



2 PART TWO

FOOD LOSSES AND WASTE

in the Mediterranean



FOOD LOSSES AND WASTE: GLOBAL OVERVIEW FROM A MEDITERRANEAN PERSPECTIVE

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Every year, one third of all the food produced for human consumption is either lost or wasted along local, national, regional and global food supply chains thus affecting the sustainability of the food system and its capacity to ensure food and nutrition security for all. *Food loss* is the decrease in quantity or quality of food reflected in nutritional value, economic value or food safety of all food produced for human consumption but not eaten by humans, while *food waste* is part of the food loss and refers to discarding or alternative (non-food) use of safe and nutritious food for human consumption all along the food supply chains (FAO, 2014a).

The huge challenge of food loss and waste (FLW) has been addressed at global level by the 41st session of the Committee of World Food Security (CFS, 2014) that called upon all public, private and civil society actors to promote a common understanding of FLW and create an enabling environment based on the “food use-not-loss-or-waste” hierarchy in order to support sustainable food systems. The approach is particularly recommended for monitoring and measurement targets.

The economic, social, and environmental impacts of FLW must be addressed concurrently. Producing food that is lost or wasted and is not adequately utilised for human consumption means unnecessary aggravating pressures on the planet while

bringing us further from the paramount objective of the sustainable food system that is to ensure food security and nutrition to all. Various studies have underlined the fact that FLW impacts food security and nutrition and that prevention and reduction are indispensable in order to minimise environmental impacts thus, preserving the food systems' ability to sustain future increases in global demand for food and ecosystem services (HLPE, 2014).

Currently, about 795 million people still suffer from hunger and over 2 billion people suffer from micronutrient deficiencies. It is unacceptable that over a third of the world's food is lost or wasted along the food supply chain or ends up in landfills (FAO, IFAD and WFP, 2015; FAO-RNE, 2011; FAO, 2014b; FAO, 2015a and 2015b; Barilla, 2013). A better management and distribution of food resources globally, regionally, nationally, and locally could be beneficial to the society's least privileged (FAO-RNE, 2011; FAO, 2014b; Rutten *et al.*, 2015).

The Second International Conference on Nutrition (ICN2) had two outcome documents, i.e. Framework for Action and the Rome Declaration on Nutrition acknowledging that "current food systems are being increasingly challenged to provide adequate, safe, diversified and nutrient rich food for all that contribute to healthy diets due to, inter alia, constraints posed by resource scarcity and environmental degradation, as well as by unsustainable production and consumption patterns, food losses and waste, and unbalanced distribution." Moreover, "food losses and waste throughout the food chain should be reduced in order to contribute to food security, nutrition, and sustainable development." While Recommendation 11 of the Framework for Action of ICN2 states that it is important to "improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste."

Food systems are confronted with major sustainability challenges (CIHEAM and FAO, 2015). Food insecurity and malnutrition are still prevalent in some countries of the region. Population is steadily increasing in the Southern and Eastern Mediterranean countries (SEMCs) in parallel with the increase in food demand across the region. At the same time, agricultural production has to cope with the ever-increasing demand with limited natural resources, principally in the south. Moreover, agriculture is the main water consumer in this region where its scarcity is the most critical development problem and one of the main factors limiting agricultural growth (CIHEAM, 2008).

FLW data are scarce and fragmented along supply chains at local, national, regional and global levels. The FAO estimates that FLW in the Near East and North Africa (NENA) amounts to 250kg/capita per year, valued at over USD 60 billion per year, or USD 120 per capita (conservative estimate). NENA natural resources lost due to FLW amount to 42km³/year of water (food production and supply chains), and 360 million ha/year of land. The Turkish bread waste data established as from 2013 is an interesting example of data produced at country level. It indicates a total of 4.9 million wasted loaves per day: 62.1% at bakeries, 10.2% at restaurants, hotels and dining halls, and 27.7% at households (OECD and FAO, 2014).

The FLW data collected use different methodologies, indicators and even definitions of FLW. There are significant gaps in their harmonisation that hinder comparability between studies, data sets, and capacity of decision makers to prioritise interventions over short, medium, and long terms. To address this issue a Food Loss and Waste Protocol¹, which is a multi-stakeholder effort to develop the global accounting and reporting standard, has been developed to enable countries, companies and other entities to quantify food waste in a credible, practical and internationally consistent manner and to identify where it occurs, thus enabling the targeting of efforts to reduce it.

The lack of accurate data exacerbates the inefficiency in the food chain. Precise and harmonised FLW data should be enhanced especially in a context where the food security and nutrition situation is fragile and the sustainability of consumption and production is threatened. To address this need, in May 2015, the G20 Agriculture Ministers invited the FAO together with the IFPRI to establish a platform, building on existing systems, for the sharing information and experiences on measuring and reducing FLW. The Ministers strongly supported the setting up of the Platform as a major outcome of the meeting, which was also endorsed by the G20 Leaders Antalya Communiqué in November 2015. The Technical Platform² on the Measurement and Reduction of Food Loss and Waste welcomes global membership. It will also work on solutions for low-income countries.

This chapter aims at providing an overview of the FLW issue and its implications for sustainability and food security, analysing drivers and causes of FLW along the entire food chain and highlighting different strategies and policies for its reduction and/or prevention. Divided into four parts, it provides a global perspective on FLW with a particular focus on the Mediterranean region.

Food loss and waste, food security, nutrition and sustainability

Food loss and waste and sustainable food systems development

A food system includes all elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to production, processing, distribution, preparation and consumption of food; outputs of these activities include socio-economic and environmental outcomes (HLPE, 2014). A sustainable food system is a food system that provides food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.

In September 2015, the United Nations Agenda 2030 was adopted at global level engaging, for the first time, developing, transition, and industrialised countries alike. The Agenda 2030 Sustainable Development Goal (SDG) No. 12 “ensure sustainable

1 - www.wri.org/our-work/project/food-loss-waste-protocol

2 - www.fao.org/platform-food-loss-waste/fr/

consumption and production patterns” has set the target 12.3 “by 2030, halve the per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains including post-harvest losses”³. Twenty years after the Rio Earth Summit in 1992, the signatories of *The future we want* declaration committed themselves to the Agenda 2030 in response to today’s and tomorrow’s global challenges. Some countries have already taken up the challenge to ensure that enough food for the expected population growth would be available with measures including prevention and reduction of FLW, which drains natural resources, such as water, soil nutrient contents and energy when food is produced and not consumed by humans.

Four examples of national efforts to reduce FLW: China, South Africa, Turkey and the United States

China. In 2014, the Chinese government has taken several steps towards the reduction of FLW. The Central Committee and State Council issued a joint circular on “Practicing strict economy and fighting against waste”. The State Administration of Grain, the Ministry of Industry and Information Technology, and the General Administration of Quality Supervision, Inspection and Quarantine issued a notice on “Saving food and reducing food losses among foodstuffs and oil-processing industries”. The “Clean your plate” campaign focused on consumer awareness and behaviour change of actors along the supply chain.

Source: www.fao.org/platform-food-loss-waste/food-waste/food-waste-reduction/en/

South Africa. From 2 to 5 June 2015 South Africa hosted a national multi-stakeholder consultation workshop to gather information for a *National Food Waste Prevention and Reduction Programme* that will include pilot actions in Johannesburg and in Tshwane. *Think.Eat.Save (Guidance for governments, local authorities businesses and other organisations Version 1.0)* that is part of the FAO led Global Initiative on Food Loss and Waste Reduction and of the FAO and the United Nations Environment Programme (UNEP) Sustainable Food Systems Programme foresees pilots for country implementation support and South Africa is the first pilot.

Source: www.fao.org/save-food/news-and-multimedia/news/news-details/en/c/293895/

Turkey. In January 2013, the Turkish Grain Board (TMO) and the Ministry of Food, Agriculture and Livestock together with relevant stakeholders along the supply chains launched the Campaign for Preventing Bread Waste. By 2014 the programme had achieved the following outcome: (1) a reduction of 18% on average in waste from 2011 to 2012; (2) bread waste which was 5.9 million loaves per day (2.17 billion loaves per year) in 2012 decreased to 4.9 million loaves per day (1.8 billion loaves per year) in 2013. The value of bread waste, which was 1.6 billion Turkish lira (around USD 697 million) in 2012, has been reduced to 1.3 billion Turkish lira (around USD 565 million); 40% of this reduction was registered in households, staff dining halls and student dining halls.

Source: www.tmo.gov.tr/Main.aspx?ID=1045

	Before the Campaign (end of 2012)	After the Campaign (end of 2013)
Annual expenditure on bread consumption (billion Turkish lira)	26	23.5
Annual expenditure on bread consumption (billion USD)	13.8	12.4
Daily bread production (million loaves)	101	91
Daily bread consumption (million loaves)	95	86
Daily bread waste (million loaves)	5.95	4.9
Daily per capita bread consumption (g)	319	284
Daily per capita bread waste (g)	19.9	16.2

Source: OECD and FAO (2014).

United States. In September 2015, the US Environmental Protection Agency (EPA) and the US Department of Agriculture (USDA) announced a national goal to reduce food waste by 50% by the year 2030. The United States estimate that approximately 31% of the overall food supply available to retailers and consumers is lost or wasted with impact on food security, natural resources, and climate change.

The Agenda 2030 requires measurable and verifiable indicators that must reflect development pathways and be economically, socially and environmentally sound without infringing the principle of sovereignty (Voituriez, 2013). The FAO is working on the Global Food Loss Index (GFLI) indicator for SDG 12.3 to monitor the success of countries in reducing food loss. The compilation of the GFLI shall be based on the food loss estimates recorded in the Food Balance Sheets, while the quality of these figures is currently being improved by broadening and enhancing the primary database and developing further the methodology. Currently, GFLI uses dietary energy supply, expressed in kilocalories (kcal), as the reference unit of measure. The GFLI will be aligned with data on agricultural production, foreign trade and the various types of utilisation of agricultural products.

The *Zero Hunger Challenge* – the UN’s Secretary-General’s vision for a future free from hunger issued during Rio+20 – identifies five interconnected elements for key areas of intervention and strongly links food security and nutrition to food systems sustainability and food loss or food waste prevention and reduction: 1) 100% access to adequate food all year round; 2) zero stunted children under 2 years of age; 3) all food systems are sustainable; 4) 100% growth in smallholder productivity and income; 5) and zero food is lost or wasted (UN, 2012). FLW was addressed by the 41st Session of the Committee on World Food Security (CFS) in 2014. During its 39th Session (October 2012), the CFS requested the High Level Panel of Experts on

Food Security and Nutrition (HLPE) to undertake a study on “Food losses and waste in the context of sustainable food systems” to be presented during the CFS Plenary in 2014. According to the HLPE report, FLW is a consequence of the way food systems function, technically, culturally and economically at micro, meso and macro levels (HLPE, 2014). Lastly, the G20 Agriculture ministers highlighted the extent of FLW as “a global problem of enormous economic, environmental and societal significance” and encouraged all G20 members to strengthen their collective efforts to reduce FLW. In the context of policy coherence fostered by the G20, the Development Working Group was encouraged to continue its efforts to develop actions to reduce FLW as part of its Implementation Plan for the G20 Food Security and Nutrition (FSN) framework. During its Presidency of the G20, Turkey took the initiative at the G20 Ministerial meeting on Agriculture, to place the challenges of food security and nutrition among one of the priorities⁴.

FLW indicators on global food security and nutrition

One third of the food produced is lost or wasted, this is unacceptable in a world where approximately 795 million people do not have appropriate food availability and access for sufficient energy, macro and micronutrient intake (Gustavsson *et al.*, 2011; FAO, IFAD & WFP, 2015; WHO, 2016). This mega scale of energy deficit and macro and micro-nutrient deficiencies worldwide requires increased diversified food sources.

Food energy loss in FLW. When converted to calories, global FLW amount to approximately 24% of all food produced (Kummu *et al.*, 2012). Every one out of four food kilocalories intended for human consumption is not ultimately consumed by humans (Kummu *et al.*, 2012; Lipinski *et al.*, 2013; Searchinger *et al.*, 2013). This figure is lower than the commonly cited figure (one-third), which measures food loss by weight. This points to the basket of different types of food that are lost and wasted ranging, for example, from calorie rich cereals to nutrient-dense but low-calorie fruits and vegetables (Searchinger *et al.*, 2013).

According to the FAO (2013a), if 25% of the global FLW could be saved, it would be sufficient to feed 870 million hungry people in the world under the condition of ensuring adequate social, economic, and physical access. A global overview of FLW along food chains has found that, on average, only 43% of foods cultivated for human consumption were actually consumed. Globally, farmers were able to produce food that was equivalent to 4,600kcal per capita per day. However, 600kcal per capita per day was lost because of inefficiencies in harvest, transport, storage, and processing. Moreover, the conversion of food supply (mainly grains) to feeds for livestock caused a further net decrease in 1,200kcal/capita/day. Furthermore, caloric estimates of FLW did not capture the nutritional quality or micronutrient losses (e.g. vitamin A, iron, zinc, iodine) (Smil, 2004).

4 - One of the main outcomes of the Turkish Presidency of the G20 consists of the establishment of the *Technical Platform on the Measurement and Reduction of Food Loss and Waste* (available at www.fao.org/platform-food-loss-waste).

Nutrient losses in FLW. Until recently, there has been a lack of data on nutrient loss in FLW to understand the scales and causes of the issue at global, national and local levels. The availability of these analytical data is crucial to inform data-driven food systems policies and programmes aimed at reducing FLW and its associated nutrient loss, and to advocate for sustainable food consumption and production patterns.

Two recent FAO studies indicated that micro-nutrient losses due to FLW along the food chain are alarmingly high (Serafini *et al.*, 2015; Lee *et al.*, 2015). Based on the Global Food Losses and Food Waste Report (Gustavsson *et al.*, 2011), the first FAO study estimated loss and waste of vitamins A and C from fruit and vegetables loss along the food chain in seven regions of the world. Massive micro-nutrient losses from FLW occur in the industrial Asia, with Europe in the middle, and Latin America and Sub-Saharan Africa at the lower end (Serafini *et al.*, 2015). Higher nutrient loss occurs during agricultural production, post-harvest and consumption. Reduction in FLW could potentially avail more nutrients and phytochemicals for human consumption, contributing to the alleviation of micronutrient deficiencies, health promotion and prevention of non-communicable diseases, in both low and high income countries, in particular among vulnerable populations. Unfortunately, current methodologies in collecting FLW data and estimating nutrient losses have limitations that need to be addressed to improve precision (Serafini *et al.*, 2015). Findings from the FAO country-based study on micro-nutrient losses in FLW are shown the following Box.

Micro-nutrient loss for human consumption due to FLW: FAO methodology

Based on the current available data and methodology developed by the FAO, the annual vitamin A loss along food chains in Norway in 2011-2012 was approximately 354,824 tonnes per year (227,667 tonnes per year of fruit; 127,157 tonnes per year of vegetables) which has led to about 280.3kg Retinol Equivalent (RE) per year loss of vitamin A. If this level of vitamin A loss were reduced and made available to feed vitamin A deficiency (VAD) children under 5 years old, approximately 1,807 million of VAD children in the world would have met their vitamin A needs.

Using an FAO case study in Kenya (2013), the annual volume of food loss in four selected food supply chains were estimated at 1,835,468 tonnes per year (451,842 tonnes of bananas per year, 879,789 tonnes of maize per year, 462,453 tonnes of milk per year and 41,284 tonnes of fish per year). This food loss corresponds to approximately 338.8kg RE per year loss of vitamin A. If such a quantity of vitamin A were made available to feed VAD children under 5 years old about 2.18 million children would have met their vitamin A needs. In Kenya, the number of VAD children under 5 years old was about 5.84 million during that period; therefore, nearly 37.4% VAD children under 5 years old in the country would have benefited from an access to these vitamin A rich foods if food loss was prevented and reduced and if adequate (social, economic and physical) access was ensured.

Source: Lee *et al.* (2015).

Hidden nutrient losses in the food chain. FLW is generally measured in weight. Some studies have also used caloric metrics while others use economic units. Food quality loss or waste (FQLW) is more difficult to access and measure, as there are different quality and nutritional attributes, which may or may not be correlated to each other. According to HLPE (2014), *food quality loss or waste* (FQLW) refers to the decrease of food quality attributes (e.g. nutrition, aspect, etc.) due to the degradation of the product throughout the food supply chains, from primary production to end consumption level. FLW in mass does not fully take into account the nutritional dimensions as food quantity might be preserved (with low levels of FLW measured in mass) while this does not necessarily mean that micro- and macro-nutrients are equally preserved (HLPE, 2014).

As food travels from the producer to the consumer, through handling, processing and storage along the food chain, qualitative losses of nutrients take place. Understanding how nutrient concentration in food varies with different handling processes and storage conditions as well as the hot spots in the food chain where hidden nutrient losses occur would help improve food handling, processing and storage procedures, thereby maximising the nutritional quality of food for human consumption. The HLPE (2014) recognised that this is a research gap that warrants new research to unveil the nutritional aspects of “food quality loss or waste”. To address this issue of hidden nutrient losses in the food chain, the FAO plans to explore the methodologies to evaluate qualitative loss of nutrients in the food chain.

Promotion of food security and nutrition through recovery and redistribution of safe and nutritious food. Where FLW cannot be prevented at source, recovery and redistribution of safe and nutritious food for human consumption (RR) could contribute to food security and nutrition, option indicated also by the Committee on World Food Security (HLPE, 2014). In 2015, the FAO provided a voluntary framework definition of recovery and redistribution: “Recovery of safe and nutritious food for human consumption is to receive, with or without payment, food (processed, semi-processed or raw) which would otherwise be discarded or wasted from the agricultural, livestock, forestry and fisheries supply chains of the food system. Redistribution of safe and nutritious food for human consumption is to store or process and then distribute the received food pursuant to appropriate safety, quality and regulatory frameworks directly or through intermediaries, and with or without payment, to those having access to it for food intake.”

Worldwide various community level initiatives are implemented along supply chains from primary production to end consumer level: gleaning networks, food banks and food pantries, as well as social supermarkets. The dual approach of reducing FLW at source while implementing, monitoring and evaluating RR presents challenges and opportunities for all food system actors, including the end consumer. It warrants empirical country data to assess the FLW scale in order to inform policy actions that sustainably minimise FLW while providing RR tools for operators and ensure monitoring, evaluation and appropriate accountability.

Food banks networks

The main mission of a food bank is to provide recovered safe and nutritious food available along supply chains to food insecure people. It also supports the community through potential auxiliary functions such as the implementation of job training and supplemental educational programmes. Food banks restrict distribution to vetted and qualified institutions that deliver services to the low and/or no-income community and that incorporate food assistance as a component of those services (e.g. homeless or domestic abuse shelters, orphanages, soup/community kitchens, drug and alcohol rehabilitation facilities, medical clinics, food pantries, social supermarkets).

Founded in 1986, the European Federation of Food Banks (FEBA) brings together 256 food banks situated in 21 countries. Supply management and food distribution are handled by 12,934 volunteers and 924 employees. FEBA food banks recover food from the food industry and retail stores, European and national food aid programmes or from individual donations of retail pre-packaged foodstuffs. Nearly half (44%) of the food collected in Europe comes from the European programme of food aid for the most deprived, 22% comes from the food industry, 17% comes from retail stores, 14% from individuals through national and local collections, and 3% from withdrawals from national markets. 401,000 tonnes of food were distributed in 2011, 388,000 tonnes in 2012 and 402,000 tonnes in 2013 (FEBA, 2014). In 2014, FEBA member food banks distributed 411,000 tonnes of food to 5.9 million people in partnership with 33,800 partner charitable organisations.

The Global Food Banking Network (GFN) was founded in 2006 and currently supports a network of over 250 operational food banks in more than 30 countries (21 countries in 2013, 23 countries in 2014). Recovery and redistribution differs highly in quantity across food banks for cereals, roots and tubers, oil crops and pulses, fruits and vegetables, meat, fish and seafood, dairy and eggs and beverages. In 2012, the network distributed more than 450,000 tonnes of food to more than 19,000 institutions that support communities directly. In 2013, more than 550,000 tonnes of food were distributed to approximately 25,500 social service agencies. The total number of people that are annually accessing the food bank services ranges from 1,000 to 1,500,000 in their respective countries (GFN, 2014).

Food banks require access to multi-stakeholder dialogue platforms and resource mobilisation, infrastructure and public-private partnerships. Moreover, tools for monitoring and evaluation are essential as they provide guidance on food safety and quality (including human nutrition) and further data on the four dimensions (availability, access, utilisation and stability) of food and nutrition security for the people accessing the services provided. Finally, food banks cannot be used as a substitute of social protection measures that address the underlying poverty and inequality, and subsequently generated food and nutrition insecurity.

Source: Bucatariu (2016).

Food security and nutrition in the Mediterranean region. In the Mediterranean region, food availability is limited for several reasons. Water scarcity is a constraint for agriculture production as per capita renewable water availability in most countries falls below the threshold of water scarcity of 1,000m³ per capita per year. Likewise, constantly threatened by desertification and urban encroachment, the availability of arable land per capita is the lowest in the world (FAO, 2015b). There is also a growing demand for food from fast-growing populations in urban areas with rising incomes. There is also a shift in food preferences towards higher-value products (often more

perishable). Moreover, FLW in the SEMCs are high and contribute to reduced food availability, aggravated water scarcity, adverse environmental impacts and increased food imports in an already highly import-dependent region. There is an increasing concern for the food security and nutrition situation in the South of the Mediterranean as they highly depend on food imports. The South Mediterranean is a net importer of agricultural commodities, animal products and feed (FAO, 2015a). SEMCs import half of their basic crops. In 2013, the region imported about 29 million tonnes of wheat, and between 2002 and 2013, imports of all agricultural food products have risen by 63% (USD 69 billion) (FAO, 2015a). Prevention and reduction of FLW is essential because FLW undermine all four components of food security and nutrition, i.e. availability, access, utilisation and stability (HLPE, 2011; FAO, 2012a, 2012b, 2012c). Reduction of FLW contributes to make more foods and nutrients available to feed the world and prevent and control energy deficits as well as micronutrient deficiencies, especially among the vulnerable.

The Second International Conference on Nutrition (ICN2)

The Second International Conference on Nutrition (ICN2) was an inclusive inter-governmental meeting on nutrition held at the FAO Headquarters in Rome on the 19-21 November 2014 and jointly organised by the FAO and the World Health Organisation (WHO), in cooperation with the High Level Task Force on the Global Food Security Crisis (HLTF), IFAD, IFPRI, UNESCO, UNICEF, World Bank, WFP and the WTO. The main outcomes of this high-level ministerial conference were the Rome Declaration on Nutrition and the Framework for Action.

The ICN2 Rome Declaration on Nutrition acknowledged “that current food systems are being increasingly challenged to provide adequate, safe, diversified and nutrient rich food for all that contribute to healthy diets due to, inter alia, constraints posed by resource scarcity and environmental degradation, as well as by unsustainable production and consumption patterns, food losses and waste, and unbalanced distribution”. Moreover, it invites the States to “reduce food losses and waste throughout the food chain should be reduced in order to contribute to food security, nutrition, and sustainable development”. Recommendation 11 of the Framework for Action incites them to “improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste”.

Source: www.fao.org/3/a-ml542e.pdf and www.fao.org/3/a-mm215e.pdf

Understanding the qualitative nutrient losses in the food supply chain (hidden nutrient losses) would help improve post-harvest food handling, processing and storage so that maximum nutrient concentrations in food are retained for human consumption. A reduction in 50% of food waste at retail and consumer level as well as a reduction of food loss along the food supply chains, as targeted by the SDG 12.3, is a promising policy action to help achieve the SDG 2, i.e. to end hunger and eradicate all forms of malnutrition, including micro-nutrient deficiencies, by the year 2030.

FLW and sustainable food systems

The world's food system is not nutrition-sensitive, efficient and sustainable to ensure global food security and nutrition. "The world's food system – with its reliance on industrialised production and globalised markets – produces ample supplies, but creates some problems for public health. Part of the world has too little to eat, leaving millions vulnerable to death or disease caused by nutrient deficiencies, while another part overeats, with widespread obesity pushing life-expectancy figures backwards and pushing the costs of health care to astronomical heights." (Margaret Chan, Director General, WHO, ICN-2 Rome, 19 November 2014).

Launched in the context of the 10-Year Framework of Programmes (10YFP) on Sustainable Consumption and Production (SCP), the Sustainable Food Systems Programme (SFSP)⁵ identified, through a public consultation, FLW as a key issue that the SFSP should focus on for accelerating towards sustainable food systems (FAO-UNEP, 2014). The Sustainable Consumption and Production Regional Action Plan for the Mediterranean, the first regional plan to promote SCP, was presented for endorsement at the meeting of the Contracting Parties to the Barcelona Convention (COP19) (UNEP-Mediterranean Action Plan) held on the 9-12 February 2016 in Athens (Greece). The 21 Mediterranean ministers and the European Union approved the Regional Action Plan on SCP for the Mediterranean. Its multi-stakeholder focus approach focuses on four areas: 1) food, agriculture and fisheries; 2) goods manufacturing; 3) tourism; 4) housing and construction. Its roadmap for implementation includes suggested actions, specific targets and relevant partners and initiatives. The food and agriculture priority area calls for the promotion of good environmental practices for production and processing, including the transfer of innovation and technology upstream and downstream and minimising resource waste. The SCP Action Plan applies the hierarchy of "prevention at source, recovery and recycling of resources".

Sustainable Consumption and Production Regional Action Plan for the Mediterranean

Operational objectives and actions for consumption and production priority area Food, Fisheries and Agriculture (FFA).

Operational Objective 1.1: Promoting Innovation and Knowledge in the implementation of Best Environmental Practices and Technologies in the growing, harvesting, processing and consumption phases, allowing efficient management of resources, minimising environmental impacts of the FFA sector throughout its life cycle.

Suggested actions (No. 4) to reach operational objective 1.1: Prevent and minimise resource waste and food wastage throughout the life cycle of the food; promote the production and use of energy and compost from food waste coming from the selectively-collected fraction of the municipal waste and agricultural organic waste.

5 - www.fao.org/fileadmin/templates/ags/docs/SFCP/Activities/Preliminary_proposal_for_the_10YFP_on_Sustainable_Food_Systems_Programme.pdf

Progress indicators including baseline (BL) and Target (T) by 2021:

- Number of agriculture ministries that benefit from capacity building on resource and food waste.
- Number of pilot projects implemented that adopt the prevention of resource and food waste.
- Number of dissemination events at regional level aimed at promoting the findings.

Key Partners: IFAD, FAO, WFP.

Operational Objective 1.3: Sensitise and educate food producers, retailers and consumers, and support the development of appropriate market tools and information, to promote sustainability throughout the value chains of agriculture and fisheries management, as well as food processing and food distribution.

Suggested actions (No.12) to reach operational objective 1.3: Implement information and education campaigns to promote the concept of the “Mediterranean Diet” and ensure public engagement in the production and consumption of sustainable food and local agriculture and fisheries products, along with reduction of food waste. Increase consumer awareness regarding best practices to prevent food wastage (quantity, storage, expiry dates, etc.).

Progress indicators including baseline (BL) and Target (T) by 2021:

- Number of countries participating in the regional competition related to the “Mediterranean Diet”.
- Number of regional workshops and trainings organised to support producers and consumers in adopting the concept of the “Mediterranean Diet”.

Key Partners: UNEP, FAO, UNESCO, CIHEAM, WWF, *Fundacion Dieta Mediterranea*

Source: UNEP-MAP (2015).

There are many regions and countries engaged in efforts tackling FLW. For instance, the 2013 Near East and North Africa (NENA) Regional Strategic Framework for reducing FLW⁶ is based on the region’s socio-economic and natural resources context. Moreover, the 2014 FAO report on FLW Reduction in Europe and Central Asia⁷ for Improved Food Security and Agrofood Chain Efficiency complements the FLW reports for Turkey, Ukraine, Armenia, Kazakhstan, and Tajikistan. Finally, the European Commission launched the Communication on Closing the loop – An EU action plan for the Circular Economy⁸ on the 2 of December 2015. The EU and Member States are committed to meeting the SDG 12.3 and to support this achievement they will: 1) elaborate a common EU methodology to measure consistently and in co-operation with Member States and stakeholders; 2) create a multi-stakeholder platform in order to help define measures needed, facilitate inter-sector co-operation, and share best practices and results achieved; 3) take measures to clarify EU legislation related to waste, food and feed and facilitate recovery and

6 - www.fao.org/documents/card/en/c/e9589c20-5507-4eee-a965-22fc5a08f42f/

7 - www.fao.org/save-food/regional/easterneurope/en/

8 - http://ec.europa.eu/priorities/jobs-growth-investment/circular-economy/docs/communication-action-plan-for-circular-economy_en.pdf

redistribution of safe and nutritious food for human consumption and the use of former foodstuffs and by-products from the food chain for feed production, without compromising food and feed safety; 4) examine ways to improve the use of date marking by actors in the food chain and its understanding by consumers, in particular “best before” date labelling.

Concurrent environmental implications of FLW

FLW reduction is considered essential to reduce the environmental footprint of food systems (HLPE, 2014; FAO 2012a, 2012b, 2013a, 2014b, 2015a et 2015b; UNEP, 2012a and 2012b). FLW amount to major squandering of resources, including water, land, energy, labour and capital, and needlessly produce greenhouse gas emissions (Gustavsson *et al.*, 2011; FAO, 2013a). FLW leads to unnecessary greenhouse gas emissions and inefficiently used water and land, which in turn can lead to diminished natural ecosystems and the services they provide (Lipinski *et al.*, 2013). According to the FAO (2014b) estimations, total FLW reaches up to USD 1 trillion of economic costs per year with additional environmental costs that reach around USD 700 billion and social costs around USD 900 billion.

FLW environmental and social costs include:

- 3.5Gt CO₂ of greenhouse gas emissions. Based on the social cost of carbon, these are estimated to cause USD 394 billion of damages per year;
- Increased water scarcity, particularly for dry regions and seasons. Globally, this is estimated to cost USD 164 million per year;
- Soil erosion due to water is estimated to cost USD 35 billion per year through nutrient loss, lower yields, biological losses and off-site damages. The cost of wind erosion may be of a similar magnitude;
- Risks to biodiversity including the impacts of pesticide use, nitrate and phosphorus eutrophication, pollinator losses and fisheries overexploitation are estimated to cost USD 32 billion per year;
- Increased risk of conflict due to soil erosion, estimated to cost USD 396 billion per year;
- Loss of livelihoods due to soil erosion, estimated to cost USD 333 billion per year;
- Adverse health effects due to pesticide exposure, estimated to cost USD 153 billion per year.

Losses or waste of the resources used for production are a major source of negative impacts, including emissions of greenhouse gas (GHG) at disposal. Indirect environmental externalities include unnecessary surface and ground water pollution caused by the intensive use of nitrogenous fertilisers in agriculture. Negative externalities include also those that mono-cropping and agriculture expansion into wild areas create in terms of biodiversity loss (FAO, 2013b). Food waste is also waste of land resources (Wirsenius *et al.*, 2010; FAO, 2013b). FLW account for more than one quarter of total consumptive use of finite and vulnerable freshwater resources and more than 300 million barrels of oil per year (Lundqvist *et al.*, 2008; Hall *et al.*, 2009).

National case study by WWF-Italy

A study conducted by WWF-Italy (2013) analysed the environmental footprints of food waste in Italy. It showed that in 2012, 706 million m³ of water were associated with the waste of meat, cereals, fruits and vegetables, tubers and roots, and milk by Italian consumers. The contribution to water waste changes from a food product group to another: 43% of water waste is due to the waste of meat and meat products, 34% due to cereals and bakery products, 16% due to fruits and vegetables, 3% due to roots and tubers, and 4% is associated to milk and dairy products waste.

Food waste-related greenhouse gas emissions amount to 14.3 million tonnes of CO₂ equivalent associated with food wasted by Italian consumers in 2012 (10.2 million tonnes more are associated to food loss along the supply chain). Moreover, 143 thousand tonnes of reactive nitrogen are associated with food wasted by consumers, plus other 85.8 thousand tonnes of nitrogen wasted along the supply chain.

Source: WWF-Italy (2013).

In the SEMCs, the environmental impact of FLW is dire given the scarce and declining natural resources, especially water, and the pressure from the growing demand for agriculture production. The FAO (2013b) estimated the blue water footprint of FLW in SEMCs (NAWCA region) at 42 km³ annually, or 17% of the global figure of 250 km³. This exceeds by far the water loss of any other region in per capita terms (Kummu *et al.*, 2012), and a large share of the blue water footprint is attributed to cereal production (FAO, 2013b). Land loss due to FLW is also severe, exceeding 360 million hectares and greater than in any other region. This is largely explained by animal feeding for meat and milk production on non-arable grasslands, and low livestock productivity due to low yields of the grasslands themselves (FAO, 2013b). The carbon footprint attributed to FLW is estimated at 200 million tonnes per year, or 6% of the global total of 3.3 Gtonnes (FAO, 2013b).

Making the food supply chain more efficient through loss and waste reduction measures will reduce pressure on resources required for food production and lower greenhouse gas emissions (Foresight, 2011). Reducing the amount of food wasted throughout the food chain in the entire Mediterranean area would help to improve food and nutrition security and contribute to easing pressure on natural resources especially water; increase the amount of food available for human consumption for the given level of inputs, thereby improving input use efficiency (Ingram, 2011); and reduce water needs in agriculture (Lundqvist *et al.*, 2008) as well as environmental impacts (Lundqvist *et al.*, 2008; Nellemann *et al.*, 2009).

Economic implications and value of FLW

From an economic viewpoint, FLW generation, prevention and reduction, as well as management have impacts for all actors in the food supply chains and in the overall food system (Gustavsson *et al.*, 2011). Research shows that the prevention and reduction of the loss or waste of safe and nutritious food for human consumption is being supported in all regions of the world. The potential for intra- and inter-regional economic impacts would need to be further understood. Moreover, high-level considerations of the socio-economic impacts of FLW need to be balanced

with value chain analyses that include data on costs related to the prevention and reduction measures to be implemented for short-, medium- and long-term returns on investments along food supply chains, including for the end consumption level (Rutten *et al.*, 2015).

Food loss during harvest and in storage represents a loss of income for farmers and higher food prices for consumers (FAO, 2013a; Lipinski *et al.*, 2013). FLW imply that consumers pay a higher price for food due to the inefficiencies of the food system as a whole. In principle, with a reduction in FLW, the overall food supply available for human consumption would increase. According to the FAO (2013), FLW roughly amount to USD 680 billion in industrialised countries and USD 310 billion in developing countries. In SEMCs (or NAWCA region), the FAO (2013b) reaches a conservative estimate of USD 60 billion per year.

FLW reduction may improve food security and nutrition due to potential lower food prices and increased food purchasing power. However, if food becomes more affordable, households may waste more or trade-up and spend the saved income from the reduction of food waste for other services or higher quality food (Mhlanga and Bucatariu, 2015)⁹. In the short-run, producers may have to incur also food loss reduction costs. Meanwhile, consumers may delay spending savings on previously wasted foods (Rutten, 2013a). Some studies point out that a greater supply of food due to the reduction of food loss at production stage, without changes in consumption patterns, could simply raise waste downstream. Some consumers would have access to more food so could produce more food waste while other consumers would continue on their path of waste if nothing is done to avoid it (Rutten, 2013b; Godfray *et al.*, 2010). All in all, the economic outcomes of FLW reduction actions and strategies depend on the extent to which food loss or waste are prevented and reduced, causes, and costs involved (Rutten, 2013a).

Drivers, causes (micro, meso and macro) and extent of FLW along the food supply chains

FLW in the world

Extent of FLW. An FAO study (Gustavsson *et al.*, 2011) was the first systematic effort to quantify FLW at global and regional levels. It estimates that around one third of all food produced in the world is lost or wasted. The study indicates that FLW vary from one country, commodity and season to another (Lundqvist, 2010). Losses in the first part of the food chain are more important in developing countries (Venkat, 2011; Lundqvist *et al.*, 2008), while in industrialised countries most losses occur at

⁹ - FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies) is a project about working towards a more resource efficient European Union by significantly reducing food waste. and it is funded by the Framework Programme 7 of European Commission from August 2012 to July 2016. According to the FUSIONS definitional framework (2014), “food waste is defined by the final destination of all food, and inedible parts of food, removed from the food supply chain. Any food and inedible parts of food, removed from the food supply chain sent to recovery and disposal operations are termed “food waste”. Any food, or inedible parts of food, sent to animal feed, bio-material processing or other industrial uses are termed “valorisation and conversion” and are distinct from “food waste”.

later stages of the supply chain and at consumer level (Gustavsson *et al.*, 2011). In developing countries, 40% of losses occur at post-harvest and processing levels while in industrialised countries more than 40% of losses happen at retail and consumer levels. Every year, consumers in rich countries waste almost as much food (222 million tonnes) as the entire net food production of sub-Saharan Africa (230 million tonnes) (FAO, 2013c).

Fruits and vegetables, plus roots and tubers have the highest wastage rates of any food. Studies carried out by the FAO estimated yearly global FLW by quantity at roughly 30% of cereals, 40–50% of root crops, fruits and vegetables, 20% of oilseeds, meat and dairy products, and 35% of fish (FAO, 2013c). As for post-harvest losses, estimates range from 8–22% of cereals lost at farm-level and post-harvest due to poor storage (Bala *et al.*, 2010) to nearly 100% in some situations for horticultural produce (Parfitt *et al.*, 2010). Moreover, over 40% of marine fisheries are wasted as by-catch (Davies *et al.*, 2009). According to Davy Vanham *et al.* (2013), the foods that households waste the most in the 28 EU countries (EU27 and Croatia) are fresh vegetables and fruit as well as bakery items (cereals product group) such as bread and cakes.

FUSIONS Food waste data set for the 28 EU countries: new estimates and environmental impact

The total estimate equates to 173kg of food waste per person in the 28 EU countries. As the total amounts of food produced in the EU for 2011 were around 865kg per person (FAOSTAT, Food Balance Sheets), this would mean that 20% of the total food produced ends up as food waste. It should be noted that this 20% in part comprises inedible food, which is unavoidable by nature. There is a moderately high uncertainty on this estimate of food waste amounts; the approximate 95% confidence interval is of about 14 million tonnes (or about 16%). Given that the approach is new, in particular the results for the production and processing sectors are likely to change when more studies become available. Moreover, according to FUSIONS calculations, the generated food waste costs the 28 EU countries around 143 billion euros.

Source: FUSIONS (www.eu-fusions.org/index.php/publications).

Drivers and causes of FLW. The identification of causes of FLW is important in order to identify solutions for prevention, reduction and priorities for action. Several studies on FLW have identified different causes of FLW. Loss and waste along the food supply chain often result from interrelated causes and an action at one stage in the chain can affect the whole chain. According to High Level Panel of Experts (HLPE, 2014) and other literature sources, the main FLW causes include:

- Pre-harvest factors and produce left un-harvested: differences in production and agronomic practices may result in different quality at harvest, different suitability for transport and shipping, different storage stability and different shelf-life after harvest (Florkowski *et al.*, 2009).

- Harvesting and initial handling: poor harvest scheduling and timing, inefficient harvesting equipment, inappropriate handling of the produce, and temperature management are key contributors to FLW.
- Storage: the major cause of post-harvest loss is the lack of proper storage facilities (Gustavsson *et al.*, 2011). If infrastructure for initial storage is lacking, perishable produce can spoil within hours (Rolle, 2006; Stuart, 2009).
- Transport and logistics: can be a major cause of FLW, by introducing a time span between production and consumption, of particular importance for fresh products, as well as additional risks of mechanical and heat injury. Losses occur when, for instance, the cooling system malfunctions during transport or other logistics systems parts break down.
- Processing and packaging: lack of raw packaging materials and technologies for manufacturing of appropriate packaging along with technical malfunctions and inefficiencies cause food loss. Errors during processing lead to defects in the end product, such as wrong size, weight, shape, appearance or damaged packaging that may lead to food loss if the safe and nutritious food is not recovered and redistributed for human consumption.
- Retail and other distribution systems: influences the activities of supply chains as they dictate the quality of the produce to be supplied and displayed in outlets. Conditions within the retail outlet (temperature, relative humidity, etc.) and handling practices have an effect on quality, shelf-life and acceptability of the product.
- Consumption: socio-economic, demographic, or income-related behaviour are among FLW causes at consumer level (WRAP, 2009; HISPACOO, 2012; Baptista *et al.*, 2012). These include poor planning of purchases often leading to buying more than is needed; discarding food due to confusion over “best-before” and “use-by” dates and misinterpretation of other information displayed on the food labels; lack of appropriate storage or stock management in the home; excess portions prepared and not eaten; inadequate food preparation techniques.

Recovery and redistribution of safe and nutritious food for human consumption

Where FLW cannot be prevented at source, recovery and redistribution of safe and nutritious food for human consumption could contribute to food security and nutrition. This option was indicated by the CFS. In 2015, the FAO provided a voluntary framework definition: “Recovery of safe and nutritious food for human consumption is to receive, with or without payment, food (processed, semi-processed or raw) which would otherwise be discarded or wasted from the agricultural, livestock, forestry and fisheries supply chains of the food system. Redistribution of safe and nutritious food for human consumption is to store or process and then distribute the received food pursuant to appropriate safety, quality and regulatory frameworks directly or through intermediaries, and with or without payment, to those having access to it for food intake.” This pyramid of usage may be useful in examining and making decision on food uses (see Figure 1 in chapter 12, p. 285).

Source: Bucatariu (2016).

FLW in the Mediterranean

Accurate estimations of the magnitude of FLW are lacking. Nevertheless, there is no doubt that FLW remain unacceptably high. Per capita food waste by consumers is between 95 to 115kg a year in Europe and North America, while consumers in sub-Saharan Africa, south and south-eastern Asia, each throw away only 6 to 11kg a year (Gustavsson *et al.*, 2011). In North Mediterranean countries, there is the example of Spain where more than 7.6 million tonnes of food are wasted each year. These statistics echo across the European Mediterranean with France wasting 9 million tonnes and Italy 8.8 million tonnes each year (Charalampopoulou *et al.*, 2014). Additionally, the study carried out by Andrea Segrè and Luca Falasconi (2011) were the first ones to provide a quantification of waste along the whole food supply chain in Italy: 20 million tonnes from the field to the fork. FLW were estimated in five stages along the food supply chain: manufacturers; primary cooperatives; processing industries; wholesale and retail distributors; consumers (Segrè and Falasconi, 2011). In 2009, 17.7 million tonnes of agricultural produce was left in the Italian fields, representing 3.25% of total production (Segrè, 2013). Previous literature highlighted the need to have better FLW data (BCFN, 2012; WWF-Italy, 2013).

The 2013 Near East and North Africa (NENA) Regional Strategic Framework for reducing FLW is based on the region's socio-economic and natural resources context (FAO, 2014a). FLW in the NENA region are high (see Table 1) and contribute to reduced food availability, aggravated water scarcity, adverse environmental impacts and increased food imports, in an already highly import-dependent region. FLW severely affect the availability of food in the Near East region including many SEMCs and are unexpected in a region that is so dependent on the international markets to meet its food needs. Quantitative FLW in the NENA region are estimated at 14 to 19% of grains, 26% of roots and tubers, 16% of oilseeds and pulses, 45% of fruits and vegetables, 13% of meats, 28% of fish and sea foods, and 18% of dairy products. For fruits and vegetables, which have the highest proportion of loss and waste, country-specific data indicates that a substantial part (as high as 29% for fresh vegetables in Egypt) of this loss occurs at post-harvest stage (FAO, 2014a). Up to 68% of FLW occur during production, handling, processing and distribution phases of the food supply chain, due to many reasons such as extreme environmental conditions, inadequate storage, transport and packaging infrastructure (FAO-RNE, 2011). Waste at consumption stage is estimated at 32% and occurs mostly in urban centres. Significant waste takes place during various social events and festivities (FAO, 2014a).

The percentages of FLW of the edible parts of seven food commodity groups in the Mediterranean countries are shown in Table 2. Food waste at consumption stage is higher in Northern Mediterranean countries (Europe region) while post-harvest loss is higher in SEMCs (NAWCA region). In April 2014, the FAO Europe and Central Asia Regional Office published the Draft Synthesis Report on FLW in Europe and Central Asia including Turkey (whose aim was to quantify FLW) (Lacirignola *et al.*, 2014).

Table 1 - Magnitudes of FLW in selected crops in the Near East and North Africa (NENA) countries

	Amount of FLW	Phase(s) of FSC	Year	Source
Egypt				
Fresh fruits	19%	Production, transportation, marketing	1980	Blond (1984)
Fresh vegetables	29%	Production, transportation, marketing	1980	Blond (1984)
Wheat	13%-15%	Production to baking (processing)	2011	Kader <i>et al.</i> (2012)
Cereal and oil seeds	17.6 million tonnes	Farm, food processing	2009	Saleh (2012)
Legumes	1.9 million tonnes	Farm, food processing	2009	Saleh (2012)
Fruits and vegetables	8.8 million tonnes	Farm, food processing	2009	Saleh (2012)
Food processing by-product (e.g. stems, peel, husk)	570 thousand tonnes	Food processing	2009	Saleh (2012)
Pomegranate	23% (11 million Egyptian Pounds)	Post-harvest (Assiut Governorate)	2006	Kader <i>et al.</i> (2012)
Vegetables	7%	Marketing (Sharquia, Giza, Kaliobia governorates)	2006	Kader <i>et al.</i> (2012)
Fruits	6.5%	Marketing (Sharquia, Giza, Kaliobia governorates)	2006	Kader <i>et al.</i> (2012)
Iran				
Grapes	13%	Post-harvest	2002	Jowkar <i>et al.</i> (2005)
Cereals	12.9%	Post-harvest	2007	Kader <i>et al.</i> (2012)
Libya				
Potatoes	45%	Post-harvest	1985	Yahia (2005)
Onions	45.1%	Post-harvest	1985	Yahia (2005)
Tomatoes	40.8%	Post-harvest	1985	Yahia (2005)

Table 1 - Magnitudes of FLW in selected crops in the Near East and North Africa (NENA) countries (continued)

	Amount of FLW	Phase(s) of FSC	Year	Source
Lettuce	52.1%	Post-harvest	1985	Yahia (2005)
Cucumber	44.5%	Post-harvest	1985	Yahia (2005)
Oranges	33.5%	Post-harvest	1985	Yahia (2005)
Lemons	16.5%	Post-harvest	1985	Yahia (2005)
Grapes	29.9%	Post-harvest	1985	Yahia (2005)
Morocco				
Dates	40%-50%	Total		Ait-Oubahou and Bartali (2014)
Oman				
Total waste in supermarkets	3%-19%	Retail	2003	Opara (2003)
Summer potato	1.4%, 1.8%, 0.1%, 1% and 2%	Picking, sorting, packing, storing and transportation (respectively)	1997	
Fruits	24%	Household (Consumption)	2007	Opara <i>et al.</i> (2007)
Banana	28%	Household (Consumption)	2007	Opara <i>et al.</i> (2007)
Dates	7%	Household (Consumption)	2007	Opara <i>et al.</i> (2007)
Food	33% USD 175/month	Household (Consumption)	2012	Al-Beloushi (2012)
Saudi Arabia				
Tomato	17%	Production	2008	Al-Kahtani and Kaleefah (2008)
Fig	19.8%	Production	2008	Al-Kahtani and Kaleefah (2008)

Table 1 - Magnitudes of FLW in selected crops in the Near East and North Africa (NENA) countries (continued)

	Amount of FLW	Phase(s) of FSC	Year	Source
Grape	22.8%	Wholesale, import	2008	Al-Kahtani and Kaleefah (2008)
Cucumber	21.3%	Wholesale, import	2008	Al-Kahtani and Kaleefah (2008)
Grape	15.9%	Retail	2008	Al-Kahtani and Kaleefah (2008)
Dates	15%	Retail	2008	Al-Kahtani and Kaleefah (2008)
Cucumber	7%	Wholesale and Retail	2006	Alhamdan (2012)
Beans	4%	Wholesale and Retail	2006	Alhamdan (2012)
Green leaves	7.2%	Wholesale and Retail	2006	Alhamdan (2012)
Strawberry	13.05%	Wholesale and Retail	2006	Alhamdan (2012)
Tunisia				
Apples (government sector production)	10%-15%	Production, storage, transport, wholesale	1992	Kacem (1999)
Pears (government sector production)	10%-15%	Production, storage, transport, wholesale	1992	Kacem (1999)
Wheat	18.3%	Farm to fork, in terms of total wheat (production plus imports)	Before 2006-2012	Ksouri (2014)

Source: compilation of references.

Table 2 - Weight percentages of FLW (in % of what enters each step of the food supply chain) in Europe, in North Africa, in Western and Central Asia and in Turkey

Region	Commodity groups	Steps of the food supply chain					Consumption
		Agricultural production	Postharvest handling and storage	Processing and packaging	Distribution: Supermarket retail		
Europe	Cereals	2	4	0.5-10	2	25	
	Roots and tubers	20	9	15	7	17	
	Oilseeds and pulses	10	1	5	1	4	
	Fruit and vegetables	20	5	2	10	19	
	Meat	3.1	0.7	5	4	11	
	Fish and seafood	9.4	0.5	6	9	11	
	Milk	3.5	0.5	1.2	0.5	7	
North Africa, West and Central Asia	Cereals	6	8	2.7	4	12	
	Roots and tubers	6	10	12	4	6	
	Oilseeds and pulses	15	6	8	2	2	
	Fruits and vegetables	17	10	20	15	12	
	Meat	6.6	0.2	5	5	8	
	Fish and seafood	6.6	5	9	10	4	
	Milk	3.5	6	2	8	2	

Table 2 - Weight percentages of FLW (in % of what enters each step of the food supply chain) in Europe, in North Africa, in Western and Central Asia and in Turkey (continued)

Region	Commodity groups	Steps of the food supply chain					Consumption
		Agricultural production	Postharvest handling and storage	Processing and packaging	Distribution: Supermarket retail		
Turkey	Cereals	5.1	4	2	1	5	
	Roots and tubers	7	6	2	3	2	
	Oilseeds and pulses	15	5	7	1	4	
	Fruits and vegetables	20	8	10	10	5	
	Meat	10	0.2	5	0.5	1	
	Fish and seafood	10	0.2	0.04	0.01	2	
	Milk	10	1	1.5	6	1.5	

Source: Adapted from Gustavsson *et al.* (2011) for data regarding Europe and NAWCA region and Tatlıdili *et al.* (2013) for data regarding Turkey.

Regarding bread waste in Turkey, the results of the studies conducted show that of a total 4.9 million loaves of bread wasted daily in 2013, 62.1% are wasted at bakeries, 27.7% are wasted by households, 10.2% are wasted at restaurants, hotels and dining halls. The bread waste occurring particularly at bakeries is mostly due to the fact that sales points return unsold bread to bakeries. This bread is then either used as animal feed or thrown away (OECD and FAO, 2014).

Turkish policy and initiative on bread waste reduction

Launched in 2013, the Preventing Bread Waste campaign is coordinated by the Ministry of Food, Agriculture and Livestock and its subsidiary organisation, the Turkish Grain Board (TMO). The campaign aims to raise public awareness on waste, avoid waste throughout bread production and consumption stages, promote the consumption of whole wheat bread and contribute to the national economy. Thanks to the campaign carried out in 2013, the bread waste at household, staff and student dining halls decreased by 40% and by 1% in the private sector (restaurants, hotels and bakeries). The campaign has had remarkable outcomes although it has been carried out without imposing any legal sanctions and only with voluntary support. As a result of a study carried out to measure the impacts of the campaign in 2013, 384 million loaves of bread have been saved thus saving the Turkish economy 300 million Turkish liras (USD 136 million), a decrease in bread consumption occurred and 2.5 billion Turkish Liras (USD 1.1 billion) were saved. Consequently, the campaign resulted in a total of 2.8 billion Turkish Liras (USD 1.3 billion) savings for the national economy in 2013.

Source: Eker (2014).

In Egypt, the annual losses of wheat (both locally produced and imported) are valued at 6.6 billion Egyptian Pounds (over USD 1 billion), while the value of maize losses is estimated at 1.5 billion Egyptian Pounds. The reduction of half of the wheat and maize losses would lead to the savings of some 4 billion Egyptian Pounds annually. An estimate of average total waste ranged from 3 to 19% across supermarkets in Oman; while the amount of loss directly associated with handling damage was approximately 2% (FAO, 2013c). Egypt loses between 13 and 15% of the available cereals between harvesting and final consumption (FAO, 2013c). All fresh produce managers consistently identified tomato and banana as the two most important contributors to total wastage, with significant contributions also from grapes and lettuce.

According to the FAO (2013c), the major causes of food losses and waste in the NENA region include the lack of appropriate policy and regulatory framework, institutional weaknesses, inadequate and weak infrastructural base, and technological deficiencies or lack of innovation. The region suffers from very low cold chain capacity, especially important due to the hot climate of the region. Refrigerated storage capacity in Egypt is 0.0144 m³ per capita, in comparison to 0.141 m³ per capita in France, indicating that it is very low although the hot climate in the region requires a much higher capacity. The lack of and unreliability of power supply is a key challenge to establishing the cold chain in the region. Poor maintenance and management practices are another major factor concerning the infrastructure in the

region. Other types of infrastructure face similar major constraints. Wholesale and retail markets in the region are often small, overcrowded, unsanitary and lacking cooling equipment, and adequate facilities for loading, unloading, ripening, consumer packaging and temporary storage.

According to the expert consultation meeting on FLW reduction in the Near East Region held in Egypt in 2012 (FAO, 2013c), lack of appropriate policy and regulatory frameworks and institutional weaknesses are the two main points to focus on in order to reduce FLW as they encourage negative attitudes and actions. Thus, intra-regional trade regulations which are inappropriately designed or implemented lead to perishable products (breaks in the cold chain and to the products being subjected to poor handling). There is also a lack of clarity in the institutional responsibility for food security, market management and monitoring and evaluation. In several countries, municipal governments and Ministries in charge of Agriculture, Supply, Industry and Health are all involved in managing food handling, processing, retailing and wholesaling with no or insufficient coordination, vertical and horizontal harmonisation, or demarcation of jurisdiction. The institutional framework at national and regional levels is usually short-lived and unsustainable as it depends on the government in place. Furthermore, there is usually no framework to foster strong partnership between ministries at various administrative levels as well as donors and international organisations.

Observation of household food waste

In Italy, waste reaches alarming levels at the consumer level. The data released by the Italian Association for the Defence and Orientation of Consumers show that the average household waste is of 35% for fresh produce, 19% for bread and 16% for fruits and vegetables (BCFN, 2012). According to Andrea Segrè (2013), household food waste is mainly caused by the fact that food is mouldy or expired, fruits and vegetables are not stored appropriately, and food has not been prepared according to the consumer's preferences or it is left to spoil. Yearly food waste in Italy reaches a value of approximately 8.7 billion euros that corresponds to a value of approximately 7.06 euro per family per week (Segrè *et al.*, 2014). In the same time, the food banks in Italy are contributing to recovery and redistribution of safe and nutritious food for human consumption: in 2015, the Fondazione Banco Alimentare Onlus estimated the recovery of 75,000 tonnes of food products and 1,100,000 ready meals.

Food Banks in Italy

Through its Food Bank Network composed of 21 Food Banks in Italy, the Fondazione Banco Alimentare Onlus (FBAO) is committed to fight against food waste and feed the most deprived. The FBAO was established in Italy in 1989 and is a member of the European Federation of Food Banks (FEBA) since 1990. Its mission consists of the daily recovery of food from all the sectors of the food supply chain (agriculture, production, distribution and collective catering) and its daily redistribution to 8,103 charitable organisations that assist 1,558,250 food-insecure persons in Italy. In addition, the network distributes food products received from the EU.

In 2015 the FBAO recovered about 40,448 tonnes of surplus food and collected 14,965 tonnes of donated food products, of which 9,201 tonnes during the National Food Collection Day. The Network also recovered 1,043,351 portions of ready meals and 319 tonnes of bread, fruit and fresh products from the collective catering, company and school canteens. The activity of this Network is made possible thanks to the daily commitment of 1,843 volunteers. A Manual for appropriate operational practices for charity organisations was published in early 2016 by Caritas Italiana and Fondazione Banco Alimentare.

Source: *Fondazione Banco Alimentare Onlus, Italy* (www.bancoalimentare.it).

A study estimated the annual food waste generation in the EU27 at approximately 89 million tonnes or 179kg per capita (Monier *et al.*, 2010). However, this study does not include primary agricultural and fisheries sectors in its estimations. Food waste is expected to rise to about 126 million tonnes by 2020 without additional prevention policy or activities. Households produce the largest fraction of EU food waste among the four sectors considered (manufacturing, households, wholesale/retail, and food service/catering sectors), at about 42% of the total (38 million tonnes), i.e. an average of about 76kg per capita (of which 60% may be avoided). In households, food waste comes from meal preparation, leftovers and purchased food that is not used in time. The proportion of food waste – in relation to the amount of food produced – is 5% of the total for the EU. However, it varies from country to country; from 1% in Germany to 21% in Estonia (Monier *et al.*, 2010). Data regarding the eight Mediterranean countries considered in the study show that the highest food waste, per capita and per year, is estimated in Cyprus while the lowest is recorded in Greece (Table 3). Considering national food waste in tonnes, three Mediterranean countries are ranked among the first six ones: France (3rd), Italy (5th) and Spain (6th).

According to the EUROSTAT data for 2006, France produces about 9 million tonnes of food waste every year of which, over 6 million tonnes can be attributed to the final consumer stage, 626,000 tonnes to the industry, while the remaining 2 million tonnes, more or less, can be attributed to the distribution and restaurant and food service sectors. According to ADEME (2010), every year, a French citizen wastes, on average, the equivalent of 20kg of food products: 7kg are still in their original packaging and 13kg of meal leftovers, damaged fruits and vegetables. In terms of catering, it is estimated that every meal, including the preparation and consumption stages, generates about 150g of organic waste.

A study by the Spanish Confederation of Consumers' and Users' Cooperatives (Hispacoop) showed that 31.6% of food waste comes from unconsumed leftovers. Each Spanish citizen wastes on average 250 euros per year in unused food; more than 45% of this is edible (Vay, 2014). A study carried out in 2005 to estimate household food waste – using a sample of 500 households in Ankara showed that waste accounted on average for 9.8% of the daily energy intake per person (i.e. 215.7kcal/person). The average daily food discard per person was 318.8g (Pekcan *et al.*, 2006). The Department of Sustainable Agriculture, Food and Rural Development of the

CIHEAM-Bari has undertaken an online survey in February-May 2015 to assess the knowledge and relative importance of FW in ten Mediterranean countries: Albania, Algeria, Bosnia-Herzegovina, Egypt (Elmenofi *et al.*, 2015), Lebanon, Macedonia, Morocco (Abouabdillah *et al.*, 2015), Montenegro, Tunisia and Turkey. The survey paid a particular attention to the issue of bread and bakery products wastage especially in Mediterranean Arab countries (Capone *et al.*, 2016).

Table 3 - Estimates of total food waste generation by Mediterranean EU member states

Mediterranean country	Manufacturing	Households	Other sectors*	Total food waste (in tonnes per year)	Food waste (in kg per capita)
Cyprus	186,917	47,819	21,000	256,000	344
France	626,000	6,322,944	2,129,000	9,078,000	144
Greece	73,081	412,758	2,000	488,000	44
Italy	5,662,838	2,706,793	408,000	8,778,000	149
Malta	271	22,115	3,000	25,000	61
Portugal	632,395	385,063	374,000	1,391,000	132
Slovenia	42,072	72,481	65,000	179,000	89
Spain	2,170 910	2,136,551	3,388,000	7,696,000	175
EU27	34,755,711	37,701,761	16,820,000	89,277,472	179

*The category other sectors includes wholesale/distribution and professional and collective catering services. Source: according to Monier *et al.* (2011) based on EUROSTAT data.

Methodology and profile of respondents that took part in the CIHEAM-Bari survey on FW in selected Mediterranean countries

The tool used to conduct the food waste survey is a self-administered questionnaire. It was designed and developed in English, French and Arabic languages in December 2014 and made available from January till the end of May 2015 through the *Survio* website. The questionnaire consisted of 26 questions (one option and multiple-choice questions) and was divided into 6 sections: 1) food purchase behaviour and household food expenditure estimation; 2) knowledge of food labelling information; 3) attitudes towards food waste; 4) extent of household food waste; 5) economic value of household food waste; and 6) willingness and information needs to reduce food waste.

A total number of 2,657 completed questionnaires were received: 185 from Albania; 323 from Algeria; 583 from Bosnia and Herzegovina; 181 from Egypt; 216 from Lebanon; 245 from the former Yugoslav Republic of Macedonia; 122 from Morocco; 371 from Montenegro; 281 from Tunisia; and 150 from Turkey. The respondents from the ten countries were mostly females (64% female and 36% male) and rather young (84.7% are less than 44 years old) while most of them have high education level.

The results show that household's planning and shopping activities are important predictors of FLW. On the other hand, attitudes may change according to periods especially in Ramadan (84.8% declare that FW is higher during this month in Algeria, Egypt, Lebanon, Morocco, Tunisia and Turkey), due to the high quantity of food purchased and prepared but never eaten.

It seems that FLW is widespread in all these 10 Mediterranean countries, mainly in Albania (82.2%), Turkey (50%), Montenegro (47.2%), Tunisia (45.2%) and Morocco (45.1%). Few respondents declare that they do not waste any food (Table 4).

Table 4 - Level of household food waste (% of responses)

	Much more than it should	More than it should	A reasonable amount	Very little	Almost nothing
Albania	5.4	13.5	63.2	14.6	3.2
Algeria	4.6	6.5	29.4	47.4	12.1
Bosnia Herzegovina	4.3	11.1	25.0	39.3	20.2
Egypt	1.1	2.8	29.3	53.0	13.8
Lebanon	0.5	5.1	30.6	48.6	15.3
FYROM*	1.2	10.2	18.8	46.1	23.7
Morocco	6.6	13.1	25.4	51.6	3.3
Montenegro	3.8	14.0	29.4	38.3	14.6
Tunisia	3.9	9.6	31.7	48.8	6.0
Turkey	1.3	3.3	45.3	28.7	21.3

* FYROM: Former Yugoslav Republic of Macedonia.
Source: CIHEAM-Bari, *Household Food Waste Survey* (2015).

Regarding the category of food, the most wasted product groups are cereals and bakery products, fruits and vegetables (Table 5). In Tunisia, 81.5% of the respondents declare that they throw bread when they do not finish eating it.

Table 5 - Estimated quantity of purchased food thrown away

Food categories	Less than 2%	3% to 5%	6% to 10%	11% to 20%	Over 20%
Cereals and bakery products	45.5	20.3	12.5	8.7	13.1
Roots and tubers	63.3	20.4	8	5.5	2.7
Pulses and oil seeds	71.8	14	9.3	3.6	1.3
Fruits	64.8	18.3	8.1	5.6	3.2
Vegetables	56.7	22.5	9.3	6.8	4.7
Meat and meat products	72.8	11.7	7.7	4.6	3.2
Fish and seafood	82.5	10.7	4.1	1.8	0.9
Milk and dairy products	61.6	20.1	8.4	4.5	5.4

Note: The figures in the table refer to response percentages.
Source: CIHEAM-Bari, *Household Food Waste Survey* (2015).

The economic value of food waste generated each month is more than USD 6 for 52.7% of respondents' households, mainly in Lebanon (80.1%), Montenegro (63.3%) and Albania (61.6%) (Table 6).

Table 6 - Value of food waste generated per month (in USD)

	Less than 5	6-20	21-50	More than 51
Albania	38.4	25.9	29.2	6.5
Algeria	52	40.2	5.6	2.2
Bosnia Herzegovina	47.9	43.2	6.5	2.4
Egypt	78.5	14.9	5.5	1.1
Lebanon	19.9	54.2	19.0	6.9
FYROM*	55.5	38.8	3.7	2
Morocco	45.9	42.6	10.7	0.8
Montenegro	36.7	52.8	8.9	1.6
Tunisia	57.3	36.3	5.3	1.1
Turkey	42	42.7	10.7	4.7

* FYROM: Former Yugoslav Republic of Macedonia.
Note: The figures in the table refer to response percentages.
Source: CIHEAM-Bari, *Household Food Waste Survey* (2015).

In order to investigate knowledge about food labels, respondents were asked what is meant by “use by” and “best before” dates. Most of the respondents have a good understanding of food labels. However, few respondents answered wrong indicating that there is still some confusion surrounding the definitions.

Legal framework and institutional environment for FLW reduction in the Mediterranean countries

Strategies to improve food security in the region have traditionally focused on increasing food production while putting relatively much less emphasis on measures to reduce FLW. If implemented in an appropriate way, measures to reduce FLW offer the opportunity to increase food security while at the same time reducing further stress on scarce natural resources such as land and water (FAO, 2013c). As for the European Mediterranean countries, the European Union’s Waste Framework Directive¹⁰, published in December 2015, requires Member States to adopt a common methodology for food waste measurement and to report food waste levels to the European Commission on a biennial basis.

Several countries have launched broad multi-stakeholder initiatives. In June 2013, France launched its National Pact against Food Waste. In April 2015, French policymakers released ambitious proposals for a national policy against food waste and for prevention, recovery and recycling. Some measures, including a ban on distribution level food waste, have already entered the legislative processes. The proposals are the result of a yearlong study led by the Ministries of Agriculture and the Environment. The national policy reflects a collaborative process, led by Parliament member Guillaume Garot. Inputs were sought and received from various experts and stakeholders. Their report calls for 36 regulatory and policy measures across the French food system (Mourad, 2015). The proposed policies against food waste also aim to create a new form of collaborative policy development in partnership with civil society, business, government, and grassroots movements.

36 measures for a policy proposal against food waste in France

Stakeholder responsibilities

- 1) Set into law a hierarchy of preferable actions to fight food waste;
- 2) Create innovative communication;
- 3) Clarify expiration dates on food products;
- 4) Organise local food recovery days;
- 5) Offer lifelong education about sustainable food;
- 6) Forbid supermarkets from throwing away edible excess food;

10 - http://eur-lex.europa.eu/resource.html?uri=cellar:c2b5929d-999e-11e5-b3b7-01aa75ed71a1.0018.02/DOC_1&format=PDF

- 7) Mandate donations to charitable organisations;
- 8) Ban destruction of edible food;
- 9) Include messages on food waste in retail advertisements;
- 10) Enable the donation of rejected “house” brand products;
- 11) Use QR codes to better inform consumers;
- 12) Adjust portion and packaging sizes;
- 13) Improve the use of expiration dates;
- 14) Encourage use of food by-products for animal feed;
- 15) Extend tax incentives to processed agricultural products;
- 16) Better regulate gleaning activities;
- 17) Strengthen professional training on food waste;
- 18) Promote the “doggie bag” habit.

The tools of a public policy on food waste

- 19) Create a dedicated public agency to implement food waste policies;
- 20) Measure food waste;
- 21) Mobilise households to conduct a large-scale food waste study;
- 22) Establish 1,000 community service positions focused on food waste;
- 23) Offer grants to encourage innovation;
- 24) Create a zero-waste certification programme;
- 25) Require product quality in exchange for tax benefits;
- 26) Assess the impact of food waste regulations;
- 27) Build innovative partnership to overcome logistic challenges.

Towards a new development model

- 28) Develop local working groups and local strategies against food waste;
- 29) Create dedicated devices in case of a production crisis;
- 30) Coordinate public policies related to food;
- 31) Form an inter-ministry committee on food waste;
- 32) Require leniency with regards to dumpster-diving and gleaning;
- 33) Establish a European committee against food waste;
- 34) Push for changes in European regulations to reduce food waste;
- 35) Integrate food waste in the COP 21 climate change negotiations;
- 36) Establish a decentralised cooperation programme: “1 percent” against food waste.

Source Guillaume Garot, Lutte contre le gaspillage alimentaire: propositions pour une politique publique, Paris, Ministry of Agriculture, Agro-food and Forests and the Ministry of Ecology, Sustainable Development and Energy, April 2015.

Six of the above-mentioned proposals were approved by both bodies of the French Parliament (Senate and National Assembly) in mid-2015. However, the French Constitutional Council subsequently raised procedural concerns, making it necessary for the Parliament to reconsider proposals 1, 5, 6, 7, 8, and 10 before their submission to the President of the Republic for final approval. On the 9th of December 2015, the proposal for a French law on the fight against food waste was voted unanimously by the National Assembly. The Senate voted unanimously in February 2016. Supermarkets with a footprint of 400m² or more will have to sign donation contracts with charities or face a penalty of 3,750 euros.

Source: National Assembly (www.assemblee-nationale.fr/14/propositions/pion2492.asp) and Senate (www.senat.fr/rap/l15-268/l15-268_mono.html).

The Spanish Ministry of Agriculture, Food and Environment is leading the multi-actor “More Food, Less Waste” Strategy. In this framework, a number of guides including the following ones were published, particularly the *Practical guide to reduce food waste in the retail sector* (2015), the *Practical guide to reduce food waste at education centres* (2014) and the *Practical guide for the consumer: How to reduce food waste* (2014) along with studies on the quantification of food waste. At sub-national level, local and regional authorities often play an important role, as in Catalonia for instance (Vay, 2014).

Governments from the NENA region have made concerted efforts to recognise the issue of FLW, and bring awareness to the need to reduction, and commit to strategic action. A major step was the collective request for support from the FAO to reduce FLW by 50% over 10 years (FAO, 2012c), particularly in the form of strategy development and analysis. A process to meet this request began with an Expert Consultation Meeting held in December 2012 (FAO, 2013c) to deepen the understanding of FLW and start charting a strategy for FLW reduction. Several workshops and meetings between diverse stakeholders were organised to hold discussions on regional and national perspectives of FLW. The major strategic thrusts to a reduction plan were established in a consultative manner. The resulting Regional Strategic Framework for Food Losses and Waste Reduction was presented by the FAO to its regional governing body (32nd Near East Regional Conference) in February 2014, and endorsed by member countries (FAO, 2014a). The document calls for evidence-based national action plans for FLW reduction, with clear objectives, baseline, indicators and targets. Some countries have engaged themselves through concrete actions: in 2013, the Kingdom of Saudi Arabia launched a commitment to reduce FLW and a proposed a “Strategy and Action Plan to Reduce FLW in the Kingdom of Saudi Arabia” that evolved into a component of the KSA Food and Nutrition Security Strategy. The focus is on both food loss and food waste reduction, and on generating quantitative and qualitative evidence as a first step.

On the 6 of February 2014, in the final declaration of the 10th meeting of the Ministers of Agriculture of the thirteen Mediterranean Member Countries of the CIHEAM in Algiers, the ministers and heads of delegations proposed the CIHEAM to strengthen instruments and networks and encourage regional initiatives aimed at addressing the issue of food waste (CIHEAM, 2014). While much work remains to

be done by 2024, several activities are already underway also in Egypt, Jordan, Lebanon, Morocco, Tunisia, and elsewhere in the NENA region. Policy measures taken by Egypt regarding the subsidised “baladi bread” supply chain is contributing to the reduction of waste. Many initiatives and awareness activities focusing on waste are carried out at consumer level in Lebanon and in Italy.

Reforming subsidies in Egypt to improve targeting and reduce waste

In 2014, a reform of the Egyptian bread subsidy system sought to make subsidised bread more accessible to the most vulnerable, reduce inefficiencies and waste and reduce cost. In terms of waste, the subsidies on bread in Egypt are believed to be a driver of consumer wasteful behaviour and of the opportunistic behaviour among supply chain actors. Previously, flour was subsidised. It was therefore bought cheap and sold at higher prices as flour, bread, or “leaked” from the chain. Leakages occur at all stages of the chain, in ports, storage facilities, mills and bakeries. Consequently, up to 43% of purchased wheat is not turned into bread.

The reform introduced a smart card system that subsidised bread rather than flour and limited the amount to 5 loaves per person each day. Moreover, the quota is allocated through a credit balance, so that any leftover credit that is not spent on loaves can be converted into points and used to buy other subsidised food commodities (cooking oil, rice, or macaroni, for example). In this way, consumers have the incentive to acquire only the bread they need. Upstream actors are also encouraged to manage the supply chain more effectively since losses will result in less bread being sold.

In April 2015, the Egyptian government launched two others initiatives as part of its Cash Transfer Programme, entitled *Takaful* and *Karama* (“solidarity and dignity”). Under this programme, poor families receive the equivalent of USD 43 to USD 83 per month, while some elderly people and people with disabilities receive USD 47 per month. The programme aims to cover 1.5 million families by 2017. *Takaful* provides the income support provided that there are: 80% school attendance by children aged 6 to 18, attendance to medical check-ups for mothers and children under 6, and also to nutrition classes. In contrast, *Karama* provides unconditional income support to the elderly and people with disabilities. A national database is established to consolidate social safety net programmes. This Unified National Registry has made some progress in linking the smart card to other social assistance and social security databases.

Source: World Bank (2015) and FAO (2013c).

Initiatives to reduce FLW in Lebanon

The Lebanese Food Bank (LFB) was launched in 2013 with the main objective to eliminate hunger from Lebanon by 2020 by building on strong partnerships in the public and private sectors as well as on cooperation, and donations from individuals. Among the many LFB’s actions, the Awareness Programme “Not To Waste Food” targets hotels, restaurants, catering companies, food factories, and individuals. Instead of throwing away the excess food, the LFB distributes it to orphanages, nursing homes and NGOs. The *MED-3R (Euro-Mediterranean Strategic Platform for a Suitable Waste Management)* is a waste management project. Regarding food waste, the aim of this project is to apply in Lebanon the same initiative carried out in France regarding the encouragement of restaurants and clients to use the take away leftover bags.

Source: Oneissi (2014).

Policies and initiatives to reduce FLW in Italy

The Italian Presidential Decree of 26 October 1972, No. 633 (“Establishment and implementation of value added tax”, Article 10, Paragraph 12) states that donations made to public bodies, recognised associations or foundations with the sole purpose of assistance are exempt from tax (VAT). Italy is the first European Union country to have adopted the “Good Samaritan Law”(Law No. 155/2003) ensuring tax benefits similar to non-profit and of social utility institutions for organisations carrying out free distributions of food to the needy as charity. These fiscal benefits are within the bounds of the service provided i.e. food donation.

A national task force for the reduction of food waste has been set up by the Italian Ministry of Environment. On the 5 of February 2014, on the occasion of the national day against food waste, the task force met to start developing a national plan for waste prevention. Over 500 Italian municipalities have signed the “Charter for a network of local and regional authorities with zero waste” promoted by Last Minute Market, an academic organisation derived from the University of Bologna, thus pledging to reduce waste and loss along the food supply chain. In December 2013, the “National Network of Municipalities against Waste” (association Sprecozero.net) coordinated by the city of Sasso Marconi (province of Bologna) was established from the experience of the Charter.

Source: Last Minute Market (2014).

Challenges and opportunities for FLW reduction

Trends in production, consumption and local, national, regional and international trade of food suggest an increasing dependence of the NENA region on external sources for its basic food supplies. To close this widening import gap, there is a need to address several challenges such as: demographic pressures; sustainable management of water resources; enhancement of crops, livestock and fisheries productivity; reduction of food losses; and management of food imports (FAO, 2015b).

The challenge of addressing FLW must consider the whole supply chain from food production to food processing and retail, including the end consumer and waste management systems. Understanding and preventing FLW requires a deep understanding of international, regional, national and local food systems (HLPE, 2014; Ericksen, 2008; Ingram, 2011). For this purpose, further research and multi-stakeholder consultation and knowledge sharing is needed in the Mediterranean. Potential areas of interest could be:

- FLW quantification methods harmonised at different levels (in international food supply chains, and at national, local, and households level, etc.) for different food categories, groups, and identification of potential trends in time;
- Social, technological (storage, packaging), behavioural, attitudinal and cultural drivers and causes of FLW as well as the most effective solutions for different stakeholders;
- Environmental, financial and economic implications of FLW for different stakeholders;
- Effectiveness of main policy measures and coping strategies to reduce FLW;

- Potential contribution of food safety laws, regulations, and their interpretation and implementation for FLW prevention and reduction;
- Cost-benefit and cost-effectiveness analyses of technological, social, institutional solutions to FLW;
- Impacts of labelling, marketing, retailing and distribution approaches on FLW;
- Compositional analysis of FLW in the Mediterranean countries;
- Impacts on food and nutrition security of FLW;
- Knowledge of and perceived relevance of FLW among Mediterranean consumers;
- Consumer attitude towards waste and FLW;
- Impacts of gender and behaviour regarding food, food management, food waste along supply chains.

Improving the efficiency of the food supply chain, production techniques and infrastructures is of utmost importance for developing countries (Kader, 2005), while developed countries should conduct consumer education campaigns, and facilitate recovery and redistribution of safe and nutritious food for human consumption (Monier *et al.*, 2010; FAO, 2015a and 2015b). In addition to an enabling policy environment, the FAO (2014a) states that collaboration and coordination between all agents of the food supply chain and other stakeholders, and regional and international networking are also fundamental. Advocacy, education and legislation may also reduce loss and waste in the food service and retail sectors. In some countries, the existing legal and legislative framework regarding food quality and safety needs to be updated and revised. Legislation on date labelling of foodstuffs should be re-examined (Godfray *et al.*, 2010) and clarified for the industry as well as consumers. Public awareness campaigns are required for all food supply chain actors to promote relevant and practical procedures and technologies (FAO, 2014a). A comprehensive approach was adopted by Italy in August 2016 as it can be seen in the box provided below.

Law on food waste prevention (Italy)

On 2 August 2016 Italy adopted the law against food waste that has the following points:

- 1) It creates a regulatory framework to comprehend the existing rules concerning fiscal incentives (L. 460/97, L. 133/99), civil liability (L. 155/03) and hygiene and food safety procedures (L. 147/13).
- 2) It provides a set of definitions (e.g. food business operator, surplus food, food waste, donation, best before and use by dates, etc.).
- 3) It fosters the donation of confiscated food products.
- 4) It encourages companies to donate food rather than to destroy it by simplifying the administrative procedures to be given to public authorities.
- 5) It establishes a hierarchy for the use of products prioritizing the recovery for human consumption. Whether it is not possible to redirect food to feed people, it should be used for animal feeding or energy.

6) It recognizes the role of the “round table” managed by the Minister for Agricultural, Food and Forestry Policies as a tool for consulting all the stakeholders of the food supply chain. It adds 2 millions euros to the National Fund for the distribution of food products to the most deprived in order to purchase food.

7) It ensures an adequate number of hours of television and radio programs devoted to information and awareness about food donation and the fight against food waste.

8) It simplifies the donation of agricultural and farming surplus that fit for human and animal consumption.

9) It enables municipalities to reduce waste taxes for companies donating surplus food.

Source: www.bancoalimentare.it/en/Legge-Gadda-Spreco-Aliementare

Operational Manual for food donation in Italy by Caritas Italy and the Italian Food Banks Foundation

The Operational Manual aims to develop the correct hygienic practices that enable the recovery, collection, storage and redistribution of food by charitable organizations. The identification of good hygiene practices helps maximizing the collection and recovery of food, throughout the food supply chain, such as, primary production, products with defects in labelling, foodstuffs near their expiration date, public catering safe and nutritious cooked meals or ingredients. In reference to Regulation (EC) No. 178/2002 all food business operators must ensure food safety. According to Art. 21 of the Regulations (EC) No. 178/2002 R&R units are subject to the rules relating product liability (Law 155/2003 National Italian legislation) that equate them to the final link before the end consumer for the purposes of civil liability. The manual highlights and identifies the correct operating practices in terms of hygiene to guarantee food safety as governed by Regulation (EC) No. 852/2004. The manual is mainly referring to European Community law and national legislation (Italy) and welcomes the principle of flexibility granted by the Regulation 852/2004 that considers R&R units as food business operators.

Source: Recupero, raccolta e distribuzione ai fini di solidarietà sociale. Manuale per corrette prassi operative per le organizzazioni caritative, *Caritas Italy and the Italian Food Banks Foundation*, 2015 (http://cdn3.bancoalimentare.it/sites/bancoalimentare.it/files/manualecaritasbanco016_web.pdf).

The role of the private sector in FLW reduction is crucial. An enabling environment is needed for governments to stimulate private investment and engage the private sector. For the latter, the FAO (2014a) specifies that investment is required in improved food supply chains, appropriate farming technologies and household equipment, and in the use and reuse of lost food. During the last decades, efforts aimed at reducing FLW were significant. The first *Global Initiative on Food Loss and Waste Reduction* (also called SAVE FOOD) launched in 2011 and led by the FAO includes the following main partners: Messe Düsseldorf (Germany) and UN programmes such as IFAD, WFP and the UNEP and its *Think.Eat.Save Reduce Your Foodprint* awareness raising campaign. Moreover, SAVE FOOD collaborates with public sector representatives, private sector engaged companies and civil society

organisation to ensure: 1) advocacy and awareness raising; 2) collaboration and coordination of world-wide initiatives; 3) policy, strategy and programme development; 4) support to investment programmes and projects.

To further stimulate commitment to the reduction of FLW, several cross-sectional strategies requiring action from multilateral and bilateral donors, intergovernmental agencies, national governments, and the private sector are needed (Lipinski *et al.*, 2013). It is clear that the feasibility, efficiency and sustainability of solutions and interventions for FLW reduction in the short, medium and long term have to rely on a multi-actor and cross-sectoral coordinated effort involving all relevant actors in the food supply chains including private and public actors as well as civil society. Policies can facilitate prevention and reduction of FLW and the sustainable use of limited natural resources such as water and land in view of their importance in the region. Additionally, policies should be time- and cost-bound and should set up appropriate results-based monitoring and evaluation systems that are transparent and provide appropriate accountability mechanisms. Steps should be taken to enhance the harmonisation of policies and strategies at international, sub-regional and regional levels. The development and endorsement of a regional strategic framework for FLW reduction in the SEMCs (NENA region) has been a major step forward in this regard (FAO, 2014a). The Milan Urban Food Policy Pact is another example of policy frameworks facilitating coordination.

The Milan Urban Food Policy Pact

On the 15 of October 2015, 117 cities across the world signed the Milan Urban Food Policy Pact. The Pact was presented to the United Nations Secretary General, Ban Ki Moon on the 16 of October, on the occasion of the World Food Day. This Pact aims to support policy coherence and was launched together with its Plan for Action and Selected Good Practices.

The Pact recommends actions for food waste reduction and measurement:

- Convene food system actors to assess and monitor food loss and waste reduction at all stages of the city region food supply chain (including production, processing, packaging, safe food preparation, presentation and handling, re-use and recycling) and ensure holistic planning and design, transparency, accountability and policy integration.
- Raise awareness on food loss and waste through targeted events and campaigns; identify focal points such as educational institutions, community markets, company shops and other solidarity or circular economy initiatives.
- Collaborate with the private sector along with research, educational and community-based organisations to develop and review, as appropriate, municipal policies and regulations (e.g. processes, cosmetic and grading standards, expiration dates, etc.) to prevent waste or safely recover food and packaging using a “food use-not-waste” hierarchy.
- Save food by facilitating recovery and redistribution for human consumption of safe and nutritious foods, if applicable, that are at risk of being lost, discarded or wasted from production, manufacturing, retail, catering, wholesale and hospitality.

Source: www.foodpolicymilano.org/en/urban-food-policy-pact-2

Strategies and best practices for reducing and/or preventing fish loss and waste

As described previously, the causes of FLW are specific to context and it is now unanimously acknowledged that multiple interventions focusing on the efficient use of resources and on the areas where FLW are most significant are required. Given the interwoven factors involved in their occurrence, the reduction of FLW will most likely rely on a combination of improvement in awareness, knowledge and skills, as well as technical, financial, infrastructural and policy support. While acknowledging the importance of common control measures (maintaining the cold chain, improving processing technology and packaging or assessing loss) buttresses the fundamental fact of “no one size fits all” in addressing FLW challenges. Therefore, a context-specific systematic analysis, inclusive of the sustainable value chain approach, and addressing the multifaceted dimensions of FLW, to set priority actions tailored to the given context, is necessary. It should be centred on the efficiency of the entire upstream and post-harvest system, and provide sound information to make cases for evidence-based policies, strategies and programmes. The analysis also includes a worthy ground for stocktaking of previous loss and waste reduction interventions and lessons, which can be adapted and up-scaled to the appraised context. The overview of a good practice in cold chain development in Moroccan fisheries casts some light on these patterns.

Cold chain and landing sites in Morocco, markets

This example is based on the work conducted by the Moroccan government in conjunction with the Millennium Challenge Corporation (MCC) and the US Trade and Development Agency (USTDA) to upgrade the cold chain infrastructure, services and knowledge and skills of artisanal fishery operators in better handling practices to reduce quality losses and improve the contribution of fish to national food security.

Morocco is a lead fishing country in the Mediterranean region irrespective of the effective area of origin of the fish produced. In 2013, it represented about 20% of the production share (excluding marine mammals, crocodiles, corals, sponges, shells and aquatic plants) of the region. It ranked third after Egypt (23%) and Spain (20.2%) for the production and second together with France after Spain (38.4%) for exports. However, this performance hides some challenges hindering the country's ability to satisfy the increasing domestic demand for quality fish, driven by an expanding tourist sector and expected growth in domestic fish consumption. So far, domestic consumption is well below the average for the region (12.5 against 20.1kg in 2011).

Indeed, due to inadequate coastal landing sites and port infrastructure, lack of unbroken cold chains from sea to consumer, weak integrity of the value chain, limited access to open markets, and insufficient training for fishermen and their cooperatives, small-scale fisheries remains the most undeveloped segment of Morocco's fishing sector. To address these issues, a modernisation programme was designed and implemented to improve the quality of the catch, maintain the value chain, and increase the fishermen's access to both local and export markets. Hence landing sites were built, support provided to help mobile fresh-fish traders invest in motorbikes with insulated boxes, transportation was improved along with the associated technical assistance and training was adapted to the targeted beneficiaries,

designed to ensure that all beneficiaries become stewards of the new infrastructure and equipment after the end of the project. Efforts are also deployed to establish a network of Marine Protected Areas and increase monitoring efforts to ensure the sustainable catch of fish resources. More than 125,000 people are expected to benefit from the Small-Scale Fisheries Project, and household income is expected to rise by more than USD 273 million over the coming twenty years.

This approach was beneficial from two different perspectives. On the one hand, the project was built on approaches that had been field-tested by the government, incorporating some of the lessons that had been learned through trial and error. On the other hand, building the project on the past experiences of the Moroccan Government was an excellent way to build trust with the partners and to show the extent to which existing knowledge and “knowhow” were appreciated and valued. This project is a good reference for post-harvest loss reduction and design and implementation of interventions in similar contexts. The table below presents the process and key features identified by the consultant, who was involved in the implementation of one of the project’s components.

Table 7 - Key features of cold chain development, Morocco

Building process	Key issues
Policy	Government is committed to economic improvement and development with the 2005 National Growth Strategy making fisheries a priority sector.
Legislation	Various standards developed to help implement better practices.
Skills and knowledge	Learning from previous projects during phases of planning and implementation. Capacity building is a strong aspect of project and associated with infrastructure and equipment modernisation including basic technical aspects. Capacity building for local construction companies to meet donor standards should have been provided earlier in project.
Services and infrastructure	Focus on the modernisation of infrastructure and services. Access to land is problematic in some locations and more communication with local authorities is required during planning. Feasibility studies completed were slower than expected due to differences in environmental and social standards.
Technology	Upgraded equipment is required to enable better handling of products and to improve the cold chain.

Some other good practices related to FLW reduction should be highlighted such as the one presented below and that are aimed at enhancing the utilisation of by-products to reduce food waste and support food and nutrition security.

Fish by-products, a valuable source of nutrients

Fish by-products constitute about 50% of processed fish and are the most valuable part from an economic point of view. Indeed, by-products are of higher nutritional value with a high concentration of the micronutrients lacking in many diets at global level, particularly affecting the most vulnerable groups especially women and children.

As more fish is being processed at industrial level before being sold, more of the remaining raw material (by-products) can potentially be processed into valuable products for direct human consumption. In most cases, these by-products are further processed into fishmeal and fish oil, primarily for feed purposes, and therefore indirectly contributing to food security. At present, more than 30% of the raw material used for the production of fishmeal and fish oil comes from by-products and waste rather than whole fish. This percentage is growing and increasingly replacing the small pelagic species historically used for this purpose. Fishmeal and fish oil are internationally traded products and represent an important source of revenue for some countries. These are also a very important feed ingredient for the aquaculture sector, the fastest growing food production system in the world.

The increasing demand for fish oil as a nutritional supplement has made it highly profitable to extract fish oil from by-products such as tuna heads. Oil extracted from cod livers has been a valuable source of vitamin D and vitamin A for centuries, and it is also increasingly recognised as a valuable source of long chain omega-3 fats. Mineral supplements can be made out of fish bones, although this is not yet widely done. However, low cost products with a high concentration of essential nutrients can easily be made from fish by-products. If traditions and demand for such products exist, fish by-products can play an important role in combating micronutrient deficiencies. The FAO is involved in several pilot activities, developing fish bone-based mineral products with high levels of essential minerals such as zinc, iron and calcium. A recent pilot production of a fish bone based mineral product showed high levels of most essential minerals, with for example 85mg/kg of zinc, 350mg/kg of iron and 84g/kg of calcium, in addition to significant amounts of iodine and essential omega-3 fats. The product was successfully mixed into traditional school feeding meals and highly appreciated by school children in Ghana. More than 2 billion people suffer from iron, iodine, zinc and vitamin A deficiencies, all found at high concentrations in fish by-products. Although most of the rest of the raw material, as a result of fish processing, is not currently utilised for human consumption, international trade has opened up new markets for fish products that are traditionally not consumed in their country of origin. For example, there is a growing demand for fish heads in some Asian and African markets, a product that is not considered as food in other regions. For years, the Nile perch caught in Lake Victoria has been locally processed, and high valued fresh fillets were exported out of the region. Raw materials such as back-bones and frames that have become a popular product on the local market, are now important products traded at local and regional level, and they are an important source of nutrients in local diet.

Source: Glover-Amengor et al. (2012) and Olsen et al. (2014).

Some other good practices related to reduction of FLW have been identified. They can serve as food for thought in planning and interventions, strategies and plans. In France, the “Small-scale fisheries and the zero discard target”¹¹ was set up but in other EU countries, regulations have been established to ban discarding of foodstuffs at the retailing level¹². The FAO has a long history of collaboration with the CIHEAM-Zaragoza revolving around the organisation of advanced training workshops in different areas of fisheries. In the Mediterranean region the CIHEAM has the mandate to contribute to human resource development. Joint courses addressing “seafood Processing: Modern technologies and new product development”, especially by-products and their benefits, economy and health challenges are provided.

Conclusions and recommendations

Globally, more than 1 billion tonnes of food produced for human consumption is lost or wasted each year while millions of people are still undernourished and over 2 billion people are micronutrient deficient. In order to move towards sustainable food consumption and production, demand and supply issues must be addressed by fostering socially innovative, efficient, and sustainable food production and consumption patterns. FLW have a direct and indirect effect on both food security and nutrition and food systems sustainability. Curbing the amount of FLW is therefore a tangible starting point.

Under the framework of the 2030 Sustainable Development Agenda, the Sustainable Development Goal 2 (SDG 2) aims to end hunger, achieve food security and improve nutrition while promoting sustainable agriculture by 2030, while the SDG 12.3 aims to ensure sustainable consumption and production patterns, 50% reduction in food waste at retail and consumer level and food losses along the supply chain by 2030. The relation and synergy between SDG 12.3 and SDG 2 to achieve global food security and nutrition should be strengthened because reduction in FLW (SDG 12.3) is indeed a promising solution to end hunger and all forms of malnutrition in the world, in addition to the resulting sustainable impacts on our economy, environment and society. Policy makers, food systems actors, namely farmers, food manufacturers, retailers, researchers, legislators, educators and consumers, etc. should collaborate to apply a food systems approach in an enabling environment to promote sustainable food production and consumption and to reduce FLW for better food security and nutrition for all.

In 2014, the ICN2 acknowledged “that the current food systems are being increasingly challenged to provide adequate, safe, diversified and nutrient rich food for all that contribute to healthy diets due to, inter alia, constraints posed by resource scarcity and environmental degradation, as well as by unsustainable production and consumption patterns, food loss and waste, and unbalanced distribution¹³”. The ICN2 Framework for Action recommends to “Improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste” (Recommendation 11).

11 - [www.europarl.europa.eu/RegData/etudes/STUD/2015/540360/IPOL_STU\(2015\)540360_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2015/540360/IPOL_STU(2015)540360_EN.pdf)

12 - Loi du 21 mai 2015, www.legifrance.gouv.fr/

13 - www.fao.org/3/a-ml542e.pdf

Improved methodologies and standardised approaches to assess and evaluate energy and nutrient losses in FLW are important for countries to understand the extent and the root causes of the FLW issues so that appropriate strategies and measures can be implemented to monitor and curb FLW. This is to ensure that safer and more nutritious foods could be made available to feed the world populations. Furthermore, understanding the hotspots of qualitative losses of nutrients in the food chain would also help improve food handling, processing and storage after harvesting in order to preserve maximum nutrient contents in food intended for human consumption. As recommended by the CFS in 2014, where FLW cannot be prevented at source, the recovery and redistribution of safe and nutritious foods for human consumption could also contribute to food security and nutrition.

Losing or wasting food is economically, environmentally and socially unsustainable. FLW exacerbate food supply chain inefficiencies and contribute to food insecurity and malnutrition globally and in the Mediterranean region, especially in SEMCs. FLW lead to a major squandering of resources, including water, land, energy, labour and capital and needlessly produce greenhouse gas emissions, thus contributing to global climate change. Policy and strategy measures should be informed by reliable data that can lead to effective and efficient interventions for FLW reduction with short, medium, and long term return on investments that concerns all actors in the food systems, including food security and nutrition of end consumers and waste management challenges and opportunities. The recommended actions include the necessity of access to reliable data that includes harmonisation of definitions and terminology, methodologies, and reporting to establish baseline and benchmark statistics, and tracking systems to monitor FLW over time; coordination of public, private, and civil society policies and strategies; identification of specific contexts and needs for the organisation of appropriate awareness-raising and information campaigns; education programmes; improvement of food system management and governance.

Strategic plans must be developed for the food and agricultural sector. They should incorporate dimensions relevant to FLW reduction that are vertically and horizontally coordinated with the related sectors, for instance, health, social protection, education and training, trade and industry, energy and environmental sustainability. Policies aimed at achieving food and nutrition security in the Mediterranean region should address the issue of FLW. Strategies for FLW prevention and reduction can integrate:

- The application of current knowledge to improve food handling systems and ensure food quality and safety;
- The harmonisation of methodologies and terminology as well as definitions for FLW monitoring and reporting;
- The reduction of socio-economic constraints and facilitation of short, medium, and long term investments;
- The provision of more effective education to all stakeholders of the food supply chain, including farmers, processors, distributors, and consumers from all age groups;
- The availability of better and adequate infrastructure, including storage facilities and marketing systems;
- Improved research and capacity development;

- Enhancement of the capacity of small-scale producers;
- Human nutrition sensitive food systems.

Research outcomes should help design adequate policies, guidelines and recommendations for state and non-state actors in the Mediterranean food system. Given the seriousness of the problem, Mediterranean countries should urgently adopt FLW prevention and reduction strategies that are monitored and evaluated.

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The Global Initiative on Food Loss and Waste Reduction (SAVE FOOD)

The *Global Initiative on Food Loss and Waste Reduction (SAVE FOOD)* was launched in 2011 and works worldwide with the public and private sector as well as civil society for:

- 1) *Advocacy and awareness raising* on the impact of, and solutions to food loss and waste and for increased knowledge and changed behaviour of decision makers, food supply chain actors and consumers.
- 2) *Collaboration* and coordination of worldwide initiatives on food loss and waste reduction. SAVE FOOD is establishing a global *partnership* for information, solution sharing, and harmonisation of methodologies, strategies and approaches.
- 3) *Policy, strategy and programme development* for food loss and waste reduction. This includes field studies at local, national and regional levels and studies on the socio-economic impacts as well as the political and regulatory framework that affects food loss and waste.
- 4) Support to *investment programmes and projects*, implemented by private and public sectors. This includes technical and managerial support and capacity building (training) of food supply chain actors and organisations, either at the food sub-sector level or policy level.

To *Join the Global Initiative on Food Loss and Waste Reduction* and subscribe to the newsletter go to www.fao.org/save-food/partners/get-involved/en/

Technical Platform on the Measurement and Reduction of Food Loss and Waste

In December 2015, the FAO together with the International Food Policy Research Institute (IFPRI) launched the *Technical Platform on the Measurement and Reduction of Food Loss and Waste* for information-sharing and coordination of diverse stakeholders, such as international organisations, development banks, non-governmental organisations, the private sector and civil society. The Platform facilitates food loss and waste prevention, reduction and measurement at local, national and regional levels (www.fao.org/platform-food-loss-waste/en/).

Community of Practice on food loss reduction (CoP)

The *Community of Practice on food loss reduction (CoP)* serves as a global convener and an integrator of knowledge related to post-harvest loss (PHL) reduction. It offers a platform to facilitate linkages and information sharing amongst stakeholders and relevant networks, projects and programs such as the Global Initiative on Food Loss and Waste Reduction (SAVE FOOD) and the Swiss Development and Cooperation Agency (SDC) funded projects on post-harvest management (www.fao.org/food-loss-reduction/en/).