question are particularly remote, safeguarding against technical, mechanical repairs and maintenance would be of greater importance.

Assessing and managing potential risks, hand-holding and a local technical service ecosystem, as well ensuring a quick supply chain and stockpile of spare parts would all contribute to a more reliable and dependable system.

4. In the rice value chain, as well as commonly in other food based value chains, technologies used for value addition have been developed keeping in mind large scale food production settings. A whole range of household based micro enterprises though exist parallel who continue to use manual methods and whose businesses would greatly benefit from automation.

As seen in the case of home based puffed rice manufacturers, production quantities are limited to small quantities possible to make manually. Such businesses have the potential to expand their production and address larger or further markets with improved technology and reliable energy. An analogy here can be drawn from the experiences of solar powered roti rolling machine deployment, where most businesses engaged in value addition of millet based food were an expansion of home based livelihoods. For such businesses, having packaged solutions to choose from -- including a range of energy efficient technologies and energy solutions, based on volume requirements, food manufacturing process needs as well as appropriate financial tools would be needed.

Sustainable Energy Access and the Rice Value Chain

Implementations, Solutions and Learnings
from an Ecosystems Perspective

Thank you,
Do get in touch!

---

www.selcofoundation.org | info@selcofoundation.org

SELCO FOUNDATION

JULY 2020