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Positive
Off-Grid Solutions



**"1/3 of produce
that is harvested
worldwide every
year gets wasted"**

United Nations

**Could Off-Grid Refrigeration
End World Hunger?**



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FOOD LOSS AND WASTE (FLW) SCENARIO: GLOBAL AND DEVELOPING COUNTRIES

Key Facts

Each year, the world loses or squanders a third of the food it produces. This means that somewhere between planting seeds in the fields and providing nourishment to the world's 7 billion people, approximately 1.3 billion tonnes of the food with a value of more than US \$1 trillion is lost or wasted. These numbers are simply untenable in a world where according to Food and Agricultural Organisation (FAO), some

million people do not have enough to eat. In fact, according to the FAO-commissioned study that tallied these numbers, if just one-fourth of lost or wasted food were saved, it could end global hunger. When the study results were released, they focused global attention on the need to improve the efficiency of food-production systems. In parallel, FAO has established SAVE FOOD, a global initiative involving coalition of partners from the public and private sector focused on reducing loss and waste.

According to the United Nations, one-third of produce that is harvested worldwide every year gets wasted: that is 1.3 billion tonnes of food wasted, that could feed two billion people in the world.

All over the world, only 40% of food is getting eaten by humans, and the other 60% gets wasted. Borgen Project data presents that medium and high-income countries have the highest levels of waste and it occurs at the consumption stage when consumers discard food that is still suitable for human consumption. Annually, food waste in rich countries records

almost as much food (222 million tonnes) as the entire net food production of sub-Saharan Africa (230 million tonnes).

In developing countries, 45% of fresh produce spoils because of the lack of access to cold storage, which is one of the main methods of food preservation.





In most African nations, like most low-income countries across the world, these losses (40%) tend to occur early in the food supply chain - between the field and the market. Unlike industrialized countries, much less food is wasted at the consumer level.

While industrialized countries waste more food per capita than developing countries, low-income countries lose food at the beginning or in the middle of the food chain. This is long before it reaches consumers, because of a host of reasons and the impact of financial, technical, and other limitations.

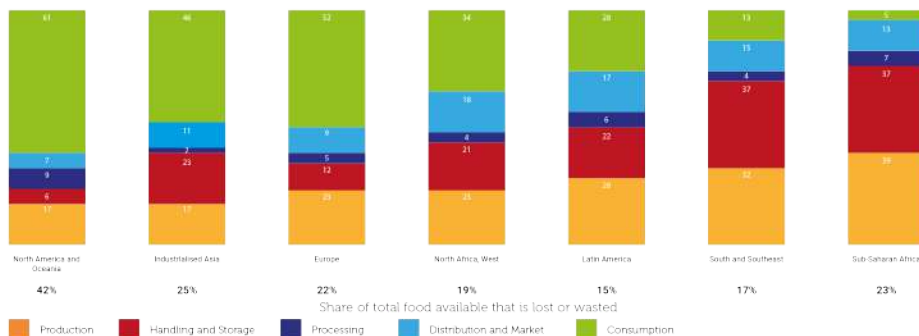
Improper harvesting techniques, handling and processing practices, inefficient stockpiling and storing, and inadequate supply chain infrastructure are instrumental factors in food losses in Africa. The post-harvest loss in Sub-Saharan Africa is estimated to be US\$4 billion every year – or enough to feed no less than 48 million individuals.

Food losses during harvest and in post-harvest impart into lost income for small farmers and into higher prices for poor consumers.

In sub-Saharan Africa alone, 30-50% of production is lost at various points along the value chain.

30% - 80% of produce lost their value before reaching the consumer, according to separate studies conducted at Rwanda, Ghana, Benin, and India. These losses have been observed during harvesting, packing, and shipment to their consumers. The causes of this food loss are predominantly poor practices in harvesting, careless handling of produce, lack of refrigerated storage or poor storage conditions and transportation.

Food Lost or Wasted by Region and Stage



World Resources Institute
<https://www.wri.org/blog/2015/07/why-africa-needs-look-its-cities-end-hunger>

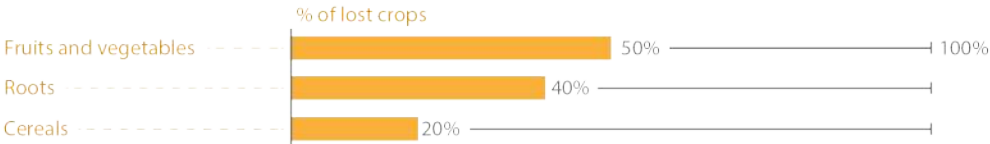
Estimates suggest that about 10 million tonnes of food is wasted in South Africa every year. This is equal to a third of the 31 million tonnes of food produced annually.

The losses comprise 44% fruit and vegetables, 26% grains, 15% meat, and 13% roots, tubers and oilseeds.

Most of this waste and loss occurs early in the food supply chain, where 50% is lost during the post-harvest phase, 25% - during processing and packaging, 20% - during distribution and retail, and 5% - at the consumer level.

For example in Nigeria, it was ranked as the 16th on the global tomato production scale, accounting for 1.2% of the total world production of tomatoes. About 45% of tomatoes harvested in the country is lost due to the poor Food Supply Chain (FSC) management.

Food lost in Africa during post-harvest or processing stage



ATLAS | Data: Rockefeller Foundation

INNOVATIONS AND ISSUE DYNAMICS: Country and value chain perspective



maximizing consumption in the household levels.

In developing countries, where produce is often wasted before they come to the market, preservation is a must. Fresh fruits and vegetables, poultry, meat, and seafood start to deteriorate after harvest. Of course, the quality of the produce is affected and therefore its market value is affected, too. Farmers often lose revenue over the spoilage of food, as farmers lack the capacity to store food safely.

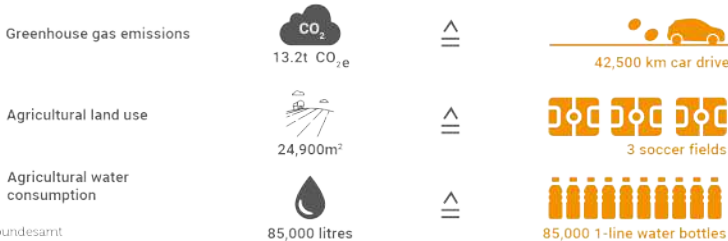
World hunger is one of the most pressing issues that humanity faces and is the one that should be promptly addressed. However, with a rapidly growing population (it is expected that the population will reach 8.5 billion by 2030) the resolution of the food wastage issue is urgent.

Such shortages of capacity are still continuous. The Food and Agriculture Organization reports that largely because of a lack of infrastructure for refrigeration, transportation and sanitary and airtight storage, 15 to 20 percent of grain crops in sub-Saharan Africa and about half of fruits and vegetables get spoiled before they reach to the market.

Sub-Saharan Africa is the region with the highest prevalence of undernourishment, affecting about one in four people and an estimated 30% to 40% of food produced on the continent for human consumption is lost or wasted.

Food waste or losses also have an impact on climate change, because we use resources to produce food that we will not use. It has an impact on the production of greenhouse gas emissions and consequently on climate changes. In developing countries, as farmers lose their produce due to spoilage or during harvest, their income reduces and results in a higher price for poor consumers, who can't afford to pay for the food. Reducing food losses is one of the ways to improve livelihoods and food security of small farmers and poor consumers.

Environmental impacts of food waste (per 100 persons)



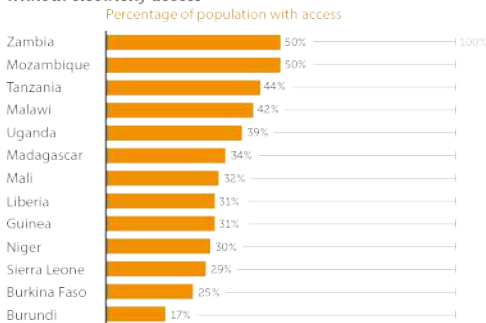
Source: Umweltbundesamt

Access to Electricity

There are several ways to preserve crops and other food produce, like the traditional drying or preserving methods. However, the demand for fresh produce is higher than that of the preserved foods. One of the best ways to preserve food is to do it through refrigeration.

According to research by the Nottingham University, lack of access to cold chain technology is one of the major reasons for the spoilage after harvest. Although there is a big investment in the production of food (95% of agricultural resources are invested in the production of food), only 5% is invested on its preservation.

African countries with a majority living without electricity access



ATLAS | Data: Afrobarometer

This technique, however, requires a substantial amount of capital, which most small-scale farmers in the developing countries could not afford. Also one of the problems that the farmers face in developing countries is the limited or lack of access to electricity.

Access—defined as living within the range of an electrical grid—remains a major mitigative factor among some countries. While the

average percentage for access to electric grids across the continent stands at 66%, according to the study of Afrobarometer which was surveyed for the 36 African countries, 13 countries still have 50% or less of their populations with any access to electricity.

Government and Private Sectors Interventions

Governments can also help in avoiding food losses, by investing in infrastructure, like roads, to facilitate the commercialization of food, electricity, and water to process food. It is also important to invest in research and extension, to identify where the food chain food losses are happening and how to tackle them.



Marketing is another important factor to consider. Consumers in the developed countries do not see the “imperfect” product in the supply chain, as only the aesthetically appealing produce is being imported to their market. Behaviour and preferences on this aspect should be encouraged, as well as, taking more accountability on food waste.

Encouraging private investment and civil

society that helps small farmers access existing solutions that are proven to maximize yield and move more food to the market along with creating alternatives to oversaturated local markets by building partnerships between smallholder farmers and big companies can also play a significant role in the solving the issue of food loss.

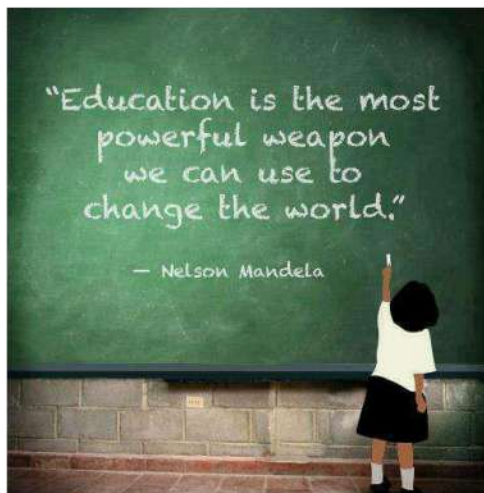
Microfinancing initiatives that invest in small-scale farmers can greatly alleviate the waste load. Through education of how food waste occurs and what is being done to prevent it, small farmers can gain a better grasp on the solutions being implemented. Educated farmers can greatly benefit from increased access to waste-reducing technology and equipment.

Knowledge gaps and technology

Even when countries have more reliable modern storage technologies available for their usage, such as the case with the grain sector in Nigeria and Ghana, workers at these facilities may lack proper training. This has imparted into significant post-harvest losses of up to 50%, attributed to the lack of adequate knowledge and implementation of sound grain storage management.

For smallholder farmers who lose most of their products during harvest, technology can be useful. They should be provided with requisite technology and get trained to prevent post harvest loss and help with food processing and distribution.

There are many innovative technologies available to assist farmers improve retention rates of their harvested produce but without adequate training to implement new technologies, losses may not be mitigated.



REDUCING FOOD LOSSES CLOSE TO THE FARM: WE CAN DO THIS

Refrigeration and alternative power sources

The lack of access to cold chain technology is one of the reasons food waste is abundant in tropical areas. For example, even though India is the top leading producer of bananas, it only holds 0.3 percent of the world's market. Some of this gap can be attributed to lack of refrigeration and reliable energy sources. By providing a better system of refrigeration, the food loss would be cut by 25 percent.



Renewable energy resources like hydropower, wind, and solar can be used to power 24/7 refrigeration for this produce. By utilizing off-grid power resources, the farmers can prolong the freshness of their produce, until its delivery to the consumers.

In this case, solar energy is the best alternative source of power to use, since the sun shines all across the globe, it can be used anywhere. Solar panels that are used to catch sunlight and convert it into electricity are also cheaper than the other alternatives, and they come in a variety of shapes and sizes to suit the needs of the consumers.

The most important part of using solar power is its low impact on the environment. Unlike burning fossil fuels which release a substantial

amount of toxic gases in the atmosphere, solar power's greenhouse gas emissions are inconsequential.

There have been designs of a solar-powered refrigeration system for 24/7 storage and preservation of produce. These companies promise at least 80% reduction in post-harvest loss and bigger revenues for the farmers, who will use the technology.

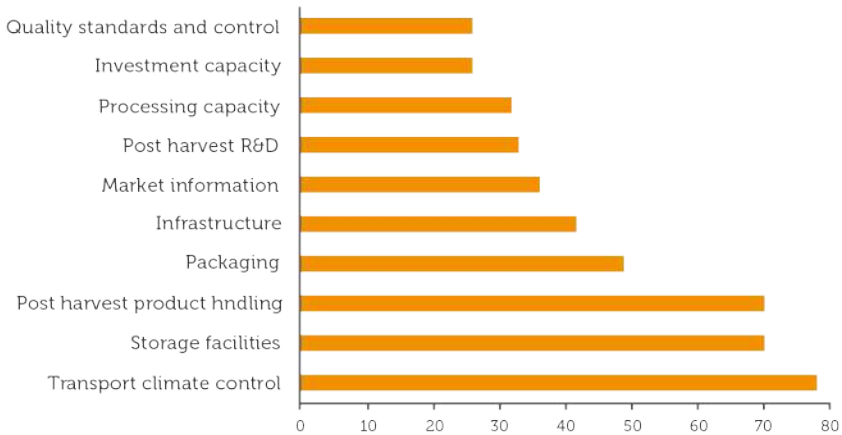
Refrigeration holds unique potential to unlock economic and social progress for the 600 million people living without a reliable power source in sub-Saharan Africa. Refrigeration can prolong the nutritional value of food, diversify diets, enable income-generating activities, and reduce the time that households spend on shopping or gathering food.

The marketplace for off-grid refrigeration is nascent, and refrigerators have yet to penetrate the non-reliable powering market in sub-Saharan Africa in a significant way. To be viable in the market that lacks a reliable market, refrigeration solutions must be significantly more efficient and lower in cost than conventional products.

It's a win-win situation: people get to consume fresh food, there will be less food wastage and spoilage, farmers will get more from their crops and produce, and the environment is protected because of the solar technology that will be used in off-grid refrigeration.

CONCLUSION

Main categories for causes of postharvest losses (in %)



Source: Aramyan and Van Gogh (2014)

The post-harvest loss (PHL) issue in Africa is a big concern for a wide group of stakeholders, as its costs are vast:

- The amount of food lost each year due to PHL is enough to feed the total number of undernourished people globally.
- In sub-Saharan Africa (SSA) alone, 30–50% of production is lost at various points along the value chain.
- FLW causes as much as \$940 billion per year in economic losses.

Numerous organizations and groups are putting significant effort into advancing the issue, but there is a massive information gap.

Refrigeration holds unique potential to unlock economic and social progress for the 600 million people living without reliable power in sub-Saharan Africa. Refrigeration can prolong the nutritional value of food, diversify

diets, enable income-generating activities, and reduce the time that households spend shopping or gathering food.

Social and Environmental impacts of having off-grid refrigeration and cooling systems could include:

- Reducing Food Waste – refrigeration helps extend the shelf life of perishable food also means reducing post-harvest loss by 80%
- Increase Local Farmer Income – by reducing PHL, smallholder farmers would have more of their harvest to sell thereby increasing their annual income
- Reduce Malnutrition - more nutritious food will be available to rural and urban dwellers, especially children.
- Use of Renewable energy - using an energy source that is not renewable is absurd. Fossil fuels are not renewable; at least at the rate

we are consuming them. So it makes sense to use sources of energy that are completely renewable, and that can be shared. Renewable energy is also more sustainable long term, and that's just smart living.

- Positive Environmental Impact - Global warming has been a major topic of global political discussion, and with good reason – climate change is projected to significantly alter the way we live over the next century. Switching to renewable energy and staying off the grid can lessen global emission rates. The impact you can personally make by going off the grid is huge. Over the course of 30 years, a single residential solar array will offset 178 tonnes of carbon dioxide, and a personal wind turbine will offset 200 tonnes of greenhouse gases over the same amount of time. Using both can significantly reduce your carbon footprint.
- Financial impact on solar installation – immediate and lifetime savings are some of the most important elements to consider in installing off-grid refrigeration

Food insecurity may be one of the biggest problems facing humanity nowadays, but it is not an impossible problem to solve. It however may take a lot of effort from the different sectors of the community: from the government, the investors, to the farmers themselves.

The first step towards food security is to create awareness on the problem and educating the community especially the farming and fishery communities and educate them on the importance of correct handling and preservation of their products for longevity

and boosting their revenues, not to mention helping more people to have better access to fresh produce.

In the part of the government, especially in the third-world countries, while most of them invest in better policies on helping farmers in terms of food production in stages of land preparation, providing irrigation to farms, creating farm to market roads for proper accessibility, loaning out money for seeds, pesticide and fertilizer and giving education for farmers to help in crop yield gains, the governments could assist this change by investing in studies about post-harvest losses and how to curb the numbers to benefit more people. Another way is to invest in improved storage methods that can drastically cut post-harvest loss percentages to almost zero, or the sustainable 24/7 solar storage, among others.

On the farmer's part of course, they should be open to innovation. While some traditional produce preservation techniques are quite effective, there is still a high chance of losses through several factors such as pests and temperature conditions. Therefore, they should be prepared to invest in preservation technology that will help them in the long run.

The issue on post-harvest loss is one of the more important but highly overlooked problems. If this problem is addressed all over the world, then it may help in the alleviation of food insecurity and world hunger.

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