Summary of Systematic Review on Food Loss and Waste in Egypt

Introduction:

In the framework of cooperation between the Food and Agriculture Organization of the United Nations (FAO) in Egypt with Food Loss and Waste Monitring and Evaluation Unit of the Agricultural Economics Research Institute (AERI), a systematic review of the losses and waste of food in Egypt was conducted in 2018 to identify the size of loss and waste and to better understand the amount of loss and waste during the period 2000-2018 in order to achieve the desired economic benefits such as saving money for small farmers, businesses and households, as well as environmental benefits through the provision of water and land, food security.

Objective

the objective of conducting a systematic review of existing literature investigating the state and magnitude of food loss and waste in Egypt in different value chains for agricultural products (Horticulture, strategic crops, milk, meat fish, and poultry) over the period 2000 to 2017, in addition to summarizing the estimated magnitudes of losses, evaluate the methodologies used to generate those estimates, identify gaps and recommend areas for future assessment of FLW impacts and magnitudes. The obtained information is critical for developing effective FLW reduction strategies and monitoring progress over time, ultimately leading to bringing economic benefits through saving money for small farmers, companies, and households; environmental benefits by saving water and land resources; food security; and nutritional benefits.

Methodology

Relevant studies on FLW were collected through searching libraries and databases available at different universities.

Results according to Category

Horticultural Crops

Citrus Crops

Citrus is the main fruit crop in Egypt. Oranges represent around 30% of Egypt's total fruit production and around 65% of Citrus production. A study found that average loss in oranges at the production and handling stages has been estimated at 11.1% over 14 years (2000 to 2014), and losses in post-harvest operations totaled 14%.

At the farmers' level, main causes of losses include insects followed by bruising. At traders' level (marketing), loss during sorting reached 1.67%, while reached 5.11% during transport, and ranged between 1.06 and 6.67% during retail sales to customers according to package type.

At the Governorates' level, loss in Navel orange in Behera Governorate at the farm level was 2.81%, mainly due to insect (1.10%) and mechanical injuries (1.27%). Marketing loss reached 2.21%, of which 1.17% is due to harvest, 0.61% due to sorting and grading and 0.43% at the packing stage. At the wholesale level, loss ranged from 0.53% to 2.38%, while ranged from 4.33% to 7.13% at the retailer level.

In Assiut Governorate, total loss in *'Balady'* orange at production stage was estimated at 6.78%. Factors leading to such losses include bad weather (42.18%), and poor agricultural practices (57.83%). Total loss at the marketing stage was 3.84%, mainly attributed to harvesting and packaging (63.01%), transportation (20.29%) and losses at wholesale market (16.70%). Average post-harvest loss in lime over the period 2001-2010 was reported at 6.69%. A study that was conducted in Fayoum during the season 2012/2013 revealed that average loss in lime was 4.6% of total production. Equivalent loss in resources has been estimated at 198 feddans of land, 1.74 million cubic meters of water and 59 tons of fertilizers. The study found the main factors causing loss include infestation by fruit fly, fruit splitting and mechanical injuries at harvest, respectively. Growers deal with lost fruits either by processing (pickling), selling in local markets at lower price, or disposal of those totally unsuitable for consumption.

Recommendations to Reduce Losses in Citrus

- Apply good pest management program, especially for fruit fly.
- Use well-trained labor for harvesting to reduce mechanical injuries.
- Harvest at the optimum time.
- Sort continuously to get rid of damaged fruits quickly.
- Use suitable packages and avoiding over-packing.
- Provide refrigerated transportation trucks.

Grapes

Losses in grapes' production and handling stages until retail at the national level over 14 years, from 2000 to 2014 averaged to 13.1%. Loss in grapes' marketing (sorting, packaging, transport, processing) has been estimated at 15.21% in 2015. In Fayoum Governorate, different studies estimated average loss in grapes at 8.99%. Post-harvest loss in grapes has been estimated at 8.77% over the period 2007-2014.It was also found that loss is proportional to farmer's total yield, and that equivalent loss in resources is 116 feddans, 0.7 million cubic meters of water and 23 tons of fertilizers. Causing factors include over-ripe cluster that lead to shattering, lack of skilled labor to perform harvesting, and wrong handling practices (sorting and grading), beside other stages.

Recommendations to Reduce Loss in Grapes

- Use trained labor to perform good pruning
- Spray with mineral oils
- Harvest at the proper time and use proper harvesting methods
- Use suitable packages and avoiding over packing
- Practice continuous sorting to get rid of damaged fruits quickly
- Provide means cold transport.

Mango

Average post-harvest loss in mango has been estimated at 12.43% over the period 2001-2010. In Fayoum Governorate, a study conducted during 2015 estimated post-harvest loss in mango at 10% over the period 2007 to 2014. Another study conducted in 2015 found that equivalent loss in resources reached 820 feddans, 7.91 million cubic meters of water and 328 tons of fertilizers.

In terms of loss prevention, it was found that the maturity stage of mango fruits at harvest has an impact on storability and loss during storage. Moreover, pre-harvest spraying with chitosan, potassium silicate, and calcium chloride reduced weight loss and decay. Other post-harvest treatments were recommended like waxing emulsion and calcium chloride, applications of 1-methylcyclopropene (1-MCP) and GA3, salicylic acid and chito-care.

The main factors causing loss during harvest include tree height, which increases the difficulty of harvesting and risk of fruit falling to the ground, followed by lack of experience among harvest workers and the importance of using harvest scissors. Through grading and packaging stage, infestation with fruit fly and fruit bruising were the main factors.

Recommendations to Reduce Loss in Mango

- Cultivate in high density mango plantation in which the trees are easy to be managed
- Apply proper pest management programs.

Date Palm

Average losses in date palm production reached 8.1% over the period 2000-2010 worth US$ 84.1 million. Losses during marketing have been estimated at 22.49% of total supply.

Post-harvest treatments found to be effective in extending date palm storability during cold storage include applying paraffin oil and lemon grass oil, together with keeping the cap and spikelet.

Olives

The relative importance of olive losses to total olives' production in Egypt was estimated at 17.56% for the period 2001 to 2010. At the level of Fayoum Governorate, average loss has been estimated at 15.32% for the period 2007-2014. Farm-level loss during the season 2012/2013 has been estimated 5.44 %.

Guava

Estimated losses in guava at the level of farmers, wholesalers and retailers in Alexandria Governorate revealed that the highest percentage of loss in guava has been recorded at the farmer's level, followed by retailer and wholesaler levels (5%, 3%, and 1.5%, respectively). Main causes of losses at the farmer's level include incidence of diseases and insects, using inappropriate harvest containers, fruits deformation and small size, and bad picking process by workers, respectively.

At the wholesale level, main causes of losses include poor loading and unloading during transport, lack of farmer's interest in conducting sorting and grading operations، and transportation of goods using unequipped vehicles. The main causes for losses at the retailer's level include rough sorting of fruits by consumers, lack of farmer's interest in conducting sorting and grading operations, delay in the selling due to high prices, and exposure to climate conditions.

Figs

In Alexandria Governorate, the highest loss in figs indicated has recorded at farm level, followed by retailers and wholesalers (3%, 2%, and 1.2%, respectively). Main causes at the farmer's level include fruits' falling to the ground during harvesting, bad packaging methods, over-ripe fruits, and rough loading and transportation the wholesale market, respectively. At the wholesale level, main causes include delayed selling, fruit exposure to poor climate conditions, lack of farmers' interest in

conducting sorting and grading operations, and bad loading and unloading during crop transportation. Main reasons for losses at the level retailer include delayed selling due to rising prices, packing in inappropriate containers and lack of farmer interest in conducting sorting and grading operations. Total loss in figs has been estimated at 360 tons and equivalent losses in resources have been estimated at 49 feddan of farmland and 73.5 thousand cubic meters of irrigation water.

Pomegranate

Post-harvest loss in pomegranate has been estimated at 23%. Some studies found that some post-harvest treatments are efficient in reducing loss, like using paraffin oil plus packaging in polyethylene, using Nigella sativa essential oil coating plus wrapping with fungicidal treated tissue paper, either under cold storage or at ambient temperature.

Potatoes

Several studies that assessed the percentage of loss in potatoes over time found that it ranged between an average of 10.60% for the period 1998-2012 and 12.8% for the period 2000-2014. A study calculated loss potatoes loss over the period 2000-2011 using the following equation: Loss = Total production – (Consumption+ Exports).

In Sharkia Governorate, the percentage of loss in potatoes during sorting at the farm reached 1.87%. Major causes of loss include insects followed by bruising. At the marketing level (traders), loss reached 2.93% during sorting, 8.73% during transportation and 3.05 - 5.51% during retail sales based on type of displaying (packaged or stacked on the ground).

Tomato

Many studies have calculated tomato loss in Egypt. A study that assessed the "marketing loss" in tomatoes over the period 2001-2011 found that average loss reached 18%, and that equivalent loss in resources reached 87 thousand feddans, LE 315 million loss in production cost and 415 million m^3 of wasted water. Another study found that tomato loss in Egypt reached 2,301,000 tones representing 30% of the quantity available for consumption.

At the governorates' level, a field study was conducted in Dakhalia Governorate to minimize tomato loss. Results revealed that pre-harvest losses reached 51.5% (either unseen loss or lower than expected yield) with variation between the studied varieties representing 29.2% of the total loss. According to farmers' opinion, main causes of such include sharp variations in temperature (high or low temperatures), which negatively impacts yield, in addition to ineffective pesticides and infection with Tuta Absoluta. Loss during tomato harvesting reached 9.13%, whereas post-harvest loss reached 5.93%.

In Assiut Governorate, losses in winter tomatoes have been estimated in two sites during production and marketing stages. Results revealed that total loss at the production stage was estimated at 11.19%, part of which is due to bad weather (63.95%) and the other part is due to poor agricultural practices (36.05%).Total loss at the marketing stage reached 4.41%, of which 66.44% is due to rough harvesting and poor packaging, 17.93% is due to transportation and 15.63% is due to problems at the wholesale market.

Recommendations to Reduce Losses in Tomatoes

- Establish tomato paste factories near major production areas.
- Set-up and encourage marketing societies.
- Encourage contract farming with processing and exporting companies.

- Open new markets in the area.
- Use high yielding hybrids with extended harvest season.
- Organize extension meetings for farmers and extension agents.
- Supply guaranteed pesticides at reasonable prices.
- Intercrop maize with tomato to protect the crop from heat in summer.

Onions

Average loss in onion reached 8% over the period 2001-2011. Equivalent loss in resources has been estimated at 10,000 feddans of farmland, LE 31 million in production cost and 23 million m^3 of irrigation water.

Peas and beans

A study found that total loss in green peas and *Balady* dry beans reached 43% and 19%, respectively, representing 25.44 % and 4.91% of total supply of both crops, respectively. Another study found the proportion of wilted pods during transportation of fresh beans in non-refrigerated and refrigerated trucks reached 11.6% and 3.8%, respectively. Poor management of harvesting represented the main reason for low exportable ratio; in particular 15.2 -27.7% were found to be harvested without calyx and 11.8-16.2% with undersized pods.

Strategic crops

Wheat

Results of the several studies conducted to evaluate loss in wheat in Egypt revealed that average loss over the period 2000-2015 reached 20.40%, indicating that serious attention should be paid to the reduce such dramatic amount of loss from that is almost five folds. In 2015, estimated amount of loss reached 3.2 million ton worth some LE 8.903 million. Another study that was conducted in 2017 estimated the marketing loss in wheat in the same year at 3.9 million tons representing 20.04% of total wheat supply. A second study conducted in 2016 estimated the marketing loss in wheat in 2013 at 3.335 million tons representing 35.89% of local production and 49.15% of wheat imports. The equivalent economic value of the estimated loss reached LE 6.239 million. The difference between the two estimations might be due to the difference in reference year used.

Another study estimated the average of total loss in wheat over the period 2001-2013 at 4.020 million tons. This loss was estimated over three stages: harvesting, threshing, transport and storage (1.43 million ton); grinding, sifting and backing (1.06 million ton); baking (1.53 million ton). In Sharkia Governorate, the study estimated total loss in wheat at the level of the study sample at 3.08%, collected over three stages: production, storage and packaging. Loss reached 59.1 Kg/feddan at the production stage, 12.4Kg/feddan at the harvesting stage and 6.3 Kg/feddan at the packaging stage. As for losses during storage, average loss reached 2.34% of the stored quantity. The highest loss was due to insect and rodents (1.12%) followed by spillage while preparing for storage, sifting and using sackcloth for packing (0.38, 0.29 and 0.28%, respectively). Total loss of wheat during baking reached 7.19 Kg/bakery/year, equivalent to 5.44 kg of flour. As for the impact of harvesting method, mechanical harvesting recorded lower loss (11.755 tons) compared to manual harvesting (19.238 tons).

Recommendations to Reduce Loss in Wheat

- Improving the infrastructure of ports for loading and unloading imported wheat.
- Develop a medium-term plan that considers the required transportation capacities for current and future demand.
- Improve public and private silos' infrastructures.
- Expand mechanization through all stages, especially harvesting, to reduce loss.
- Cultivate varieties characterized by the non-diversion of the ears during = transfer from production areas to stores or distribution to wholesalers.
- Disseminate audio and visual aids and increase the number of extension centers to raise farmers' awareness of the importance of reducing the losses in wheat crop and its contribution to increasing the productivity of wheat.

Rice

A stud that was conducted to identify variables that have impact on rice losses revealed that plantation date, acreage size, harvesting method, crop variety, transportation mean, type of sack and length of drying period after harvest are the main variables influencing losses in rice crop.

In Dakahlia Governorate, a study that investigated the causes of rice losses found an inverse relationship between crop loss per feddan and size of land holding. Rice losses in small plots (less than 1 feddan) reached 201 kg/feddan compared to 82 kg/feddan in large plots (3 feddan or more). Early planting has been associated with lower loss (95.6 kg/feddan) compared with that associated with late planting (112.8 kg/feddan). Similarly, primitive harvesting techniques were accompanied with higher loss (154.5 kg/feddan) compared with modern mechanical harvesting techniques (56.3

kg/feddan).Furthermore, primitive transportation means (animals) from the farm to storage destination has been associated with higher loss (168.5 kg/feddan) compared to loss during transportation by vehicles (84.3 kg/feddan).

Losses in resources associated with loss in rice production (778.3 thousand tones) have been estimated at 241.3 thousand feddan of farmland, 16.89 thousand tons of seeds, 12.065 thousand hours of machine work, 9.652 thousand labor-days, 504 million cubic meters of water and 36.19 thousand tons of fertilizers, summing up to LE 3719.4 million in 2015.

Recommendations to Reduce Loss in Rice

- Apply better harvesting and packaging techniques as well as modern means of transportation and sturdy sacks.
- Support agricultural extension as critical for educating farmers on good farming practices like optimum planting date and using appropriate cultivars.
- Improve post-harvest treatments and handling.

Maize and Sorghum

A study that estimated losses in maize marketing in 2015 found that it reached a total of 1.398 thousand tons representing 9.75 % of maize supply.

As for the losses in marketing summer sorghum grown in Assiut Governorate found that it reached 4.04%, of which 1.71% is due to harvesting and packing, 0.52% due to transport, 0.90% due to selling in wholesale market and 0.92% due to selling in retail markets. Total loss at the level of the governorate reached 63,313.31 *Ardeb*[1], equivalent to 3920.33 feddans of lost farmland, LE 26.737 million of lost production cost, and 12.55 million cubic meters of lost irrigation water.

Others food commodities

Bread

A study that was conducted to assess the waste in 'Balady' bread using primary data collected from sample of different bakeries and consumers in different districts of Fayoum Governorate found that waste in 'Balady' bread averaged 7.9%, and that such wasted amount are either used to feed chicken, sold, or disposed of.

[1] *Ardeb* = 140kg

Recommendations to Conduct Research in Other Fields of Food Loss

- Further studies on food loss and waste on some food commodities like processed food, fish, poultry, meat and milk;
- More studies on qualitative waste and loss;
- Common use of the same definitions and stage of value chain by researchers working in the field of food loss and waste
- Conducting multidisciplinary studies with the help of scientist from multi-science disciplines including economists, social scientists and physiologists, who can provide a comprehensive methodology and viewpoint on food loss and waste issue, which contribute to making effective strategies to achieve food security
- Continuous monitoring of newly released studies in food loss and waste in all regions of Egypt and opportunities for dialogue among researchers about the methodology, findings and future research.
- For many crops, trained labor is an important factor to reduce loss. So, extension needs to be more effective and devote attention for training growers and workers on good agricultural practices.