

PROSPECTS FOR IMPROVING FOOD AVAILABILITY THROUGH FOOD LOSS AND WASTE REDUCTION

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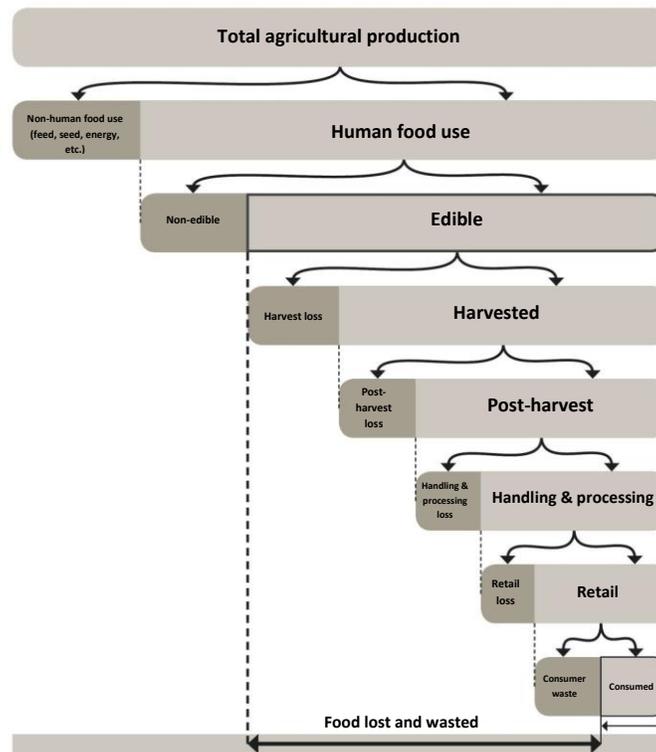
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Introduction

Over the last decade the issue of food loss and waste has received a great deal of attention at all levels, from local to national, regional and global. The issue gained even more emphasis following the 2008 and 2011 food price crises as the idea that reducing food loss and waste could either help reduce the food bill or increase food availability gained increasing traction. The thinking seems attractive as it is often highlighted that about a third of the food produced is lost or wasted though in practical terms it is hard to achieve as food loss and waste cannot be traced to a single or few easily identifiable point source and in many cases might not be even apparent that it is happening.

As defined in the FAO's landmark report by Gustavsson et al (2011), food loss and waste consist of a "decrease in edible food mass" that occurs throughout the food supply chain. Specifically, food loss refers to a decrease in food mass that occurs during the stages of production/harvest, post-harvest handling and storage, processing and retail until prior to consumption and is usually a result of existing gaps in practices and technology. Food waste on the other hand refers to a decrease in food mass that occurs at the retail and consumption stages at the end of the food supply chain and is largely a result of behaviors of market participants, i.e. both retailers and consumers. As shown in Figure 3.1, food loss and waste is presumed to concern only food for human consumption and as such is supposed to exclude edible products reserved for feed, seed or energy to name a few (HLPE, 2014) though not in all cases as will be highlighted below. Food loss and waste includes food spilled, destroyed or discarded and food spoiled or degraded through contamination or pest infestation along the food supply chain from production to retail as well as the food discarded at retail and consumer levels.

Figure 1: Schematic representation of food loss and waste along the food supply chain



Source: Adapted from HLPE (2014)

The concept of food loss and waste is more complex than it sounds and more so as there are still no full agreement neither on a precise definition nor its scope and measurement (Schuster and Torero, 2016). With regards to the definition, though it is agreed upon that food loss and waste concerns the edible part of the food that is not consumed, there is still debate on whether the edible food diverted to other purposes such as bio-energy, animal feed or seed should not be counted as lost or wasted since it results in a reduction of the food mass available for consumption while on the other hand non-edible food parts such as peels, bones, shells, inner core or grains, etc. might be included as food since they are difficult to separate from surrounding edible parts. With regards to the scope, there is still strong debates on determining at which stage food loss and waste should start being recorded as sometimes pre-harvest losses, such as food not harvested or left in the field, are sometimes included some other times not while on the other side food waste occurring at retail and consumption levels is often omitted as it is difficult to measure. With regards to measurement, a number of methodologies are being used some of which might underestimate or alternatively overestimate the phenomenon while also not allowing comparability across supply chains, across nations or across institutions. This discrepancy becomes apparent the terms used, often interchangeably, such as post-harvest loss, food loss, food waste or food loss and waste while they might mean different things.

Despite these drawbacks, it is increasingly recognized that food loss and waste impact the food system and adds to the pressure exerted on natural resources as it results in a loss or misallocation of resources and exacerbates carbon and other greenhouse gas emissions among others. As such, they have come at the forefront of political, scientific and development debates due to their perceived potential impact on the

achievement of several of the goals of the 2030 Development Agenda, or SDGs, including those on poverty (Goal 1), hunger and food security (Goal 2), production and consumption (Goal 12), climate change (Goal 13) or the protection of the ecosystem (Goal 15) and indirectly on others such as those on water and sanitation, infrastructure, health or peace and security (Schuster and Terrero, 2016).

The above overview highlights the complex nature of food loss and waste and shows that it could be tackled from a number of perspectives depending on the aim to be achieved. In this report, the focus will be put on analyzing food loss and waste as related to its: (i) magnitude and measurement, (ii) linkage to food security and nutrition and (iii) place within the 2030 Development agenda including monitoring its implementation both in general and as related to the Arab region. The report includes as well an overview of suggested policies and actions that build on the FAO's Near East regional strategic framework (FAO, 2014) and the Global Initiatives on Food Loss and Waste (FAO, 2015).

Magnitude and measurement

So far, there appears to be no global consensus on the magnitude and extent of food loss and waste. There are many reasons to this including the fact that food loss and waste estimations are usually not accurate, which lead to wide variations and a few inconsistencies. Thus, for example, it is often reported that food loss and waste varies from 10 – 50 percent (Rosegrant et al, 2015) though in a few cases estimates go as high as 80 percent such as for selected and highly perishable products like fisheries when no adequate cooling facilities are available (HLPE, 2014). This range is wide enough to generate ambiguity on what constitute loss and waste, where it happens and how it is measured and, as a correlation, its exact impact on food availability. This is more so as it is reported that up to 85-90 percent of the food is usually consumed in the place or country where it is produced (Barrett, 2015).

Estimations of food loss and waste use differing methodological approaches and have differing scopes, which make data and information comparison somehow difficult. As reported in HLPE (2014), “*different definitions, different metrics, different measurement protocols and the lack of standards for data collection adapted to different countries and products, makes it difficult – and sometimes impossible – to compare studies, systems and countries*” and importantly “*there is no agreed method to evaluate the quality of data, method and numbers produced.*” In recent years, most literature often seem to refer to the landmark report published by Gustavsson et al produced for the FAO (2011). It is increasingly becoming a reference point even though questions about definitions and methodologies still linger (HLPE, 2014; Rosegrant et al, 2015; Schuster and Torero, 2016).

There are two main ways to estimate food loss and waste. The first is to aggregate food loss and waste data available from local and national entities (e.g., trade boards, wholesalers, importers/exporters, other large traders, etc.) and large companies (e.g., restaurant chains, caterers, hotels, supermarkets/grocery stores, schools and other public institutions, etc.) in order to get an order of magnitude. It is the easiest way to estimate food loss and waste though it might result in inaccuracies in countries without a well-established data collection system and might miss detailed and sometimes crucial data notably when the food supply chain is dominated by small operators, e.g. farmers, transporters, middlemen, small shops and restaurants. The second is to follow the structure of major food supply chains (e.g., fruits and vegetables, cereals, roots and tubers, animal products, etc.) or of specific commodities (e.g., potatoes, wheat, meat, dairy, etc.). This

method provides more accurate and detailed data but it is time consuming and expensive to run with the added inconvenience that the data might not be readily comparable or extrapolated across supply chains (EIU, 2014).

Moreover, food loss and waste is assessed in weight, which has 2 caveats. For one, it equates all products in terms of weight without taking into account the water, caloric/nutrient content or the cost of each product. In weight terms, bulky food items with high water content – e.g., melons, oranges, cabbage, potatoes or meat – account for most food loss and waste. In recent years, attempts have been made to express food loss and waste in caloric and/or nutrient content with a view to link more food loss and waste to food security and nutrition. In such cases, wheat and cereals become the primary determinants of food loss and waste due to their relatively high caloric content combined with the relatively high losses and/or waste in weight. Livestock products are also a major determinant due to their high protein content and bulkiness. Food loss and waste can also be expressed in economic terms in an attempt to take into account the financial implication of food loss and waste on either revenues or costs and purchasing power, which tilts food loss and waste towards high value products such as meat or fruits and vegetables. Food loss and waste could be measured as well in terms of its impact on the environment such as to better reflect their contribution on greenhouse gas emissions and/or carbon footprint to name a few (Gustavsson et al, 2011; Lipinski et al, 2013; EIU, 2014). As a result, it is increasingly being suggested to present food loss and waste in multiple formats, i.e., weight, nutrient/caloric content, economic terms and/or environmental impact, so that policy makers and the public could have a better feel on the issue. Such a multi-pronged approach of representing and highlighting food loss and waste could allow for a better grasp on its complexity, which could lead to more integrated solutions and increased awareness (EIU, 2014).

In the Arab region, countries tend to have substantially high environmental footprints largely driven by over-consumption (Zeitoun, 2012). The region faces challenges with food loss and waste even though accurate estimates of regional food loss and waste are not readily available and usually tend to differ from one institution to the other. However, to give an order or magnitude, the FAO puts food loss and waste at about 15 percent for oilseeds, pulses and meat products, between 15-20 percent for grains and dairy products, 25 percent for roots and tubers and fish and seafood products and about 45 percent for fruits and vegetables (FAO, 2014). Food loss and waste occurrence along the food supply chain differs among countries as well though the bulk of the loss and waste for all countries happens in the early part of the food supply chain between harvest and storage, transport and handling. In low income countries (the LDCs¹), most of the food loss and waste occurs during the stages of production, harvest, storage and transport operations. In middle income countries (Maghreb² and Mashreq³), there is an increased occurrence as well during intermediary stages (i.e., handling, transport, storage and processing) and increasingly as well in the last stages (i.e., retail and consumption). In the high income countries (GCC⁴), there are substantial losses and waste in the last stages of the food supply chain (i.e., retail and consumption).

Figure 3.2 shows the level of food loss and waste in selected countries of the region in kilocalories per capita as computed based on FAO data (FAO, 2017). The largest levels of food loss and waste are recorded

¹ Arab Least Developed Countries (LDCs) include Comoros, Djibouti, Mauritania, Somalia, Sudan and Yemen.

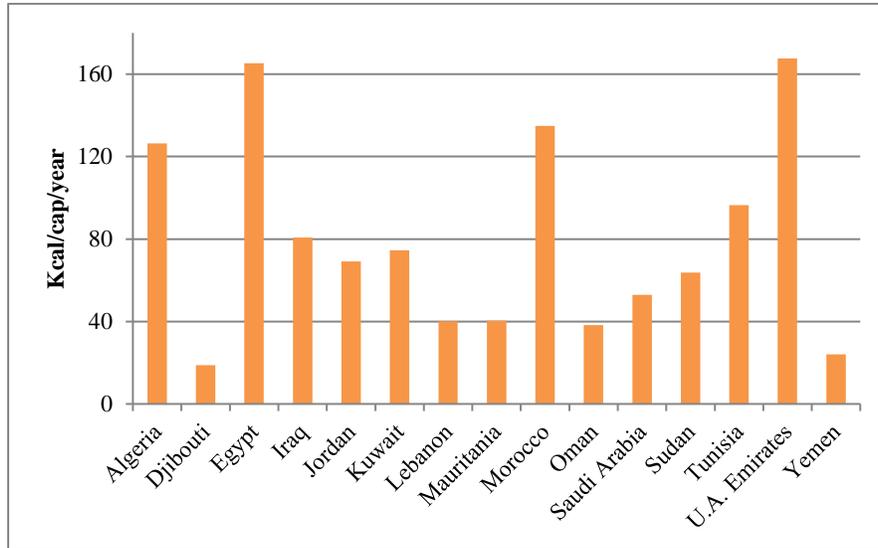
² Maghreb countries include Algeria, Libya, Morocco and Tunisia.

³ Mashreq countries include Egypt, Iraq, Jordan, Lebanon, Palestine and Syria.

⁴ Gulf Cooperation Council (GCC) countries include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

in Egypt and the United Arab Emirates (UAE) even though the data might not seem to be exhaustive. Countries with low numbers might be more a result of incomplete data rather than having low food loss and waste rates.

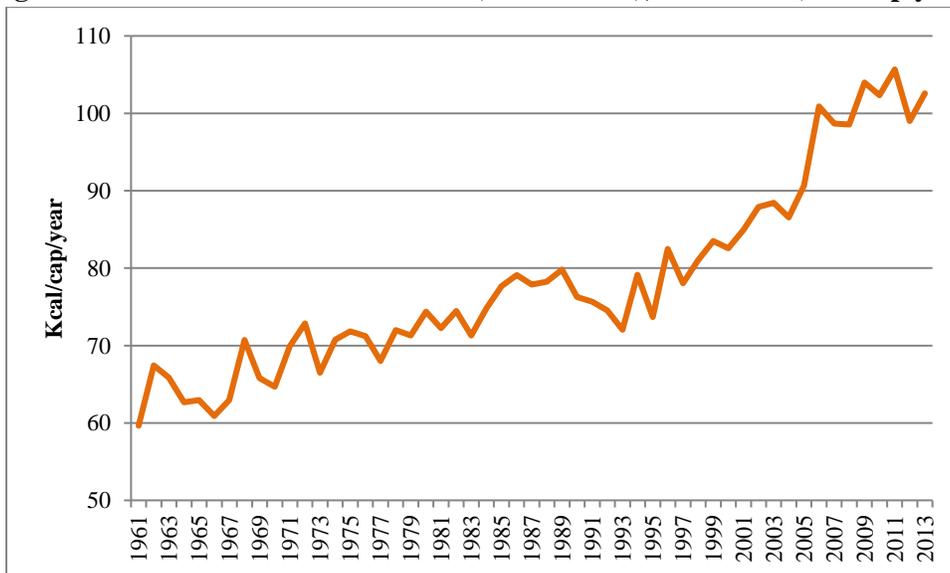
Figure 2: Food loss and waste by country, Average 2011-13 (Kcal/Cap/Year)



Source: Computed from FAOSTAT (2017) and UN (2015a)
Sudan includes South Sudan and is for the 2009-2011 period.

Figure 3.3 shows the overall regional trend in food loss and waste in kilocalories per capita, which shows an upward sloping trend since the early 1960s. The relatively rapid growth in food loss and waste of the last 15 years is a more a reflection of a higher data completeness and better collection standards than a sudden increase in the rate of food loss and waste occurrence.

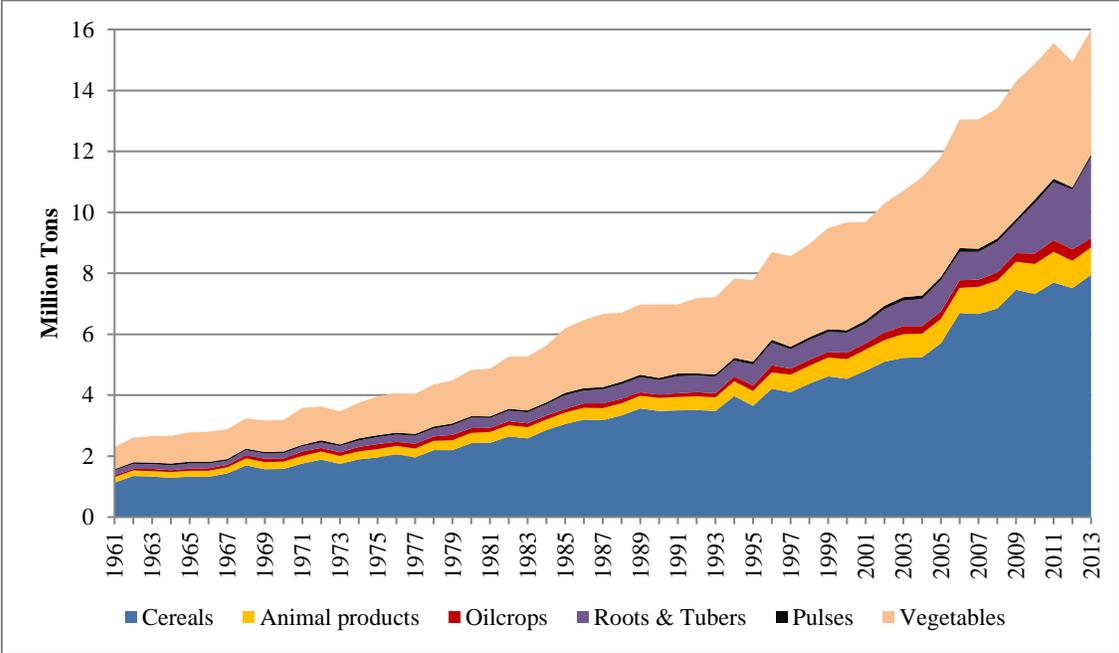
Figure 3: Trend in food loss and waste (15 countries), 1961-2013 (kcal/cap/year)



Source: Computed from FAOSTAT (2017) and UN (2015a)

Figure 3.4 and Figure 3.5 show the distribution of food loss and waste by major commodity groups. In Figure 3.4, where food loss and waste is expressed in tons, food loss and waste occurs primarily in fruits and vegetables followed by cereals.

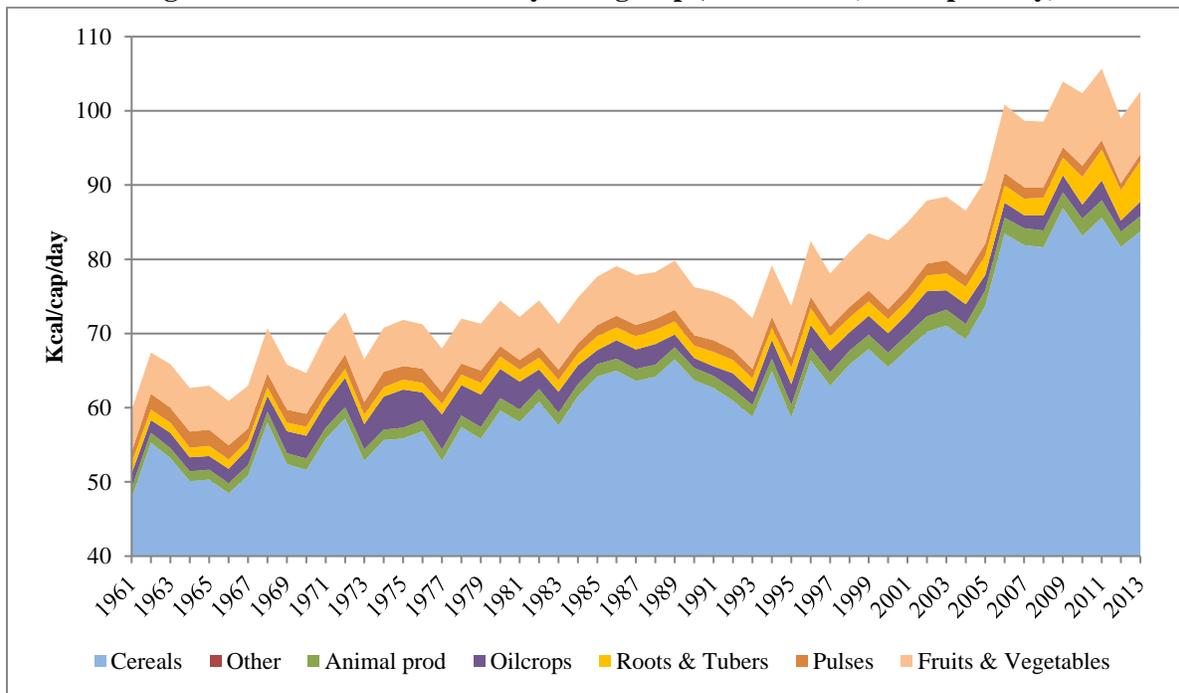
Figure 4: Food loss and waste by food groups, 1961-2013 (million tons)



Source: Computed from FAOSTAT (2017)

In Figure 3.5, where food loss and waste is expressed in kilocalories per capita, food losses and waste appears to be more consequent in cereals.

Figure 5: Food loss and waste by food groups, 1961-2013 (kcal/capita/day)



Source: Computed from FAOSTAT (2017)

Linkage to food security and nutrition

With the rapidly growing population, which is expected to reach 500 million in the region and 8.5 billion globally by 2030 (UN, 2015a), demand for food is expected to keep growing at a rapid rate. Urbanization rates are expected to continue unabated, which will go hand in hand with increased affluence and changing food preferences towards more sophisticated products including livestock-sourced, fruits and vegetables and processed or semi-processed products and increased eating outside the home. The combination of the higher and diversifying demand and constraints in regional food production will lead to higher imports and as such the lengthening of the food supply chain, which might lead to increased levels of food loss and waste unless substantive changes are made throughout the supply chain. For example, it has been argued that improving the wheat import supply chain could lead potentially to a doubling of the import capacity of selected countries of the region including as result of reduced food loss and waste through improved efficiency (World Bank, 2012). The nutrition quality of the food could also be maintained and even enhanced through better handling and processing, which might also reduce food loss and waste rates.

The most acknowledged impact of food loss and waste on food security is a deterioration in food availability and access by the most vulnerable either because there are reduced quantities of food or food prices hike lead to scarcity and social unrests thus disturbing further the acquisition and supply of food.

Moreover, in certain circumstances, the lost and wasted food could be reintegrated into the food supply systems. With appropriate investments and technology adoption and breakthrough, part of the food lost and wasted can be recovered and reintroduced in the food supply chain system and as such affects food security. Other parts of food loss and waste are largely unrecoverable and do not affect food security. Food loss and

waste arising as a result of infrastructure or structural deficiencies affecting the food supply chain, which usually form the core food loss and waste in countries of the region, can be recovered while food loss and waste occurring as a result of operators and especially consumer behaviors might not be recovered as no longer suitable for human consumption. The former food loss and waste usually occurs in the early stages of the food supply and is more consequent in LDCs where it could impact food security. The later food loss and waste tend to happen most at retail and especially at consumer levels and is more consequent in Developed Countries where its mass is said to be bigger than all the food produced in LDCs though it has minimal impact on food security as it occurs in food secure countries and is a result of the behavior of consumers and retailers (EIU, 2014).

However, it should be noted that the linkage between food loss and waste and food security is not fully established and as a result there are not clear policies, strategies and programmes that can help reduce food loss and waste to directly improve or impact food security (Barret, 2015). In most cases, the benefits derived from those policies, strategies and programmes lead to much higher benefits in other areas such as increased efficiency throughout the food supply chain or higher productivity of resources or their benefits could not be easily untangled from others such as investments in the cold chain which lead to higher reliability, improved trust from customers, better marketing or more savings to name a few.

Food loss and waste and the Sustainable Development Goals

The issue of food loss and waste has been integrated in the 2030 Development Agenda or Sustainable Development Goals, under Goal 12 which aims to “*ensure sustainable consumption and production patterns,*” Target 12.3 which calls to [halve by 2030] “*per capita global food waste at the retail and consumer levels, and reduce food losses along production and supply chains, including post-harvest losses*” (UN, 2015b). Food loss and waste is expected to be monitored through an index still in development, namely, the Global Food Loss Index (GLFI). The index would be volume and price based – it is the prices weighted sum of the ratio of current food loss and waste to a base period. Food loss and waste would be measured along the food supply chain between harvest and retail but prior to consumption. As such, it is anticipated that the index will be sensitive to actions and policies – or their lack – that impact the food supply chain while being unresponsive to changes and including improvements in consumer behaviors (UN, 2016).

In order to assess how countries are achieving the SDGs, a first step is to examine what could be the situation by 2030 if the “business-as-usual” scenario continues (Nicolai et al, 2015). This would provide a benchmark against which achievements in implementing the SDGs could be assessed. The “business-as-usual” scenario assumes that the rate of food loss and waste will remain constant until 2030. The rates for this scenario are extracted from Gustavsson et al (2011) with minor adjustments. As Table 3.1 shows, the Mashreq and Maghreb countries will be expected to remain within the food loss and waste rates prevailing in the North Africa and West and Central Asia region. The LDCs countries will be expected to have food loss and waste similar to those in the Sub-Saharan Africa and/or South and Southeast Asia region, which are similar. The GCC countries will be expected to have food loss and waste that are comparable to those of the Europe and North-America regions. In all these cases, upper limits in food loss and waste rates will be used whenever available.

Table 1: Per capita food loss and waste by Arab sub-region (kg/year)

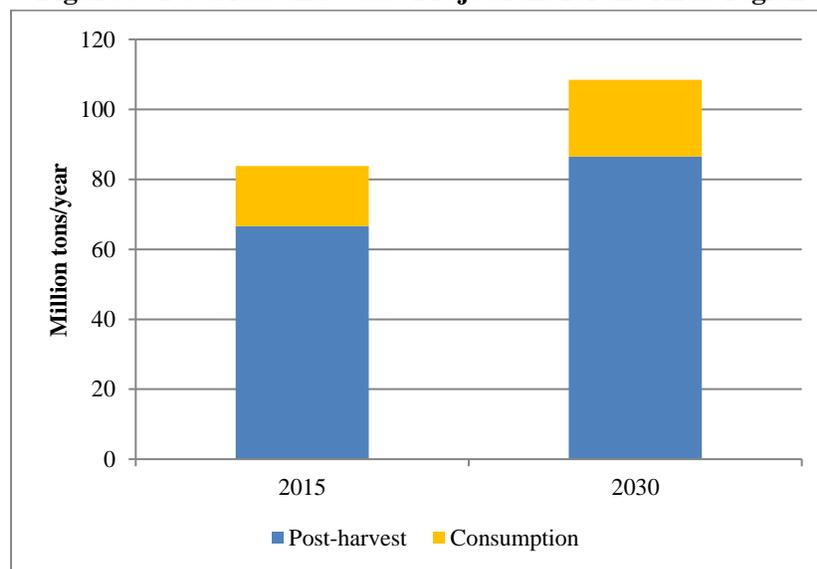
Region	Comparable region in Gustavsson et al (2011)	Per capita food loss (kg/year)	Per capita food waste (kg/year)
Maghreb	North Africa, West & Central Asia	210	40
Mashreq	North Africa, West & Central Asia	210	40
GCC^(*)	Europe & North America	280-300	95-115
LDCs^(*)	Sub-Saharan & South/Southeast Asia	120-170	6-11

Source: FAO (2011)

(*) Upper limits are used for further computations

Food loss and waste by 2030 or any other year in between are computed by multiplying current food loss and waste rates to the projected population by that year, which is a similar methodology that was used by Hoornweg and Bhada-Tata (2012) while attempting to estimate the likelihood of achieving selected Goals of the Sustainable Development Agenda. As a result, food loss and waste which was estimated at close to 85 million tons per year in 2015 will be expected to increase to about 110 million tons per year by 2030 as shown in Figure 3.6 or about a 30 percent increase compared to prevailing levels. Food loss will increase by about 20 million tons while food waste will increase by about 5 million tons.

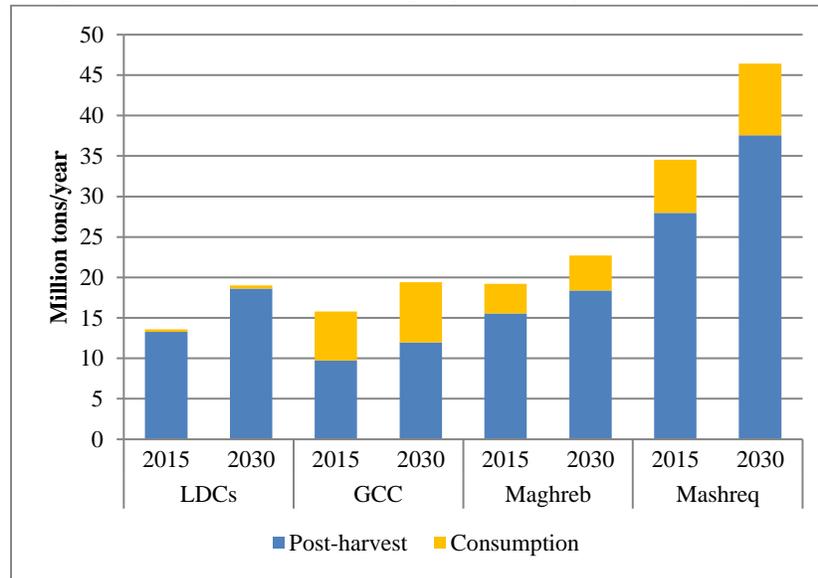
Figure 6: Food loss and waste Projections for the Arab region



Source: ESCWA computation based on FAO (2011) and UN (2015a)

At sub-regional level, the Mashreq will account for the largest level of food loss and waste because of its high population notably in Egypt. It will be followed by the Maghreb and then the GCC and LDCs. Food waste in the LDCs will remain relatively low compared to other sub-regions as per Figure 3.7 and most of it will be recorded in the early stages of the food supply chain.

Figure 7: Food loss and waste projections by Arab sub-regions



Source: ESCWA computation based on FAO (2011) and UN (2015a)

Reducing food loss and waste

Before delving much into the policies and recommendations, it is worth reviewing some of the challenges facing the region when it comes to the issue of food loss and waste. First, there is a lack of awareness on the magnitude and importance of food loss and waste. Significant food waste occur during festivities such as wedding ceremonies and family and other social gathering and over religious holidays notably during the fasting month of Ramadan, as the Arab culture is characterized by a strong sense of hospitality and generosity, which often translates into large quantities and varieties of food being served of which a substantial amount is discarded. However, this lack of awareness is apparent as well throughout the food supply chain where it is compounded by a lack of capacity both technical and technological and substantial inefficiencies. Second, and related to the first, there is a deficiency in data and information collection and as a result food loss and waste is not assessed and quantified in all its magnitude and at all levels. Related to the above, as well, is the lack of an agreed upon methodological framework to collect data and information to ensure comparability and comprehensiveness across supply chains and nations. Third, most countries still lack well designed and enforceable policies and regulations on food loss and waste reduction while on the other hand some prevailing policies might favor the occurrence of food loss and waste, e.g., the frequent use of across the board subsidies. There are also serious gaps in institutional setup and coordination as food related issues are spread across various governmental departments, e.g. agriculture, commerce, industry, health, local government, food safety institutions and others. Finally, although some countries have developed and/or are developing fast, levels of investments in the food supply chain are still inadequate particularly those from the private sector while most food loss and waste occur in the hands of private operators (FAO, 2014; Barre, 2015; Charbel et al, 2016).

In order to reduce food loss and waste, actions will be needed at multiple levels and probably in various format based on the level of income of the country concerned. In low and middle income countries, measures such as improving production and handling at farm level, enhancing rural infrastructure notably

for efficient transport and handling while also addressing other structural deficiencies that might affect the rapid and efficient movement of food throughout the supply chain, e.g., red tape, paperwork, taxes, regulations, opportunity costs, etc. (World Bank, 2012) will also help address issues related to food loss and waste. In higher income economies including those in the upper-middle income categories such as Lebanon, with thriving middle classes, efforts would be geared towards encouraging the adoption of enhanced behavioral practices among food operators such as retailers and restaurants as well as consumers in addition to continued investments in the modernization of the food supply chain. This would include, for example, eliminating or reducing unnecessary subsidies that tend to encourage over-consumption or encouraging the development of numerous financing arrangements that could enhance investments. Throughout the region, improving the functioning of local, national and regional markets and the modernization and greater integration of the regional food supply chain will have to be pursued in order to open new market opportunities including enhancing intra-regional trade. Several good initiatives can be cited as provided in the Boxes below.

Box 1: Food loss and waste reduction around the Arab region

During a recent conference on food loss and waste held at the AOAD-Arab Organization for Agricultural Development(*) attending experts talked about a few of the achievements made at country level to reduce food loss and waste. It was highlighted that countries are exerting substantial efforts and making investments to reduce food loss and waste. For example, in Iraq, the government introduced new and better adapted cereal varieties and supported the adoption of more modern harvesting practices to replace the traditional way manual system, which lead to great losses, encouraged local processing and the use of better adapted packaging to improve shelf-life and improved the transport infrastructure. In Algeria, Oman, Saudi Arabia and the United Arab Emirates, efforts are being made to improve the dates supply chain with a view to reduce losses and waste, which include providing greater support to farmers, introducing new and better adapted practices and technologies, supporting investments notably for processing and marketing and others. In Oman and Saudi Arabia, efforts are being made as well to reduce losses and waste in the fish supply chain by providing training to stakeholders on improved handling of products and making investments to enhance the cold chain both for storage and transport. In Sudan, a new grain handling and storage system was introduced at Port Sudan that uses silo bags, which allows for the storing the grain in an airtight system devoid of sunlight and in which the temperature, CO₂ levels, humidity and grain moisture are easily controlled and monitored while also being safe, economic and preserving the grain in an optimal quality for much long period of times. In Tunisia, investments are being made to extend and strengthen the national cold chain with a view to minimize food loss and waste particularly in perishable products and so far the cold storage capacity has been increased by 65 percent including the acquisition of about 3,000 refrigerated vehicles and 1,500 isotherm vehicles of which 70 percent were for the transport of fresh fruits and vegetables. In Egypt, a food bank initiative has been set up to take advantage of the food waste from hotels and restaurants by redistributing it to the needy. The food bank has partnered with the Egyptian Hotel Association to reached about 400 hotels, restaurants and local coffee shops is now serving more than 17 million meals per month.

(*) Conference on “Reducing food loss in the Arab countries to achieve Arab food security,” 27-28 September 2016, AOAD, Khartoum, The Sudan

Box 2: Egypt's experience with post-harvest storage

Egypt has been at the forefront in terms of reducing food loss through post-harvest storage. Horizontal silage field bags are a lower-cost, flexible storage solution for in situ processing and storage, offer a rapidly deployable response to local and regional storage issues. Suffering from up to 25 per cent grain storage loss, and keen to reduce dependency on international grain markets, Egypt successfully tested their effectiveness in storing some 2,000 tonnes of wheat in Daqahliyya province. The costs were found to be significantly lower to both burlap, and metal silo storage systems. Changes in CO₂ levels inside the silo bags, grain moisture content, fungal and total microbial load count, percentage of aflatoxins, insect count, and physical, mechanical and other qualitative changes to the grain were monitored over one season, with minimal losses in grain quality and quantity reported. Long distances between production areas, ports and processing facilities also make horizontal wheat silo bags an important instrument for expanding national and regional storage capacity and efficacy. It also has considerable potential for reducing storage losses affecting other grains and legumes.

Source: El-Kholy, 2015

Box 3: Food loss and waste reduction programs in the United Arab Emirates

With over 30 percent of all food loss and waste in the region is estimated to take place at the consumption stage alone. Initiatives from the UAE show efforts to raise awareness on the issue against a backdrop of cultural and social habits of consumers. The “IMPERFECT campaign”, launched in 2015 by the Ministry of Climate Change and Environment with the support of FAO, is one of the leading programs reflecting recognition of the problem. The campaign aims at using fruits and vegetables of imperfect shapes or sizes, though of no compromise in nutritional value to reduce food waste and increase food surplus. The campaign also aimed to highlight the importance of food safety, irrespective of imperfectly-shaped produce, and the sustainability of local production, as well as the hierarchy of waste management, from waste reduction, to reuse, segregation and recycling.

“Food Forward UAE” is another national initiative aiming at channeling food in excess/surplus from households and social events to delivery mechanisms that reach those in need. Civil society bodies, like the General Women’s Union in UAE, promote sustainable consumption, including through nutrition education in schools, while the Dubai municipality Food Safety Department is promoting the “Grow your Food Campaign” to promote a culture of freshness and healthy living by encouraging the residents to grow their own vegetables and herbs.

Additionally, and within the strong hospitality sector in the country, roundtable discussions among hotels and caterers were launched on World Food Day 2014, highlighting such best practices and citing awareness raising in schools and underscoring the need to sustain such programs over the long-term to change consumer habits and reduce waste.

The Dubai Municipality has recently teamed up with UK-based Winnow, a start-up that provides smart meters in hotels that helps kitchens cut food waste in half by automatically measuring what's put in the trash bin. The collaboration is under the Dubai Future Accelerators programme that allows the private sector to work closely with public entities to co-create breakthrough solutions for the public good. Under the smart system, a meter placed under the trash bin is connected to an iPad that records top five areas and items of waste, helping chefs to make better decisions and manage waste. On average, hotel kitchens waste up to 20 per cent of food purchased, and the number doubles during the holy month of Ramadan due to the recurring lavish Iftar and Suhoor buffet.

Source: <http://www.leanpath.com/> and Khaleej Times, April 1, 2017 available at <http://www.khaleejtimes.com/lifestyle/food/smart-meters-to-help-reduce-food-wastage-in-uae-hotels>

There are as well multiple initiatives from around the world which could be highlighted as best practices:

In the European Union:⁵

With more than 80 million tons of food wasted every year representing about 20 percent of the food produced and costing more than 140 billion euros, the European Union (EU) has begun pushing for the implementation of food waste prevention measures to strengthen the sustainability of the food system. Food loss and waste in the EU happens along the entire food supply chain from the farm, to handling, storing, transporting and processing and most importantly at retail level in shops, supermarkets, restaurants and canteens, and at home, which is putting excess pressure and a heavy toll on Europe's natural resource base and the environment. Since 2012, attempts have been made, in collaboration with all stakeholders, to identify where food is lost and/or wasted in the food supply chain, what are the barriers to food loss and waste prevention and what actions are needed to remedy to the issue. Following the initial review, an integrated action plan to tackle food waste was elaborated as part of the circular economy initiative; an initiative, which aims to promote the use of Europe's resource base in a more sustainable manner.

Food waste prevention requires action at all levels, from global, to regional, national and local, and the engagement of all stakeholders to build integrated programmes that could help usher in changes throughout the entire food supply chain. At national level, some countries have developed national food waste prevention programmes which have already delivered concrete results. These include, for example, France and Italy, which in 2016 introduced legislations to promote and facilitate the implementation of programmes to reduce food loss and waste and to promote cooperation among key stakeholders.

At the EU level, the circular economy initiative is putting a special focus on the prevention of food loss and waste and is helping to identify key priorities for action that could also help fulfil related goals and targets of the Sustainable Development Goals (SDGs) that call for the reduction of food loss and waste generation. Within the initiative all EU countries are mandated to reduce food loss and waste at each stage of the food supply chain, to monitor food loss and waste and to report back on a regular basis both as a way to monitor implementation and to allow the exchange of experiences on programmes, strategies and progress made.

The EU action plan to prevent food loss and waste calls for:

- The development of a common methodology to measure food loss and waste that include specific indicators;
- The establishment of a common platform on food loss and waste that allow countries and food stakeholders to better identify measures needed to achieve the SDGs on food loss and waste and to share best practices and results achieved;
- The strengthening of legislations related to waste, food and feeds notably to ease food donation and promote the safe re-use of discarded foodstuffs and by-products as animal feed without compromising food and feed safety; and
- Devising ways to improve the use of date markings on products throughout the food supply chain so that consumers could be better informed on their meaning and characteristics.

To minimize food waste at retail and consumer levels, the EU is developing food donation guidelines that will help food donors, food banks and other charity organizations to comply more easily with existing EU and national legislations notably on food safety, food traceability, food hygiene and food labelling among others, and these guidelines are planned

⁵ Adapted from: http://europa.eu/rapid/press-release_MEMO-16-3989_en.htm

to be rolled out towards the end of 2017. Guidelines on the use of discarded foodstuffs as feed will also be put forward noting already that these potential feed materials – such as broken biscuits or stale bread, which are safe to eat but difficult to be marketed – will no longer be referred to as lost or wasted.

The EU Platform on food loss and food waste was established in 2016 to help actors of the food supply chain to better identify and implement food loss and waste prevention solutions in support of the achievement of the related SDGs. The Platform promotes, as well, cooperation and sharing of best practice to help minimize food loss and waste while enhancing the benefits accrued from the food produced in support of the EU circular economy initiative and the development of more sustainable food systems. The Platform brings together food experts that represent a whole range of stakeholders and experts from all stages of the food supply chain. It is comprised of about 70 members with about just under half representing governmental or public institutions of EU countries, European Free Trade Association countries, EU bodies (EU Commission, Committee of the Region, European Economic and Social Committee, etc.) and international organizations (OECD, FAO and UNEP). The remaining represent the private sector involved in the food supply chain.

One of the leading cause of food waste at retail and consumer levels is the date markings on the food product labels. More than half the consumers (58 percent) check date markings on food labels (i.e., "use by" and "best before") when shopping or preparing meals but only about 1 in 2 understand their meaning. The resulting confusion on these date markings determine the quantity of food wasted at retail and home levels. New ways of presenting these dates are being developed to prevent the wasting of food which might still be safe and edible from being discarded throughout the food supply chain. Other options being considered is to extend the list of products on which there would be no date markings on labels such as done for vinegar, sugar, salt or chewing gum for as long there are no food safety concerns. The EU support as well campaigns to explain differences existing among date marking on food labelling in addition to supporting the many initiatives to prevent or limit food loss and waste being carried out by individual countries such as the “Love food, Hate waste” campaign in the United Kingdom or global initiatives such as the “Think. Eat. Save” by UNEP and the “Save Food” initiative by FAO.

In South Korea:⁶

Food waste at consumer level is a significant problem in South Korea, especially that most meals consists of many small dishes. Over the years, the government launched varied programmes to raise awareness on the issue of food waste, which have led to great benefits in reducing the amounts of food loss and waste. Among these were:

- The ‘Food Waste Reduction Masterplan’ which was launched in 1996;
- A recycling programme launched in 1998 and revamped in 2004, which promotes on the collection of food waste in residential areas and from restaurants;
- The banning of food waste in landfills initiative, which began in 2005;
- The food waste reduction project launched in 2010, which promotes the signing of agreements between concerned government ministries and actors in different sectors, including restaurants, hotels, schools, rest areas on highways, etc., for voluntary cooperation with, for example, restaurants being encouraged to use fewer small side-

⁶ Adapted from <http://www.innovationseeds.eu/policy-library/core-articles/south-koreas-food-waste-reduction-policies.kl>

dish plates and to adopt eco-friendly menus or cafeterias in public institutions conducting mandatory "no-leftover days" campaigns once a week; and

- The introduction in 2010 of a volume-based food waste fee system as described below.

This last initiative has led to the most significant results. Under the volume-based charge scheme, households are charged a fee based on the amount of food waste they generate. Municipalities were given the options to choose among three “pay-as-you-throw” solutions, which are paying for standard plastic bags to be used to discard food, buying stickers to attach to food-waste bins (which are not emptied if they do not carry a sticker), and the use of food-waste bins with magnetic card-readers that households must use when disposing their waste.

The mix of the above food waste reduction measures has had a great impact on raising consumer awareness on reducing food waste, which in return has greatly benefited the environment. The recycling rate of food waste has risen from 2 percent in 1995 to 95 percent in 2009, and in turn, food waste going to landfill has decreased substantially. Food waste is now being turned into compost or livestock feed as well as biomass and biofuels. However, to support all these initiatives and to promote recycling, the government provides incentives for the expansion of public facilities to assist in transforming the food waste collected into livestock feed, compost or biomass. The government has built 17 biogas facilities and 4 sewage sludge drying fuel facilities that are estimated to turn 188,000 tonnes of organic waste into biofuels every year. Korea’s food waste reduction policies are among the most advanced in the world in promoting sustainable practices. The mix of policies as seen in the regulations and standards and the various measures have proved highly successful.

In Sub-Saharan Africa:⁷

Food loss and waste occurs most significantly during harvest and post-harvest operations and are significant since it is estimated that about 30 percent of the food produced is lost which far exceeds the food aid received by the region. Thus, addressing post-harvest losses in sub-Saharan Africa have the potential to enhance food security. Post-harvest losses are so pervasive that stakeholders are no longer realizing their extent or how they impact their bottom in terms of income generation or increased food availability as they consider them as the “cost of doing business”. To address these deficiencies, analyses were conducted to identify where, why and how the losses occurred and below are the main results and scalable solutions that were identified and are being proposed to farmers and other actors of the food supply chain to improve overall efficiency:

- (i) Contract farming: Linking farmers to buyers through formal agreements help mitigate the uncertainties faced by farmers by assuring them a market and a set price for their commodities. Moreover, when buyers are big companies they are able to invest in solutions to reduce post-harvest losses as it strengthens their commodity supply chains. Buyers are able as well to pressure farmers, wholesalers, handlers and transporters to improve their practices, which help decrease losses significantly.
- (ii) Diversification: Linking farmers to multiple buyers was also found to help decrease post-harvest losses as farmers can sell their excesses or non-conforming (less quality) supplies

⁷ Adapted from <https://www.growafrica.com/groups/briefing-paper-how-collaboration-can-improve-post-harvest-profits-within-smallholder-supply>

elsewhere. The availability of additional buyers help stabilize prices, which encourage farmers to invest in post-harvest technologies and practices. Farmers learn also to produce and cater to differing markets and in some cases a buyer could become a stepping stone for farmers to build their capacity to implement more rigorous standards.

- (iii) Farming associations: Supporting farmers to operate in groups such as cooperatives allow them to more easily adopt post-harvest management skills and technologies and to better meet the requirements of markets both in terms of quality and quantity. The capacity of farmers is more easily developed as well through group training particularly with the advent of advanced technologies (e.g., ICTs) and techniques (e.g., online trainings). More recently, the adoption and use of shared smart technologies such as smartphones has ushered innovation throughout the supply chain allowing buyers and farmers to reach each other's and their customers more easily and at a lower cost than before and to identify and respond faster to changing consumer preferences all without costly investments while staying as well closer to their farms.
- (iv) Financing: Identifying and accessing financial products is essential to maintaining the flow of goods through the supply chain. Farmers get financing more easily and at better terms while buyers are able to acquire the needed working capital, which help build trust and confidence as payments are promptly made. Supply chain actors become more competitive and enhance production through the use of adapted inputs and adoptions of innovative practices and technologies.
- (v) Technology: Finally, promoting the adoption of adapted technologies is essential to improve crop handling, transport, storage and processing. For example, the use of dryers helps reduce losses during storage and transport of maize and cassava while the use of hermetic bags and silos on the farm helps reduce pest infestations. Fruits can be covered with an organic solution that form an ultra-thin coating shield that help maintain quality for longer period of times without the risk of ripening too fast or losing flavors while innovative storage systems are used to extend the shelf-life of fruits and vegetables by 2-3 weeks without the need of an expensive cold storage unit. The use of crates and ultra-resistant plastic bags help improve the handling of products during transport, which minimizes losses substantially.

Examples of techniques and technologies used to reduce post-harvest losses in Africa:

		Post-harvest solution	Description
Product solutions	Storage and handling	Super grain bags	Multi-layered, water resistant storage bags for grain
		Gum Arabic coating	Edible coating to delay ripening
		Zero-fly bags	Insecticide-incorporated storage bags to prevent infestations
		Heavy moulded plastic containers	Durable, protective and cost-effective plastic containers to prevent crops damage during storage and transport
		Metal silos	Robust, water resistant, hermetic storage units
		Plastic silos	Food-grade, UV-resistant flexible PVC and cheap storage units for both indoor and outdoor
		Low energy cooling	Use of conventional air conditioning to lower temperatures in storage units
Process solutions	Value addition	Mobile processing units	Autonomous mobile processing units to grind or thresh crops
		Graters and pressers	Traditional transformation of crops to increase shelf-life e.g. for cassava
		Mobile solar drying	Drier to reduce moisture in crops operated with diesel or solar

Procurement channels	Collection centers	Provide services to farmers to store, handle, pack collectively to reduce costs
	Contract farming	Provide farmers with input and training and purchase their outputs
	Direct sourcing	Farmers deliver to specific buyers but with limited inputs and technical assistance
	Supply chain technology platforms	Use of technology to connect farmers and buyers

In the Arab region, the FAO (2014) proposes a regional strategic framework with the aim to reduce food loss and waste by half over the decade 2014-2024. The framework revolves around four main components for which specific actions have been outlined as summarized in Table 3.2:

- Improving knowledge and collecting regional data and information: This would help to better understand the source, scope and magnitude of the food loss and waste throughout the region through data and information collection and the conduct of related research. A common methodological framework would be needed to ease comparability and the development of common strategies and programmes both for the entire food supply chain and for specific food commodity chains, e.g., wheat, potatoes, fruits & vegetables, etc.;
- Raising awareness and promoting good practices: Increasing awareness on food loss and waste notably on its magnitude and scope, where it happens and what could be done to reduce it will help reduce its occurrence. Raising awareness is important as well because of the rapidly changing consumer taste and demand which lead food supply chain operators to anticipate by over-stocking and/or over-producing (e.g., retailers, restaurants, etc.) leading to unnecessary food loss and waste and financial losses to smaller operators and farmers;
- Adopting appropriate policies and adapting and adequate regulatory framework: Policies and institutions are the drivers force behind a reduction in food loss and waste. Appropriate policies and adequate institutions have to be designed and supported to ensure that stakeholders are encouraged to adhere to directives while also encouraging supply chain operators to both invest and self-regulate; and
- Promoting investments and adopting and transferring appropriate technologies: Given the magnitude of food loss and waste in the region, investments need to be substantially increased and go hand in hand with the adoption and transfer of appropriate technologies. Investments by governments to improve the capital asset have to be complemented by those from the private sector geared towards the adoption and/or transfer of proven technologies. These investments would be made along the entire food supply chain from agriculture production and harvest to post-harvest storage, handling and processing as well as at retail and consumer levels.

Table 2: Actions for a strategic framework to reduce food loss and waste

Knowledge and data collection	Awareness raising and dissemination of good practices	Policies and regulations	Investments and technology transfer and acquisition
<p><u>Data & information:</u></p> <ul style="list-style-type: none"> Assess magnitude, causes and types of food loss and waste at each stage of the food supply chain; Build related database and identify gaps; Investigate and fill identified gaps. <p><u>Cooperation for Research & Development :</u></p> <ul style="list-style-type: none"> Define common methodology to quantify food loss and waste; Undertake joint research to generate data; Allow all stakeholders to access the database; Identify areas for sustained food loss and waste reduction; Monitor & evaluate gains in reducing food loss and waste; Investigate available technologies & procedures; Identify technology need and adapt existing ones to local conditions. 	<p><u>Raising awareness:</u></p> <ul style="list-style-type: none"> Conduct varied awareness campaigns; Raise awareness among elementary & secondary school students; Promote a healthy nutritional culture and responsible purchasing and consumption <p><u>Practical procedures and technologies:</u></p> <ul style="list-style-type: none"> Develop material incorporating educational, economic, cultural and religious considerations; Disseminate information targeting farmers, agribusinesses, CSOs, schools & universities; Promote two-way communication to identify real opportunities to reduce food loss and waste. <p><u>Capacity building:</u></p> <ul style="list-style-type: none"> Support public and private initiatives to build capacity; Introduce food loss and waste related issues into the curricula in universities & colleges as well as for training food industry experts; Build capacity throughout the food supply chain. 	<p><u>Enabling environment:</u></p> <ul style="list-style-type: none"> Integrate food loss and waste policies into policies & programmes; Identify gaps in policies and fill them; Strengthen the institutional framework. <p><u>Collaboration & coordination:</u></p> <ul style="list-style-type: none"> Enable effective communication; Provide incentives for greater collaboration such as market information, enhance efficiency & quality, build partnerships and promote export; Promote greater integration throughout the food supply chain; Promote sustainable food systems including sustainable food production and sustainable diets and consumption. <p><u>Networking:</u></p> <ul style="list-style-type: none"> Promote the exchange of experience at regional & international levels; Develop regional networking; Build partnerships at the international levels. <p><u>Coordination:</u></p> <ul style="list-style-type: none"> Establish national coordination mechanisms comprising all stakeholders; Establish means for monitoring collaboration & coordination. 	<p><u>Investments:</u></p> <ul style="list-style-type: none"> Invest in public infrastructure & services (e.g., roads, ICTs, water & sanitation, energy, etc.); Provide incentives to invest in the supply chain; Identify & promote financing for low-cost technologies. <p><u>Appropriate technologies:</u></p> <ul style="list-style-type: none"> Invest in simple-to-use technologies adapted to local conditions and accessible to small & medium operators. <p><u>Use & reuse of food loss and waste:</u></p> <ul style="list-style-type: none"> Promote R&D and private-public partnerships to support use and reuse of food loss and waste for feed, composting, energy, etc. <p><u>Financing:</u></p> <ul style="list-style-type: none"> Identify & finance low-cost programmes and strategies to reduce food loss and waste.

Source: Adapted from FAO (2014) and (2015)

Conclusion

As noted above, the causes of food loss and waste differ among countries of the region particularly as they are not at the same level of income. As such, adapted strategies and actions have to be devised to fit the circumstances of each country or group of countries that are linked through a commodity supply chain, e.g. regional fruit and vegetables or cereals import/export. The involvement of consumers and operators should be sought and encouraged as if they do not accept or agree to change their behaviors, their practices or their management styles and adopt appropriate technologies, food loss and waste will not be reduced by the set horizon 2030.

With its rapidly growing population and the associated rising food bill, the Arab region as a whole and many countries individually can no longer afford to continue ignoring the prevailing high levels of food loss and waste. However, little will be achieved if the magnitude and causes of food loss and waste are not identified and addressed through appropriate and adequate policies, strategies and programmes. Food loss and waste will not be reduced as well if attitudes do not change. Public actors and institutions will not be able to make any advances in reducing food loss and waste unless a majority of the Arab population is brought on board though these institutions will remain as the main driving force behind the food loss and waste reduction movement by ensuring that appropriate policies are enacted, a proper institutional framework is put in place, a proper environment for private actors is outlined, adequate and sustained awareness campaigns are conducted, innovation and technologies are promoted and adequate capacity is built.

The link between food loss and waste and food security or food availability has yet to be clearly established and as such specifically-designed strategies linking food loss and waste and food security cannot be developed while existing actions aimed at reducing food loss and waste tend to offer much greater gains and/or benefits in other areas as well making the reduction of food loss and waste a by-product of such initiatives or else leading to food loss and waste in other areas. For example, reducing food prices to encourage consumption might reduce food loss and waste at producer or retail level while increasing it at consumer level. Thus, carefully designed and integrated programmes will have to be developed notably as part of the overall implementation of the 2030 Development Agenda or SDGs.

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