

SUSTAINABLE ENERGY IN THE TOMATO AND POTATO VALUE CHAINS

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SELCO FOUNDATION

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Tomato Farm promoted by APMAS in
Ramasamudram in Chittoor District, Andhra Pradesh





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ABOUT SELCO FOUNDATION

SELCO Foundation is a 10 year old organisation that engages in field-based R&D and ecosystem building for the deployment of sustainable energy-based solutions that alleviate poverty in tribal, rural and urban poor areas. The organisation works closely with practitioners in the social sector, energy entrepreneurs and partners from various developmental sectors. It is an open-source platform with a network of research and development labs that implement and disseminate sustainable social innovations through an Inclusive Ecosystems Approach.

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Nursery promoted by APMAS in Madanapalle
in Chittoor District, Andhra Pradesh

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GLOSSARY

AFC - Agriculture Finance Consultants
AKIS - Agriculture Knowledge and Innovation Systems
AMI - Agricultural Marketing Infrastructure
AMIGS - Agricultural Marketing Infrastructure, Grading and Standardisation
APMAS - Andhra Pradesh Mahila Abhivruddhi Society
APMC - Agricultural Produce Market Committee
CMEGP - Chief Minister Self Employment Scheme
DIC - Department of Industries and Commerce
DRE - Decentralized Renewable Energy
FPO - Farmer Producer Organization
FSG - Farmer Study Group
GDP - Gross Domestic Product
GoI - Government of India
GST - Goods and Services Tax
ICT - Information and Communications Technology
KVIB - Khadi and Village Industries Board
MCS - Micro Credit Scheme
MEP - Minimum Export Price
MMT - Million Metric Tonnes
MoFP - Ministry of Food Processing
MSP - Minimum Selling Price
NABARD - National Bank for Agriculture and Rural Development
Operation TOP - Operation Tomato Onion Potato
PCM - Phase Change Material
PPGI - Pre-Painted Galvanised Iron
PSU - Public Sector Undertaking
PUF - Polyurethane Foam
RIDF - Rural Infrastructure Development Fund
RKVY - Rashtriya Krishi Vikas Yojana
SFAC - Small Farmer Agri-Business Consortium
SHG - Self Help Group
TFO - Total Financial Outlay

EXECUTIVE SUMMARY

India ranks first in the world in production of fruits and second in vegetables, accounting roughly 10 and 15 per cent, respectively of total global production. National Agricultural Income was estimated as about 57 per cent in the early fifties which presently, accounts for 18 per cent of India's gross domestic product (GDP) and provides employment to 50 per cent of the country's workforce.

With a 17 per cent share of the country's electricity supply, agriculture is one of the largest consumers. Most electricity is used to operate irrigation pumps, and many other farm activities remain manual or are centralised due to unavailability of sustainable energy and an appropriate ecosystem which also compromises the productivity and value creation for the farmers. To elaborate on the need of energy for irrigation itself, a total of 18 million electric pumps are currently in use in India and around 400,000 new electric pumps are added each year. At locations without connection to the public grid, or with insufficient power supply, about 7 million diesel pumps are deployed for irrigation purposes. With state government schemes in Andhra Pradesh and Karnataka with respect to free electricity provided to farmers for using farm implements like pumps, over pumping is leading to abuse of already depleting water tables in the states at an alarming rate. Uptake of cheap energy, inefficient technologies proves unsustainable in the longer run, resulting in a pattern of increasing consumption resulting in hikes in environmental and economic costs that someone or the other in the system has to bear. Energy-efficient technologies powered by renewable energy across the value chain from pre-farming to market level which can be generational assets require development and investment from all stakeholders involved in the agricultural value chains to ensure farming is done in a sustainable manner with a low carbon footprint. This allows for an increase in healthy produce with reduced carbon emissions and reliable assets leading to complete energy autonomy.

Labourers loading tomato produce at the Madanapalle Mandi



This study has been conducted by SELCO Foundation to analyse the role of sustainable energy in the tomato and potato value chain in order to identify the specific nodal points where energy efficient and sustainable energy integrated agricultural machines will have the highest likelihood of improving productivity and income of small-holder farmers in horticulture (tomato and potato) value chains. Based on the needs of the farmers, FPOs and NGOs on ground, the objective of the study was to identify and develop solutions keeping in mind the limitations present on ground. The study aims to guide the implementing organisations to deploy the solutions in a holistic manner by engaging various stakeholders across the value chains. This will also allow for other environmental benefits such as reduced carbon emissions across the value chain. The findings and recommendations will in turn inform investments and potential pilot designs to showcase the viability of interventions.

A detailed value chain analysis was done of both tomato and potato crops to understand the energy needs and gaps which helped identify solutions through technical and market research. Based on context and participatory research with farmers and other stakeholders, the solutions were squared down on.



Left:
Interviews
with Farmers
in Andhra
Pradesh



Right: Nursery
Farm labourer
sowing
tomato seeds

For the tomato crop, issues of water availability at a nursery level led to identifying rainwater harvesting tanks with solar powered floating pumps and hydroponics as solutions. Due to spraying of fertilizers and bio manure manually at both nursery and farm level, solar powered sprayers is an appropriate cross cutting solution which can be used through a rental model or through individual ownership. There is a very long drawn complex supply chain of the tomato produce with multiple visits to the APMC by the farmers to sell their produce. Under Operation TOP by the Ministry of Food Processing (MoFP), APMAS, the on ground organization in Andhra Pradesh is setting up primary processing centres for which grading and sorting machines are required which is one of the solar powered solutions being proposed.

For the potato value chain, farmers get free on-farm electricity in Karnataka which has fixed timings which change from week to week creating disruption in routines and loss of irrigation in case of voltage fluctuations and power cuts. To resolve this issue, solar powered submersible pumps are being proposed to enable complete energy autonomy for irrigation. The seed potatoes presently are being procured from the APMC or via trucks from Punjab by the Hassan farmers which have high transportation costs and a heavy carbon footprint. AFC, the on-ground organization has started a program where the farmers have started to cultivate their own seed potatoes which will be supplied to the FPO farmers in the region. This requires a cold storage to store seed potatoes for long durations two times in a year. A solar-powered decentralized cold storage has been proposed to support the program.

The report starts by giving an overall background of the horticulture value chain and the opportunities that lie across the sector, approach and methodology of the study. It is followed by the key findings through interviews with a plethora of stakeholders in both tomato and potato value chain in Andhra Pradesh and Karnataka respectively. The recommendation section is divided into criteria of development which will guide the reader on why certain solutions were selected, what stage of development they lie in and why some potential solutions were not studied at this stage of the report being published. The second part of the section delves into summaries of each solution with the need identified, the technical, financial and social solution being proposed along with the perceived impacts. For implementers, the solutions Annexure will take them through the market research, the technical specifications, design, costing and various central and state schemes/policies to tap into. It will also inform one on the possible pathways of implementation.

INTRODUCTION

India is the second-largest producer of vegetables in the world, with about 180 MMT, next only to China, which produces more than 4 times the Indian production. China's ability to produce such quantum with limited arable land has a lot to do with its investment in Agriculture Knowledge and Innovation Systems (AKIS). India still has a long way to go in this regard and with agri-marketing reforms. It is estimated that nearly 15 to 20 per cent of the produce is wasted during picking, harvesting, packing, transportation, storage, marketing and consumption. This shows the complete lack of appropriate agri machinery like modern storage capacities in the forms of cold chain investment in all levels of the supply chain. Nearly 60 per cent of India's farmers depend on rains for irrigation and a failed monsoon results in crops failures and grave losses for the farmers. This has led to the formation of a threat to food security and hence increasing levels of malnutrition as well.

Tomatoes, Onions and Potatoes which form almost half of vegetable production in the country, have shown a very healthy growth. For example, during 2003-04 to 2017-18, potato production increased from 28 MMT to 49 MMT, while onions went up from 6.3 MMT to 21 MMT, and tomatoes from 8.1 MMT to 22 MMT over the same period. As per First Advance Estimate, Tomato production in 2019-20 is estimated to be 193.27 Lakh Tonnes and potato is estimated to be 519.47Lakh Tonnes.

Tomatoes, Onions and Potatoes are the three basic vegetables that face extreme price volatility and the government is torn between ensuring remunerative prices for farmers and reducing costs for consumers. Sights of farmers dumping potato and tomato produce on the streets across parts of the country was a cause for alarm.

In September 2019, the prices of tomatoes went above Rs 50/kg and onions at Rs 40/kg with the government imposing Minimum Export Price (MEP) \$850/tonne inviting criticisms from neighbouring countries relying on Indian produce. The spikes were due to lower supply due to unpredictable heavy rains in the states of Andhra Pradesh, Karnataka and Maharashtra which are major tomato and potato producing states.

Hassan, Chikmagalur, Kolar, Chikballapur, and Belgaum account for major production with Hassan district accounting for more than 41 per cent of total Potato production in the state. Land under potato cultivation in Hassan has reduced by 77 per cent in the last 10 years.

The government had announced "Operation Green-TOP " with an allocation of Rs 500 crore in its budget of 2018, a scheme nested under the Ministry of Food Processing (MoFP). TOP are mostly traded in APMC markets, with mandi fees and commissions, farmers get less than one-third of the consumer's rupee which begs for reforms at the APMC levels.

Agriculture is a fixed output industry, but efficiency and management of agriculture value chain can play a significant role in improving the value of that output. It is also important to note that the consumption is increasing with increasing demand and population. In the current scenario, wastage of agricultural produce is of huge concern as well. As soon as the perishables are produced, if the amount is more than the demand, a glut situation is created, leading to value decrement. Price volatility of the tomato and potato crop is leading to great losses for the farmers, wastage of produce and increased buying costs for end users. To improve value for farmers, the need for mechanization, efficient use of resources, financing mechanisms that allow for investment in agro-processing is very high in this situation. However, low capacity, technological obsolescence and marketing are observed as challenges in agro-processing.

The report studies the existing value chain and ecosystem that exists in selected regions of Karnataka and Andhra Pradesh for Potato and Tomato Farmers. While the scope of the report focusses on understanding the role of sustainable energy and energy-efficient technology in the value chain and bringing value to the farmers, it recognises that those efforts need to be complemented with the right mobilisation, training and market linkages. The analysis in the report is done in partnerships with APMAS and AFC, who have been working in the region on creating opportunities and strengthening the forwards and backward linkages for the tomato and potato farmers.

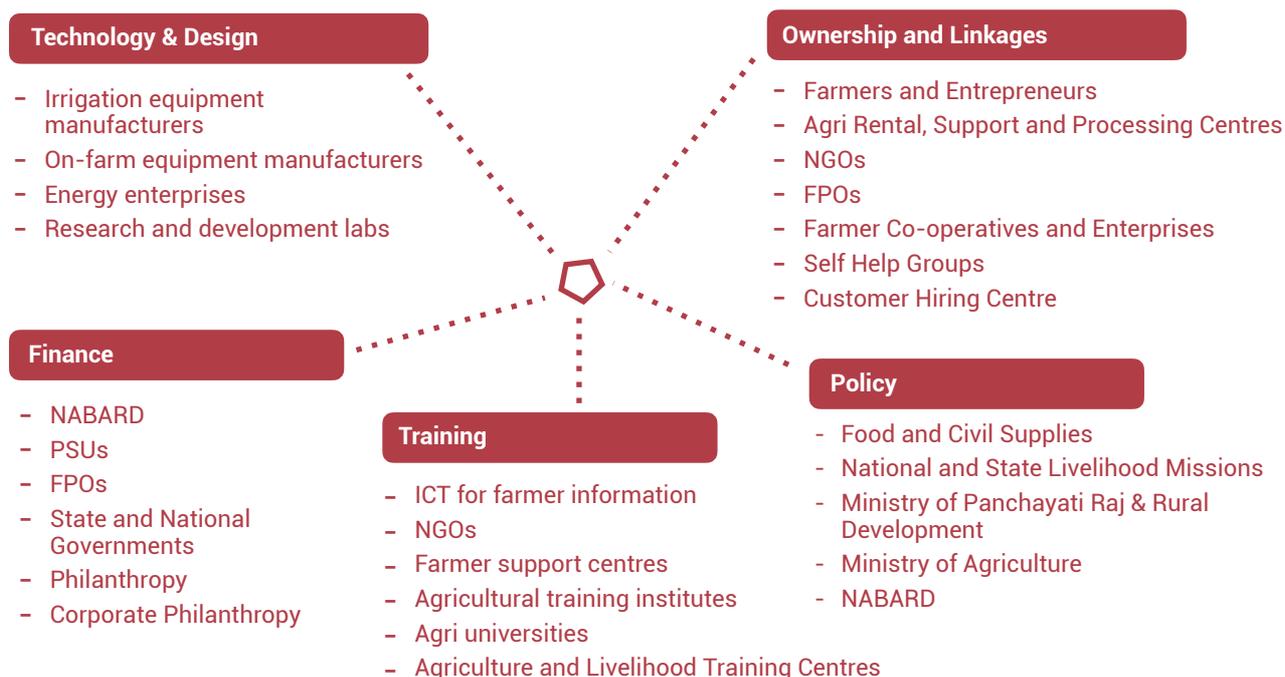
Due to agriculture being a critical element in India's socio-economic fabric and almost half of the available land being used for agriculture, it requires a significant amount of energy in every stage of its value chain. Access to reliable energy in pre-production, production and post-production processes not only improves the production and brings efficiency across the value chain, but also reduces the detrimental economic and climatic effects of fossil fuels, as most of the available off-grid solutions in the country are fossil fuel-powered and are expensive over the lifetime of the equipment.

APPROACH

Inclusive Ecosystem for Sustainable Energy Access and Livelihoods

Poverty and climate risk are the two most important issues that are decreasing social sustainability and leading to more disparities across geographies. Both are man-made and solvable using sustainable energy as a catalyst. Replicable ecosystem processes, banking on sustainable energy that encourage various income-generating activities for the marginalised populations can help solve poverty and climate crisis. In recent times, the majority of innovations in livelihood and productivity have been focused on a centralised industrial scale- whose benefits do not trickle down and the ownership does not transfer to the poor. Innovations for the vulnerable have to be decentralised and customised. At the same time, 'innovation' often focuses on technology alone, and not on processes around ownership models, financial models, supply chain and service delivery models; that allow for sustained impact from the design and deployment of the technology. The need of the hour is to catalyse and enhance these missing ecosystem factors in order to demonstrate the linkage between sustainable energy and development: thus, demonstrating the capability of decentralised energy to transform communities. While a huge potential lies in enhancing and decentralising agriculture value chains through energy, financing has been a barrier to scaling. All aspects of the ecosystem need to be developed for any solution to be self-sustainable and a long term investment.

FIG 1. SUSTAINABLE ENERGY AND AGRICULTURE ECOSYSTEM



In order to address the value chain issues at hand and the for the solutions to be long term and self-sustainable, the aforementioned arms of the ecosystem need to be in place. The key parts of the ecosystem include:

- Technology & Design** of machinery, solar, implementation & social design
- Finance**, which should be appropriately designed for comfortable uptake of the solutions by the stakeholders based on studying the inputs, outputs, cash flows and mitigation of any issues
- Training** of stakeholders for the use of machinery, solar system, basic maintenance and other best practices which are recommended
- Policy** and schemes by the government which can tapped into to ensure uptake of solutions and financial support by various allied government agencies
- Ownership and linkages** with on-ground organizations to build a interconnected support system for stakeholders

Each of the parts of the ecosystem have stakeholders and players (as illustrated above) who need to be involved at throughout the various stages of the value chain and solution provision - before, during and post.

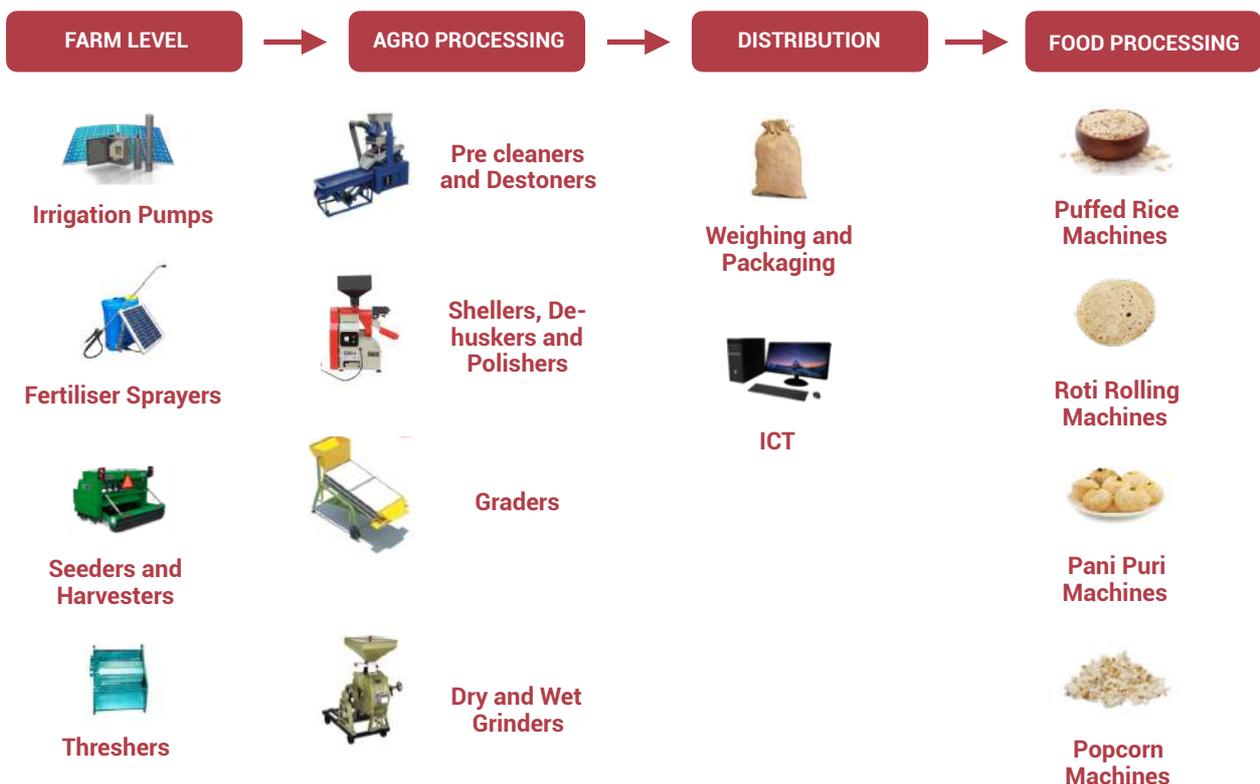
Value Chain Approach

Any livelihood practice if looked at through the lens of value chain approach helps determine the gaps and requirements at every stage. Any solution looked at in a silo ignores the holistic nature of the problem at hand. In agriculture - pre-farming, farming, market level and processing are the broad stages of any value chain which require to be studied for mapping gaps and the interconnectedness of issues. Considering that farming communities are facing challenges in procuring basic amenities due to the economic gap, value chain mapping can help develop understanding in possible areas of intervention to reduce production cost by increasing the value of the product. Energy might not be the only area of intervention, but collaboration with an array of stakeholders can promote solutions by using the ecosystem approach.

One of the major hindrances faced when it comes to agriculture based livelihoods, is the lack of appropriate farming technologies across the value chain specifically for small and marginal farmers, either severely lacking in terms of access or completely missing from value chain of products, services and systems available to farmers in India. Efficient need based productive assets can improve productivity, increase incomes and maintain well being by removal of drudgery, increased savings and product diversification. Decentralization presents the opportunity to maintain maximum value at a farm and farmer level. This combined with efforts on strengthening value chains via sustainable technologies can go a long way towards social, financial and environmental sustainability of small and marginal farmers.

As illustrated in the diagram below, a cereal value chain can be mapped across the value chain in a broad manner. The solutions mapped could be applicable to any cereal from farm level, agri-processing, technologies required for distribution and food processing. All these technologies have been solar powered by SELCO Foundation through the sustainable livelihoods program.

FIG 2. SUSTAINABLE ENERGY INTERVENTION IN CEREAL VALUE CHAINS



METHODOLOGY

The value chains for individual crops differ, and each crop required unique opportunities for technology-driven improvements in efficiency and efficacy. Two primary regions were selected to conduct the study in – Andhra Pradesh and Karnataka for tomato and potato crops respectively as they are the highest producing regions for the crops. Secondary research involved reviewing and studying existing reports and resources on this subject matter. The initial research findings were used to identify components of the value chain, energy and technology needs throughout the value chain, in the specific defined geographic focus. These findings covered crop information regarding farming techniques, cropping methods, seasons, processing prospects, packaging prospects, storage, distribution/supply chain, consumption patterns, existing technological solutions etc.

Primary research involved data collection through original or first-hand research. During this approach, findings formed from secondary research were validated, further strengthening them, or forming new insights. In-depth interviews (user-centric approach) with farmers, FPO heads, traders, NGOs, Agri Institutes and Selco Foundation partners; community socio-cultural practices, education, financial influx and outflow, attitude towards agri-technology, perception towards Decentralized Renewable Energy were gathered. In the early stage of this step, typologies of farmers and their needs were also identified and documented. This resulted in the analysis and development of a spectrum of appropriate Decentralized Renewable Energy based agri-technology solutions.

During the synthesis and analysis stage, there was formation of product journey (potato and tomato) maps – value chain + supply chain, mind maps, inter-connected circle maps, causal loop diagrams, hierarchy models were made. A wholesome ecosystem map with ecological, social, financial and technological factors was mapped to understand the need for stakeholders for solving the issues at hand. Identification of possible areas of intervention areas and identification of existing solutions through market research by the technical team and creation of probable solutions in the scope of SELCO Foundation was done. The right channels and solution providers were reached out to and connected to the on ground organizations and FPOs in the required cases to assess the viability of the solutions. In cases of all the solutions, a detailed baseline on site will be required. For some solutions proposed, a detailed need assessment along with a technical baseline will be required to create appropriate designs, capacities and costs for the selected end users and sites.

FIG 3. RESEARCH SCOPE & STAKEHOLDERS

.....

SECONDARY RESEARCH

Farming Techniques, Cropping Methods, Seasons, Processing Prospects, Packaging Prospects, Storage, Distribution/Supply Chain, Consumption Patterns, Existing Technological Solutions

PRIMARY RESEARCH

Community Socio-Cultural Practices, Education, Financial Influx and Outflow, Attitude Towards Agro Technology,

STAKEHOLDERS

Farmers, Farmer Producer Organisations, Traders, Green Agents*, Commission Agents, Cold Storage & Processing Unit Owners, NGOs, Agri Institutes and Partner Organisations

*Green Agents or Rayta Mitras Are the First Point of Contact Between the FPO and the Farmers. They Are Like the ASHA (Accredited Social Health Worker) Equivalent of the Agricultural Setup by APMAS. Their Role Is To Conduct Regular Farmer Meetings, Understand Issues, Raise Them in Larger FPO Meetings and Sabhas, and Trouble Shoot Them. They Also Act as Key Information Carriers as They Inform Farmers on Best Practices.

CRITERIA FOR DEVELOPMENT OF RECOMMENDATIONS

The solutions use renewable energy and try to optimise carbon emissions in the supply chain while the energy efficient machinery increases productivity and value for the farmers. Devaluing practices such as excessive chemical fertilizer use, excess irrigation, excess water usage in nurseries, high carbon footprint in arbitrary supply chains, dependence on untimely grid electricity have been tackled with. Importance for value addition in most of the solutions has been centred around the farmer, being most vulnerable in the value chain. Allied NGOs and Government bodies play an integrated role in the implementation of the solutions, for capacity building and subsidy management respectively. Financial institutions would play a critical role in providing appropriate affordable financial mechanisms through tapping into existing farmer-friendly schemes and policies. The solar providers and system integrators would train the farmers and the key stakeholders in basic maintenance and servicing the systems in a timely manner. Importance has been given to solutions that have a higher impact in the value chains than micro level technology solutions. All the solution technologies exist (currently in the market) and are not hypothetical. Testing is required mostly for the ownership models as different geographical contexts have different requirements and unprecedented circumstances.

The solutions proposed are defined by the various stages of development that they are nested under. Based on technological development, number of past implementations, and base pre-requisites on ground for implementation, recommendations have been made accordingly.

FIG 4. FOUR TYPES OF SUSTAINABLE ENERGY INTERVENTION RECOMMENDATIONS

Test First

Solutions that exist but require to be assessed on site and multiple types of designs to be developed

SOLUTIONS

Solar powered hydroponics

Pilot First

Technologies and machines that exist in the market but require to be piloted on site along with appropriate solar designs to understand financial modelling better. Once implemented, monitored thoroughly and proven successful, they will be in a position to scale

SOLUTIONS

Solar powered grading and sorting machines and Pre-digesters

Scalable

Technologies and machines that exist in the market and enough examples have been set in similar contexts which demonstrate financial viability. However, demonstrations might be required to raise awareness of the technologies in the region. Once demonstrated, monitored thoroughly and proven successful, they will be in a position to scale

SOLUTIONS

Solar powered pumps, Sprayers, & Cold storage

Future

Solutions that exist in the market, can be easily developed, but require setting up of infrastructure, registering entities, hiring human resources, establishing market linkages etc before which technologies will not add sufficient value

SOLUTIONS

Solar powered tomato and potato processing technologies, Refrigerated transportations

LIMITATIONS FOR TECHNOLOGIES

Ecologically Negative Impact : Insect Repellers, Irrigation Pumps for Tomato Crops in Andhra Pradesh

Insect repellents are implemented to avoid the loss of crops for disease prevention, spread or caused by insects. Though, these traps/repellers have been the reason for major biodiversity loss in the certain types of insects and pollinators. These pollinators are essential to maintain ecological balance. Permaculture techniques that repel pollinators and insects can be communicated to the farmers instead.

In case of groundwater levels in Andhra Pradesh, it is increasingly depleting with the level at 1200 ft presently. Farmers need to use very high capacity pumps to pump water and due to free electricity being provided, they tend to over irrigate their farmlands. Thus, irrigation needs in the region are not limited to solar powered water pumps alone, and need to be supplemented with improved water management practices in the region.

Nature of Crop and Market Unpredictability: Cold Storage for Tomatoes and Potatoes

Cold chain is an essential technological intervention identified by several agri practitioners, policy makers and has been given subsidies by the Government of India. But, conflicting areas in terms of implementation of the same and value addition were observed. Both the crops face severe market price fluctuation when the produce is supplied to the market. So much so, that farming revenue is compared with gambling revenue. In this volatility, it cannot be predetermined how much value could be added in times of undersupply. Mostly, the input cost addition will not lead to profit generation always. Hence, unless the region or sector sees significant policy changes for direct market linkages with contractual farming or Minimum Selling price (MSP), cold chain for table potatoes and tomatoes has not been recommended to implement.

Need for High Capital Expenditure and Setting Up of Infrastructure for Future Solutions Like Processing Technologies

Numerous processing intervention possibilities have been observed in both tomato and potato value chains as they can add high value to produce when the rates are low at the market level. Policy makers have highly recommended processing as an alternative solution to setting MSPs. Implementation of processing requires certain prerequisites such as availability of raw material. Currently, processing tomatoes and potatoes are not produced in Karnataka or Andhra Pradesh on a scale large enough for processing. The few existing processing units procure them from the Northern states, which is not economically or ecologically sustainable. Moreover, high upfront cost is required to build these units as no infrastructure or land is allotted/available presently. As market volatility of potatoes as well as tomatoes is high, revenue of processed food is also volatile. Also, machines in processing units like boilers, consume higher levels of energy and hence cannot be solar energy based. These numerous barriers require infrastructure set up, policy intervention both, before implementation and hence have not been recommended at this stage.

TOMATO VALUE CHAIN



SUMMARY OF FINDINGS & RECOMMENDATIONS

TOMATO VALUE CHAIN

NURSERY

STAKEHOLDERS

Nursery Farmers, Green Agents, Technical Coordinators of FPO, State Agricultural Departments, Central Agricultural Departments (for schemes), Technology Providers, Training institutes, Financing entities

KEY CHALLENGES

- Water scarcity in summer months due to which there is lesser cropping leading to reduced quantities of tomato saplings
- Excessive manual labour
- Pests infecting crops
- Nursery level tomato sapling wastage

INTERVENTION RECOMMENDATIONS

- Rainwater harvesting + solar powered floating/surface pumps,
- Solar powered hydroponics,
- Solar powered sprayers,
- Solar powered insect repellents
- Small scale compost machines for on-farm wet waste

FARM

STAKEHOLDERS

Farmers, Green Agents, Technical Coordinators of FPO, FPO Project Leads, State Agricultural Departments, Central Agricultural Departments (for schemes), Technology Providers, Training institutes, Financing entities

KEY CHALLENGES

- Water scarcity in summer months due to which there is lesser cropping and crop losses
- Excessive manual labour
- Pests infecting crops
- Farm level crop wastage
- Burning of waste tomato plant stalks

INTERVENTION RECOMMENDATIONS

- Ploughing Machine
- Sprayers
- Irrigation pumps
- De-weeders
- Insect repellents
- Farm level cold storage
- Electric fences

PROCESSING

STAKEHOLDERS

FPO staff, Processing Unit Workers, Commission Agents and Traders, State Agricultural Departments, Central Agricultural Departments (for schemes), Technology Providers, Training institutes, Financing entities

KEY CHALLENGES

- Lack of production of processing tomatoes
- Lack of infrastructure
- Price volatility affecting processing units
- Lack of market linkages
- High upfront capital cost

INTERVENTION RECOMMENDATIONS

- Refrigerated transport
- Boiler
- Dryer
- Juicer
- Processed food cold storage
- Other allied processing machinery

MARKET

STAKEHOLDERS

FPO Staff, Commission Agents and Traders, Market Labourers, State Agricultural Departments, Central Agricultural Departments (for schemes), Technology Providers, Training institutes, Financing entities

KEY CHALLENGES

- Market level wastage
- Arbitrary supply chains
- Transportation to market
- Price volatility and fluctuations
- Electricity and voltage fluctuations

INTERVENTION RECOMMENDATIONS

- Refrigerated transport
- Packaging interventions
- Passive cooling
- Grading and sorting machines

STAKEHOLDERS

TOMATO VALUE CHAIN

PARTNER ORGANISATION

APMAS
Andhra Pradesh Mahila
Abhivruddhi Society

LOCATION

Madanapalle and
Ramasamudram Blocks,
Chittoor District,
Andhra Pradesh

FARMERS

20 Farmers

5 farmers in each group.
Two farmer group
discussions in each mandal.
A mix of marginal, medium
and large farmers

- Farming methods, technologies, supply chain, value chain mapping
- Issue mapping
- Processing prospects
- Input and output costs
- Feedback on secondary research and potential solutions
- Energy scenario

NURSERY FARMERS

4 Farmers

2 nurseries in each
mandal

- Farming methods, technologies, supply chain, value chain mapping
- Issue mapping
- Input and output costs
- Feedback on secondary research and potential solutions
- Energy scenario

GREEN AGENTS

6 Agents

6 green agents in one
focus group discussion

- Farmer issues mapping
- Solutions and advice provided by them
- Feedback on secondary research and potential solutions
- Input and output costs

FPOs

2 FPO Heads

FPO head in each mandal

- Basic details of FPO
- About farmers, govt support, crops grown, energy used at each point, technologies used and processing (current and prospects)
- Value and supply chain
- Policies and subsidies

TECHNICAL CO-ORDINATORS

4 Co-ordinaters

2 technical co-ordinaters in
each mandal

- Technologies tested for farmers and reasons for failure
- Technologies being used and supplied by FPOs
- Costing and servicing networks
- Validation of market research and viability of solutions being proposed

APMAS PROJECT LEADS

6 Projects Leaders

1 focus group discussion
with project leads and
management

- Structure of the organization with roles and responsibilities
- -Details and history of the organization and program
- Interventions proposed and being carried out under the program
- Needs and gaps in the tomato value chain
- Energy gaps and requirements
- Connecting solution providers with managements

COMMISSION AGENTS

1 Commission Agent

- Data collection on the price volatility
- Structure of HR at the mandi level
- Issues at the mandi level
- Information on waste

KEY FINDINGS

TOMATO VALUE CHAIN



- ❑ **Average land holding size of nursery farmers in Andhra Pradesh is half to 1 acre.** They primarily grow tomato saplings along with a mix of other vegetables and flowers.
- ❑ **Nursery farmers require high input cost** and are economically affected due to market fluctuations and climate volatility.
- ❑ **Tomato sapling production has 3 cycles in one season** and are not produced in December and November.
- ❑ The saplings are **planted in a zigzag manner** (15,000 saplings per acre) and in **straight rows** (8000 saplings per acre).
- ❑ **Accessibility and availability of water is a major issue** for Andhra Pradesh nursery farmers. They use pumps ranging from 5 HP to 7 HP as the ground water is at 1200 ft presently.
- ❑ **Most nursery farmers use Hybrid seeds** such as 'Saaho' and '448' which require **heavy fertiliser inputs** which also makes up for a large part of their input costs.
- ❑ None of the farmers practice organic farming methods i.e. **no organic fertilizers or manure are used**.
- ❑ Most of the **practices and cultivation patterns are inspired from adjacent nursery farmers**.
- ❑ Sprinkler irrigation was tried by nursery farmers yet did not work because the water did not reach all crops equally. Now **manual spraying is practiced**.
- ❑ Some nursery farmers complained of the **bore well water being saline**. It was described as '*Kaara Neeru*'.
- ❑ **High quantity plastic tray waste** is observed.
- ❑ **Pumps are the only technological inputs at a nursery level**. Weeding, spraying of water and pesticides, ploughing, planting, harvesting is all done manually by farm labourers or family members.
- ❑ A nursery farmer pays their **labour INR 20,000 (total) approximately per season**.
- ❑ **30 per cent of the diseases begin on a nursery level**.
- ❑ The **waste stalks are strewn on farm land** and a tractor is run over it before the land is ploughed. However, this **can only be practiced by farmers who can afford tractors**. The **marginal farmers resort to burning the stalks**.

KEY FINDINGS

TOMATO VALUE CHAIN



- ❑ **Average land holding is 1-2 acres. Most of the farmers are marginal farmers.**
- ❑ **Farmers decide the amount of produce to be cultivated** according to water availability and market .
- ❑ There lies a **deep cultural and social value to tomato crops** and hence are farmed in a **water scarce region**, even though **tomato is a water requirement crop**.
- ❑ **Most farmers rely on bore well** where the **depth of water is 1200 ft** presently.
- ❑ **Excessive use and unnecessary varieties of chemical fertilizers** are observed to have affected the yield.
- ❑ **Bore well water is often saline** and degrades the quality of the yield.
- ❑ **Seven hours of free electricity is provided** to the farmers by the Andhra Pradesh Government, **four hours of which is given in the day and is used for irrigation. Unreliability leads the farmers to excessively irrigate their land**, causing decrease in yield and soil health.
- ❑ Cost of '448' variety of **seeds costs Rs. 200 to Rs. 300 per crate**. It provides around **4-5 yields**. The **duration of a cycle is two to three months**. The other famous seed variety of seeds 'Saaho' (TO-3251).
- ❑ The different varieties of seeds include, Prabha, 440, Saaho, Vaibhava, Rishika. The Karnataka ones include; Abhinava, Abhilasa, Aisha. Posaruby and 'Early drop' are two seed varieties from Tamil Nadu and Hyderabad, respectively.
- ❑ There is **waste at the farm level during growth, harvesting and pre-transportation** loading due to **pests, inadequate growth, heavy rains or lack of rains/irrigation**. An approximate **5-10 per cent wastage is observed at a farm level** based on the seasons.
- ❑ The **stalks and some of the waste tomatoes are piled** onto the farms and **burnt at the end of the farming cycle**.
- ❑ During **summer months, 30 per cent lesser production** is observed at a farm level
- ❑ Farmers are **unaware of water-management practices** and **overuse water through bore well** due to free electricity provided by the government.
- ❑ **Mono-cropping is practiced** which can decrease the soil health.
- ❑ **Heavy rainfall leads to water logging** which leads to **20-50 per cent loss during harvest**.
- ❑ **Mulching sheets lead to excessive plastic waste** and degrades soil quality.
- ❑ Farmers are **not aware of organic farming techniques, but few are interested**.

KEY FINDINGS

TOMATO VALUE CHAIN

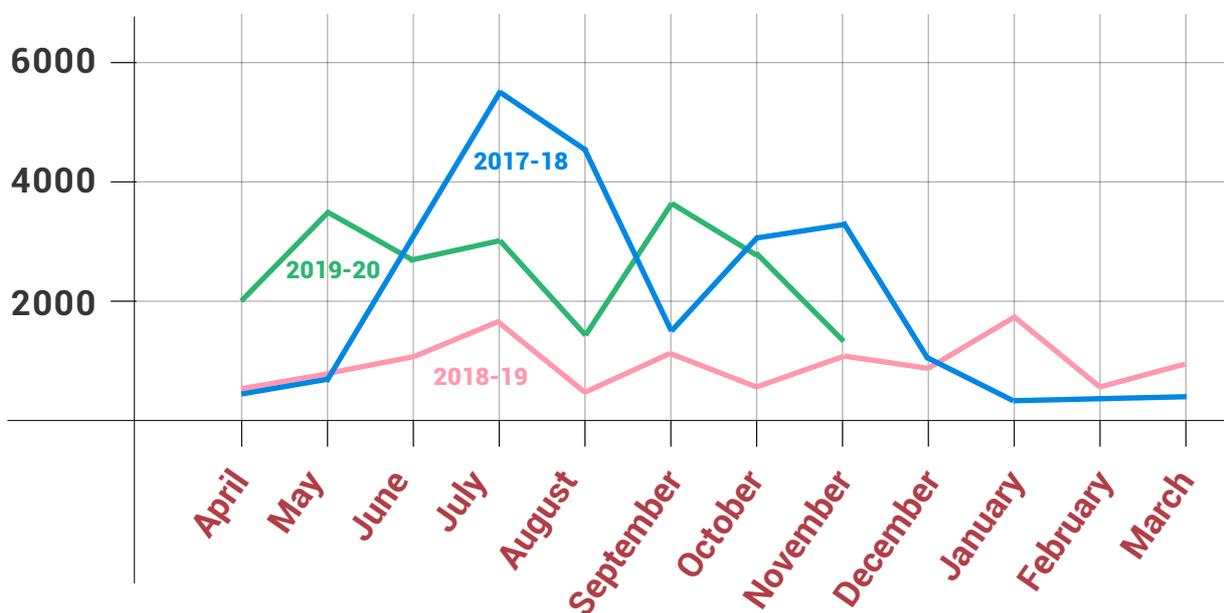


- ❑ The **APMC at Madanapalle is the largest in Asia** spanning across 19.80 acres. There are 137 commission agents who are now being converted to traders over time under orders of the government.
- ❑ The **commission agents are linked to traders from across the country** - both wholesalers and retailers.
- ❑ The **mandi sees an average of 300-600 MT of tomatoes on a daily basis** (low to peak season).
- ❑ There is **2-15 tons of waste tomatoes observed on a daily basis** as well depending on the production and season.
- ❑ There are **various grades of waste crop at the market level**: The **highest grade waste crop is bought by juice processing units** at Rs.500 / tray. They make juice and sell it at Rs. 40 / bottle. The **second grade is bought by local eateries** and the **third grade is discarded into landfills**. There is huge potential of usage of this waste (in tons per day).

FIG.5. PRICE VOLATILITY OF TOMATO SELLING PRICE IN THE MADANAPALLE MARKET, ANDHRA PRADESH - 2017-2020 (NOVEMBER)

The data for this graph has been sourced from commission agents from the Madanapalle APMC.

The graph is indicative of the volatility in prices of tomatoes month wise over the course of 10 years. The volatility informs the need for certain interventions as well as the reason why certain interventions will not be feasible. Due to this, storing their produce in a cold storage for tomatoes could put the farmers at risk of greater losses if they invest in a cold storage or with any form of collection model. However, a primary processing centre with appropriate grading and sorting machinery and market linkages with fixed pricing could eliminate the susceptibility of volatility.



- ❑ In times of **over-supply**, a **glut situation occurs** and leads to **heavy economic loss** for the farmers.
- ❑ It has been observed that the **plastic crates are not ergonomic** as the **crate edges are sharp and cause pain to the labour workers**.
- ❑ The committee has set up **4 units of bio-composters that turn any wet waste into compost**. However, each machine **only has a capacity of 100 kgs per batch** out of which only 50-60 kgs of compost is produced. For each batch to be processed into compost, the **machine has to run 24 hours on electricity**. **Due to voltage fluctuations and power cuts, each batch takes longer** than the stipulated time of one day per batch. **When the team visited the market for primary research, the composters were not functioning due to an extended unpredictable power cut**.
- ❑ **Most of the markets are under 100 kms** and hence there is **no need for cold storage**. Due to **heavy fluctuation of prices**, cold storage for tomatoes does not add enough value for any of the stakeholders and has **potential increased losses**, even though it is **functionally necessary in times of glut and under supply**.
- ❑ **As selling price decreases, economic loss and waste both increase**. This is also reflected in **local post processing units** being shut during said durations.
- ❑ **Malpractices by commission agents during auctioning leads to heavy economic losses**.
- ❑ **High market fluctuation due to unprecedented supply and trader based supply chain leads to high revenue fluctuation**.



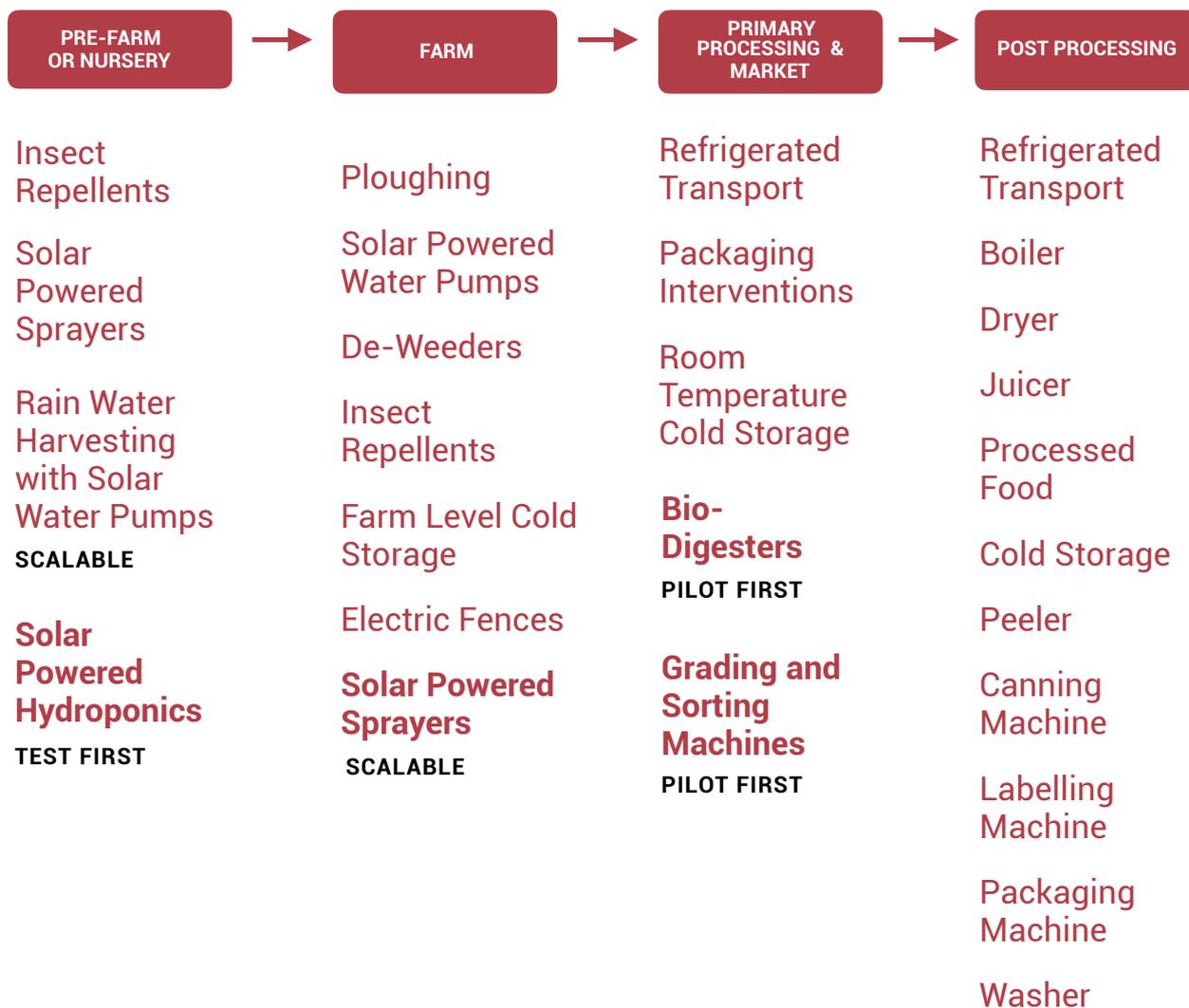
- ❑ **Round-shaped table tomatoes** which are produced in Andhra Pradesh and are suitable for making curries such as Sambar and Rassam, as their water content is high. This also makes drying solutions unviable.
- ❑ **Karnataka tomatoes can be useful for processing** as the water content is lower.
- ❑ **Primary processing that includes grading, sorting, loading, unloading, packing and unpacking is done manually** and can lead to a **high labour cost** of Rs. 500 per person for one day. Moreover, it is **practiced at least 4 times at different stages (farmers, traders, retailers and commission agents)** which leads to **excessive wastage**.
- ❑ Tomato food processing requires **high upfront cost** and **lacks entrepreneurial encouragement, awareness of subsidies**.
- ❑ **Market volatility is very high - nearly 40 times** - where the observed highest selling price has been Rs. 40/Kg, while the lowest selling price has been Rs.1 /Kg. (data procured from commission agents in the Madanapalle market)

RECOMMENDATIONS

TOMATO VALUE CHAIN

A total of 28 nodal points have been identified across the 4 stages of the tomato value chain out of which 5 solutions have been proposed for implementation. These solutions are elaborated on in the following section.

FIG 6. SUSTAINABLE ENERGY INTERVENTION IN TOMATO VALUE CHAINS



* Interventions in Bold are Identified as High Impact Points and Solutions are Detailed for the same



Solar Powered Water Pump for Close Range Rain Water Harvesting Tanks

Farmers in Andhra Pradesh (including nursery farmers) rely on groundwater entirely for irrigation. Some nursery farmers complained of the bore well water being saline. It was described as *kaara neeru* and it affected crops. With the current groundwater level at 1200 ft, farmers are dependent on high capacity bore well pumps. Reduction of groundwater also leads to excessive use of grid electricity to run 7.5 hp-10 hp electric pumps. Electricity is provided for free by the government for 7 hours daily leading to over pumping of existing aquifers leading to dramatic depletion of groundwater. Nurseries usually operate the whole year and often suffer from regular power cuts. To cover periods of load shedding, many nurseries are unable to irrigate their seedlings or resort to using diesel-driven pumps as well.

SOLUTION 1 Rain Water Harvesting with Solar Water Surface Pumps

SCALABLE

Description

The rainwater harvesting tank can act as an efficient alternative to lack of water accessibility and availability particularly in the summer months. This will enable farmers to avoid sapling loss and act as a backup for current and immediate future needs. To pump the water from the rainwater harvesting tank, a small solar water surface pump is recommended which will increase reliability. For the tank, the catchment area will be decided upon depending on the land size and availability. A tank with a minimum capacity of 10,000 litres can be constructed with two chambers of 5,000 litres each. A catchment pond on the side could collect excess water allowing increased capacity. The tank at full capacity will be able to irrigate 2-3 cycles of cropping.

Hours of Usage

One hour for three/ four days a week

Ownership

The rainwater tank+solar surface pump is recommended to be owned by a single nursery farmer as given space constraints. If a larger area is available with farmers willing to share, two farmers could use a common larger tank with a higher capacity pump or two small pumps for a farmer each. However, the likelihood of conflict or unwillingness is higher for shared ownership of water at a nursery level

Perceived Impact

Nursery farmers can incur a loss of upto 5 Lakh INR (80 paise / Rs.1 per sapling) at such times if the whole plot has been cultivated. They resort to planting only on selected patches of the land. Nursery farming requires timely consistent irrigation, without which the quality of the saplings can degrade. 3,000 litres of water is required per cycle, and there are 3 cycles per season. During summer and winter (dry seasons), when the ground-water recedes, the farmers can rely on harvested rainwater. Also, the inconsistent grid electricity will not be an issue.

In Andhra Pradesh, through the existing program, 16 nursery nursery farmers can be impacted through this solution. Each nursery serves upto 50 farmers who can also be impacted through higher supply of saplings in the summer months.



Solar Powered Hydroponics Solution

SOLUTION 2 **Solar Powered Hydroponics**

TEST FIRST

Description

The quantity of water used at the nursery level is high at 3,000 litres per cycle which has a lot of scope to reduce. The total cost of farming at nurseries, with inputs such as coco peat, plastic trays, land leasing, infrastructure, labour, and seeds comes upto 5 lakh INR. As nurseries are often completely dependent on the demand of the farmers, they incur losses due to market fluctuation and farmer malpractice as well. With depleting ground water levels, the need for conserving and using water judiciously is critical.

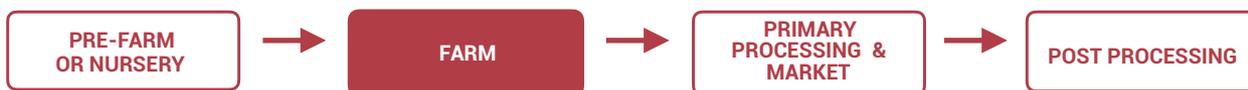
Ownership

Each hydroponics system should be owned by one nursery farmer at a testing and pilot stage. On ground implementation and testing is required to understand the maintenance and care required to run this system. As the saplings require intensive care, it would be advisable to own hydroponics at an individual level

Perceived Impact

The water crisis is perceived to have an economic loss on the vulnerable population, especially farmers whose livelihoods highly depend on this resource. Decentralized renewable energy based hydroponics system can cut the high input cost as well as reduce land use. If successful, whole nurseries could be converted to using hydroponic practices which would be very healthy with respect to reduced water consumption. In Andhra Pradesh, through the existing program, 16 nursery nursery farmers can be impacted through this solution. Each nursery serves upto 50 farmers who can also be impacted through higher supply of saplings in the summer months.

For both solutions, one common solar system can be designed if to be piloted in the same nursery. The same pump and rainwater harvesting tank can be used for hydroponics as well as for irrigation of the traditionally grown saplings.



Solar Powered Sprayers

SOLUTION 3 Solar Powered Sprayer

PILOT FIRST

Need Identified

Tomato farmers in the Chittoor district belt use a lot of pesticides. Over the last two years itself, their input costs have risen by 40 per cent every cycle due to increased pesticide usage. The pest commonly known as *oozi* affects tomato crops right from the initial stages of cropping leading to nursery farmers and tomato crop farmers having to use pesticides and fertilizers from the start. During the harvesting period is when the no of sprays are at a maximum. They apply fertilizers 2-3 times in a crop cycle and close to 10 times every season which is either done manually by labourers using petrol sprayers or by diesel powered tractors

Description

Spraying pesticides and fertilizers is a very critical component of the farming cycle. Presently, a lot of farmers fill drums with 200 litre capacity with pesticides and use a pump based system to sprinkle pesticides which are highly inconvenient and time consuming. The FPOs have been wanting to move to a portable model to save time and increase mobility.

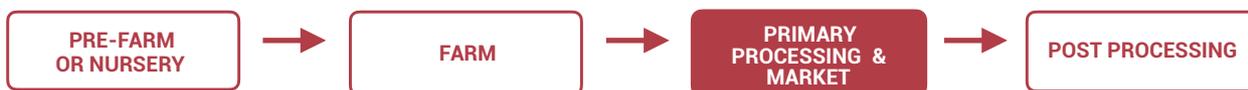
To reduce the carbon footprint and costs expended on petrol and diesel, solar powered sprayers could be a very effective solution. A rental model is being proposed where each unit can have 5 sprayers being charged by the same solar design. They can be charged at the same time and farmers could use them on a rental basis which will work for 6 hours.

Ownership Models

The sprayers could be FPO owned and utilized by farmers. The servicing and maintenance will also be undertaken by the FPOs itself. The FPOs have 3 Farmer Development Centres, 8 mandal offices and 1 office at the Madanapalle mandi which could host the sprayer units as the farmers visit these centres very regularly and are situated at convenient locations. When being scaled, they could be hosted at the panchayat level as well.

Perceived Impact

The solution being ergonomically friendly would reduce the time taken for spraying fertilizers and increase mobility for the farmers as well. These sprayers could also be used by the farmers to apply liquid bio-fertilizers which can be procured from the market or the pre-digester which has been recommended above. The costs incurred on petrol and diesel will be reduced as well as the carbon footprint it carries. Each spraying unit could impact 20 farmers each and if each office has one unit, the solution could impact 240 farmers.



SOLUTION 4 Solar Powered Grading and Sorting Machines

PILOT FIRST

Description

Grading and sorting is practiced at every stage of the supply chain; farm-level, market-level, trader-level, and buyer level. This leads to excessive waste and high labour cost (Rs.2-Rs.3 per crate, Rs. 500 per day) on all stages. Loading, unloading, packing, unpacking, grading and sorting are the activities that are included. FPOs in Andhra Pradesh have identified the need for technology interventions and have allocated land for primary processing units which will be a project under Operation Greens, Ministry of Food Processing. Glut incidences due to oversupply can lead to excessive loss due to which farmers prefer to throw away their produce at such times. Primary processing units will have controlled supply chains with set market linkages, which will reduce the vulnerability and economic loss during excessive market fluctuation. With the grading and sorting machine set up, the number of incidences of manual sorting which have arbitrary methods will be cut down drastically, saving produce as well.

Ownership

The primary processing centre with the grading and sorting machine will be FPO owned and utilized by farmers. Based on the capacity, every machine can serve up to 10 farmers who would all belong to the same FPO. The CEO could assign the farmers for collections and the profit will go back to the members. The implementing NGO can identify market linkages and can partner with buyers and supermarkets for upfront cost and contractual farming if the farmers wish to do so on their own terms. Farmers can supply their produce to these collection centres. Those producing processing tomatoes can partner with food processing companies for contractual farming. They will supply 'A grade' to larger conglomerate level linkages, 'B grade' to hotels, religious institutions for cooking and 'C grade' to tomato food processing centres

Perceived Impact

With each mandal having approximately a 50 km radius, farmers travel approximately 30-40 kms to reach the APMC and some much further. They travel the previous night to keep the tomatoes ready before the auction. The next morning they attend the auction and return 2-3 hours after the auction to collect their wages. Farmers end up traveling back and forth the market a minimum of 3 times in two days presently. A controlled supply chain from the primary processing unit and reduction of farm to unit distance by 20 kms will reduce the carbon footprint, time invested, farmers stress and input cost exponentially. They will also earn an additional Re 1 per kg minimum and the FPO hopes to provide a higher profit margin through the year. Across 8 mandals in Chittoor District, 500 MT capacity per cycle is required for grading and sorting. With 3 grading and sorting units per mandal, 1000 farmers can be impacted from the same.

FIG 7. LOSSES AT VARIOUS LEVELS OF TOMATO VALUE CHAIN



Need Identified

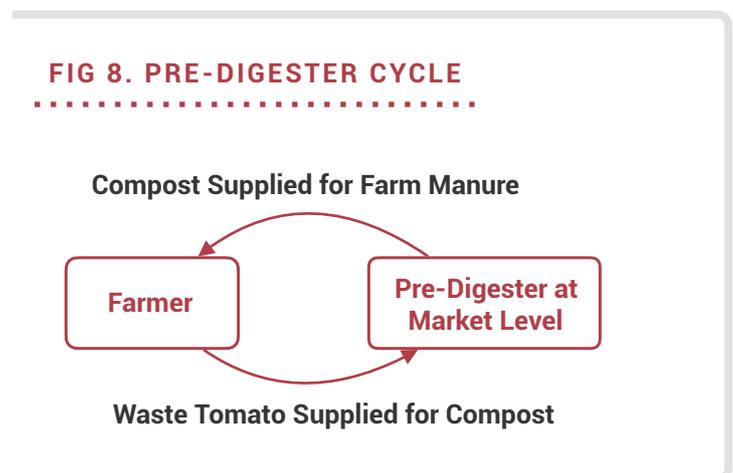
It was observed that Andhra Pradesh farmers have been applying excessive and unnecessary varieties of fertilizers and pesticides on their tomato crops. 40 per cent increased input cost in two years was observed (30,000 INR per acre per cycle). Also, excessive waste is observed on a market as well as harvesting stage (10 per cent) and overall 23 per cent at mandi level including farm waste. This waste cannot be fed to cattle either as the pest *oozi* is harmful to them. At the Madanapalle mandi, there is 2-15 tons of waste observed on a daily basis based on the produce. To deal with the waste, there are 4 electricity powered compost machines set up at the Madanapalle APMC. These machines are highly energy consuming and are hence inefficient, as they require 24 hours of continuous energy and have a capacity of merely 100 kgs of waste. This converts into 50 kgs of compost, which is less in quantity and hence not very useful. Market level renewable based pre digesters can treat the waste efficiently. The waste is converted into solid and liquid bio manure which can be used by the farmers on farm.

Description

The pre-digesters could be constructed at the mandi level where the farmers visit regularly. If the digesters are placed elsewhere, the likability of them traveling to drop their waste and collect bio manure is not very high. The alternative location could be at the primary processing units that are being set up where farmers would be visiting regularly as well with their produce. For the waste being deposited, they can collect manure accordingly. The treated waste that is coming out from the pre digester is in the form of liquid manure. Another byproduct is the biogas discharged from ADs after-treatment process. A part of this treated liquid is reused in the next day's operation of the plant to replace the use of freshwater, through a specially designed slurry loop system reducing the need for excess water usage. A pre-digester unit usually is designed with 3 pre-digesters components with 500-1000 kgs capacity (capacity in actuals to change on the basis of site survey and requirement) each at every location. The liquid fertilizer produced will be 50 per cent of the quantity deposited i.e. if at full capacity, there will be 500 litres of fertilizer as the output. Due to the slurry loop system, the quantity of fresh water used per batch is not more than 100-300 litres. Each batch takes about 30 days to convert into manure.

Perceived Impact

The pre-digesters will convert the waste into compost which then can be used by farmers. They will also prevent stubble burning as it can be used in the pre-digester to convert into manure in order to reduce carbon emissions. If the farmers convert even 10 per cent of their land to organic farming practices by applying this bio-fertilizer, it will be highly impactful. Thus, a gradual shift to use compost made in a decentralised manner can reduce the chemical fertilizer use, decreasing salinization of groundwater, increasing yield and soil health as well. This could act as a decentralized circular economy model in the coming future in the context of agriculture. To assess the number of farmers who would utilize this service, a detailed need assessment will have to be conducted based on which a service delivery model will have to be designed with equal number of trainings and awareness building activities conducted by the on-ground staff.



Wastage on all stages of the supply chain is an issue as it leads to loss of revenue. Pre-digesters will act as an economic value for APMC as well as the farmers. The farmers could trust the compost over time and reduce fertilizer use. Subsidies with National Institute for Rural Development, implementation of the same will decrease the barriers for APMC participation

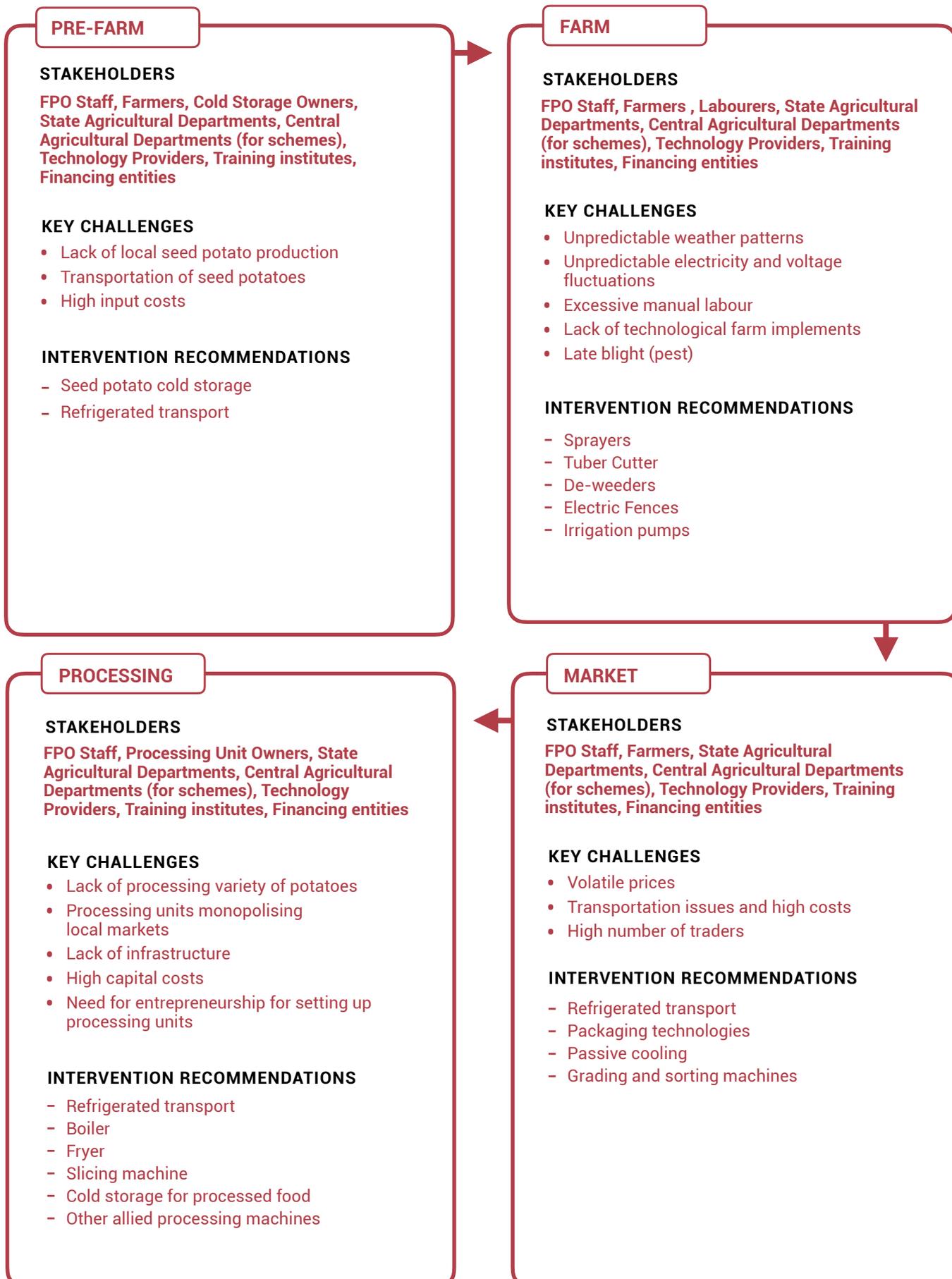
POTATO VALUE CHAIN



Potato Chips produced at a
pvt. processing unit in
Hassan District Karnataka.

SUMMARY OF FINDINGS & RECOMMENDATIONS

POTATO VALUE CHAIN



STAKEHOLDERS

POTATO VALUE CHAIN

PARTNER ORGANISATION

AFC
Agricultural and
Finance Consultants

LOCATION

Hassan District,
Karnataka

FARMERS

20 Farmers

Individual interviews
Focus group discussion with 10 farmers
Focus group discussion with 5 farmers

- Details on farming techniques (from irrigation to harvesting)
- Understanding of farm level processing
- Current business models
- Financial influx and outflows
- Socio-cultural factors
- Technologies used, perceptions of technology etc.

FPOs

2 FPOs

- Basic details of FPO
- About farmers, govt, policies, crops and varieties grown, energy used at each point, technologies used and processing (current and prospects)
- Value and supply chain
- Policies and subsidies

PROCESSING UNITS

1 Business Owner

- Machinery used
- Business model
- Inputs and outputs
- Energy usage and costs
- Market linkages
- Labour and staff
- Understanding viability of a processing unit

COLD STORAGE UNIT

1 Business Owner

- Raw material procurement
- Labour training
- Cold chain management
- Energy and machinery requirement
- Overall management
- Supply chain

AFC STAFF

5 Member

One focus group discussion

- Structure of the organization with roles and responsibilities
- Details and history of the organization and program
- Interventions proposed and being carried out under the program
- Needs and gaps in the tomato value chain
- Energy gaps and requirements
- Input and output costs of farmers

AFC MANAGEMENT

1 Member

3 meetings conducted

- Introduction on the project
- Programs being carried out
- Energy requirements
- Viability of solutions
- Validation of secondary research

KEY FINDINGS

POTATO VALUE CHAIN



- ❑ **Seed potatoes are imported from Punjab (2600km) by the farmers (FSGs under AFC), after they check the quality. High carbon footprint is observed and farmers spend upto INR 2,00,000 per batch.** Other farmers procure them from local traders (who also procure seed potatoes from Punjab) but **do not trust the quality. AFC is training the farmers to produce seed potatoes.**
- ❑ **Jyothi is a famous hybrid seed variety. Himalini has tolerance to late blight and hence is accepted by farmers. Mostly, hybrid seed potatoes are farmed.**
- ❑ **Farmers have a societal value towards potatoes and farm during Rabi and Kharif seasons both.**
- ❑ **Water levels are at 150-400 ft in Hassan which means availability of water is not an issue. There are a lot of water sources in the form of ponds near farms which are not used for surface water irrigation as there is an understanding between farmers on that water being essential for ground water recharge.**
- ❑ **Availability of electricity is an issue for irrigation. Fluctuations experienced leads to the transformer to breakdown and hence leads to crop loss.** Timing inconsistencies result in lifestyle related issues.
- ❑ **IFCO, Mangala, Nagarjuna, Koramandala, are some input supplier companies.**
- ❑ **Green manure in the form of crop Dayajhasanghem. It is applied before the flowering stage to add nutrients to the soil. This shows the scope of introducing organic.**
- ❑ **The 2017 drought and 2019 floods resulted in revenue loss for most of the farmers.**
- ❑ **Drip, sprinkler, flood are types of irrigation practiced in sequence according to the amount of yield. Micro sprinklers are used for ginger crop farming.**
- ❑ **Labourers, while using chemical fertilisers, experience giddiness, headache, go to hospital for treatment, while some say they have become tolerant to the effects.**
- ❑ **6 nozzle petrol based sprayers and hired tractor services, pumps for irrigation are technologies used on farm level. A need for small sized planters for marginal farmers is necessary.**
- ❑ **Stubble burning is not practiced. They collect the stalks into a heap and mix it with the soil when re-harvesting.**
- ❑ **To tackle above issues, Farmer Study Groups (up to 15 farmers) have been formed for discussions and finding solutions by the FPO.**
- ❑ **Women labourers are paid less than male labourers, though the manual labour done by women is more.**
- ❑ **The FPOs and AFC have started a program where a few farmers have started to cultivate seed potatoes and are hoping for more farmers to take it up in the year. Once upto 15 farmers start growing seed potatoes, having a cold storage at the farm level would be imperative.**
- ❑ **Farmers are able to store harvested table potatoes on farm under a heap of maize stalks for a period of one month. However it is very susceptible to late blight and the time period of storage has been reducing over the years.**

KEY FINDINGS

POTATO VALUE CHAIN



- Most processing units are local who sell the food (mostly potato chips) on spot (Unorganized sector) and to local establishments. They have a monopoly over the local markets.
- There is one chip making unit in Hassan which procures its potatoes from Gujarat because they need a consistent size of processing potatoes and the Hassan variety are not processing material. The unit has very high capacity machines for drying, frying and other allied activities. They consume a lot of firewood for boiling potatoes.



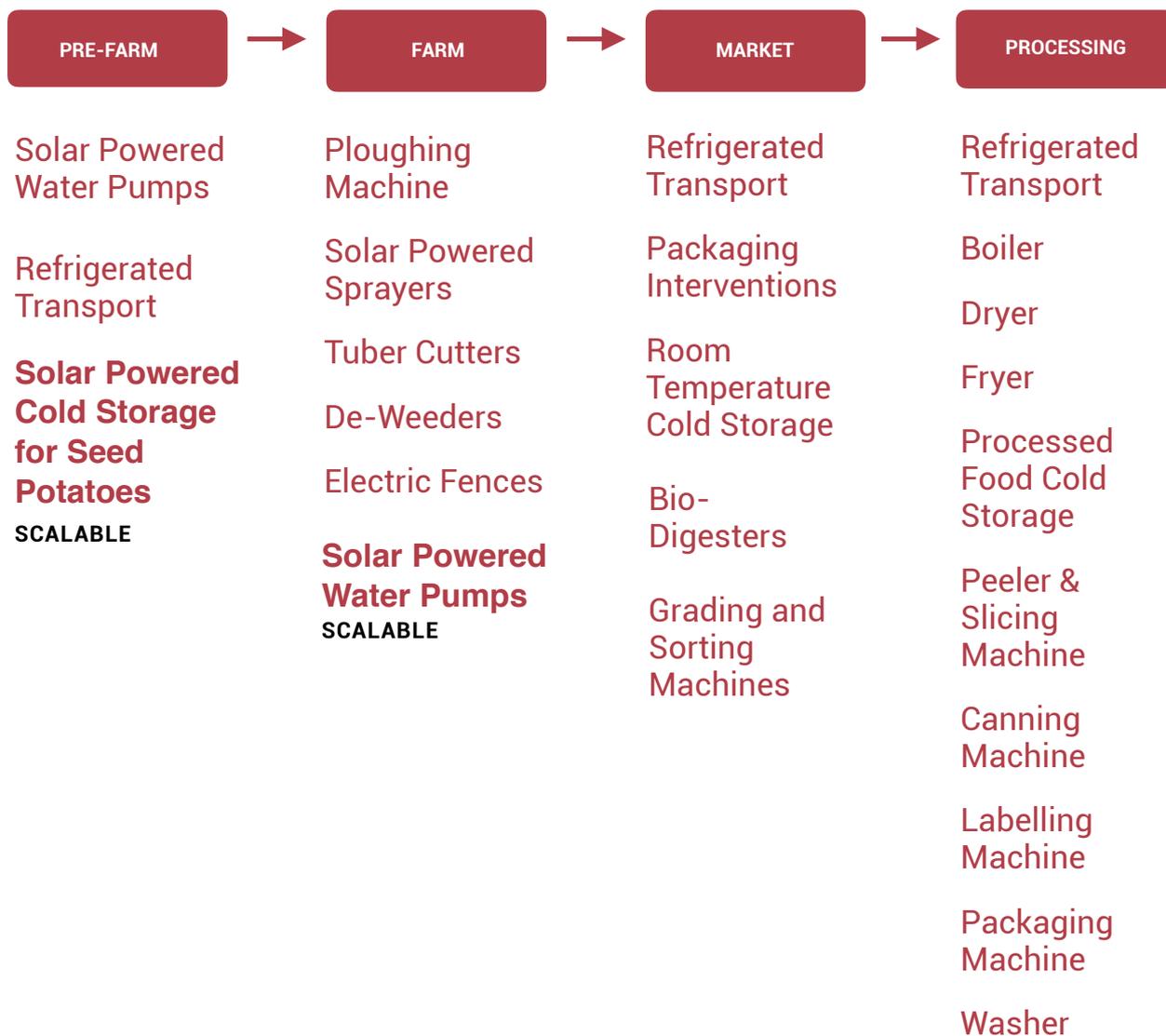
- **Hassan's harvesting cycles for potatoes don't coincide with other districts or states. There is no competitive pricing with other states due to this.** This is also the reason stated for why **cold storage for table potatoes would not make sense in these regions as it would increase competitive pricing.**
- Farmers either supply the produce to Yeshwanthpur market based on the pricing but have to arrange and pay for transportation. If the APMC is providing appropriate pricing, the agents collect the produce using their own transportation.
- **Farmers don't produce seed potatoes in Karnataka and procure them from either Punjab or the local APMC.**
- **Traders own cold storage in Karnataka for seed potatoes. Table potatoes are not stored. They face issues due to market fluctuation and climate vulnerability as the quantity of buying seed potatoes depends on the risk vulnerability of the farmers.**
- Increase in the number of traders, results in increase of wastage and carbon emissions.

RECOMMENDATIONS

POTATO VALUE CHAIN

A total of 25 nodal points have been identified across the 4 stages of the potato value chain out of which 2 solutions have been proposed for implementation. These solutions are elaborated on in the following section.

FIG 6. SUSTAINABLE ENERGY INTERVENTION IN TOMATO VALUE CHAINS



* Interventions in Bold are Identified as High Impact Points and Solutions are Detailed for the same



Left - Centralised Privately Owned Cold Storage in Hassan District

Right - Decentralised Solar Powered Cold Storage

SOLUTION 6 Solar Powered Decentralized Cold Storage for Seed Potatoes

SCALABLE

Need Identified

Seed potatoes are imported by the farmers from Punjab (2600 kms of transportation), or they are procured from local traders. It costs Rs. 4 - 4.5 per bag of seed potatoes, and can go up till Rs. 8 - 9 during high fluctuation. The farmers who procure it from Punjab, check on the quality and reduce input cost as that cuts out the middleman. Traders procure from Punjab too, but they store it in massive cold storages in Karnataka. There lies an excessive carbon cost to these seed potatoes. One truck for direct procurement can cost upto 1 lakh INR which is borne by the farmers. The on-ground NGO and their FPOs have formed FSGs (Farmer Study Groups) who have identified the need for seed potato production in Hassan, as potato is a culturally important crop and is grown year round. Seed potatoes have to be stored for 6-8 months in 2-3 degrees Celsius temperature to be used for the next season.

Description

Based on the project by the NGO and FPOs, the plan is to have one innovation farmer per farmer study group cultivating seed potatoes of upto 1 metric ton each. Cold storage is imperative for seed potatoes which can be set up at convenient locations at the farm/panchayat level. Transportation for the seed potatoes to the cold storage will have to be established. However, the costs incurred by the farmer for transporting seed potatoes from Punjab will be offset, a small part of which can be utilized for local transport.

A 10 metric ton decentralized solar powered cold storage is proposed for storing seed potatoes. The cold storage structure is made from refurbished shipping containers and has cooling vents on the roof and walls to ensure that the potatoes stacked at the bottom are equally cooled. The cold storage has a system for data logging, the control for which is on the structure itself. Racks and crates are not required, however they can be provided as well.

Ownership Model

Ownership can be taken up by FPOs for their farmer clusters and could be operated and maintained by the Farmer Study Groups. The NGO and their FPOs can help in subsidizing the storages by tapping into existing central and state schemes for cold storage infrastructures

Perceived Impact

Seed potato storage for FSGs can help encourage a decentralized supply chain system for input procurement and production. This will reduce the carbon footprint and the input cost exponentially for the farmers. If the program is scaled to its projection of 80-100 farmers taking up seed potato farming, 8 solar powered cold storages would be required which could meet the seed potato needs of 160 farmers.



Solar Powered Water Pumping Solutions

SOLUTION 7 Solar Powered Water Pumps

SCALABLE

Need Identified

Potato farmers in Hassan deal with fluctuating grid electricity. They receive 4-6 hours of electricity daily under the Nirantar Jyothi scheme. But, the inconsistent timings week on week hampers their irrigation practice as farmers sometimes need to awaken at 4 AM to irrigate which disrupts their routines not allowing them autonomy. In case of heavy fluctuation, the farmers have lost their irrigation pump transformers. Dependency on irregular electricity makes the farmers irrigate excessively, resulting in yield loss and soil nutrition loss. Farmers have set aside water bodies for ground water recharging, which has proven useful in summer as the water levels have never drastically reduced. Decentralized Renewable Energy based submersible water pumps will provide reliable access of water to the farmers and complete autonomy allowing them time to dedicate to other activities.

Description

The solar powered submersible pumps could be installed using the existing bore well systems which all farmers have on-farm. The farmers could irrigate their crops at whatever time they prefer and in required quantities only. There will also be reduction in over-irrigation due to fear of power cuts will cease. Some level of basic training and awareness building will be conducted by the system integrators in support with the FPO staff.

Solar powered submersible water pumps of a capacity of 3 HP and 5 HP would be sufficient for the groundwater levels which range from 150-350 ft in certain regions based on land size, seasons and rainfall. These pumps would require minimum maintenance

Ownership Model

An individual farmer can own one pump or two adjacent farmers can share and own one pump if they are willing. The on-ground NGO and FPOs can provide the required capacity building for the farmers. The NGO can help the Farmer Study Groups which they have formed for communication of importance of Decentralized Renewable Energy and replicating adapting the same model by other farmers.

Perceived Impact

The solar based submersible water pumps will replace the grid based unreliable and inconsistent electricity. This will reduce the carbon emissions as well increase the capacity of farmers to practice agriculture in a way that adequate irrigation is practiced which will not affect the yield. Economic loss can be avoided for every cycle, particularly summer months. The on ground FPOs in Karnataka work with 2000-2500 farmers out of which if even the innovation farmers from their localized groups take up these pumps, 100 farmers will be impacted.

FUTURE SUSTAINABLE ENERGY INTERVENTION RECOMMENDATIONS

TOMATO & POTATO VALUE CHAINS

Solar Powered De-Weeders

Solar powered de-weeders can be designed and piloted for tomato and potato farmers on an FPO level. The ones available in the market are for mere gardening level use. Also due to the difference in gaps between two planting rows and practices of farmers, a flexible design is required. Research for the design and application of small-scale electric de-weeders is in progress. Most power weeders are tractor powered which are diesel run and cannot be solar powered. Small scale alternatives are not available for farm level at the market.

Solar Powered Juicers and Other Processing Machines

Tomato juice processing units can be proposed for tomatoes grown in Andhra Pradesh as the water content is high, though market research for demand, as well as creation of necessary market linkage for the same will be necessary. This is specifically in relation to the discussions held with the on-ground organization and their FPOs. Introduction of solar-based industrial mixer, pulverizer, crusher is possible, but there is a requirement of infrastructure and trained staff. Moreover, market linkages and validation of tomato juice requirement has to be researched.

Farm Level Passive Potato Storage

Possibilities of Farm-level passive potato storage is being explored for disease prevention in the post-harvest period. This passive cooling can be enabled through an energy efficient green built structure with appropriate lighting, ventilation for temperature control. However, more research is to be done with respect to the potatoes catching late blight after a certain time period which would result in huge losses.

Solar Powered Small Scale Planter

To explore designing small scale planters which are run on clean energy. Available ones are diesel-based as high levels of energy are required. Research for the design and application of small-scale electric planters is in progress.

CONCLUSION

The need for energy efficient and renewable energy based solutions in strengthening the tomato and potato value chains is critical. For the proposed solutions to be implemented successfully, every arm of the ecosystem needs to be strengthened. Appropriate financial products and business models need to be developed to ensure easy uptake of solutions and faster return on these long term investments for farmers. Financing can be unlocked through banks or government programs, schemes and other financing channels for energy efficient and Decentralized Renewable Energy integrated technologies. Training should be provided to these institutions, on-ground implementing bodies, FPO staff and farmers by system integrators, solution providers and training centres. If solutions are implemented through the support of all stakeholders sustainable energy can prove to be a trigger to ensure long term financial and environmental sustainability for the farmers.

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ANNEXURE A

Solution 1 - Rainwater Harvesting Tank With Solar Powered Surface Level Pump

Description: The rainwater harvesting tank can act as an efficient alternative to lack of water accessibility and availability particularly in the summer months. This will enable farmers to avoid sapling loss and act as a backup for current and immediate future needs. To pump the water from the rainwater harvesting tank, a small solar water surface pump is recommended which will increase reliability.

For the tank, the catchment area will be decided upon depending on the land size and availability. A tank with a minimum capacity of 10,000 litres can be constructed with two chambers of 5,000 litres each. A catchment pond on the side could collect excess water allowing increased capacity. The tank at full capacity will be able to **irrigate 2-3 cycles of cropping.**

Market research:

Company	Khethworks	Jain irrigation	Kotak	Kotak	Kotak	Kotak
Panel capacity	0.3 hp	80 Watt (40 WP* 2 Nos)	300 Wp (300 WP*1 Nos)	300 Wp (300 WP*2 Nos)	250 Wp (250 WP*4 Nos)	300 Wp (300 WP*4 Nos)
Vmp	24	14V	37.08 V	37.08 V	37.08 V	37.08 V
Imp	8.5	3amps	8.32 amps	8.32 amps	8.32 amps	8.32 amps
Open circuit Voc	36	18V	44.07 Volts	44.07 Volts	44.07 Volts	44.07 Volts
Connection type	Parallel	Parallel	Single panel	Parallel	Parallel	Series
DC Surface Pump						
Make	Khethworks	Jain irrigation	Bharath electric motors	Bharath electric motors	Rotosol Solar	Shakti Pumps
Model	KM-r1-320	Nano pump	BEM24SS	BEM24S	MBP-30	110V AC
Capacity	0.3 hp	Quarter (60 watt)	0.25 hp surface (Self priming)	0.5 hp surface (Self priming)	1 hp surface (MONOBLOCK)	1 hp AC Surface Pump
Rated Suction Head	NA	6 m	7 m	7 m	7 m	3 m
Rated Shut off	15m	30m	12 m	12 m	12 m	10 m
Discharge ltrs/hr at 12M	5040	500 litres	800 litres	1200 litres	15000 litres	30000
Rated Motor Voltage	24	12 Vdc	24V	24V	24V	110V AC
Rated Current	8.5	5 amps	10 Amps	19 Amps	25 Amps	8.32Amps
Pump controller	Inbuilt-Khethworks	NA	0.25 hp, 24Vdc, 15amps	0.5 hp, 24Vdc, 20amps	1 hp, 24Vdc, 30amps	1 hp , 110V AC
Recommended	Agricultural	Domestic purpose	Domestic purpose	Domestic purpose	Agricultural purpose	Agricultural
Cable						
Type			Copper	Copper	Copper	Copper
Size (Module to Module)	4sq mm	2.5 sq mm	6 sq.mm	6 sq.mm	6 sq.mm	4 sqmm
Size (Module to Pump)	6 sq mm	4 sq mm	10 sq.mm	10 sq.mm	10 sq.mm	30m
Indicative cost*	38000 INR	26000 INR	45000 INR	65,000 INR	1,35,000 INR	1,25,000 INR

Proposed solution:

Khethworks 320 pump is a portable and highly efficient solar pump. It is built with a stainless steel body to ensure corrosion resistance. The impeller and pump casing are made with highly engineered plastic to ensure maximum durability and strength. An aluminum frame is provided for protection across the pump casing, which also acts as a resting surface for a filter bag. The pump features a rubber-padded, stainless steel handle which is to be used both to carry the pump and to provide a surface for knotting the rope to lower the pump in the water body.

Technical specifications for Khetworks surface pump:

Pump Model Number	KW-r1-320
Type of Pump	Centrifugal
Voltage (V)	30
Power (per panel) (W)	160
No. of Panels	2
Maximum Flow (L/hr)	4800
Maximum Head (m)	15
Outlet Diameter	1" or equivalent
Length of Cable (m) between Pump and Pump Controller	15

No of hours of usage: One hour for three/ four days a week during summer months.

Ownership model: The rainwater tank+solar surface pump is recommended to be owned by a single nursery farmer as given space constraints. If a larger area is available with farmers willing to share, two farmers could use a common larger tank with a higher capacity pump or two small pumps for a farmer each. However, the likelihood of conflict or unwillingness is higher for shared ownership of water at a nursery level.

Pilots: APMAS FPO Heads is to identify *5 model nursery farmers* across mandals to pilot this solution. Based on the results of the 5 pilots, scalability could be assessed and considered by APMAS.

Business case:

An initial rough analysis shows a transition of enabling farmers to plant sapling throughout (instead of half) their nurseries due to sufficient availability of water during summer months. While this needs to be monitored via implementation on site, the current calculations show an improvement in profits of the nursery farmers by 50 per cent.

Perceived impact:

Nursery farmers can incur a loss of upto 5 Lakh INR (80 paise / Rs.1 per sapling) at such times if the whole plot has been cultivated. They resort to planting only on selected patches of the land. Nursery farming requires timely consistent irrigation, without which the quality of the saplings can degrade. 3,000 litres of water is required per cycle, and there are 3 cycles per season. During summer and winter (dry seasons), when the ground-water recedes, the farmers can rely on harvested rainwater. Also, the inconsistent grid electricity will not be an issue.

In Andhra Pradesh, through the existing program, 16 nursery nursery farmers can be impacted through this solution. Each nursery serves upto 50 farmers who can also be impacted through higher supply of saplings in the summer months.

Solution 2 - Solar Powered Hydroponics for Tomato Nurseries

Description: The quantity of water used at the nursery level is high at 3,000 litres per cycle which has a lot of scope to reduce. The total cost of farming at nurseries, with inputs such as coco peat, plastic trays, land leasing, infrastructure, labour, and seeds comes upto 5 lakh INR. As nurseries are often completely dependent on the demand of the farmers, they incur losses due to market fluctuation and farmer malpractice as well. With depleting ground water levels, the need for conserving and using water judiciously is critical.

Technical Specifications:

Cycle of growth	45-90 days
Agriculture	Vertical
Product Name	Kambala
Product Dimensions	7 ft h x 3.3 ft L x 4 ft W
Total Racks	7
Total Trays	28
Total Micro Sprinklers	14
Total Angle makers	56
Seed Input per rack	<4Kgs (4 Trays)
Harvest capacity per rack	25 to 30 Kg every day
Power	Single phase 230V AC
Time taken to install	15 to 30 minutes
Operating Temperature	Up to 50 Degrees
Shade Net	Black, UV stabilized
Patented Timer	Custom control settings

Ownership model: Each hydroponics system should be owned by one nursery farmer at a testing and pilot stage. On ground implementation and testing is required to understand the maintenance and care required to run this system. As the saplings require intensive care, it would be advisable to own hydroponics at an individual level.

Pilots: FPO heads can identify model nursery farmers and pilot 3 solutions to begin with each of which could have a design based on the needs and land availability.

Business case:

Number of tomato plants per acre are 10,000. One or maximum two hydroponic systems can produce that many sapling and reduce the input cost of saplings per cycle drastically.

Perceived impact

The water crisis is perceived to have an economic loss on the vulnerable population, especially farmers whose livelihoods highly depend on this resource. Decentralized renewable energy based hydroponics system can cut the high input cost as well as reduce land use. If successful, whole nurseries could be converted to using hydroponic practices which would be very healthy with respect to reduced water consumption. In Andhra Pradesh, through the existing program, 16 nursery nursery farmers can be impacted through this solution. Each nursery serves upto 50 farmers who can also be impacted through higher supply of saplings in the summer months.

Conclusion for Solutions 1 and 2

For both solutions, one common solar system can be designed if to be piloted in the same nursery. The same pump and rainwater harvesting tank can be used for hydroponics as well as for irrigation of the traditionally grown saplings.

Identification of Potential Policies/Schemes for Loans or Subsidies

- ❖ Krishi Bhagya Scheme - A subsidy ranging from ₹7,332 to ₹72,777 is given by the government to farmers digging farm ponds, depending on the size of the pond. Owing to small land holdings, nearly 75 per cent of fields have farm ponds of 7m x 7m x 3m, while the remaining 25 per cent have ponds ranging from 10m x 10m x 3m to 21m x 21m x 3m.
- ❖ For collective purchase, NABARD schemes can be assessed and tapped into. Along with this horticulture department schemes are to be explored
- ❖ Mudra - Micro Credit Scheme (MCS) for loans up to 1 lakh finance through MFIs. Micro Credit Scheme is offered mainly through Micro Finance Institutions (MFIs), who deliver the credit up to 1 lakh, for various micro enterprise / small business activities. Although the model of delivery may be through SHGs/JLGs/ Individuals, the loans are given by the MFIs to individual entrepreneurs for specific income generating micro enterprise/ small business activities.
- ❖ Chief minister self employment scheme (CMEGP) - Under CMEGP scheme, Government provides a subsidy on loan for the rural entrepreneurs to start a new business. The Karnataka Government implements this scheme in consultation with District Officers of Karnataka Khadi and Village Industries Board (KVIB) and Joint Director of Department of Industries and Commerce (DIC). Working Capital at least once should touch 100 per cent limit of Cash Credit within three years of Lock-in period of M.M. and not less than 75 per cent of the utilisation of the sanctioned limit on an average. The lock period for Government Subsidy is three years.

Solution 3: Solar Powered Tomato Grading and Sorting Machines

Need identified:

Grading and sorting is practiced at every stage of the supply chain; farm-level, market-level, trader-level, and buyer level. This leads to excessive waste and high labour cost (Rs.2-Rs.3 per crate, Rs. 500 per day) on all stages. Excessive waste is observed on a market as well as harvesting stage (10 per cent) and overall 23 per cent at mandi level including farm waste. At the Madanapalle mandi, there is 2-15 tons of waste observed on a daily basis based on the produce. Loading, unloading, packing, unpacking, grading and sorting are the activities that are included. FPOs in Andhra Pradesh have identified the need for technology interventions and have allocated land for primary processing units which will be a project under Operation Greens, Ministry of Food Processing. Glut incidences due to oversupply can lead to excessive loss due to which farmers prefer to throw away their produce at such times. Primary processing units will have controlled supply chains with set market linkages, which will reduce the

vulnerability and economic loss during excessive market fluctuation. With the grading and sorting machine set up, the number of incidences of manual sorting which have arbitrary methods will be cut down drastically, saving produce as well.

Market Research:

Three vendors were identified and their specifications have been compared. Additional machines are being researched upon to identify the ideal solution. A grading and sorting machine by Aman Vishwakarma Engg. Works from Haryana has been benchmarked at this stage.

Sr no	Observation	Haryana model	Maharashtra model	Karnataka model
1	Procured / not procured	Not procured	Not procured	Not procured
2	Motor capacity	2HP, 220V	1.5HP, 440V (VFD applicable)	1HP, 220V
3	Cost	173600	90000	100000
4	Solar system cost (Approx)	327000	264000	180000
5	Solar specs	250Wp X 10 nos; 150Ah X 8 nos; 5kW (6kVA) - inverter	300Wp X 6 nos; 135Ah X 8 nos; 4kW (5kVA) - inverter	200Wp X 6 nos; 150Ah X 4 nos; 3kW (4kVA) - inverter
6	Manufacturer	Aman vishvakarma engineering works, Haryana	Prectech enterprises, Pune	Dharma technologies, Tumkur
7	Load being taken	800 kg/hr	500 kg/hr	300 kg/hr
8	Safety	Concealed and safe	Concealed and safe	Concealed and safe
9	Overall Feedback	The machine has been implemented in Haryana and other parts of India, no issues in technical part - there is an option to run the machine through tractor	As per discussion with the manufacturer, the feedbacks are positive in all the sites where the implementation has been done	They have tried this machine for lemon grading and potato grading, with some customization it can be modified for tomato grading as well
10	Steps taken	NA	NA	NA
11	Reason for selection/not selection	Along with tomato, potato and other products can also be graded	Small scale machine with multiple options to grade	Small scale machine with multiple option to grade

Proposed Solution:

A grading and sorting machine by Aman Vishwakarma Engg. Works from Haryana has been benchmarked at this stage. This machine has a 2 HP motor capacity and can grade upto 800 kgs per hour. The machine has been implemented in Haryana and other parts of India and has had no issues in the technical aspects so far. There is also an option to run the machine through tractor

Technical specifications:

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 Viridis, Coimbatore)	250 Wp, 1 M	10
4	Glowpower GPM5008 with MPPT Technology	5 kW (6 kVA), 96 V	1
5	Cables red+black (M-B)	6 sq.mm	40
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	With SPD and 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 and 1 OUT	1
12	Double pole MCB (load side)	16 A, 230 Vac	1
13	Earthing kit		2
14	Consumables		1

Amount produced and time taken:

Based on the capacity of this machine, a grid tie system is recommended. With high voltage fluctuations and power cuts, the solar back up will ensure constant operation of the machine. Per month, the machine should be able to grade and sort a minimum of 6 tons per day and 150 MT per month. This pilot could allow 10 farmers to grade and sort their produce.

Amount graded + sorted	Time taken
3 tons	4 hours
6 tons	1 day
150 MT	1 month

Ownership model:

The primary processing centre with the grading and sorting machine will be FPO owned and utilized by farmers. Based on the capacity, every machine can serve up to 10 farmers who would all belong to the same FPO. The CEO could assign the farmers for collections and the profit will go back to the members. The implementing NGO can identify market linkages and can partner with buyers and supermarkets for upfront cost and contractual farming if the farmers wish to do so on their own terms. Farmers can supply their produce to these collection centres. Those producing processing tomatoes can partner with food processing companies for contractual farming. They will supply 'A grade' to larger conglomerate level linkages, 'B grade' to hotels, religious institutions for cooking and 'C grade' to tomato food processing centres.

Business case:

On farm level at time of plucking, minimum grading sorting. simultaneously happens They will take 30-40 kms to market. They bring tomatoes the previous evening. Then they come back to mandi. at the time of auction. then after 2-3 hours they will again come to mandi to collect money. Time, stress, increased income will happen with grading sorting.

A rough analysis from data gathered on the field , and discussions with farmers associated with APMAS, shows a transition of high fluctuating market prices to a set selling price of tomatoes due to retailer based contractual farming with shared sorting and grading practice. Losses caused by repeated manual grading, sorting, loading, unloading activities were taken into account in the current year model, and a 40-50 per cent profit increase is predicted.

Revenue of marginal farmers	Can fluctuate from 200 INR - 4000 INR per quintal
Current profit	Can fluctuate from 0 INR - 3000 INR per quintal
Revenue after solutions implementation	Contractual farming (set MSP)
Number of reduced intermediaries	3 - 7 (commission agents, traders)
Transport time taken before solutions	3 days
Transport time taken after solutions	3 - 4 hours
Retail partners	Bigbasket, Namdhari etc
Peak season (no of months)	Jan - October
Non peak season (no of months)	November - December

Pilot:

As a pilot, one machine in a mandal in a controlled manner is being proposed to be testing with 10 farmers along with existing market linkages. The ownership will lie with the FPO and the operational aspects can be taken care of by the farmer collective. The CEO should assign one person for collections and the profit could go back to members.

Perceived impact:

With each mandal having approximately a 50 km radius, farmers travel approximately 30-40 kms to reach the APMC and some much further. They travel the previous night to keep the tomatoes ready before the auction. The next morning they attend the auction and return 2-3 hours after the auction to collect their wages. Farmers end up traveling back and forth the market a minimum of 3 times in two days presently. A controlled supply chain from the primary processing unit and reduction of farm to unit distance by 20 kms will reduce the carbon footprint, time invested, farmers stress and input cost exponentially. They will also earn an additional Re 1 per kg minimum and the FPO hopes to provide a higher profit margin through the year. Across 8 mandals in Chittoor District, 500 MT capacity per cycle is required for grading and sorting. With 3 grading and sorting units per mandal, 1000 farmers can be impacted from the same.

Identification of Potential Policies/Schemes for any Loans or Subsidies

- ❖ Operation Greens (MOFPI) - The Post-harvest processing facilities including secondary processing facilities will be mandatory components of the Integrated value chain development project. The projects will be eligible for grant-in-aid at the rate of 50 per cent of the eligible project cost

- ❖ in all areas, subject to maximum Rs. 50 crore per project. However, in case where PIA is/are FPO(s), the grant-in-aid will be at the rate of 70 per cent of the eligible project cost in all areas, subject to maximum Rs. 50 crore per project. (Component C-3)
- ❖ Integrated Scheme for Agricultural marketing (Agricultural Marketing Infrastructure) - AMI scheme is a back ended capital subsidy scheme in which rate of subsidy is 25 per cent and 33.33 per cent based on the category of eligible beneficiary and is provided on capital cost of the project. For the creation of Agricultural Marketing Infrastructure, Grameen Bhandaran Yojana (GBY) along with Scheme for Development/ Strengthening of Agricultural Marketing Infrastructure, Grading and Standardisation (AMIGS) are in coordination. Under the Integrated Scheme for Agriculture Marketing, these two schemes are subsumed into one subscheme known as Agricultural Marketing Infrastructure. (**Eligible Organizations:** The project for construction of rural godowns can be taken up by individuals, farmers, Group of farmers/ growers, Partnership/ Proprietary firms, Non-Government Organizations (NGO's), Self Help Groups (SHGs), Companies, Corporations, Co-operatives, Local Bodies other than Municipal Corporations, Federations, Agricultural Produce Marketing Committees, Marketing Boards and Agro Processing Corporations in the entire country. Assistance for renovation of rural godowns will, however, be restricted to godowns constructed by cooperatives only.)
- ❖ Scheme on Development of Commercial Horticulture through Production and Post Harvest Management of Horticulture Crops (NHB) - Credit linked back-ended subsidy @ 35 per cent of the cost of project in general areas and 50 per cent of cost in case Hilly States for subsidy on the pattern of HMNEH State & Scheduled areas for individual entrepreneurs.
- ❖ Chief minister self employment scheme (CMEGP) - Under CMEGP scheme, Government provides a subsidy on loan for the rural entrepreneurs to start a new business. The Karnataka Government implements this scheme in consultation with District Officers of Karnataka Khadi and Village Industries Board (KVIB) and Joint Director of Department of Industries and Commerce (DIC). Working Capital at least once should touch 100 per cent limit of Cash Credit within three years of Lock-in period of M.M. and not less than 75 per cent of the utilisation of the sanctioned limit on an average. The lock period for Government Subsidy is three years.

Solution 4: Pre-Digester

Need identified: It was observed that Andhra Pradesh farmers have been applying excessive and unnecessary varieties of fertilizers and pesticides on their tomato crops. 40 per cent increased input cost in two years was observed (30,000 INR per acre per cycle). Also, excessive waste is observed on a market as well as harvesting stage (10 per cent) and overall 23 per cent at mandi level including farm waste. This waste can't be fed to cattle either as the pest oozi is harmful to them. At the Madanapalle mandi, there is 2-15 tons of waste observed on a daily basis based on the produce. To deal with the waste, there are 4 electricity powered compost machines set up at the Madanapalle APMC. These machines are highly energy consuming and are hence inefficient, as they require 24 hours of continuous energy and have a capacity of merely 100 kgs of waste. This converts into 50 kgs of compost, which is less in quantity and hence not very useful. Market level renewable based pre digesters can treat the waste efficiently. The waste is converted into solid and liquid bio manure which can be used by the farmers on farm.

Description:

The pre-digesters could be constructed at the mandi level where the farmers visit regularly. If the digesters are placed elsewhere, the likability of them traveling to drop their waste and collect bio manure is not very high. The alternative location could be at the primary processing units that are being set up where farmers would be visiting regularly as well with their produce. For the waste being deposited, they can collect manure accordingly.

Market Research:

Parameters	Biotech India	SAAF Energy	Green Elephants
Capacity	500 - 1000 kgs	500 kgs to 5 Tonnes Capacity	500 kgs to 2 tonnes capacity
No of units in one location	3	1 shipping container	1 Shipping container
Quantity of water required	100-300 liters of freshwater	1:2 Ratio of water required for processing	Not known
Horticulture waste done before?	Yes	No, But worked on food waste based biodigesters	Applicable for Organic waste based biodigester
% of compost/fertilizer from the waste	40-50% of the total quantity	50% of it is solid fertiliser and the other 50% is liquid waste. The solid and the liquid waste has separate outputs	50% of the total quantity
No of days for one batch to process	15-20 days	30-40 days is the retention time	Not known
Output from waste	Fertilizer and energy	Solid fertiliser Liquid fertiliser & Bio fuel	Fertilizer and energy
Material of the system	concrete+PVC pipes	Shipping containers+Metal pipes with special coatings	Shipping containers+Metal pipes with special coatings
Cost of system	7.5 lakhs approx	10 lakhs to 12 lakhs	Not known
Case study available	Yes	Yes	Not available

Proposed solution:

Biotech Renewable Energy has been identified and partnered with to conduct site surveys and develop solutions for the same. Biotech has improved pre digesters capable of treating all types of easily and slowly degradable materials. The treated waste that is coming out from the pre digester is in the form of liquid manure. Another byproduct is the biogas discharged from ADs after-treatment process. A part of this treated liquid is reused in the next day's operation of the plant to replace the use of freshwater, through a specially designed slurry loop system reducing the need for excess water usage.

A pre-digester unit usually is designed with 3 pre-digesters components with 500-1000 kgs capacity (*capacity in actuals to change on the basis of site survey and requirement*) each at every location. The liquid fertilizer produced will be 50 per cent of the quantity deposited i.e. if at full capacity, there will be 500 litres of fertilizer as the output. Due to the slurry loop system, the quantity of fresh water used per batch is not more than 100-300 litres. Each batch takes about 30 days to convert into manure.

Ownership Model: The pre-digester could be owned by the FPO or the Madanapalle APMC. The operational aspects could be handled by APMAS as well as designing the service model, creating awareness and mobilizing farmers. The farmers could allocate a small part of their land for utilization of this bio-fertilizer and cutting out chemical fertilizers for that particular parcel of land. Farmers could start paying a small fee when procuring the bio-fertilizer. When the farmers visit the mandi, they can deposit the waste and in turn collect the compost.

Business case:

An initial analysis from the data gathered on the field predicts decrease of fertilizer use and input cost spent in fertilizers. The goal of this solution is to let farmers gradually transition to organic farming, thus increasing productivity, nourishing soil health and adding value to the yield.

Pilot:

As a pilot, a pre-digester unit (3 nos) in the Madenapalle market in a controlled manner is proposed to be tested for a time period of three months.

Perceived impact:

The pre-digesters will convert the waste into compost which then can be used by farmers. They will also prevent stubble burning as it can be used in the biodigester to convert into manure in order to reduce carbon emissions. If the farmers convert even 10 per cent of their land to organic farming practices by applying this bio-fertilizer, it will be highly impactful. Thus, a gradual shift to use decentrally made compost can reduce the chemical fertilizer use, decreasing salinization of groundwater, increasing yield and soil health as well. This could act as a decentralized circular economy model in the coming future in the context of agriculture. To assess the number of farmers who would utilize this service, a detailed need assessment will have to be conducted based on which a service delivery model will have to be designed with equal number of trainings and awareness building activities conducted by the on-ground staff.

Identification of Potential Policies/Schemes for any Loans or Subsidies

- ❖ Mandi finance committee (APMC) special schemes can be mapped and explored. The APMC can write proposals to Rural Infrastructure Development Fund (RIDF), NABARD for fund allocation. Biotech Renewable Energy has an MoU signed with NIRD in order to ease implementations and utilizing subsidies. The APMC or FPO could write a proposal to NIRD requesting for installation and fund disbursement. NIRD will contact Biotech who will conduct the assessment and take on the implementation.
- ❖ National Agriculture Development Programme/Rashtriya Krishi Vikas Yojana (RKVY) - RKVY Funds will be made available to the States in two installments of 50 per cent each. Eligibility & Inter-State allocation criteria will not be applied for providing funds under the sub-schemes of RKVY or RKVY Special schemes. State Governments will also determine sectoral classification for investment requirements for infrastructure in public, public-private and private sectors and accordingly work out financial support for funding gaps in infrastructure taking into account viability gap which would be based on financial analysis. However, in any case, subsidy will be capped to 25 per cent of total project cost.
- ❖ Chief minister self employment scheme (CMEGP) - Under CMEGP scheme, Government provides a subsidy on loan for the rural entrepreneurs to start a new business. The Karnataka Government implements this scheme in consultation with District Officers of Karnataka Khadi and Village Industries Board (KVIB) and Joint Director of Department of Industries and Commerce (DIC). Working Capital at least once should touch 100 per cent limit of Cash Credit within three years of Lock-in period of M.M. and not less than 75 per cent of the utilisation of the sanctioned limit on an average. The lock period for Government Subsidy is three years.
- ❖ Scheme on Development of Commercial Horticulture through Production and Post Harvest Management of Horticulture Crops (NHB) - Integrated Post Harvest Management Projects e.g. Pack House, Ripening Chamber, Reefer Van, Retail Outlets, Pre-cooling units etc. Credit linked back ended subsidy @ 35 per cent of cost limited to Rs.50.75 lakh per project in general areas and @ 50 per cent of project cost limited to Rs. 72.50 lakh per project in NE, Hilly States for subsidy on the pattern of HMNEH States and scheduled Areas, ensuring backward and forward linkages.
- ❖ The FPO can approach the Horticulture Department for Subsidy Schemes to unlock funds.

Solution 5: Solar Powered Sprayers

Need identified:

Tomato farmers in the Chittoor district belt use a lot of pesticides. Over the last two years itself, their input costs have risen by 40% per cent every cycle due to increased pesticide usage. The pest commonly known as *oozi* affects tomato crops right from the initial stages of cropping leading to nursery farmers and tomato crop farmers having to use pesticides and fertilizers from the start. During the harvesting period is when the no of sprays are at a maximum. They apply fertilizers 2-3 times in a crop cycle and close to 10 times every season which is either done manually by labourers using petrol sprayers or by diesel powered tractors by large scale farmers.

Description:

Spraying pesticides and fertilizers is a very critical component of the farming cycle. Presently, a lot of farmers fill drums with 200 litre capacity with pesticides and use a pump based system to sprinkle pesticides which are highly inconvenient and time consuming. The FPOs have been wanting to move to a portable model to save time and increase mobility.

Market Research:

Parameters	Model 1	Model 2	Model 3
Make	Aspee	PAD Corp	Shambhavi
Model	AELP001/8AHBR	High pressure blow gun sprayer + Manual	SPS-12
Product Price	5000	8000	8000
Solar price (approx.)	25000	30000	45000
Tank capacity	16 litres(+/- 500 ml)	16 litres (+/- 500 ml)	
Battery	8AH,12V	12 Ah,12V	12Ah,12V(SMF)
Charging time	08:30Hrs(10V-13.2V)	10Hrs(11.2V to 13.3V)	9Hrs
Run time	04:30Hrs(12.7Vto11.2V)	04:00Hrs(12.8V to 11.2V)	3:30Hrs
Pump (As per company standards)	Maximum 80 psi		15psi
Charger	Input 220V AC, 50Hz,Output 12VDC,1A	Input 220V AC,50Hz,Output 12VDC,1.7A	Input 220V AC, 50Hz,Output 12VDC,1.7A
Power consumption for Charging	13W	22W	22.5W
Weight of equipment with battery	4.86kg(Approx.)without water	5Kg(Approx. without water)	2.5Kgs(Approx)
Type	Sprayer	Sprayer+Blower+Manual	Sprayer
Liters/min			Rated open flow 8-10 LPM

Proposed solution:

To reduce the carbon footprint and costs expended on petrol and diesel, solar powered sprayers could be a very effective solution. A rental model is being proposed where each unit can have 5 sprayers being charged by the same solar design. They can be charged at the same time and farmers could use them on a rental basis which will work for 6 hours.

This same model has been implemented with Harsha Trust run FPOs in Odisha. Marginal farmers who grow variety of horticultural produce rent the sprayers and use them in a rotational model.

Ownership:

The sprayers could be FPO owned and utilized by farmers. The servicing and maintenance will also be undertaken by the FPOs itself. The FPOs have 3 Farmer Development Centres, 8 mandal offices and 1 office at the Madanapalle mandi which could host the sprayer units as the farmers visit these centres very regularly and are situated at convenient locations. When being scaled, they could be hosted at the panchayat level as well.

Pilots: A unit each in the 3 FDCs across 8 mandals of APMAS could be the initial pilots. A few willing farmers who do not have high capital to invest in tractor based spraying should be selected to utilize these services. A collection model and appropriate fees for utilization to be set which is affordable for the farmers, ideally the amount that is offset by the cutting off of petrol and diesel expenses.

Perceived impact:

The solution being ergonomically friendly would reduce the time taken for spraying fertilizers and increase mobility for the farmers as well. These sprayers could also be used by the farmers to apply liquid bio-fertilizers which can be procured from the market or the pre-digester which has been recommended above. The costs incurred on petrol and diesel will be reduced as well as the carbon footprint it carries. Each spraying unit could impact 20 farmers each and if each office has one unit, the solution could impact 240 farmers.

Solution 6 - Submersible Water Pumps for Potato Farms

Need identified:

Potato farmers in Hassan deal with fluctuating grid electricity. They receive 4-6 hours of electricity daily under the Nirantar Jyothi scheme. But, the inconsistent timings week on week hampers their irrigation practice as farmers sometimes need to awaken at 4 AM to irrigate which disrupts their routines not allowing them autonomy. In case of heavy fluctuation, the farmers have lost their irrigation pump transformers. Dependency on irregular electricity makes the farmers irrigate excessively, resulting in yield loss and soil nutrition loss. Farmers have set aside water bodies for ground water recharging, which has proven useful in summer as the water levels have never drastically reduced. Decentralised Renewable Energy based submersible water pumps will provide reliable access of water to the farmers and complete autonomy allowing them time to dedicate to other activities.

Description:

The solar powered submersible pumps could be installed using the existing borewell systems which all farmers have on-farm. The farmers could irrigate their crops at whatever time they prefer and in required quantities only. There will also be reduction in over-irrigation due to fear of power cuts will cease. Some level of basic training and awareness building will be conducted by the system integrators in support with the FPO staff.

Market research:

AC Submersible Solar Pumps- 3 HP					
Make	Shakti Pumps	Rotosol Solar	Amruth Solar Pumps	TATA Solar Power	MEC Solar Pumps
Model	SSP3000-50-19	RA030H030	3 HP V6	Saavan3000BACM 050- 3 HP	MEC-3HP V6
Solar Panel Capacity (Array)	3KW	3KW	3KW	3KW	3KW
Capacity	3 HP, 230V, 3 Phase	3 HP, 120-290V	3 HP, 120-290V	3 HP, 120-290V	3 HP, 120-290V
Type of pump	AC Submersible Pump	AC Submersible	AC Submersible	AC Submersible	AC Submersible
Rated Dynamic Head in meter	50	50	50	50	50
*Discharge per day (Avg sunshine: 7.15kwh/sq.m)	65000 liters	58000	62000	57000	57000
AC Submersible Solar Pumps- 5 HP					
Make	Shakti Pumps	Rotosol Solar	Amruth Solar Pumps	TATA Solar Power	MEC Solar Pumps
Model	SSP5000-50-19	RA050H050	5 HP V6	Saavan4800BACM 050- 5 HP	MEC-5HP V6
Solar Panel Capacity (Array)	4.8KW	4.8KW	4.8KW	4.8KW	4.8KW
Capacity	5 HP, 380V, 3 Phase	3 HP, 380V			
Type of pump	AC Submersible Pump	AC Submersible Pump	AC Submersible Pump	AC Submersible Pump	AC Submersible
Rated Dynamic Head in meter	50	50	50	50	50
*Discharge per day (Avg: 7.15kwh/sq.m) Approx	135000 liters	135000 liters	115000	91000	91000

Proposed solution:

Shakti pumps have been benchmarked as the appropriate solution based on the need of the potato farmers in Hassan, Karnataka. Detailed need assessments will have to be conducted at each farm before implementation to assess which pump would be best suited for them. Based on the land holding, ground water table level, the 3 HP with a 3 KW solar capacity or the 5 HP with a 4.8 KW solar capacity submersible pump would be recommended.

Ownership model:

An individual farmer can own one pump or two adjacent farmers can share and own one pump. AFC can provide the required capacity building for the farmers. AFC can help the Farmer Study Groups for communication of importance of Decentralized Renewable Energy and replicating adapting the same model by other farmers.

Technical specifications:

Sl. no.	HP	Water Head (meter)	Discharge (LPD)	Suitable watt power required	Panel side DC	Voltage Motor Voltage-3Ph, AC
1	0.5	25	15,000	600	100-350 Vdc	110 Vac
2	1	35	30,000	1200		
3	1.5	40	30,000	1500		160 Vac
4	2	60	30,000	2000		
5	3	100	35,000	3000	150-400 Vdc	230 Vac
6	5	50	125000	4800	300-680 Vdc	
7	5	100	50000	4800		380 Vac
8	7.5	100	100000	7500		
9	10	100	85000	9600		

Business case:

An initial understanding of the business case shows decrease of losses farmers face during grid electricity fluctuation or excess irrigation.

Pilot:

AFC could select 2 farmers per taluka of their willing innovation farmers who are representative of the Farmer Study Groups from Hassan district. A total of 8 farmers could be piloted with, monitored with regular feedback being gathered and analysed. If successful, awareness building through study group sessions could enable more farmers to switch to decentralised renewable energy based pumps.

Perceived impact:

The solar based submersible water pumps will replace the grid based unreliable and inconsistent electricity. This will reduce the carbon emissions as well increase the capacity of farmers to practice agriculture in a way that adequate irrigation is practiced which will not affect the yield. Economic loss can be avoided for every cycle, particularly summer months. The on ground FPOs in Karnataka work with 2000-2500 farmers out of which if even the innovation farmers from their localized groups take up these pumps, 100 farmers will be impacted.

Identification of Potential Policies/Schemes for any Loans or Subsidies:

- ❖ Collective purchase schemes through NABARD
- ❖ Agriculture and horticulture department schemes both state and centre to be mapped
- ❖ KUSUM scheme: Component B - Under this Component, individual farmers will be supported to install standalone solar Agriculture pumps of capacity up to 7.5 HP for replacement of existing diesel Agriculture pumps / irrigation systems in off-grid areas, where grid supply is not available. Pumps of capacity higher than 7.5 HP can also be installed, however, the financial support will be limited to 7.5 HP capacity.
- ❖ Agricultural loans from public and private sector banks

Solution 7 - Seed Potato Solar Powered Cold Storage

Need identified:

Seed potatoes are imported by the farmers from Punjab (2600 kms of transportation), or they are procured from local traders. It costs Rs. 4 - 4.5 per bag of seed potatoes, and can go up till Rs. 8 - 9 during high fluctuation. The farmers who procure it from Punjab, check on the quality and reduce input cost as that cuts out the middleman. Traders procure from Punjab too, but they store it in massive cold storages in Karnataka. There lies an excessive carbon cost to these seed potatoes. One truck for direct procurement can cost upto 1 lakh INR which is borne by the farmers. The on-ground NGO and their FPOs have formed FSGs (Farmer Study Groups) who have identified the need for seed potato production in Hassan, as potato is a culturally important crop and is grown year round. Seed potatoes have to be stored for 6-8 months in 2-3 degrees Celsius temperature to be used for the next season.

Description: Based on the project by the NGO and FPOs, the plan is to have one innovation farmer per farmer study group cultivating seed potatoes of upto 1 metric ton each. Cold storage is imperative for seed potatoes which can be set up at convenient locations at the farm/panchayat level. Transportation for the seed potatoes to the cold storage will have to be established. However, the costs incurred by the farmer for transporting seed potatoes from Punjab will be offset, a small part of which can be utilized for local transport.

Market Research:

Parameters	Ecozen	Inficold	Pluss Advanced Technology
External dimensions (L x W x H)	40ft. x 8 ft. x 8 ft.	40 ft x 8 ft x 9.5ft.	40 ft. x 8 ft. x 8 ft
Internal / Storage Volume	1520 cu. ft	1870 cu.ft	1520 cu. ft
Cold room insulation	100mm PUF* panel with PPGI lined sheets	100 mm PUF panel (container based on refurbished ISO high-cube container)	100 mm PUF panel with Stainless steel exterior
Storage capacity	10 MT	10MT	10 MT
Pre-cooling capacity	0.5 MT	2 MT (daily) 4 MT (occasional)	-
Temperature range	4-10 °C (using setpoint control)	4 - 15 °C	2 - 8 °C
Minimum possible temperature	3.5 °C	3 °C	2 °C
Humidity range	65-95% (using setpoint control)	80-95%	65 –90%
Inbuilt Thermal backup	Yes	Yes	Yes
Refrigeration TR	~4.5	~4.5	~6
Thermal Backup	PCM plates (wall mounted).	Uses Ice as a thermal storage medium	PCM lined on walls
Backup duration	24-30 hours (non-door opening & 5.5 kWh/m2/day)	200 MJ 18 – 24 hours	

Loading rate	10-15% of total capacity (1000-1500 kg of produce per day)	2000 kg per day	
Door opening	20-30 minutes in a day	8 openings per day for 30 sec	
Remote monitoring	Yes	Yes	Yes
Source of energy	Hybridization - Solar based system, runs on grid supply too	Hybridization - Solar based system, runs on grid supply too	Local grid- 1-phase, 230 V connection or Solar based system
Solar array capacity	5 kWp	7.6 kWp	9 kW
Auxiliary battery	100Ah, 24 V	200 Ah, 48 V	-
Alternative power source	Diesel generator –5 kVA, Single phase Grid –5 kVA, Single-phase or three-phase	1 - ph / 3 -ph Grid	-
Warranty	1 year	1 year	1 year
AMC per year	Rs. 30,000/-	Rs.30,000/-	
Services provided per year	As requested	4 Service	
Delivery duration	45 days	45 days	30 days
Total cost (Cold storage + Solar system)	Rs. 16,48,000/- (Excluding GST & transportation)	Rs. 17,77,000/- (Including taxes and logistics)	Rs. 31,21,960/- (Including GST and transportation cost)

*PUF - Poly Urethane Foam

Proposed Solution:

InfiCold India Pvt Limited's cold storage is the benchmarked solution based on the needs of the farmers. As in terms of technology, InfiCold cold storage is designed to provide cooling via thermal storage through a traditional evaporator which provides precise temperature control whereas, Ecozen & Pluss is designed to provide cooling via phase change material lined walls results in low-temperature control. For InfiCold Cold Storage, the thermal storage is kept outside the cold room whereas for Ecozen & pluss the phase material lined walls placed inside the cold room which results in water dripping & poor temperature control. The InfiCold solution is the most suitable to take care of the specific need of the site (Cold Storage + Thermal Backup + Solar). At the same time the cost of the entire solution is expected to be the least of the others.

Ownership model:

Ownership can be taken up by FPOs for their farmer clusters, or FSGs (15 farmers). FPOs can help in subsidizing the storages. A collection model can be designed based on the willingness of the farmers and the cost of which can be utilized from the savings from Punjab transportation costs.

Business Case:

An initial analysis for a business case shows the transition of farmers in Hassan district farming seed potatoes. Introduction of cold chain *enables* farmers to use locally grown seed potatoes hence cutting down the transportation cost completely.

Pilot:

As a pilot, three machines for one FSG (15 farmers in one Farmer Study Group) in a controlled manner is proposed to be tested.

Perceived impact:

Seed potato storage for FSGs can help encourage a decentralized supply chain system for input procurement and production. This will reduce the carbon footprint and the input cost exponentially for the farmers. If the program is scaled to its projection of 80-100 farmers taking up seed potato farming, 8 solar powered cold storages would be required which could meet the seed potato needs of 160 farmers.

Identification of Potential Policies/Schemes for any Loans or Subsidies

- ❖ Scheme of Cold Chain, Value Addition and Preservation Infrastructure (MOFPI) - For storage infrastructure including Pack House and Pre cooling unit, ripening chamber and transport infrastructure, grant-in-aid at 35 per cent for General Areas and at 50% for North East States, Himalayan States, ITDP Areas & Islands, of the total cost of plant & machinery and technical civil works will be provided
- ❖ The Government has developed a number of schemes to encourage cold storages and warehousing in India through various tax exemptions and subsidies. Government institutions like the National Horticulture Board (NHB), National Horticulture Mission (NHM), Agricultural and Processed Food Products Export Development Authority (APEDA), Ministry of Food Processing Industry (MoFPI), Mission for Integrated Development of Horticulture (MIDH) and Department of Agriculture and Cooperation currently operate in the cold storage sector.
- ❖ Small Farmer Agri-Business Consortium (SFAC) - Assistance. Setting up of cold storage as a part of an integrated value chain project is eligible for subsidy, provided the cold storage component is not more than 75 per cent of Total Financial Outlay (TFO).
- ❖ National Agriculture Development Programme/Rashtriya Krishi Vikas Yojana (RKVY) - RKVY Funds will be made available to the States in two installments of 50 per cent each. Eligibility & Inter-State allocation criteria will not be applied for providing funds under the sub-schemes of RKVY or RKVY Special schemes. State Governments will also determine sectoral classification for investment requirements for infrastructure in public, public-private and private sectors and accordingly work out financial support for funding gaps in infrastructure taking into account viability gap which would be based on financial analysis. However, in any case, subsidy will be capped to 25 per cent of total project cost.
- ❖ The Horticulture department has 90 per cent subsidies for Cold Chain implementation under certain schemes to promote the cold chain sector.

ANNEXURE B

PRIMARY DATA SOURCES

TOMATO VALUE CHAIN

ON GROUND NGO: APMAS, CHITTOOR DISTRICT, ANDHRA PRADESH

- Tomato Farmers
- Tomato Nursery Farmers
- APMAS project leads
- APMAS FPO heads
- Green Agents / Rayta Mitras from APMAS
- Commission agents in the Madanapalle APMC
- Farm Labourers

POTATO VALUE CHAIN

ON GROUND NGO: AFC, HASSAN DISTRICT, KARNATAKA

- **Potato farmers**
- **FPO heads and staff**
- **AFC project leads**
- **Cold Storage owner**
- **Processing unit owner and workers**
- **Farm labourers**



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