Brief for GSDR – 2016 Update

Sustainable energy solutions to 'cold chain' food supply issues

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This brief focuses on the stages and reasons of post-harvest losses for perishable crops, in particular along the cold chain in the developing world. It concludes by raising awareness of the issue and its magnitude, as well as proposing sustainable improvements and alternatives to existing cold chains.

Introduction

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). Food security, however, has been evasive for millions of people in the developing world, with children being particularly affected. In an effort to eradicate this chronic and pervasive problem, the Millennium Development Goals' (MDGs) first objective was dedicated to ending poverty and hunger. Nevertheless, despite significant reductions in the share of undernourished people at the global level over the last decade, 805 million people remain food insecure, with progress hindered by slower and less inclusive economic growth as well as political instability in some developing regions (FAO, 2015). Population growth trends are putting additional pressure and further exacerbate the situation; the world population has increased from approximately 6 billion in 2000 to 7.3 billion currently, with projections to increase by more than one billion people within the next 15 years, reaching 8.5 billion in 2030 (UN DESA, 2015). In addition, climate change is posing a fundamental threat to food security and sustainable development, requiring prompt actions to ensure agricultural production is resilient to its effects.

Despite this urgency to satisfy demand, up to one third of all food – 1.3 billion tons per year - is lost or wasted, before it reaches consumers, representing a waste of labour, water, energy, land and other inputs (FAO, 2011). Food loss is defined as the decrease in food quantity or quality throughout the food supply chain, which as a result renders it unfit for human consumption. It can take place at production, postharvest, and processing stages in the food supply chain (Parfitt et al., 2010). The environmental consequences of food loss and waste are also significant and should not be overlooked. According to estimates, the total carbon footprint of food loss and wastage generated per year is around 4.4 $GtCO_2$ eq. In other words, if food wastage were a

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country, it would be the third largest emitting country in the world (FAO, 2011b).
In addition, the food cold chain is responsible for nearly one third of global HFC emissions - about 1 percent of global greenhouse gas emissions. However, unabated, HFCs are expected to increase to greater than 10 percent of greenhouse gas emissions by 2050 (RT, 2014). Therefore, reducing losses could lead to an increase in food availability to cover the nutritional needs of the growing population, conservation of natural resources, and reduction of greenhouse gas emissions. In this context, reducing and even eliminating food loss becomes economically, environmentally, and morally imperative, as it will help end hunger and contribute to the achievement of sustainable development.

The 2030 Agenda adopted at the September 2015 Summit on Sustainable Development is a testament to the world leaders' determination to end hunger, achieve food security, and improve nutrition as a matter of priority (UN DESA, 2015). To this end, Goal 2 is dedicated to the attainment of the above in addition to promoting sustainable agricultural practices. In line with the 2030 Agenda's aim to create an agenda for the people and the planet, the focus of Goal 12 is to ensure sustainable consumption and production patterns. Moreover, target 12.3 is considered a breakthrough since it calls for halving per capita global food loss and waste along the food supply chain by 2030. The Food and Agriculture organization and Messe Düsseldorf, in close collaboration with donors, bi- and multi-lateral agencies and financial institutions and private sector partners, have also established the SAVE FOOD - Global Initiative on Food Loss and Waste Reduction in order to help tackle the global issue of food loss and waste (FAO, 2011c).

The problem

A cold chain for perishable foods is the uninterrupted handling of the product within a low temperature environment during the postharvest steps of the value chain including harvest, collection, packing, processing, storage, transport and marketing, until it reaches the final consumer (Kitinoja, 2013). Refrigeration is of vital importance post-harvest, as it slows down bacterial growth, naturally existing everywhere e.g. in the soil, water, air and food. In the case of food, under favourable conditions, bacteria can rapidly increase in number and cause spoilage, which if undetected can lead to illness.

Food loss due to a breach of the cold chain can occur at the following stages of the food value chain: a) Storage – either long or short term warehousing; b) Packing and processing – in a cooled facility; c) Distribution – transportation in food transport vehicles with a cooling system; and d) Marketing – refrigerated or freezer storage and displays at the retail point

It has been estimated that global food production comprises roughly one third of perishable products requiring preservation (IIFIIR, 2009). Horticultural products

generally suffer higher loss rates within industrialized and developing countries, although at different points in the food supply chain and for different reasons (Parfitt et al., 2010). In low-income countries, the causes of food losses are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems (FAO, 2015b). More than 40% of the food losses actually occur at post-harvest and processing levels and a lot less at the consumer level which is mostly a problem in the industrialised, developed world (FAO, 2011). Inadequate, inefficient or non-existent cooling facilities in particular can lead to a gamut of problems for the producer e.g. investment loss, reduced income, debt accumulation, and the consumer e.g. increased retail price, decreased food availability, consumption of spoiled food resulting in illness.

As far as technical limitations in keeping food fresh from farm-to-table are concerned, there are two types of cooling practices: electrically powered mechanical and passive non-mechanical.

With regards to mechanical, farmers will have to overcome three major obstacles:

a) The upfront investment costs in mechanical refrigeration systems are often prohibitive
b) Even when farmers are able to cover the cost of purchasing such systems, they often have to deal with secondary obstacles related to energy availability, reliability, and affordability

- In sub-Saharan Africa, for instance, in the majority of the countries the share of the population with access to electricity is below 40 per cent. In rural populations, which are also mostly employed in agriculture, the percentage is even lower at an average 10% (World Bank, World Development Indicators)
- Moreover, it is often the case that poor rural sub-Saharan households are not in a position to cover the connection charge to the grid, if one exists in their proximity. In Kenya, for example, applying for electricity connection would set a family back by 119 per cent of its monthly income (Golumbeanu and Barnes, 2013).
- Along with challenges of accessing electricity and being able to afford it, rural businesses in sub-Saharan Africa have to regularly deal with unreliable electricity supply. In a typical month, there will be 19 electricity outages in Chad, 31 in Guinea, 18 in Niger, and 9 in Tanzania (World Bank, Enterprise Surveys), with a duration from 1.5 to 6.3 hours on average. Therefore, the provision of stable and affordable can have a serious impact on the continuation of the cold chain in the food supply in those countries.

c) An alternative to electricity is diesel, which is not necessarily a cost-effective solution for small-scale farmers, considering that a liter of diesel can cost US$1.44 in Uganda (Kojima et. all., 2010) Diesel is also a source of high carbon

emissions, and therefore long-term environmentally unsustainable.

In the case of non-mechanical solutions, a variety of simple methods exist for cooling produce, where electricity is unavailable or too expensive. Some examples of alternative systems include night air ventilation, radiant cooling, evaporative cooling, the use of ice and underground (root cellars, field clamps, caves) or high altitude storage (Kitinoja and Kader, 2002). Considering that horticultural crops do not require cooling at very low temperatures, non-mechanical cooling practices can achieve these moderately cool temperatures at a very low cost (Kitinoja, 2013), and provide a viable alternative for small scale farmers. The decision of which non-mechanical option to choose will depend on the type of crop and the environmental conditions of the area.

Policy recommendations

Sustainable development will be achieved on the condition of creating an enabling environment for people to exercise their right to development, within planetary boundaries. To this end and in order to address this particular issue, policy makers could bear in mind the following policy recommendations:

1. Consideration could be given to organizing capacity building activities to raise awareness among farmers about alternative, appropriate, and sustainable non-mechanical cooling options for their crops.
2. At the moment, international development programmes are mainly focusing on the production side of the food supply chain, and to a lesser extent on the cold chain. Ensuring farmers have the necessary tools in their disposal to engage in agricultural activities is vital. However, taking the right steps to make sure the produce reaches the market and the farmer actually has a stable income constitutes a more sustainable and better long-term solution. To this end, international development programmes in cooperation with local authorities and farmers could identify cold chain-related issues and come up with action plans to eliminate breaks in the cold chain.
3. Rural electrification programmes promoting sustainable and renewable sources of energy could make provisions to assist small scale farmers in purchasing equipment powered from such sources to support the cold chain. Capacity building programmes could also be planned to create a pool of technicians to provide after sales services.
4. Nowadays, women comprise approximately half of the agricultural workforce worldwide (FAO, 2015c). Considering that they are drivers of sustainable development for their families and communities, financial institutions could consider establishing micro-crediting programmes dedicated to cold chains and targeting women farmers and cooperatives.

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