This report assesses the scalability of Development Marketplace Project 4893, “Waste to Wealth by Incubating Mini Cold Storage Technology Ventures in India.” The Project seeks to reduce substantial post-harvest waste of vegetables in India by giving small farmers access to cold storage units suited to the needs of small producers. Two years of implementation demonstrates a small farmer demand for using the Mini Cold Storage Units (MCSUs), reduction in waste and increased income for small farmers. Rural and semi-urban youth have been trained in MCSU maintenance and management. The Government of Tamil Nadu is replicating the MCSUs in other farmers’ markets in the state and has agreed to subsidize electricity costs. The implementing agency, Tiruchirappalli Regional Engineering College – Science and Technology Entrepreneurs Park (TREC-STEP), has developed a financial model predicting sustainability of MCSUs as viable businesses operated by youth entrepreneurs. The project ends before the Public Private Partnership model with youth entrepreneurship model is proven, and before steps have been taken for replication in other states in India. The report makes recommendations for intermediary actions to assure that the demonstration project fulfills its potential for reducing vegetable waste in markets, for benefiting small farmers, and for fostering viable enterprises run by youth.
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Abbreviations

ARD  Agriculture Rural Development (The World Bank)
BHEL  Bharat Heavy Electrical Limited
DM  Development Marketplace (The World Bank)
EU  European Union
ICRISAT  International Crops Research Institute for the Semi Arid Tropics
IDRC  International Development Research Center - Canada
MCSU  Mini-Cold Storage Unit
MDG  Millennium Development Goals
MRC  Mother Resource Centre
PPP  Public Private Partnership
TN  Tamil Nadu – Southern State in India
TREC-STEP  Tiruchirappalli Regional Engineering College – Science and Technology Entrepreneurs Park
UNDP  United Nations Development Programme
UNIDO  United Nations Industrial Development Corporation
Executive Summary

Case Study:
Waste to Wealth by Incubating Mini Cold Storage Technology Ventures in India

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October 2011

World Bank Development Marketplace Project Number 4893
Implementing Organization: Tiruchirappalli Regional Engineering College – Science and Technology Entrepreneurs Park (TREC-STEP) Tamil Nadu
Supported by the World Bank Development Marketplace and the Agriculture and Rural Development Department.

Introduction

“The Waste to Wealth by Incubating Mini Cold Storage Technology Ventures” project funded by the Development Marketplace has demonstrated the potential to substantially reduce post-harvest vegetable waste and to increase farmer incomes by 9 to 31% by enabling small farmer access to Mini Cold Storage Units (MCSUs) especially designed to meet the needs of small farmers. The project has tested but not yet proved a Public Private Partnership (PPP) model of a delivery system, which relies on youth entrepreneurs to manage the MCSUs. The youth entrepreneurs have been trained, and they are managing and maintaining the MCSUs in the five demonstration markets. What have not yet been demonstrated are the viability of the business plan and the ability of the youth to move from a management to an entrepreneur role. The ending of Development Marketplace funding closes out the capacity of TREC-STEP, the implementing agency, to support the transition of this demonstration to the scaling up stage. The potential of this innovation to benefit small farmers and to contribute to local and national food security is at risk. The lack of transition planning and funding may make an orphan of a promising innovation.

The challenges of rural poverty and malnutrition persist in an India that is becoming a global economic power. India has the potential for increasing agricultural and food production. Sixty percent of India’s population depends on agriculture for livelihoods, and the majority of people living in poverty are in rural areas. While the growth of national GDP has increased to 9% in recent years, growth of the rural sector has been slower (4.7%) in
the same period. Agricultural productivity is low, and post harvest loss is high. TREC-STEP, the implementing agency, notes that a high percentage of land in India is cultivatable and that India annually produces 63.5 tons of fruit and 125.9 tons of vegetables, of which about 40% is lost due to the insufficiency of cold storage facilities. Existing cold stores, they estimate, meet only 11% of the need and serve only single commodities (e.g. potatoes) and large commercial farmers. Small farmers, who represent the population living in poverty, lack access to cold stores and thus lose a substantial portion of the value of production to rotting. Overall, post-harvest waste of fruits and vegetables in India is estimated at 40% of the total value.

The theory of change represented by the innovations in this project has two tracks. First, by making appropriate cold storage available to small farmers at state-run farmers’ markets, the project expects to see a decrease in post-harvest waste, resulting in increased sales and incomes for the small farmers. The internal TREC-STEP evaluation suggests initial increases in income of 9 to 31%. Increased income was verified by visits to small farmers participating in two of the markets. Increased income, the theory of change suggests, can be applied to a small fee for the cold storage as well as to investment into improved production and/or family well-being. This part of the theory has not yet been demonstrated, except through anecdotal evidence of the willingness of farmers to pay for the cold storage.

The second track of this project envisions the emergence of a viable business model for operation of the MCSUs, run by youth entrepreneurs who have been trained by the project in MCSU maintenance, repair and management. The project has demonstrated that the trained youth can manage the MCSUs, working with the managers of the farmers’ markets. The project has not yet had time to demonstrate the viability of the business model for a self-standing MCSU enterprise.

The assessment of scalability indicates that the project matches well against many criteria for scalability. The innovations are clear and credible. The implementing agency, TREC-STEP, which designed the MCSUs, is a highly respected agency with a successful track record in incubating other (mostly private sector) innovations in India. There is demand for the cold storage. Despite some initial fears on the part of farmers that the cold stores would damage produce, usage of the cold stores is up to 70% of capacity. Interviews indicate that providing access to appropriate cold storage for small farmers has been well-received by most stakeholders. The Government of Tamil Nadu is supportive, underwriting costs of energy and adopting a similar technology in other farmers’ markets. There has been interest in the MCSUs from other states in India, and from outside the country. The results (decreasing wastage and increasing small farmer income) also align well with Government of India priorities around reducing rural poverty, increasing agricultural productivity and access of small farmers to increased income through markets.

1 World Bank, Country Strategy 2009-2012

2 TREC-STEP, Evaluation Report, Mini Cold Storage Unit Project for Small Farmers, October 2011
Challenges to scaling up this innovation lie primarily in lack of clarity around 1) which agency will drive expansion of the innovation in Tamil Nadu and replication in the rest of India and 2) who will serve as a champion for the innovations to make sure that they get priority attention. The Development Marketplace funding ends without a clear designation of which agency in Tamil Nadu will take the lead in expanding MCSUs and which agency in the national government might take the lead in implementing MCSUs at farmers’ markets. TREC-STEP is highly qualified to accompany and advise on the expansion and replication, but they are not funded to play this role on a large state or national level.

The ending of the two year project also leaves unanswered other questions critical to understanding the potential for scaling up. TREC-STEP has developed a business model that predicts that the MCSU can become a viable commercial enterprise, covering its capital and operating costs within a year or two. This business model depends on some critical untested assumptions and it has not yet been demonstrated. Demonstrating that the business model does work (or not) is critical to the sustainability of the MCSU innovation and the Public Private Partnership model of implementation. Development Marketplace funding ends before this question is answered.

As with many innovations, it is difficult to measure the results within the limits of the two-year project implementation period. The income, family well-being and poverty reduction effects take a longer period to materialize.

This assessment concludes that the MCSU innovation has high promise for scaling up because of the contribution it makes to reducing post-harvest wastage and increasing incomes of small farmers. The PPP model of youth entrepreneurs also addresses the issue of youth employment opportunities that is worth monitoring to see if it works and can be replicated. The assessment recommends;

- That the World Bank and/or Governments in India use their convening power to pull together key stakeholders in this innovation to develop strategic recommendations for expanding or replicating the innovation. Recommendations from such a convening should identify and authorize key actors to drive the scaling up. The conveners may act as continuing champions of the approach.
- That the World Bank and the Government of India seek ways to incorporate the MCSU approach in ongoing projects as appropriate.
- That the World Bank and TREC-STEP together consider ways to conduct a local, independent evaluation of the income effects of the MCSUs over time and of the viability of the PPP business plan.
Introduction

1. Rationale for the Project and the purpose for the case study:

With a potential to be one of the world’s major food suppliers, India currently has an annual transaction of 230 million metric tons of perishable products. Yet it loses 40% value of perishable products due to insufficient cold storage facilities. The post-harvest vegetable waste in farmers’ and vegetable markets across India amounts to an estimated annual loss of nearly $6 billion. In a country with high rates of poverty, where 224.6 million people are undernourished, and with a growing population there is an urgent need to increase the food supply and reduce such sizeable post-harvest wastage. The constant warm weather causes produce to rot rapidly both at the farm and at the market level. On average, vegetables lose 25% to 40% of their value daily, with at least 10% of the loss in value occurring in farmers’ markets alone. Large agri-business use cold storage units to reduce waste, but such units are neither appropriate in design nor accessible to small scale farmers. The technological innovation of Mini Cold Storage Unit (MCSU) in this Project, with controlled humidity and efficient space usage, offers a solution suited to small farmers, allowing them to access refrigeration and increase the shelf life of their produce. The Project promised and delivered on helping small farmers keep their vegetables fresh for two to three days and bring down the wastage by 50%. Since March of 2011 the Project has installed coolers in five farmers’ markets across the State of Tamil Nadu, already

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generating savings that are estimated to reach $200,000 annually from reduction in post-harvest wastage in these five markets alone.

The Project also aimed to create a strong public private partnership (PPP) among the government, the private sector and civil society to create a sustainable and self-financing market-focused model that could be scaled up in the region, in the country and around the world to deliver real value to small farmers.

The case study was undertaken to understand the potential for scaling up this Project, with product and process innovations and its ability to link small farmers to input-output markets. The promise of reducing the vegetable wastage and increasing the financial benefit to small farmers was one of the key factors that led to the case study. An additional rationale for the case study was to assess the Public Private Partnership model that is part of the project innovation. As designed by TREC-STEP, the Development Marketplace Project proposed to train rural youth in management and maintenance of the MSCUs, with the expectation that they would become small entrepreneurs and sustain the cold stores on a commercial basis.

The site visit in August assessed the potential for scaling up (expanding) this project in Tamil Nadu and for replication in other states in India or elsewhere globally. In doing so it looked at whether the innovations in the project were working as planned, whether the MCSUs have prospects for sustainability and whether the conditions for scaling up exist.

2. **Country context**

In the past two decades India has gone through substantial shifts in macroeconomic policies and has experienced good rates of economic growth. India has emerged as the fourth largest economy globally\(^5\), in terms of its purchasing power. GDP growth rates, averaging 8 to 9% per year, have brought significant economic and social benefits to some of the population, yet 37% of the population falls below poverty line. Disparities between rich and poor are rising. About 70% of India's 1.2 billion people live in the rural areas, about 42% of whom are below the poverty line. The rural population relies on agriculture-oriented activities. Despite achieving self-sufficiency in food-grains, India has seen a slowdown in agricultural growth rate in the 1990s and 2000s, posing a serious concern about food security. The country needs to raise agriculture productivity (through new technologies, diversification to higher value crops, and developing value chains to reduce marketing costs), increase rural employment and ensure food security for the burgeoning population. India is considered a global agricultural powerhouse leading in the production of milk, pulses and spices and is the second largest producer of the fruits and vegetables in the world. Despite being the second largest producer of fruits and vegetables in the world, India has a higher than average post harvest loss estimated at 35-40%.\(^6\)

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\(^5\) WB India Country Results Profile

post-harvest waste arise from multiple reasons, but specifically exposure to heat and humidity, the impact of which can be addressed by appropriate cold storage. Large cold storage facilities in the country primarily service large agri-business and are out of reach and inappropriate for the small farmers, the weakest link in the value chain.

**State of Tamil Nadu background:** Tamil Nadu is the eleventh largest state in India with nearly 62 million people. As in the rest of the country, 70% people live in the rural areas and rely on agriculture-oriented activities. Vegetable cultivation in the state accounts for 234,000 metric tons every year. The State Government has established 160 farmers’ markets across the State in more than 100 towns and cities. The farmers’ markets offer direct market access to consumers without a middleman, free space, free transportation and controlled prices, benefitting both farmers and consumers. In these 160 markets, about 12,000 to 15,000 farmers sell vegetables to approximately 400,000 to 500,000 consumers everyday, selling $260 million worth of vegetables annually. The lack of refrigeration facilities in most vegetable markets cause a huge wastage, losses estimated at $25 million to $50 million annually. The State Government is deeply concerned about these losses. After the initial design of the MCSU was presented, the government enthusiastically accepted the idea of the Mini Cold Storage Unit and had installed less efficient and simpler cold storage units in 22 markets even before the Project began. Now, seeing the positive impact of the Project, the Government has shown interest in expanding its reach beyond the five markets of the current Project, using the better designed MCSUs. It is unclear if there will be a change in the agriculture policy after the recent shift from the Karunanidhi government to the new government of Jayalalitha.

3. **Government of India and the World Bank priorities in India**

The Project, assessed for scalability in this report, is aligned with the Government of India and World Bank development priorities, especially in the areas of improved farmer access to agricultural/vegetable markets, increased skills and employability for the rural youth, reduced food wastage, increased food security and income for small farmers, and a sustainable economic model through public-private partnerships.

While the country has seen the unprecedented growth in the last decade and met many of the Millennium Development Goals, India is also facing serious challenges, especially in its high poverty rate in the rural areas (42%) and slower agriculture growth of 3.5% per annum, below the target of 4% in the 11th plan. In its 11th Five Year Plan, the Government of India has made a commitment to reinvest resources into a set of ambitious programs to deliver services to the poor by focusing on elementary education, basic health care, agriculture productivity, rural employment and other infrastructure services.

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7 TREC-STEP, India (2008), DM#4893, Full Proposal Package
8 TREC-STEP, India (2008), DM#4893, Full Proposal Package
9 WB – India: Issues and Priorities for Agriculture
The World Bank program in India is closely aligned with the objectives outlined in the country’s Eleventh Plan. The Country Strategy for India for FY 2009-2012 concentrates on 1) Maintaining rapid and inclusive growth by investing in infrastructure, skill building for rural and informal workforce, agricultural growth, sustainable development practices and increasing the effectiveness of service delivery, 2) Investing in the low-income states, such as, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh, by helping them become attractive investment destinations and raise the standard of living through better public service delivery, 3) Supporting Agriculture and Rural Development with a focus on agriculture and livestock, watershed management and rural livelihood development, and 4) Increasing the effectiveness of service delivery by supporting programs that provide education, health, skills and safety nets.

Critical Criteria for Scalability
Innovation and the theory of change - promise and problems

1. **Key elements of the innovation**

The innovations in this Project are at the product and the process level. The product is an innovative form of mini cold storage unit geared towards the needs of small farmers. The service delivery method is a form of **public-private partnership**, where the State Government and a nonprofit at the regional technical college collaborate to support the emergence of youth entrepreneurs who can sustainably operate the cold storage units and deliver services to small farmers.

**Innovation in Product**: Cold Storage Units (CSU) currently exist throughout the country for large agro-industrial needs. Even though subsidized by Government, these facilities are both too costly and physically inaccessible for the vast majority of small farmers. The presently existing 5,316 cold storage facilities across the state serve only 13% of the agro-industry. TREC-STEP estimates the value loss due to lack of cold storage for small farmers to be around 20 to 40% of produce value, translating to $300,000 to $400,000 annually for the five markets in this Project alone. While the Government has made some attempts to create smaller storage units for farmers, these efforts were limited to air conditioned rooms (10’ x 10’ in a larger room of 24’x24’), which were rarely used because of inadequate and faulty technology and which did little to reduce spoilage losses. The innovation in this Project is a Mini Cold Storage Unit (MCSU) with an innovative design that offers differentiated temperature and humidity controls for different varieties of vegetables and fruits. The new product, MCSU, designed by TREC-STEP, is specifically geared toward the needs of small farmers and vegetable vendors. The MCSU is divided into two main chambers that allow for customized temperature zones needed to maintain freshness for different types of vegetables. When only one chamber is in use, the other one can be turned off, resulting in energy savings. Plastic crates are available for each farmer, with traceability and identification options. Each farmer can use flexible partitions to suit his/her daily needs. After the installation of first two units last year, more design modification in terms of larger size of the unit and eco-friendly construction materials are incorporated for all the units. The MCSUs are managed by rural youth, who have been trained in MCSU.

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10 TREC-STEP Power Point presentation to the Case Study team, Aug 16, 2011
management and maintenance by TRECT-STEP. The youth also guard against theft and pilferage, a serious concern for the farmers. For additional security, farmers use locks to secure their section of the cooler. The MCSUs fill a gap in the marketplace for small farmers who cannot afford the use of an individually owned refrigerator and lack access to large scale cooling units. The new design of MCSU prevents loss in value in the supply chain at its weakest link, the small farmers, who can least afford the loss in the value of their produce.

Innovation in Process: The public sector, in this case the State Government of Tamil Nadu, and the nonprofit implementing agency, TREC-STEP, partnered to enable small youth entrepreneurs to deliver cooling services to small farmers. TREC-STEP created the Mother Resource Centre (MRC) to provide MCSU design, installation, and service support; to recruit and train unemployed rural and semi-urban youth in technical and business skills; and to monitor the overall business performance. Rural youth entrepreneurs, trained by TREC-STEP, are responsible for daily operations, supervising the security and daily record-keeping of vegetable arrival, sales and storage, and repairing the units as needed. They work in partnership with the managers of the five farmers’ markets on a range of issues. Since the State Government owns a large number (160) of farmers markets, including the five targeted by this project, the managers are government employees. In addition to offering the space and services to the small farmers, the Government of Tamil Nadu also covers the monthly cost of the electricity - $250 per market, a large portion of the operating cost needed to operate the MCSUs.

The Theory of Change: This Project offers a critical intervention at the market level that has the dual purpose of improving farmers’ income and engagement in the market and addressing the broader national issue of food security, by reducing the estimated food wastage of 25-40% daily ($6 billion dollars annually across the country). The theory is that a key technological innovation and novel service delivery method will have sufficient net benefits to engage farmers, government and trained rural entrepreneurs to run the venture and make it into a viable, self-sustaining business. Critical to the theory are assumptions:

- that the MCSU will substantially reduce vegetable wastage by 50% or more;
- that farmers will use the cold stores in increasing numbers;
- that farmers will see an increase in income as a result of reduction in daily vegetable waste;
- that farmers will, over time, be willing to pay (up to one rupee per kilogram stored) for the use of the MCSU;
- that fees generated from farmers will over time to be able to cover costs of operation and the capital cost of the units themselves;
- that the youth trained will be able to manage operationally and financially the MCSU as a sustainable enterprise; and
- that the State Government will continue to subsidize electricity costs and will continue to offer farmers free access to the market.

TREC-STEP, India (2008) DM #4893, Full Proposal Package
**Intended, perceived and actual benefits:** The TREC-STEP proposal for this Project, testing the above theory of change, had the intended objectives of:

1. Reducing the wastage of vegetables in the farmers markets by 50% or more, thus restoring the lost value in price, rotting and breakage;
2. Training rural youth in technical skills and entrepreneurial business practice will reduce the rural unemployment as they get employed by the cold storage venture and within the community with their newly acquired technical skills;
3. The Public-Private Partnership (PPP) approach in creating the mini cold storage units for the market place will create a sustainable, scalable and efficient business model to install MCSUs in the vegetable markets across India, saving large scale wastage and making this a profitable venture.

The Project planned to install five MCSUs in five markets and to demonstrate the PPP model. TREC-STEP expected to see increase in earnings from the five MCSUs, increased income for 1000 farmers, and interest in replication of the approach.

By March 2011, this project was fully operational in all five markets – Karur, Kumbakonam, Palayamkottai, Nanganallur and Salem in Tamil Nadu. After two years in design development, stakeholders’ active engagement and installation of MCSUs, this pilot project is showing promising benefits to participating farmers, youth workers, managers and consumers. An internal TREC-STEP evaluation confirms that the MCSUs have been established at the five markets. To date 2,014 farmers are registered in the markets and 358 farmers are actively using the MCSU in the Project areas. TREC-Step evaluators indicate that vegetable wastage has been reduced by 100%, and that "the value of the vegetables that can be recovered per year from the wastage is 95% of the DM investment in the Mini Cold Storage Units (95% of $200,000)." The evaluation findings analyzed data from 2009 and 2011 to show changes following the introduction of the MCSUs. TREC-STEP also indicates that since the installation of MCSUs there is:

- Increase overall in vegetables arriving at markets;
- Increase overall in vegetables being stored once the MCSUs are installed;
- Increase in small farmer income ranging from 9% to 31% due to vegetables not being lost to wastage as a result of cold storage use;
- Reductions in costs of transport due to ability to store vegetables at market from one day to the next.

The evaluation study found that 56% of the users of the MCSUs are women farmers. At the time of the evaluation the MCSUs at 5 markets were being used to 70% of capacity leaving room for expansion. The Government of Tamil Nadu has replicated parts of the program and installed less efficient MCSUs (even before the design of TREC-STEP was finalized) in

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12 The MCSUs, as installed, include two chambers, that allow different temperature and humidity settings.

13 TREC-STEP Evaluation Report: Mini Cold Storage Unit Project for Small Farmers, October 2011
22 other farmers’ markets in the state. Now the state government and its various units, NGOs and farmers associations are interested in adopting the more efficient and well thought-out MCSU design and approach.

As part of this case study, a site visit to two farmers’ markets at Kumbakonam and Palaykottai confirmed that farmers are using the cold storage units and they feel that the storage has definitely helped them financially. They have been able to reduce the wastage, increase the selling capacity and have made financial gains to be able to reinvest in the fertilization of their land, better seeds, and better land use and water conservation techniques. Interviews with farmers and visit to a small farm in Palaymkottai indicated that farmers are getting better services and higher prices, compared to the wholesale market as the government sets fixed daily retail prices of the vegetables at the farmers’ market. They also talked about the reduction in the strain of lugging vegetables back and forth from the village each day, and about feeling happier because of the well-organized market, the absence of middlemen and steady stream of customers due to the fixed price and the outreach by the government.

The conversations with the managers of the two farmers’ markets visited by the Case Study team suggest that the Government of Tamil Nadu is keen on supporting the small farmers (possibly for political reasons), likes the innovation and is interested in replicating this model in all 160 government-managed farmers’ markets in the state. The managers enthusiastically reported that the addition of the cold storage unit has helped to recruit more farmers to sign up for the farmers’ markets. Farmers are excited about increased sales of their vegetables due to the cold storage. The thorough practice of recruitment (each farmer receives an ID card after due diligence), controlled prices, and support in terms of better production tools and techniques are allowing government managers to do their job well while supporting the small farmers to improve their livelihoods.

At the farmers’ markets in Kumbakonam and Palaymkottai, the two rural youth entrepreneurs (out of 36 that were trained by TREC-STEP) are managing the cold storage units from the opening of the farmers’ markets in the early morning to closing in the afternoon on a daily basis. Having gone through three months of intensive training in Refrigeration and Air Conditioning Systems and Business Management Training at TREC-STEP’s Mother Resource Centre (MRC), the rural youth expressed their excitement about being employed and their increased capacity to have additional contract work to repair AC and refrigeration in their community when they complete their duties at the market in early afternoon. Youth entrepreneur/manager responsibilities for the MCSUs include preventive maintenance; weighing, collection and distribution of vegetables for storage each day; categorizing vegetables by storage temperature/humidity requirements; and record keeping.

Customers reported that they received better prices compared to the open vegetable market and they didn’t need to engage in the haggling on prices. They also shared their satisfaction about getting better quality produce and supporting local farmers.
Other accomplishments of the project are:

- Active discussion with the Indian Ministry of Renewable Energy and private corporations, such as, Bharat Heavy Electricals (BHEL) and RFLEX ENERGY on power cost savings by bringing solar panels and solar trees in the design of the MCSU. The discussion with refrigeration and food industry in using bio-waste from the market itself is also underway.
- Managers and field level officers in the Agriculture Marketing and Agri-Business Department of Government of Tamil Nadu have been engaged in the discussions about monitoring and effective implementation of MSCUs.
- Extensive outreach by TREC-STEP to media, agriculture institutions, and farmers associations is underway across the country to promote the idea of MSCUs and the business model.  

Effectiveness of the innovation: The provision of cold storage is an important element in helping farmers derive more benefit in the supply chain, but it is evident from the site visits and interviews with the farmers, managers and consumers, that government plays a substantial role in helping farmers to increase production and income. This includes a free access to a stall in the common space, free transportation to the market, regulated price of the vegetables, and guidance in better crop production methods leading to increased yields and daily management of the market. The addition of a well-designed MCSU has proved to be an effective innovation, which is profitable for the farmers and has benefitted consumers as well. The benefits of the MCSU and of the farmers’ markets are readily perceived by farmers. For example, Ballama, a female farmer whose farm the Case Study team visited, was enthusiastic, like other farmers, about the cold storage facility, “We have been coming to this farmer’s market in Palaymkottai for the past decade. Earlier I used to lose nearly Rs. 200 to 300 worth of greens everyday (a loss of nearly 10 to 15% in the daily revenue, just at the market –not counting the post-harvest loss at the farm and in transportation). Now there is no wastage, thanks to the cold storage facility. Additionally we have increased the sale of vegetables and our income.”

Cost effectiveness and commercial viability of the Project: TREC-STEP believes that the MCSU can be a self-sustaining, stand-alone profitable micro venture that can be replicated in other regions of India. Not only the Tamil Nadu Government and other state governments have shown interest in replicating this idea, TREC-STEP has also received inquiries from other countries about the venture. TREC-STEP has developed a business model (see below), which it believes demonstrates the financial viability of the MCSUs as a commercial enterprise operated by youth entrepreneurs.

The business model for the MCSUs, updated in the October 2011 Evaluation Report, assumes that reduced vegetable loss due to MCSU storage will lead to increased farmer income that can be used to cover a small fee (up to 1 Rupee for kilogram of vegetables...
stored) for using the cold storage. The Table presenting the TREC-STEP business model is in the Annex to this paper. If users pay RS.1/ kg for a minimum of 2,500 kg stored per MCSU per day, then the MCSU would generate RS. 900,000 per year. After deducting annual operating expenses of RS.240,000 (for energy, manpower, maintenance costs and room rental for MCSU), the balance of RS.660,000 each year can cover the capital costs of RS.700,000 of the MCSU. This analysis assumes that the youth entrepreneur (or farmers’ association) could finance the MCSU through a subsidized loan at 12.5% interest. With interest of RS.87,500 on a loan of RS.700,000, this analysis suggests that the capital costs could be repaid in as little as 14 months.

This is an attractive business model that needs to be assessed independently and against some of the implicit assumptions:

- These cold storage facilities at the 5 farmers’ markets in Tamil Nadu operate along with other interventions for small farmers that the Government is supporting/subsidizing. As noted above, these include free access to a stall, fixed prices, free transportation, and advice to farmers to increase productivity. Similar policies may not exist in all states, but may be a critical influence on farmer participation;
- Increased farmer earnings over the year show a sustained and substantial increase because of reduction in vegetable waste as a result of effective storage. The demand for vegetables is sustained along with the increasing supply of vegetables.
- Farmers using the MCSUs without charge will be ready to pay a fee up to RS.1 per kg for vegetables stored.
- The youth trained as managers/maintainers of the MCSUs will be able to act as entrepreneurs and, for example, set aside funds for maintenance, depreciation and replacement.

Business metrics may not be the best way to measure the viability of the MCSUs. As described in the project proposal, the Project seeks to reach small farmers and to reduce poverty. The MCSU delivers a public good that has the potential to reduce the post harvest wastage and increase food security. This departure from the business venture model and reliance on government subsidies may be justified because of its creation of public goods and its contribution to Government poverty reduction goals. Since the beginning of the Project two years ago, the gains for the farmers and consumers are noteworthy. It is still an open question as to whether this Project can be a self sustaining micro enterprise without government or development agency support for an intermediary period. If the MCSU is accepted as a social enterprise, there needs to be an intentional effort on the part of a key stakeholder, probably the State Government of Tamil Nadu with support from TREC-STEP, to foster the emergence of the MCSUs as viable businesses with the gradual introduction of user fees for the MCSU as the economy of small farmers evolves and they increase earnings from marketing excess vegetable production. In the short run, subsidization of cold storage may be a public good that helps change the production and marketing patterns of small farmers and increases food supply. The MCSUs will be able to move toward being viable businesses only if fees for use are gradually introduced and if the youth managers take ownership and become true entrepreneurs. Improvements in the technology of the MCSUs and in off-grid energy sources may drive down costs. In the long run, if the MCSUs
demonstrate their commercial viability, there may be increasing spontaneous replication of MCSU enterprises and adoption of MCSUs by farmers’ cooperatives or associations.

The short site visits to two markets and to small farms clarified some basic assumptions in the project, but further evaluation and analysis of the benefits to farmers, women, consumers, government and entrepreneurs are needed in order to understand how this innovation can be transformed into a viable, self-sustaining enterprise and whether, how and for how long it needs to be supported by government subsidy as part of Government policies to address rural poverty and modernize smallholder agriculture.

Key challenges identified in the project:

- Farmers’ markets are not booked fully. In one case, a new market had opened nearby causing the outflow of the farmers and the consumers. If the cold storage units are attractive in increasing the sales, one would assume a greater interest on farmers’ part to sign up for the farmers’ markets. It is possible that if a farmer goes regularly to the market, he/she has to retain a laborer for tilling the land, which is a high cost. Increased sales from the produce may be negated by the cost of retaining a laborer or loss of hiring replacement labor on the farm while they are at market. It would be helpful to undertake the analysis of the opportunity cost to the farmers.

- The MCSUs are not currently being used to their full capacity (70% of capacity at the time of the report). Only about 35 to 40% of the registered farmers are using the cold storage units right now. TREC-STEP estimates that it is a matter of a few months before full usage is attained and that proper communication with and among farmers to demonstrate the benefits will help to see the full capacity of the units.

- The power costs to run the MCSU are high. While power costs are presently being met for the five markets in this project, it is not clear whether government commitment to subsidy will continue. The use of solar panels and solar trees have been considered as ways to reduced energy costs (and have real merits), but the start-up costs of these innovations are high and need investors for these ideas. BHEL and REFLEX Energy are looking into this innovation but no further information is available at this time.

- The idea of MCSU as an independent, self-sustaining profitable venture, attractive to a business entrepreneur, needs further research, especially in light of small-scale farmers’ limited financial and organizational capacity and even willingness to pay the user fee for the installation of MCSU. Thus an independent assessment of the business model is important to substantiate potential earnings.

- Consumers are often interested in lower prices and greater selection of vegetables and fruits. Farmers’ markets generally have lower and regulated prices than the regular vegetable market but the variety of vegetables is limited since the outside vendors are not allowed and farmers are only able to bring locally grown seasonal produce. At Palayamkottai, a new experiment of allowing a few farmers from a farther distance, but with the different vegetable variety, showed that customers tended to favor buying from those farmers because of the variety.

- The rural youth entrepreneurs are trained in refrigeration and air-conditioning systems as well as in basic business principles. While they appear to be fulfilling the role of managers of MSCUs, it is not clear that they have become ‘entrepreneurs,’ capable of scaling up the model and managing the entire project as an independent business.
• The Government that started the farmers’ markets and supported this idea of the cold storage unit no longer holds political power in Tamil Nadu. While the agriculture issues and farmers’ interests are well represented before any government, there are questions about the full commitment on the part of the newly elected government.

2. **Key stakeholders**

Interests, functions and pathways of action, influence

1. **Farmers:** with small land holdings, mostly from local communities, 56% women, 46% men on average

   a. Interests:
      i. Reduction of wastage of produce through refrigeration
      ii. Access to better designed mini cold storage unit, helping to refrigerate the vegetables for more days
      iii. Better prices leading to increased income and better livelihood
      iv. Access to market- free space, free transportation and free use of refrigeration are big plusses

   b. Pathways of action:
      i. Willingness to use the system
      ii. Readiness to pay a small user fee for the MCSU (this will require organizing of small farmers. Not clear who will handle that)
      iii. Getting long-term financing through farmer’s coops to install MCSUs

   c. Influence:
      i. Since 70% of the Indian population survives through the agriculture sector, farmers (small and large) have some political clout to get the ongoing government support at no cost for the use of the market and for the cold storage units

2. **Consumers:**

   a. Interests:
      i. Low price, high quality, fresh produce
      ii. Variety of vegetables and fruits
      iii. Support of the farmers’ market model, eliminating the middleman
      iv. Oversight of the managers for quality and controlled prices

   b. Pathways of action:
      i. Knowledge and support of MCSU (often they are not even aware of the presence of the cold storage unit)
      ii. Readiness to support the farmers’ markets despite the lack of variety

   c. Influence:
      i. Can demand better prices and higher quality of vegetables

3. **Market Managers:** Government officials of the farmers’ markets

   a. Interests:
      i. Support of farmers allows government to be seen in positive light

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16 TREC-STEP Power Point presented to the Case Study Team, Aug 16, 2011
ii. Ability to provide mentorship to farmers for getting better yield and managing the market flows

b. Pathways of action:
   i. Knowledge, support and marketing of MCSU
   ii. Detailed data collection on consumption pattern and goods movement
   iii. Ongoing mentoring to farmers

c. Influence:
   i. Can act as a bridge between the farmer's needs and government policies
   ii. Can mediate between the consumer needs and farmers' practices

4. Rural youth entrepreneurs: managers of the MCSU
   a. Interests:
      i. Being gainfully employed
      ii. Acquiring new skills in business management and refrigeration systems
   b. Pathways of action:
      i. Train others to become managers of MCSU
      ii. Create their own enterprise using the new skills
      iii. Manage and sustain the MCSU model with the new business model
   c. Influence:
      i. Provide support to manage MCSUs when the replication takes place
      ii. Assist in taking care of the community’s refrigeration needs

5. Tamil Nadu Government
   a. Interests:
      i. Supporting small farmers
      ii. Creating food security by reducing the food wastage
      iii. Building the political goodwill and voter base
      iv. Becoming a leader and innovator in social initiative that can be replicated nation-wide and even globally
   b. Pathways of action:
      i. Committing fully to the idea and replicating in the 160 farmers markets in the state of TN
      ii. Supporting MCSU as social enterprise
      iii. Helping to underwrite the power costs
      iv. Able to help other states when the scaling up begins
   c. Influence:
      i. Can guide national policies in reduction of vegetable loss and food security through MSCU example
      ii. Can assist farmers and the rural populations in improving their livelihoods

6. TREC-STEP – Implementing agency
   a. Interests:
      i. Generating social value
      ii. Supporting farmers and reducing the food wastage through improved technology and innovative public private partnership
      iii. Incubating a social initiative that can be replicated nation-wide and globally
   b. Pathways of action:
      i. Coordinating with other stakeholders, especially the government agencies and entrepreneurs to take the idea to scale
ii. Developing the technology for solar panels and solar tree, working with BHEL and REFLEX Energy, to reduce the power costs
iii. Training rural youth in managing the MCSU

c. Influence:
   i. Outreach to government and development agencies
   ii. Being a catalyst between public and private sector
   iii. Promotion of technological advancement and the strength of the idea

3. Alignment

TREC-STEP and the Government of Tamil Nadu worked well together from early on as the idea of using the cold storage units for the small farmers’ market took shape. After the positive response in the first pilot, the Government is enthusiastic about scaling the MCSUs in 160 government funded farmers’ markets in the state. It is still not clear what the priorities and strategies of the new government are in relation to its agriculture policy in general and its decision for the farmers’ markets in particular. As a result, TREC-STEP also wants to align with business entrepreneurs, Government of India, Department of Scientific and Industrial Research and United Nations Development Program to help champion the policy of instituting MCSU at all the farmers markets across the country.

4. Assessment of scalability of the innovation

**KEY FACTORS:** The project innovation can add value to national efforts to address rural poverty, increase food security, transform agriculture and reduce malnutrition. It has potential for scaling up through expansion in Tamil Nadu and replication in other states, provided some of the outstanding questions get answered in relation to the explicit goal of incubating viable business venture\(^{17}\) versus creating a different track by making the project a social enterprise, relying on government subsidies and development agency support in the beginning and then adding user fees and other financial mechanisms. It is also worth exploring whether this model can be replicated in other states where the World Bank has made a commitment in the rural livelihoods programs.

**Demand:** The MCSU has proven its viability in the five farmers’ markets where the project has been launched. Out of 2,014 registered farmers, 358 farmers, who are using the cold storage facility in these five locations, are showing that, due to refrigeration, they have gained a daily value (combined earnings) of $522, a 95% return on investment/farmer by Development Marketplace.\(^{18}\)This is a significant income increase for farmers living at or below the poverty line.

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\(^{17}\) TREC-STEP, India 2008, Full proposal

\(^{18}\) TREC-STEP Power Point presented to the Case Study Team, August 16, 2011
The government employees - managers of farmers’ markets - are fully on board with this idea and are keen to see the installation of mini cold storage units grow to other places. Managers are also very interested in providing mentoring support to other farmers’ markets in the state and elsewhere when and if the project goes to scale. The State Government has been enthusiastic about this idea of mini cold storage. Even before the final design of MCSU was rolled out, it adopted the model in 22 farmers’ markets around the state, installing and operating cheaper and less efficient variety of MCSUs. After seeing the gains in the five farmers’ markets, there is a greater appreciation for the efficient and technologically more advanced design offered by TREC-STEP.

The rural youth entrepreneurs are getting trained in new skills and are being employed by TREC-STEP to manage the MCSUs. By scaling the Project to 160 farmers markets in the state and many more nationally, there is a great opportunity to build the rural youth employment program, a stated goal of the Government of India and the Agriculture and Rural Development division of the World Bank.

**Driver:** While TREC-STEP has been a driver of this Project in Tamil Nadu, it is not clear who will drive this project for expansion in other markets in Tamil Nadu or for replication elsewhere in the country. If this program is to be seen as supporting the Government’s poverty alleviation, employment generation and food security programs, then there has to be a designated position(s) in the Department of Agriculture and Cooperation with sufficient resources within the Central Government that drives this process across the country. The implementing agency(ies) for scaling up, like TREC-STEP, will need both drivers and champions and sufficient financial resources to scale up the project.

**Champions:** Farmers, government officials, rural youth entrepreneurs, along with TREC-STEP staff, are the greatest supporters of this innovation within the State of Tamil Nadu. To assure the replication of this Project across India, a powerful advocate at the national level, able to influence decisions and facilitate action, is needed. It is not clear who at the national level will champion this innovation and foster its adoption and implementation by appropriate agencies. If the World Bank sees the merit in scaling up the Project and will consider supporting it with resources in the earlier phase, the chances that the Central Government will play a leading role in encouraging scaling up the Project in multiple states are higher.

**Uniqueness of the innovation:** The coolers are more efficient and technologically more advanced, offering customized humidification services and temperature ingredients to yield real benefits. The innovation works because ultimately it prevents food wastage and increases the profit margin for small farmers. The innovation is simple but effective. There is a sizable cost to produce and run MCSU. Presently TREC-STEP is in conversation with BHEL, REFLEX Energy, Tamil Nadu Agriculture University and ICRISAT in Hyderabad to develop solar powered and bio-mass powered cold storage units to reduce the power costs. If the technological innovation, combined with process innovation of using public-private partnership to enable sustainable management of the MCSU, is applied with a shift...
in the approach (social enterprise with government/development agencies support) this innovation could yield greater benefits for the farmers and the society in general.

**Opposition:** While there is no or relatively little opposition to this Project in Tamil Nadu, the political shift in the state government draws into question the public private partnership idea. The agriculture lobby in the country has substantial support, so if there is a right champion of this Project, the replication of MCSUs nation-wide may not meet with much opposition. TREC-STEP has done extensive outreach to the national and regional government agencies, farmers’ associations and agri-businesses.\(^{20}\) Early indications show favorable support for the Project.

**Incentives for scaling up:** The project design, reports and assessment on the ground suggest that there are clear incentives for all the actors: the farmers want to reduce the food wastage and increase income; the State Government desires to increase the public good and satisfy the electorate demands as well as to become a leader and innovator of the idea at the national level; the rural youth wishes to be gainfully employed; and the Central Government wants to increase the food security and rural employment.

**Spaces for scaling up:** As mentioned earlier, the Government of Tamil Nadu runs 160 farmers’ markets across the State and has been an enthusiastic supporter of the mini cold storage units. Farmers’ market managers as well as various agriculture-oriented departments in the State Government have shown great interest in scaling up this model. As the Project got underway, the State Government indicated its interest in providing MCSUs for additional markets in Tamil Nadu. However, it is not clear at this time if the State Government has allocated sufficient resources to support a second phase and expansion of the MCSUs to all markets in the State.

There is scope for increasing the links of poor farmers to market enhancement. Poverty remains a major problem even as India experiences GDP growth rates of 8 to 9%. More than 300 million people live below the official poverty line, and the number is even higher if measured in as PPP $1.25\(^{21}\) per day in 2005. Poverty is worse in rural areas where 70% of India’s population lives and sustains itself on income from agriculture. Poverty is particularly concentrated in the seven ‘lagging’ states (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh), and among scheduled castes, tribals, women and the disabled, many of whom are small farmers. As many as 40% of India’s villages is not connected to roads. This initiative aims at providing a solution to small farmers’ access to markets and ability to increase income. Its demonstration in Tamil Nadu is attracting attention and it has a real potential to attract support from other state governments, Central Government and development agencies.

\(^{20}\) TREC-STEP made a Power Point presentation to the Case Study team on Aug 16, 2011

\(^{21}\) Purchasing Power Parity, the World Bank
The innovation is clearly beneficial to the farmers and consumers, prevents post-harvest vegetable wastage and reduces rural poverty, generating greater public returns above and beyond those that accrue to the small farmer beneficiaries. Reduced postharvest vegetable waste, increased small farmer earnings and increased rural youth employment can help both the Government of India and the World Bank achieve stated goals of increasing food security and supporting increased agricultural productivity. It is in the space of this complementarity that the argument can be made for interim funding to allow this innovation to transition from a demonstration project to a sustainable way of assuring small farmer access to cold storage at markets.

Over the course of the Project, TREC-STEP has invested in design improvements to the mini cold storage units that reduce the environmental impact. The use of the eco-friendly construction materials, such as pre-fabricated PUF panels instead of brick and mortar and thermocole panels, is the first step in that direction. PUF panels save up to 35% compared to thermocole insulation panels and they also offer a greater life span of 15 years, compared to three years of thermocole panels. TREC-STEP has engaged BHEL and REFLEX Energy in the private sector and the Ministry of Renewable Energy and ICRISAT in the public sector to develop the solar power pack, solar trees and bio-gas technology to reduce the dependence on electrical power.

5. Type of scaling

Relevance, Viability and Credibility: The mini cold storage unit approach has clear relevance to local and national problems of high post-harvest wastage of vegetables and to the problem of small farmer access to appropriate cold storage solutions. Cold storage for vegetables does exist in India but access to it has been limited to larger scale, commercial farmers. At the micro level, small farmer access to household type refrigerators for storage of vegetables is also limited because of cost and also lack of electric supply at the village level. TREC-STEP has developed a unit which is suitable for use by multiple small farmers and allows differentiation of humidity and temperature for different types of vegetables. TREC-STEP has a strong national and international reputation for incubating technical innovations and fostering their adoption into enterprises with the potential to become large, and it carries substantial credibility with key stakeholders in its support for scaling up of this model.

Financial viability: This innovation depends on a Public Private Partnership (PPP) for managing the mini cold stores and envisions the emergence of a small enterprise to be managed in a commercially viable way by a youth entrepreneur. Two years of project implementation have not yet demonstrated that the MCSU enterprises are commercially viable, though TREC-STEP has developed business model that needs to be independently assessed. Nor has it yet been demonstrated that the youth managers are becoming entrepreneurs and able to manage a small business. To date, the World Bank Development Marketplace Project funded the MCSUs and paid the training costs and salary of the youth

entrepreneurs; the Government has subsidized the power costs of the MCSUs, provided free access to market stalls, transportation and access to the cold storage. It may be that such subsidies are important and that the incubation period for this model extends beyond the two years of the project.

6. Implementing Organization

An impressive organization with 24 years of experience in incubating technological innovations, TREC-STEP has been the primary instigator and implementer of the MCSU pilot project in Tamil Nadu. In its history of close to a quarter century, TREC-STEP has promoted more than 185 high growth start-up SMEs, supported 4000 SME and micro ventures and it annually trains 4,000 to 5,000 youth in technology and business skills. Over the years it has won innumerable awards in entrepreneurship incubation locally, nationally and internationally.

TREC-STEP's rich experience in the Refrigeration and Air-Conditioning domain, its training expertise offered to the unemployed youth in technology, and successful implementation of PPP models were the primary triggers to jump start this pilot project that turns Waste to Wealth by Incubating Mini Cold Storage Unit Technology.

Strengths:

- The organization has credibility with various stakeholders – government, development agencies, civil society, private sectors and end-users, such as farmers and rural youth - for delivering sound and sustainable projects with efficiency. It has been recognized for excellence in promoting innovation and technology entrepreneurship in India.
- TREC-STEP has a strategic focus on promoting new entrepreneurial start up ventures with a mandate to train youth in technology and business skills and trains 4,000 youth in technology trades every year.
- It has a wide network and influence in the State of Tamil Nadu as well as at the Central Government level (The Central level Home Minister Mr. P. Chidambaram has shown keen interest and recently visited TREC-STEP’s project of New Emerging Technology Skills Nodal Center at Karaikudi). This high level connection is of significance if the pilot project is to scale up in other states.
- The values and goals of TREC-STEP, especially of finding innovative solutions to increase food security, link small-scale farmers to market, and to work with rural youth are closely aligned with what Development Marketplace and the Government of India seek to achieve in terms of scaling up workable ideas.
- In addition to the World Bank, TREC-STEP has worked with International agencies like UNDP, UNIDO, EU, InfoDev, British Council Division, IDRC and others. TREC-STEP’s Vocational Training for Employment Generation Project was heralded as the best example of a good project by the European Delegation and others.

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23 TREC-STEP proposal to the World Bank, 2008, Full proposal package

24 TREC-STEP Power Point presentation, August 16, 2011
at the nexus of resource network for technological advancement for national and international organizations.

- TREC-STEP has successfully disseminated the Project DVD, Project leaflet and Project brochure to more than 38 organizations ranging from governmental, semi-governmental, agri-business, banks and farmers associations as mentioned in the Power Point \(^{25}\) and garnering interest in the mini cold storage unit.

- The pilot project in the five farmers markets has received attention and interest, not only nationally but internationally, including from Pakistan, Indonesia and Farmers’ Associations in Africa.

- At its helm, Mr. R.M.P. Jawahar has served as the executive director of TREC-STEP for over 22 years. He has been entrepreneurial in terms of ideas and strategic in his approach to grow and sustain the organization that functions as an independent NGO and no longer has to rely on the Engineering College in Tiruchirappalli for financial resources. Serving as a member of board or advisory council for more than 12 professional bodies, Mr. Jawahar is able to facilitate effective exchange between his and other organizations’ learning about technology, incubation and scaling up. Mr. Jawahar seems to motivate and engage staff to think big ideas and successfully deliver them. He has developed a large network in various sectors, allowing the organization to yield positive results from these connections.

- TREC-STEP has a dynamic management team of professionals with management experience in building and managing collaborations, partnerships and projects and deep commitment to technology and social issues.

**Weaknesses:** While TREC-STEP has a proven track record of successful implementation of projects in the private sector, it may be less suited for incubating enterprises that are aimed at small, poor farmers. The technological incubation projects that the organization started to date have been taken over by entrepreneurs nation-wide to scale them up as commercial ventures. However, as the discussion above indicates, in order to scale up the MCSU Project, governments are going to have to play a major role. The primary market for the MCSUs appears to be in the farmers’ markets across the country. Secondarily there may be opportunities for NGOs and cooperatives to invest in MCSUs. In the longer term, small entrepreneurs may take up the MCSU as a profitable enterprise, but they will have to be convinced of the financial viability of the MCSU. To move forward, there will need to be actors at the state and national level who are prepared to incorporate the technical innovation into their small farmer/poverty reduction work and to locate entrepreneurs to take the lead in outlaying the capital costs for the MCSUs and manage and monitor the project successfully. Identifying these actors, who will drive and implement expansion and replication, requires champions who will advocate for this approach.

- TREC-STEP has at least 10 large incubation projects in the hopper. Its core competency is in technological innovations and in the area of offering vocational guidance – both of these areas they have excelled at. The focus on the agriculture issues and small farmers’ problems is more recent. Despite their initiation and

\(^{25}\) TREC-STEP Power Point presentation, August 16, 2011
successful implementation of this pilot project, it is unclear if TREC-STEP alone is able to take this Project to scale, nationally or internationally. They can offer the consultation for the technology and may be able to come up with distribution systems, but it would be worthwhile to explore further how they can scale up if they are the sole implementing agency nation-wide.

- Without the financial commitment from a development agency and/or from the government, TREC-STEP will not be able to focus on the scaling up process or develop management and distribution system.\(^26\)
- TREC-STEP has provided a business plan that promises that the MCSU can be a viable commercial enterprise within a year of operation. The model has not been tested, and it is based on some assumptions (see above) that may not materialize. Since the business venture model is at the core of the design of this Project, not having a full understanding of who the entrepreneurs will be and how the business model will work is a concern.

**Recommendations:** Based on the assessment above, we recommend the following options to make the structural change in the design of the Project.

1. The pilot Project at the five farmers’ market in Tamil Nadu has clearly shown benefits. The technological innovation of MCSU has evolved significantly and is helping to reduce the wastage of vegetables and increase the income of farmers. Rural youth trainees have acquired marketable skills and are gainfully employed. There is excitement and enthusiasm at the State Government, farmer and the implementing agency levels. The outreach to expand the idea elsewhere has already begun. However, the lack of financial sustainability of the PPP model as envisaged in the current project design has yet to be demonstrated. With the termination of the current project funding, the innovation requires bridge funding to enable the project to move from demonstration to a mainstream activity driven by state and national governments or taken up by other actors. As is described in the Brandeis Report on “Mapping the Road,”\(^27\) an innovative effort cannot succeed and will not go to scale if the full support from various stakeholders is not given to the idea of scaling up.

Since the Tamil Nadu Government already runs additional 160 farmers’ markets across the state, it is worthwhile to convene TREC-STEP, the agriculture department of the State Government and the DM-ARD unit of the World Bank to discuss possible ways to sustain and scale the Project, including how to move toward the realization of the business plan. They can share the evolving knowledge from the pilot Project, take the salient features that have worked, analyze the economies of scale and develop a three to five year plan to expand the MCSU Project to all 160 farmers’

\(^26\) Mr.R.M.P. Jawahar, the Executive Director of TREC-STEP in the phone interview with Diana Schor, as quoted in the Project Assessment, No.4893, March, 2011

\(^27\) Mapping the Roads from Development Marketplace Agriculture and Rural Development Projects to Sustainable Practice, Brandeis Report, March 2011
markets in the State of Tamil Nadu. In addition to reducing the wastage of vegetables and increasing the income of small farmers in the entire state, this scale-up operation will offer valuable lessons and will help establish a process to achieve viability of the PPP model before taking it to scale nationally and internationally. At this stage, the State Government and to some extent the World Bank could assume an enabling role, support the business development of MCSU, adjust the business venture model and absorb initial risks. Over time, as the model gets better established and the farmers and their associations as well as other entrepreneurs start to see the value of the cold storage unit, increasing user fees from farmers and other financial mechanisms can assist in reducing the subsidies and decreasing the reliance on the government or a development agency. As the business model is demonstrated, one would expect to see more spontaneous adoption of the approach.

2. Demonstration of this model in other regions will immediately benefit poor farmers through the reduction of post-harvest waste, but will also accelerate the diffusion of the model as the commercial viability of the entrepreneurship model is established. The current World Bank Country Strategy for India (CAS) has identified seven low income states, namely Bihar, Chattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh, to invest greater resources to reduce poverty and achieve MDG goals. We recommend that the World Bank convene appropriate stakeholders in the state governments of these states to communicate the potential of the Tamil Nadu pilot project and to encourage them to develop pilot projects in their own states. The World Bank Country Office should be encouraged by the DM and ARD to consider incorporation of the MCSU into World Bank projects like The India National Agricultural Innovation Project or a range of other projects, many at the state level, aimed at rural livelihoods and poverty reduction.

3. Aside from the centrality of financial sustainability of the business model, the Project has a high potential for product scaling up. The energy efficiency, customized humidification services, temperature control and other features are well thought out in the design of MCSU and offer tangible benefits by reducing the food wastage and increasing the profit margin for small farmers. Presently TREC-STEP is exploring the solar options to support the cooler with the hope that the unit can operate off the grid. If this is successful, the cooler innovation can be introduced at the farm or village level, further minimizing the spoilage exposure and prolonging the vegetables’ shelf life. Even if the MCSUs are installed only in the farmers’ markets and not in the wholesale vegetable markets across the country, there will be a sizable reduction in postharvest vegetable waste across the country.

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28 Project Assessment: Waste to Wealth by Incubating Mini Cold Storage Technology: Schor, March 2011
List of Persons Met

TREC-STEP staff

- Mr. R.M.P. Jawahar – Executive Director, TREC-STEP
- Ms. Gita Chengappa – Manager, TREC-STEP
- Ms. Bindu Balkrishnan – Deputy Manager, TREC-STEP
- Mr. Antony Raju – Coordinator, TREC-STEP

Farmers Markets

- Mr. R. Babyraj - Administrative Officer at Kumbakonam market, from Tamil Nadu government
- Mr. S. Pannerselvam - Assistant Administrative Officer at Kumbakonam market, from Tamil Nadu government
- Mr. G. Rajeev - Youth entrepreneur, trained by TREC-STEP, and manager of MCSU at Kumbakonam market
- Ms. Mallika and her husband Bisva – Fruit farmers at Kumbakonam market
- Ms. Lacchmi – Vegetable farmer at Kumbakonam market
- Mr. Natarajan – Coconut, bananas and greens farmer at Kumbakonam market
- Ms. Dhanlaxmi – Farmer from the Horticultural Self help Group for Women at Kumbakonam market
- Mr. M. Balasubramanian – Administrative officer at Palayamkottai market, from Tamil Nadu government
- Mr. S. Babu - Assistant Agricultural Officer at Palayamkottai market, from Tamil Nadu government
- Mr. S. Muthu Krishnan - Youth entrepreneur, trained by TREC-STEP, and manager of MCSU at Palayamkottai market
- Mr. Dhituga Durai – Manager of MCSU at Palayamkottai market
- Ms. Peramal Amma – 80 years old farmer at Palayamkottai market
- Ms. Ballama – Farmer at Palayamkottai market, visited her farm as well
- Mr. Devdas – Organic farmer at Palayamkottai market
- Mr. Subhash Palekar – Consumer, also met three other buyers and interviewed them

The World Bank

- Mr. Samik Sunder Das – Senior Rural Development Specialist, The World Bank, India – phone conversation
# Annex

## Break-Even Analysis

<table>
<thead>
<tr>
<th>Capital Cost Requirement</th>
<th>In Rs.</th>
<th>in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Requirement for setting cold storage units of 2.5 to 3.5 MT storage capacity in a rented building</td>
<td>700,000</td>
<td>15,556</td>
</tr>
</tbody>
</table>

## Monthly Recurring cost requirement

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Cost based on usage</td>
<td>8000</td>
<td>178</td>
</tr>
<tr>
<td>Manpower cost for operation</td>
<td>4000</td>
<td>89</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>3000</td>
<td>67</td>
</tr>
<tr>
<td>Room rent that houses the cold storages</td>
<td>5000</td>
<td>111</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,000</strong></td>
<td><strong>444</strong></td>
</tr>
</tbody>
</table>

## Revenue generated through collection of usage charge for the usage of cold storage

<table>
<thead>
<tr>
<th>Usage charge collection / kg</th>
<th>Rs. 1/kg</th>
<th>75 paisa/ kg</th>
<th>50 paisa/kg</th>
<th>25 paisa/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>For minimum Storage of</td>
<td>2500 kgs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income / day</td>
<td>2500</td>
<td>1875</td>
<td>1250</td>
<td>625</td>
</tr>
<tr>
<td>Income / month</td>
<td>75000</td>
<td>56250</td>
<td>37500</td>
<td>18750</td>
</tr>
<tr>
<td>Income / year</td>
<td>900,000</td>
<td>675,000</td>
<td>450,000</td>
<td>225,000</td>
</tr>
<tr>
<td>Expenses / month</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
<td>20000</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Expenses / year</td>
<td>240,000</td>
<td>240,000</td>
<td>240,000</td>
<td>240,000</td>
</tr>
<tr>
<td>Income that could be generated after meeting all Recurring Expenses</td>
<td>660000</td>
<td>435000</td>
<td>210000</td>
<td>-15000</td>
</tr>
<tr>
<td>Repayment for Capital Expenditure</td>
<td>55000</td>
<td>36250</td>
<td>17500</td>
<td>-1250</td>
</tr>
</tbody>
</table>

(Here it is assumed that the Capital for cold storage units can be mobilized from banks with 12.5% subsidized loan)

<table>
<thead>
<tr>
<th>Break-Even Month</th>
<th>14th mth</th>
<th>21st mth</th>
<th>41st mth</th>
</tr>
</thead>
</table>

References

Extensive Personal interviews with the TREC-STEP staff, farmers, managers and youth entrepreneurs – August 16 through August 20, 2011, Tamil Nadu, India


Case Study No 4893 Project Assessment: Waste to Wealth by Incubating Mini Cold Storage Technology: Diana Schor, March, 2011

TREC-STEP, India (2008), DM#4893, Full Proposal Package

TREC-STEP, India (November, 2009), DM #4893, Progress Report

TREC-STEP, India (November, 2010), DM #4893, Progress Report

TREC-STEP, India (October, 2011), DM #4893, Evaluation Report

TREC-STEP Power Point Presentation made to the Case Study Team, August 16, 2011
