# Food losses and environmental impacts from the Greek agricultural sector and measures to reduce them

S. Papageorgiou, A. Skordilis
Circular Innovative Solutions
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Presenting author email: skor@ce-innovations.gr

Today, one of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. According to the FAO, food production will need to grow by 70% to feed world population which will reach 9 billion by 2050. In September 2015, the 193 member states of the United Nations (UN) set an ambitious agenda for 2030, including the establishment of 17 sustainable development goals (SDGs) meant to achieve economic growth, social integration, and environmental protection (UN Department of Economic and Social Affairs, 2015). The nth12 goal, which refers to 'Responsible Production and Consumption', connects to the concept of food loss and waste (FLW) management through SDG 12.3: *'By 2030, halve per capita global Food Waste at the retail and consumer levels and reduce Food Losses along production and supply chains (SC), including post-harvest losses*' (UN Department of Economic and Social Affairs, 2015). The term 'food loss' is frequently used to refer to agricultural production that is lost unintentionally because of a variety of factors including market conditions, poor infrastructure, poor agricultural practices, pests, disease, natural disasters and weather events. (WWF-UK, 2021)

The food supply chain starts in the primary or agricultural sector. Despite the fact that other sectors of the supply chain have been well studied, for the primary sector there are no analyzes regarding the issue of food losses, nor any data that could be used (Papageorgiou, 2021). This study examines food losses and reduction measures in the Greek agricultural sector. Agriculture in Greece has always been a reference point for economic and social life since its contribution to the country's GDP(< 4%) that remains higher than the European average (EU-28: 1.6%), while it employs 11.6% of the country's workforce (EU-28: 3.9%). (Klonaris, 2021). The main environmental issues that have been recorded from this sector are the emissions of greenhouse gasses, land and soil degradation, as well as the pollution and the huge amounts of water usage (Pαpageorgiou, 2021).

To identify food losses, estimates were made based on the data given by ELSTAT for the agricultural crop production and the use of indicators from the published scientific literature. According to the data, the produced quantities of agricultural products are 11980 tons per year. The estimates are focused on food losses that have been generated during the harvest and the storage processes. These losses are estimated to be 600 tons per year, representing the 5% of the total production. Moreover, it is estimated as well the amount of losses that can be generated by rinds and shells. The waste generated by rinds and shells is 1670 tons per year. In total, the losses of the above are 2270 tons per year, representing the 20% of the production. Table 1 shows the environmental impacts from food losses in the agricultural sector:

Table 1: Environmental impacts from food losses in the agricultural sector

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|---|---|
| Greenhouse gases (Kg $CO_2$eq) | 3.5 million tons / year |
| Eutrophication( KgPeq) | 330 tons / year |
| Ozone depletion (mgCFCeq) | 130 000 tons / year |
| Photochemical oxidation (KgNMVOC) | 20130 tons / year |
| Acidification (Kg $SO_2$eq) | 33 000 tons / year |
| Water consumption (L) | 30 million l / year |

According to the scientific literature, it is possible to prevent food losses in the agricultural sector by 86% (Thuenen report 71), reducing the amount of loss to 86 tons per year. To address the aforementioned food losses at producers' level different solutions have been suggested by several authors such as:

1. Use of Technology (IOT systems)
The use of sensors, drones, and the performance of monitoring systems to collect data of the field conditions (eg soil conditions, weather, pests) could prevent food loss. Regarding the storage stage, innovations such as IoT monitoring of containers and pallets , through software can ensure the product quality (Cosgorve, 2018).

2. Advanced storage facilities
Storage units must have adequate ventilation and temperature, humidity and air circulation levels, controlled by special equipment. Also, they must be cleaned and disinfected so as to stop the spread of any existing disease.

3. Development of Knowledge and Skills
In order to reduce food loss, members of the upstream chain need to be trained and educated (Kader, 2010). Training seminars on topics such as the operation of mechanized equipment and the physical handling of products during harvest, reduces product damage and degradation (Prusky, 2011).

4. Development and Management of Collaborative Relationships
Agricultural cooperatives could facilitate communication between producers and increase the knowledge of food loss reduction practices. (Foresight, 2011).

5. Donations
Food donation is the most common method of preventing food loss and waste. As long as the food is considered suitable for consumption, it can be donated from any stage of the supply chain.

6. Utilization (composting or energy production)
Food losses in agricultural facilities can be used for the production of soil improver, electricity and heat.

Concluding, the prevention of food loss and its proper management is an important contribution to the confrontation of the global crisis for waste management and the reduction of its environmental footprint. The main environmental impacts are the emission of greenhouse gases, the use of land and soil degradation, as well as the pollution and the huge amounts of water usage. Measures and tools are proposed to reduce food loss through the agricultural sector. This sector theoretically and practically is the most difficult to determine the quantities of waste and losses because the main lead - factors are exogenous. (Pαpageorgiou, 2021). Nevertheless, the prevention of food losses can be achieved by taking reduction measures.

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