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THE POST-2015 DEVELOPMENT AGENDA:
How Food Loss and Waste (FLW) Reduction Can Contribute Towards Environmental Sustainability and the Achievement of the Sustainable Development Goals

Emilie Wieben (FAO)
Issue Editor Hiroshan Hettiarachchi (UNU-FLORES)

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ABSTRACT

The issue of global food loss and waste (FLW), specifically its environmental dimension, was presented at the Dresden Nexus Conference 2015 under the umbrella "Global Change, Sustainable Development Goals (SDGs) and the Nexus Approach". This working paper continues the debate on FLW in the context of sustainable development and explores how FLW reduction can contribute to the achievement of the SDGs, emphasising the broader environmental impacts. Reduction of FLW is explicitly captured under SDG 12, which aims to halve per capita food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses by 2030. *However, as this paper suggests, reducing global food losses and waste could potentially have more extensive and cascading effects that would help facilitate progress towards wider environmental sustainability.*

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1. BACKGROUND

In September 2015, the United Nations Member States agreed on a new set of development goals that will shape the post-2015 agenda on sustainable development to be achieved by 2030. The 17 SDGs (see box 1) along with their 169 targets will replace and build on the Millennium Development Goals (MDGs). As an outcome of Rio+20, the SDGs are part of the implementation of Agenda 21 on sustainable development in all its three dimensions – economic, social, and environmental (United Nations 2015). The SDGs have expanded on the goals and targets in comparison to the MDGs (United Nations, 2000) and it is envisaged that all governments will work towards achieving the SDGs. In this way, the SDGs are more ambitious than the MDGs, as they apply to all countries and are not only goals to be accomplished in developing states through financial assistance from the industrialised countries. This is particularly pertinent for the goals related to ensuring environmental sustainability, as each of them will require committed action from every country, both domestically and internationally.

Box 1: The Sustainable Development Goals

- **Goal 1.** End poverty in all its forms everywhere
- **Goal 2.** End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- **Goal 3.** Ensure healthy lives and promote well-being for all at all ages
- **Goal 4.** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- **Goal 5.** Achieve gender equality and empower all women and girls
- **Goal 6.** Ensure availability and sustainable management of water and sanitation for all
- **Goal 7.** Ensure access to affordable, reliable, sustainable, and modern energy for all
- **Goal 8.** Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
- **Goal 9.** Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
- **Goal 10.** Reduce inequality within and among countries
- **Goal 11.** Make cities and human settlements inclusive, safe, resilient, and sustainable
- **Goal 12.** Ensure sustainable consumption and production patterns
- **Goal 13.** Take urgent action to combat climate change and its impacts
- **Goal 14.** Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
- **Goal 15.** Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- **Goal 16.** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
- **Goal 17.** Strengthen the means of implementation and revitalise the global partnership for sustainable development

In order to define the universal goals and targets, an unprecedented global stakeholder process was initiated for the Open Working Group of the General Assembly on SDGs to collectively consider the most important issues to address. The outcome of the process has shaped and defined the 17 SDGs along with their accompanying targets.

Details on each goal and their specific targets can be accessed here: *https://sustainabledevelopment.un.org/content/documents/1579SDGs%20Proposal.pdf*

1.1 The Global Food Loss and Waste Challenge

Achieving the SDGs by 2030 does present major challenges when considering the Earth's capacity to restore, sustain, and provide goods and services to the world's growing population. According to the annual Ecological Footprint studies, the human population continues to consume and deplete natural resources at a faster rate than the planet's carrying capacity (Global Footprint Network 2015). One of the unsustainable patterns is the issue of food losses and waste (FLW). Global estimates suggest that one-third of all food produced for human consumption is either lost or wasted, amounting to a total of 1.3 billion tonnes (Gustavsson et al. 2011). FLW is addressed under SDG 12 on production and consumption patterns in Target 12.3, which aims to *"by 2030 halve per capita food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses"*. In response to the FLW challenge and Target 12.3 it is important to segregate the underlying causes of losses from those of waste (for FAO's definition on food loss and waste, see box 2). The majority of global food losses – in terms of quantity – occurs in developing countries and is often a result of inadequate storage facilities, poor infrastructure and market access, as well as insufficient management capacity (Gustavsson et al. 2011). Food losses in developing countries have ramifications such as deforestation, ecosystem degradation, natural resource depletion, food and nutrition insecurity and poverty, just to mention a few (e.g. FAO 2013a; Formo et al. 2014; Pearce 2015). Therefore, addressing losses is embedded in the development process by ensuring sustainable food production through access to clean energy and technologies, as well as fostering skills and knowledge capacity. Food waste, on the other hand, is highly related to consumer behaviour and primarily occurs in medium and high-income countries where food is considered expendable. The subject of food waste is demand-driven and strategies to reduce food waste include policies and awareness raising to encourage behavioural changes (FAO 2013b).

Box 2: Definition of Food Loss and Waste

Food loss is defined as a decrease in quantity and quality of agricultural, forestry and fisheries products intended for human consumption that are ultimately not eaten by people. Food losses occur along the supply chain from harvest, post-harvest handling, to storage and processing. Food losses are largely unintentional and are caused by inefficiencies in the food supply chain such as insufficient access to energy and technologies, poor infrastructure and logistics, inadequate market access as well as managerial limitations of supply chain actors. Climatic changes and natural disasters can also lead to food losses.

Food waste refers to food appropriate for human consumption being discarded, either by choice or after the food has been left to spoil or expire as a result of negligence or oversupply. Food waste occurs predominantly, but not exclusively at consumption level and is related to consumer behaviour as well as being policy- and regulation-driven.

Food loss and waste (FLW) is defined as a decrease, at all stages of the food chain from harvest to consumption, in mass, of food that was originally intended for human consumption, regardless of the cause.

Source: FAO, 2014; HLPE, 2014

1.2 Food Losses and Waste and the Environmental Context

When discussing the environmental aspects of FLW it is important to understand the impacts of food production and its connection with the natural environment. Food systems rely on a limited natural resource base as well as the services provided by terrestrial and aquatic ecosystems. Water, energy, and other inputs are also needed to sustain the process and each stage of the food supply chain withdraws from natural capital and generates greenhouse gas (GHG) emissions that contribute to climate change (Vermeulen, Campbell, & Ingram 2012). Integrated food systems approaches are critical to improve efficiency, productivity, and resilience and central to this is addressing current levels of FLW. Ensuring that food is handled and consumed more sustainably over the next 15 years requires ambitious and collective global efforts, and transformational change is needed at both macro and micro level. Nevertheless, as this paper will highlight, reducing FLW would have positive impacts on the environment and is necessary for inclusive green growth and sustainable development (3GF 2015). Achieving Target 12.3 would exceed its contributions towards accomplishing SDG 12 and could facilitate the process for several other SDGs, particularly the goals related to ensuring environmental sustainability. Furthermore, while this is beyond the scope of this paper, the achievement of Target 12.3 is also likely to have influence on the remaining SDGs in terms of contributions towards food and nutrition security, poverty alleviation, and social protection, among others.

2. ACCELERATING PROGRESS ON THE SDGs AND ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability is influenced by external factors such as climate change, natural resource use, ecosystem functioning, energy usage, economy, population growth, and urbanisation – all of which are captured in the SDGs. Seven of the SDGs directly concern the environment while other goals contain elements that are indirectly connected. The seven "environmental goals" relate to agriculture (SDG 2), water (SDG 6), energy (SDG 7), production and consumption (SDG 12), climate change (SDG 13), marine resources (SDG 14), and terrestrial ecosystems (SDG 15). An additional two goals are included in this paper because of their indirect relevance; ensuring sustainable economic growth (SDG 8) and the final goal on global partnerships (SDG 17), which outlines the enabling framework and approach for achieving the new sustainable development agenda. Therefore, in order to assess the broader environmental impacts of FLW reduction, its potential contribution towards the achievement of the aforementioned nine goals is examined in this section.

2.1 Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

SDG 2 is aimed at eradicating hunger in all its forms while meeting the growing demand for food through sustainable agriculture. Reducing FLW is expected to increase food availability and thereby contribute to improved efficiency of agricultural production and consequently food and nutrition security (HLPE 2014). Additionally, reducing the amount of food that is lost or wasted is a prerequisite in the context of promoting and eventually achieving sustainable agriculture. In order to improve productivity and efficiency in agriculture as well as making food systems resilient to climate change, concrete action to reduce FLW levels is necessary towards the achievement of SDG 2. Otherwise FLW will simply become a bottleneck factor by undermining efforts to strengthen agricultural sustainability. Moreover, targets under SDG 2 include increased investment in the agriculture sector for technology, rural infrastructure, and research. Investments in food loss interventions for improved global value chains are likely to complement to some extent what is needed to transform the agriculture sector. Addressing policies and regulations that lead to food waste, such as certain agricultural subsidies, would also contribute to improvements and equity of food commodity markets, while reducing losses could potentially act as buffer on food price volatility. Also, adjusting subsidies would make more efficient use of public funds by reducing current subsidies spent to produce food that is ultimately not consumed by people.

2.2 Goal 6: Ensure availability and sustainable management of water and sanitation for all

The demand for freshwater resources is increasing at an unsustainable rate and water withdrawal for agricultural production constitutes one of its greatest pressures (FAO 2015a). Water is used throughout the food supply chain although most is consumed at the production stage for irrigation. FLW results in enormous wastage of water resources and represents a significant issue in the context of increasing water scarcity and adverse impacts from climate change. Estimates show that 250 km^3 of blue water (withdrawal of surface and groundwater resources) is consumed to produce food that is lost or wasted (FAO 2013a). As part of SDG 6, FLW reduction would contribute to improved water-use efficiency in the agriculture sector and mitigate risks of water scarcity. In addition, reducing FLW would make more sustainable use of resources thereby putting less pressure on ecosystems, including aquatic and other water-related systems.

2.3 Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all

SDG 7 is aimed at improving energy access, which is essential for development – primarily in the least developed countries. Targets under SDG 7 also aim to ensure that renewables constitute an increasing proportion of the energy mix as well as improve energy efficiency, particularly through technology transfer and by promoting investment.

Food systems consume about 30 per cent of global available energy and out of this proportion, 38 per cent is utilised to produce food that is either lost or wasted (FAO 2015a). Reducing FLW therefore presents a relatively cost-effective opportunity for energy saving and to improve efficiency (FAO 2011). At the same time, food losses in low-income countries are often connected to the lack of access to energy, particularly in the post-harvest phase (Flammini & Puri 2015) . Technologies that require modern energy for processing, cold storage, and packaging are important solutions to reduce losses in developing countries. However, many of these technologies rely on fossil fuel combustion to generate electricity or heat for the different stages of the supply chain (Sims & FAO 2011). In order to make the transition towards 'greener' food value chains that reduce both food losses as well as fossil fuel dependence in food systems, it is important to upscale the access to clean or low-carbon technologies. Increased deployment of technologies that use renewable energy (biomass, wind, solar, hydro or geothermal resources) would improve sustainability of the supply chain while reducing losses in developing countries. For instance, agricultural residues and bi-products that are not used for improving soil quality or animal feed can be utilised as biofuel in the food supply chain. Altogether, these measures would facilitate the progress towards SDG 7 and also contribute to the research needed to achieve the goal by identifying best practices for sustainable, energy-efficient solutions to food losses.

2.4 Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

A sustainable economic growth can only be achieved by diverting from a business-as-usual approach and there is a growing consensus towards the need for decoupling economic growth from environmental degradation (UNEP 2011). This is particularly addressed under SDG 8 Target 8.4, which emphasises the need to improve resource efficiency in consumption and production, with developed countries taking the lead. While FLW solutions are only a fraction of the efforts needed to achieve inclusive green growth, actions on FLW will no doubt contribute to the target of sustained economic growth without compromising environmental integrity. Furthermore, developed countries will play an important role in identifying and sharing solutions that lead to a halving of food waste. This is pertinent when considering that consumption patterns tend to change according to economic growth and along with this, an increase in food waste at consumer level. As more countries reach middle-income status, lessons learnt on best practices for preventing food waste could potentially facilitate their sustainable transition by not adopting the current waste patterns of the industrialised countries.

2.5 Goal 12: Ensure sustainable consumption and production patterns

SDG 12 aims to ensure global sustainable consumption and production, which are intrinsically linked to reducing current levels of FLW and addressed in Target 12.3. Other targets within SDG 12 include sustainable and efficient management of natural resources, reduced chemical and waste generation, and promoting sustainable practices in the public and private sector. Much of this is related to improving value chains and making food systems more efficient. Food production relies on an ecological resource base that has to support multiple needs of the global industry. Limited land area is needed for food production, animal feed, timber, biofuels, fibre, etc., often at the expense of natural forest lands. Likewise, aquatic ecosystems and fish stocks have to support a growing global fisheries industry, including fish feed for aquaculture. All these products are transported and traded across continents and additional inputs are needed for each activity in the supply chain. Production patterns are driven by demand, which, when looking on the amount of waste, may indicate that supply levels are exceeding actual needs in some parts of the world. Furthermore, trade mechanisms such as subsidies are in some cases also encouraging a surplus food production.

Ensuring sustainable production and consumption, partly through FLW reduction, calls for adjustments along all the stages of the food supply chain. However, addressing FLW is complex and multidimensional and requires strategies that lead to structural changes. Furthermore, while reducing FLW is a crucial part of sustainable consumption and production it is important to consider the potential environmental trade-offs such

as increased energy consumption for cold storage, processing, and transport or more widespread usage of packaging material (FAO 2013a). Therefore, in order to take full advantage of the environmental benefits that large scale FLW reductions offer, it is necessary that measures include the most environmentally-sound solutions available if sustainable production and consumption are to be achieved.

2.6 Goal 13: Take urgent action to combat climate change and its impacts

SDG 13 concerns perhaps the greatest global challenge of our time and aims for urgent and long-term responses to combat climate change. As climate change is primarily addressed by the international community through the United Nations Framework Convention on Climate Change (UNFCCC) process, targets under SDG 13 are mainly highlighting the overall means to achieve this.

Looking at food production in the context of climate change, agriculture is both a major contributor and victim of climate change. Climate change is already having an impact on agriculture and food security and this is projected to increase, posing serious risks to global food production (IPCC 2014). At the same time, food systems account for up to 30 per cent of global GHG emissions (Vermeulen et al. 2012) and FLW contributes to this. Global FLW is estimated to account for 3.6 Gt of CO_2eq/yr, with an additional 0.8 Gt of CO_2eq/yr from deforestation and managed organic soils, and is responsible for about 8 per cent of global GHG emissions (FAO 2015b). Efforts that reduce FLW are therefore important from a climate change mitigation perspective. Furthermore, preventing losses in vulnerable regions is also a critical factor for improving resilience, adaptation, and disaster risk management. Overall, achieving Target 12.3 within the broader response to climate change is essential because of its collective contribution to three overall objectives: mitigating climate change by reducing the emissions embedded in FLW, strengthening resilience to cope with climate change, while also improving food and nutrition security. FLW reduction measures that support climate-smart food systems should therefore be considered and integrated into climate change action plans as additional opportunities towards achieving SDG 13.

2.7 Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

SDG 14 is aimed at conservation of marine ecosystems and sustainable resource exploitation and considers all activities that are impacting the world's oceans and seas. The main aspect of SDG 14 and its targets is to transform the fisheries sector to effectively and sustainably manage marine resources, to improve ecosystem health and productivity, and to eliminate drivers of overexploitation. Each year, approximately 35 per cent of global fish and seafood products are either lost or wasted with a considerable proportion due to discard at catch

level (Gustavsson et al. 2011). This number is unacceptably high, considering that marine stocks and their supporting ecosystems are overexploited and degraded worldwide due to poor governance, management, and fishing practices. SDG 14 has put forward ambitious targets that aim to achieve sustainable management of marine ecosystems. Targets include ending overfishing, illegal, unreported and unregulated fishing as well as harmful subsidies, to ultimately ensure the recovery of fish stocks to levels that can produce their maximum sustainable yield. In order to achieve this, drastic measures to cut fish losses and waste would be needed, along with a transformation in marine resource governance and management. Nonetheless, reducing FLW of seafood products would contribute to a more sustainable resource use by maximising utilisation of the resource. Furthermore, if certain subsidies are eliminated and discarding is banned, this could potentially make FLW reduction a cost-effective solution towards achieving SDG 14.

2.8 Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SDG 15 encompasses the conservation, restoration, and sustainable use of terrestrial ecosystems and their biodiversity. Ensuring the protection of forests, wetlands, mountains, and soils depend on whether drivers of terrestrial ecosystem degradation are properly addressed. Agriculture, along with infrastructural development and urbanisation are major competitors for land, leading to land degradation, deforestation, and loss of biodiversity. Agricultural activities in particular have impacts on soils, forests, nutrients, freshwater, etc. and it is increasingly recognised that sustainable land use management has to follow an integrated approach (United Nations 1993). The land use sector has to be more productive by making more efficient use of the resources available. Current estimations indicate that roughly 28 per cent of the world's agricultural land area is occupied to produce food that is never consumed by humans (FAO 2013a). This emphasises the cross-cutting issue of FLW and how it is indirectly impacting natural lands through the inefficient and unsustainable handling of food. The challenges and opportunities of food loss reduction, including the indirect impacts must be recognised at national, cross-ministerial, and multi-sectoral level. Measures related to Target 12.3 should be integrated into existing development plans, sectoral strategies, and other appropriate policies and guidelines relevant to sustainable land management.

2.9 Goal 17: Strengthen the means of implementation and revitalise the global partnership for sustainable development

SDG 17 aims to enhance global partnerships to accelerate sustainable development and the achievement of the SDGs. The aim is to facilitate the mobilisation and access to finance, technology transfer, capacity building for implementation, and trade. In

line with this approach, the Global Initiative on FLW Reduction – SAVE FOOD – was established in 2011 with an objective to address the issue of unsustainable amounts of food being lost or wasted worldwide. Spearheaded by FAO, the SAVE FOOD Initiative is a global partnership of actors and stakeholders engaged in FLW reduction measures and improves the efficiency of food supply chains. The initiative follows an integrated approach spanning the entire supply chain and involves farmers, industry, policy-makers, and civil society to make significant progress in ensuring that food is handled and utilised more efficiently in the future. The SAVE FOOD Initiative has helped to establish the issue of FLW on the global agenda and the multi-stakeholder partnership holds the potential to collaboratively reduce FLW at global level and achieve Target 12.3 by 2030.

The assessment of the selected SDGs in the context of Target 12.3 highlights the critical and interdependent relation between addressing the causes of FLW and achieving the environmental goals. Figure 1 summarises how delivering on Target 12.3 will have cascading impacts that can facilitate the transition towards a sustainable pathway. The collective actions to reduce FLW will have broader impacts that go beyond Target 12.3 and can accelerate progress for sustainable food systems, enhanced climate action, and towards inclusive green growth.

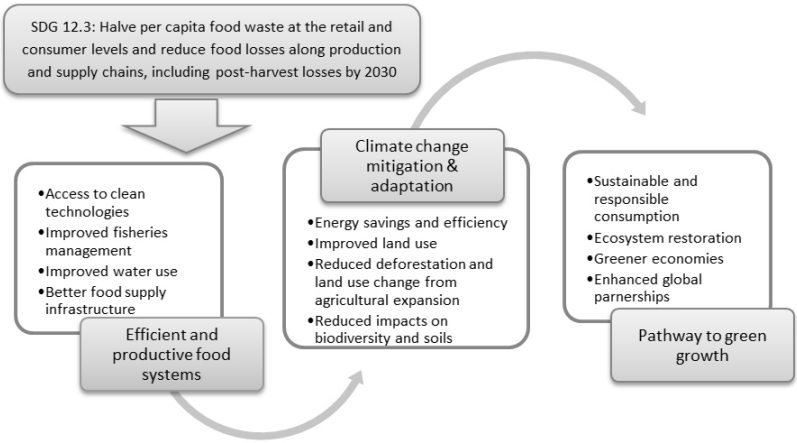

Figure 1: Illustration of the direct and indirect environmental benefits of achieving Target 12.3 and the cascading impacts.

3. SELECTED EXAMPLES OF ADDRESSING FLW CHALLENGE

Two case studies are presented here to demonstrate how actual FLW reduction measures can enhance environmental benefits on the ground. Both studies represent concrete examples of how technology interventions can reduce losses while at the same time overcome some of the sustainability challenges pinpointed in the SDGs.

3.1 Improved Fish Smoking with the FTT-Thiaroye Processing Technique: An Innovation for Post-Harvest Loss Reduction in Fisheries and Aquaculture

Fish smoking and drying are preservation techniques that are widely used in small-scale fisheries communities around West and Central Africa. Processing fish is also an important strategy to reduce losses by significantly increasing shelf-life, which ranges from 3–6 months, making transportation over long distances possible. This is advantageous as compared to fresh or frozen fish, which require energy-intensive cold storage that is largely inaccessible due to electricity scarcity in rural areas. Fish smoking techniques in the region are traditionally based on open kilns using mangrove wood as the main source of fuel because of its accessibility and ability to burn under wet conditions. However, these artisanal techniques are highly energy-consuming, release contaminants, and it is estimated that fish smoking and processing activities have resulted in the degradation and loss of more than 40 per cent of mangrove forests in the region ((UNEP-WCMC 2007) in: Ajonina et al. 2014).

The FAO-Thiaroye processing technique (FTT-Thiaroye) consists of a dual functioning smoking oven and mechanical drier and is specifically designed to improve fuel-efficiency in small-scale fish smoking by encapsulating heat and smoke. This innovative technology aims to address the shortcomings of the traditional, inefficient open-fire smoking with the introduction of energy-efficient smoke and drying ovens. The FTT-Thiaroye technology contributes to energy efficiency (SDG 7) in rural communities by using 50 per cent less wood fuel compared to traditional open-type smoking rafts (Ndiaye, Komivi, & Ouadi 2015). Agricultural residues such as coconut husks, sugar-cane bagasse or manure can also be utilised as fuel in substitution for mangrove wood. Reducing the intensity of mangrove wood harvesting will benefit the mangrove ecosystems and biodiversity through reduced deforestation and degradation of mangrove forests (SDG 15). This will contribute to climate change mitigation as mangroves have some of the highest carbon storage and sequestration potential of all terrestrial forest systems (Donato et al. 2011) while building resilience to climate change impacts through coastline protection (SDG 13). Mangrove ecosystems also play a crucial role as nursery grounds for many

aquatic and marine species by providing refuge for part of their life cycles and supporting healthy fish stocks (SDG 14). The FTT-Thairoye technology also does not release any contaminants such as carcinogens and tar directly onto the product, and is therefore in compliance with international food standards and other safety requirements while reducing quality losses during smoking (SDG 12). Additionally, processing operations can be conducted in any season thereby enabling drying activities during rainy and cloudy periods, which prevents losses otherwise due to insects, pests, and spoilage from open air exposure. This protects businesses and commercial activities of small-scale fish operators from quality and market force losses (SDG 2, SDG 8) while altogether contributing to sustainable production and consumption (SDG 12).

3.2 Climate-Friendly Cold Storage Options for the Agri-Food Sector

Refrigeration is an effective means for food preservation and to prevent rapid food deterioration caused by ambient temperatures. This is particularly the case for perishable foods such as fruits, vegetables, meat, fish, and dairy products where proper cold storage is essential to increase storage life, maintain quality, and prevent spoilage. Cooling and freezing also offer opportunities to food suppliers to store products for a longer period allowing for leverage against price fluctuations until optimal market conditions are met. As the middle class in emerging economies continues to grow, cold chain systems are expected to become more widespread along with changes in consumption patterns towards more meat-based diets (FAO/ERBD 2015). However, the development of cold chain infrastructure based on fluorinated GHG (F-gases) refrigerants would result in a rapid increase in associated emissions and impacts to climate change. Cold chains are already estimated to account for approximately 1 per cent of global GHG emissions and consume up to 15 per cent of global electricity, even though less than 10 per cent of perishable foods are currently being refrigerated (James & James 2010). About 29 per cent of the total GHG emissions from the refrigeration sector are from direct emissions due to leakage of F-gases such as HFCs along with ozone depleting substances (HCFCs and CFCs), now being phased out through the Montreal Protocol. The indirect emissions (around 71 per cent) arise from extensive global use of inefficient refrigerator appliances that have high energy demand generated from the combustion of fossil fuels or from grid electricity (GIZ 2015). Addressing FLW through cold chain extension without any technology improvement would have serious adverse effects on climate change and is not an environmentally-feasible option to be considered.

FAO and the European Bank for Reconstruction and Development (EBRD) are collaborating to monitor the adoption of key sustainable climate technologies in the agri-food sector, including options for low-emission cold storage. A shift towards climate-friendly refrigerants such as hydrocarbons, CO_2, ammonia or water will reduce the dependence on F-gases. Along with a technology upgrade in refrigerants, energy efficiency measures

(e.g. insulation) in cold chains and renewable energy applications for generating cooling power should also be encouraged. The FAO/ERDB project is targeting countries in the Southern and Eastern Mediterranean region and Central Asia; regions which are characterised by natural resource scarcity, particularly in terms of arable land and water as well as being food import-dependent. Cold storage dissemination that reduces FLW in the resource scarce areas is expected to contribute to more efficient use of natural resources (SDG 2, SDG 6, SDG 12), while indirectly reducing pressures on the surrounding land (SDG 15). As it is assumed that technologies currently in place are generally outdated, the energy saving potential of the conversion to energy-efficient, low-emission refrigerants is expected to be high (SDG 7) and will contribute to sustainable production in the value chain (SDG 12). Additionally, given the significant mitigation potential of low-emission cold chains, their implementation also presents an opportunity to mobilise the necessary investments through climate finance, carbon pricing instruments as well as other energy-regulating policies (SDG 8, SDG 13).

3.3 Key Points for Consideration

The two case studies have illustrated how improved technologies can help reduce losses while having a positive contribution to the environmental objectives of the SDGs. They also highlighted the role of energy when tackling post-harvest losses in developing countries. Improving access to modern energy will likely have a significant impact on loss reduction but will also increase energy consumption in food supply chains. Scaling up renewable energy and energy efficiency measures along with clean technology transfer presents a key opportunity to transform food production systems. However, significant investment is needed, particularly for overcoming barriers related to capital costs. Emphasis should therefore be targeted at improving access to finance while encouraging appropriate policy incentives and building management capacity. Bringing together governments, food producers, and investors can help to identify challenges and opportunities for addressing deficiencies in food systems and accelerate the deployment of sustainable technologies in food supply chains. Combining such efforts with sustainable agricultural practices and consumption patterns can pave the way towards safeguarding environmental resources and ultimately meeting the goals and targets set out in the new development agenda.

4. CONCLUSION AND THE WAY FORWARD

In 2015 the world saw the adoption of the SDGs and the Paris Agreement and affirmed universal commitment to ensure that development is set on a more sustainable track and ambitious action is taken on climate change. This paper has explored how one measure – reducing current levels of FLW – can facilitate the road towards a more sustainable future. The cascading effects of changing unsustainable patterns in food production and consumption illustrate how improving efficiency in food systems could potentially have much broader implications for environmental sustainability. Reducing global FLW is both a logical and an important opportunity to integrate actions in food supply chains with sustainable development objectives, as part of achieving the SDGs. The work ahead to achieve Target 12.3 would contribute to making food systems more productive and efficient, thereby reducing their impacts on ecosystem exploitation and overall environmental degradation. Actions towards Target 12.3 would also prioritise investment and governance towards low-emission technologies, clean energy access, and rural infrastructure, facilitated by a global multi-stakeholder partnership in the food supply chains. The collective actions to achieve Target 12.3 will altogether contribute considerably to reduce global GHG emissions while making food systems more resilient and productive.

Universal commitment to achieve the SDGs and their targets is crucial, considering a growing global population adding more pressure to the planet's limited resources and its restorative capacity. Sustainable development requires transformational change globally, which is also reflected in the issue of FLW. The work towards achieving Target 12.3 requires addressing broader development and behavioural challenges and solutions will only be effective if FLW is tackled throughout the entire food system. While the response to FLW will vary according to regions, the issue and responsibility is nevertheless global and requires action from all countries. It is unacceptable that natural resources are being depleted and vital ecosystems are degraded to produce food that is ultimately not consumed, while nearly 795 million of the world's population are chronically undernourished. This waste of resources is also aggravating climate change which in turn will have severe impact on food productivity in the coming decades. We need to change our mindset on how we value and consume resources and make it a priority to prevent FLW. A high level of ambition is critical for Target 12.3, but its achievement would have much broader impacts and presents a pathway to environmental sustainability that should not be missed.

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WATER, SOIL AND WASTE
DRESDEN NEXUS CONFERENCE

ABOUT UNU-FLORES

MISSION

"Advancing a Nexus Approach to the sustainable management of environmental resources"

In line with the general mission of UNU to foster sustainable development, UNU-FLORES aims to contribute to the resolution of pressing challenges to the sustainable use and integrated management of environmental resources, such as water, soil, and waste. UNU-FLORES strives to advance the development of integrated management strategies that take into consideration the impact of global change on the sustainable use of the environmental resources. To this end, the Institute engages in research, teaching, advanced training, capacity development, and dissemination of knowledge.

VISION

UNU-FLORES acts at the forefront of initiatives promoting a Nexus Approach to the sustainable management of water, soil, and waste. The Institute supports the overall mission of UNU as a think tank for the United Nations and its member states, in particular addressing the needs of developing countries and emerging economies. In this role, UNU-FLORES aspires to become an internationally recognised hub and intellectual focal point promoting integrated management strategies.

ORGANISATIONAL STRUCTURE

The organisation of UNU-FLORES into five academic units – three core scientific units (Water Resources Management (WRM), Waste Management (WM), and Soil and Land Use Management (SLM)), supported by two cross-cutting units (System Flux Analysis Considering Global Change Assessment (SFA) and Capacity Development and Governance (CDG)) – supports the think tank function of the Institute.

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ABOUT DRESDEN NEXUS CONFERENCE

As a hub for initiatives on the Nexus Approach, UNU-FLORES is not only committed to strengthening its own network but also to providing an international platform to foster cooperation and networking amongst all actors working on or with the Nexus Approach to managing environmental resources. That platform is the biennial Dresden Nexus Conference (DNC).

Every two years UNU-FLORES organises a DNC, welcoming scholars, politicians, and practitioners from all regions of the world to meet and discuss the most recent and innovative initiatives on a Nexus Approach to the management of environmental resources.

DNC2015: Global Change, Sustainable Development Goals, and Nexus Approach

Building on the outcomes of the 2013 "International Kick-Off Workshop on Advancing a Nexus Approach to the Sustainable Management of Water, Soil and Waste", UNU-FLORES organised the inaugural Dresden Nexus Conference (DNC). From 25 to 27 March 2015 representatives from academia, politics, and civil society assembled in Dresden under the theme "Global Change, Sustainable Development Goals and Nexus Approach". Working together with co-organisers, TU Dresden and IOER, in 2014 UNU-FLORES solicited applications from numerous renowned academic institutions from around the world. Categorised under three key themes – climate change, urbanisation, and population growth – 18 sessions were selected for the first DNC. Comprising of a comprehensive selection of the diverse initiatives on the Nexus Approach, sessions were convened by UN entities, international research organisations, universities, and non-governmental organisations.

In parallel with the organisational activities of the DNC2015, UNU-FLORES arranged for the drafting and distribution of nine position papers to help build and consolidate the background knowledge of the three topics covered during the conference.

www.dresden-nexus-conference.org