

## SUSTAINABLE PRODUCTION AND USE OF RESOURCES VERSUS FOOD WASTING

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### Abstract

*According to information provided by the FAO, all around the world about one-third (approximately 1.3 G tons per year) of food that was meant to be consumed by humans gets lost or wasted. At the same time 925 M people are starving every day. Mankind is searching for the opportunity to feed itself, that's why the food wasting prevention question becomes more and more topical, because it becomes obvious to the wider audience, that food wasting prevention and sustainable use of the resources would help to feed those, that already suffer from hunger.*

**Key words:** export, import, food supply, environment

### 1. INTRODUCTION

While the population in the world is rapidly growing, the concern also grows that produced food amounts won't be enough to feed all the people. Mankind is searching for the opportunity to feed itself, that's why the food wasting prevention question becomes more and more topical, because it becomes obvious to the wider audience, that food wasting prevention would help to feed those, that already suffer from hunger.

To motivate people to use food products more sustainably, members of the European Parliament set 2014 to be "the year against food waste". The European Parliament's resolution urged to act so in year 2025 all wasted food amounts in the EU would be reduced by half and also would improve food access for the poor (Parliament calls ... 2012). According to the resolution, it was expected that actual proposals would follow, such as how to change (in most cases non-sustainable) ways how food in the EU gets produced, and also that there would be identified the reasons why the population in the EU wastes so much food (no less than 30%, that is around 1.6 billion t), that would help to achieve set goals and would also help change people's attitude toward food. But no sustainable offers followed and current EU policies regarding food wastage is mostly focused on waste management and recycling, but not on the decrease of such food waste amount forming in the first place, or, if it is not possible to completely reduce the wasting, to provide the possibility to donate the food. Researchers and members of non-governmental organizations declare that a significant fight against food wastage in the EU isn't carried out (Staes 2014). But, to be able to fight this serious food wasting problem, it is important to know the vastness of the problem, the structure of wasted food and also the motivation of the people as to why they waste their food. It is impossible to comprehend the food wasting problem without researching the relationship between people and food and the meaning consumers attribute to food, in other words, without researching how eating habits form.

Nowadays even if the food wasting problem is getting more and more actual, and all kind of political and non-governmental organizations accentuated the importance of the research of this problem, still not much research is conducted regarding food wasting. For example, sociologists see the food wasting problem more from the viewpoint of individual eating habits, which are affected by different aspects (Bourdieu, 1984), but economists accentuate the impact of the eating habits on cost and the impact on the environment (Venkat 2011). Unfortunately, it is impossible to return money that was spent on food that got wasted in the end, or decrease the cost of recycling food wastage, if people won't change their eating habits and won't focus their attention on aspects that provoke food wastage.

The tasks of the article:

- 1) to identify food production amounts, leading producer-countries; and to explore export/import amounts;

- 2) to explore food supply changes and the impact of food industry on environment;
- 3) to identify food waste amounts and aspects that influence such behaviour.

## 2. FOOD PRODUCTION AND SUSTAINABLE USE

Historically, food products were produced for own consumption and small amounts were sold, also larger or smaller meals were prepared at home. With industrialization and globalization processes, people began to concentrate in large cities, food production became more productive, it became possible to produce more products, and also produce wider range of products, and consumers began to eat out of doors, thus traditional people's eating habits changed.

**Table 1.** Food production and consumption, year 2014/2015

| <b>Production and consumption</b>              | <b>Cereal and products</b> | <b>Meat and products</b> | <b>Milk and products</b> | <b>Fish and products</b> |
|------------------------------------------------|----------------------------|--------------------------|--------------------------|--------------------------|
| Total production in the world, million ton     | 2561.8                     | 315.4                    | 789.1                    | 146.3                    |
| Per caput food consumption, kilograms per year | 148.9                      | 43.4                     | 108.6                    | 20.1                     |

Source: authors' construction based on FAO Food Outlook 2016

Food and agribusiness form a 5 trillion U.S. dollar global industry that is only getting bigger, because that the number of people only increases, therefore the demand for food will rise (Goedde et al. 2015). Food industry's products which are produced the most in the world are wheat, rice, meat, milk, fish and its products. Overall, cereal plants for human consumption is produced the most of all food industry products in world, people also consume cereal products in much larger quantities, namely, 148.9 kg per consumer per year. Fish and its products are consumed in the smallest quantities, 21 kg per consumer per year. Wheat and rice are the most produced and consumed crops. In year 2014 wheat was produced the most in European Union, around 157 million. ton. For contrast, greatest amounts of rice were produced in China, which in 2014 accounted for around 141 million. tons of rice.

It should be noted that not everywhere in the world food is available equally and available food range can differ. Since the availability of locally grown food may vary by region, socio-economic level, eating habits, as well as seasonality and weather conditions that are connected to it, the domestic market cannot always meet consumers' demand for food, that's why countries import food products. But countries, whose food production productivity is higher or it is located in the region where soil fertility and weather conditions help to produce more food, can export the food products.

**Table 2.** Food product import-export, M USD dollars, year 2012

| <b>Region</b>           | <b>Exported food value</b> | <b>Imported food value</b> |
|-------------------------|----------------------------|----------------------------|
| Europe                  | 403                        | 418                        |
| North and South America | 266                        | 159                        |
| Asia                    | 160                        | 264                        |
| Africa                  | 29                         | 64                         |
| Oceania                 | 45                         | 14                         |

Source: FAO Statistical Pocketbook 2012

Values of food that countries export and import varies by region. Europe's food export and import amounts are very similar in quantity. North American and South American region, similar to the Oceania region, export way more food products than import. But countries in the Asian region import way more food than export. It is closely connected to the geographical location of this countries and the fact these countries do not have sufficient amount of resources – namely land, in order to meet the increased demand for food. Similar to the Asian region countries, the African region countries import by value way more than export, but at such a trend is connected not only to geographical characteristics of the region, but also the weak infrastructure and political instability countries have in this region. Top 5 food importing countries are China, USA, Germany, Japan and the United Kingdom. Top 5 food exporting leader countries are the United States, Brazil, the Netherlands, Germany and France.

Developed countries are able to produce food products with a lower cost per kilogram or litre, and it is achieved by the availability of advanced infrastructure with the latest technology in food cultivation, collection, storage, and distribution, as well as with the available subsidy payments.

**Table 3.** Food product imports and exports on a global scale, year 1990, 2000 and 2014

| <b>Food supply</b>          |                       | <b>1990</b> | <b>2000</b> | <b>2014</b> |
|-----------------------------|-----------------------|-------------|-------------|-------------|
| Food export (M ASV dollars) | <i>World</i>          | 215 425     | 276 704     | 945 572     |
|                             | <i>United States</i>  | 28 597      | 39 317      | 111 636     |
|                             | <i>United Kingdom</i> | 6169        | 6927        | 13 824      |
|                             | <i>Japan</i>          | 642         | 893         | 1750        |
|                             | <i>Latvia</i>         | 89          | 88          | 1548        |
| Food import (M ASV dollars) | <i>World</i>          | 237 329     | 294 271     | 966 964     |
|                             | <i>United States</i>  | 16 696      | 26 914      | 63 704      |
|                             | <i>United Kingdom</i> | 15 794      | 17 484      | 42 602      |
|                             | <i>Japan</i>          | 17 884      | 24 832      | 45 107      |
|                             | <i>Latvia</i>         | 38          | 398         | 1474        |

Source: created by authors based on FAO Statistical Pocketbook 2012

Achieving lower cost of the food products and producing enough food, these countries can export overproduced food, on the one hand, providing developing countries with food, but on the other hand, distorting the local market of this countries, since domestic producers are unable to compete with the low imported food products' prices, and are forced to stop production (The food value ... 2013).

It should be noted that in the last hundred years the world population has grown rapidly. In 1990, there were 5.3 billion people in the world, in 2000 - 6.1 billion. (115% increase compared to 1990), while in 2014 there were already 7.2 billion people (118% increase compared to 2000) (World Population ... 2015). Not only population has grown but also the eating habits of this people have changed. According to the World Trade Organization - from 1984, obesity rates doubled, it points to the fact that there are twice as many people with a body mass index greater than 30 in 2016 (BMI classification 2016). Currently 1.9 billion adults are overweight (body mass index 25-29.99), 600 million people's weight already pointes to obesity (Obesity and Overweight 2016).

Historically, the food supply was affected by factors such as weather, soil fertility, insect infestation, etc. Because of the changes in technology and the food supply chain - a wide range of foods became available for wider audience around the world. But food prices have also started to change more

rapidly. The price increase is affected by the rising demand for food, which is influenced by both population growth and the welfare rise of the population of developed countries. The increase of food prices is also affected by the decrease of available food, if the demand for the particular food doesn't change. The decrease of the produced food can be both conscious by reducing certain production and may be affected by natural conditions that do not allow to produce a sufficient amount of food products. Food prices are also affected by economic instability, and can affect political and economic decisions of unions and countries, such as food production subsidization, taxes and fees raise (gas, oil, etc.), regulating of herbicides, pesticides, and etc. use, as well as other measures, which may directly affect the yield. Food price decrease could be also affected by the eating habits' change, for example, if people choose to eat a less meat and products, that would decrease the prices of such products.

Manufacture of food products, as well as its utilization, has negative effect on the environment. Food industry is one of the industries, which is the most in need for resources, but from all waste that forms 40% is food waste (Mata-Alvarez et al. 2000). Because of the intensive farming the quality of the arable soil annually decreases. The 2008 data show that the arable soil degradation in the world has reached 20% (Bai et al. 2008). Water pollution, associated with the activities of the food industry, has reached 8.6% (Kumm et al. 2012). Live-stock breeding requires most resources than, for example, crop production, because that animals, during their lifetime, consume more water and they are also fed with the same cereal products. For example, to produce one ton of corn 900 m<sup>3</sup> of water is needed; for the production of wheat – 1 300 m<sup>3</sup> of water, rice – 3,000 m<sup>3</sup> of water. In turn, production of one ton of chicken meat requires 3900 m<sup>3</sup> of water, pork – 4900 m<sup>3</sup> of water, beef – 15500 m<sup>3</sup> of water. Every year, the world agricultural production requires 7 980 000 000 000 m<sup>3</sup> of water, or 1240 m<sup>3</sup> per person in the world, one-third of this amount is used for irrigation (Hoekstra, Chapagain 2007).

Impact on the environment doesn't end when the food got already produced, it still needs to reach the consumer. Produced food products need to be selected, cut, packed up, and at the selection stage food gets wasted the most, because that there exist specific standards how the end product must look like (Gunder 2012). In turn, in order for food products to reach the consumer, they need to be packed/ transported/ consumed, and the most important role at this stage is played by the packaging. Though packaging itself can serve as environmental pollution, it also can serve as a guarantee that the food will remain fresh for longer time, it also can inform the consumer about the freshness of the product (Magnier et al. 2016). And while the prices of food products for the consumers often are more important and influence consumers' choice in favour of one or the other product, it is important to take notice of the packaging, because that the packaging aspect has become an equally important aspect, because it affects the food storage and future use, and also can affect environment.

The food packaging has changed drastically in the last 100 years, nowadays food packaging helps to store food for longer and prolong the freshness of the food, it also helps to make food products more attractive for the consumer and also makes consumption easier. The latest innovation in food packaging industry is "smart" labels that are incorporated in food product's packaging and informs consumers of the food freshness, thus helping to reduce wasted food amounts and to reduce the negative impact on the environment.

When unconsumed food is wasted and thrown away, not only the food itself gets wasted, but also all the resources that were invested in the food production, storage, processing, transport, as well as the preparation. In the end in the worst case scenario the wasted food ends up in landfills and where it decomposes, releasing in the atmosphere harmful gases (carbon dioxide, methane and other gases), which provokes the worsening of the greenhouse effect. The average amount of carbon dioxide per year that wasted food emits per the world's population is 500 kg. The direct economic costs of food waste are equal to 750 billion US dollars per year, the cost is equal to all the Swiss GDP annual revenues (FAO Food wastages footprint 2013).

The change of people's eating habits could drastically reduce the negative impact of wasted food on the environment, for example, if people had decreased meat consumption and had paid more attention to their food packaging, if they had shopping pattern and cooking routine planned, than, in the end, less food would have got wasted, and it would have positive impact on the environment.

### 3. WASTAGE AMOUNTS

Research about wasted food amounts and motivating aspects are not done regularly, and they don't help to characterize global trends (Okawa 2015).

**Table 4.** Research on food waste and results of such research

| Country and union | Year | The amounts of wastage                                                                                           | Causal relationship discovered                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------|------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EU                | 2006 | 89 M. t of food, 179 kg per one person per year                                                                  | The most food gets wasted on household level – 42%.                                                                                                                                                                                                                                                                                                                                                                                                                |
|                   | 2011 | 280–300 kg per one person per year                                                                               | In overall, in the world 24% of all food that is meant for human consumption gets wasted or lost.                                                                                                                                                                                                                                                                                                                                                                  |
| Denmark           | 2012 | 105 kg per household member per year.<br>3 kg per week.                                                          | 40% of discarded food was still fit for consumption. Most often vegetables and fruits gets wasted, they are also often discarded when were still suitable for consumption. In households, that consist of four or less members, food leftovers of uneaten meals get wasted more often, while bigger households more often integrate leftovers into new meal cooking. One-person households waste the most food, even food that never was used in meal preparation. |
| UK                | 2009 | 22% of food gets wasted, 330 kg per household member per year.                                                   | 65% of all food is thrown away when was still valid for the consumption. 35% of food is thrown away because that it wasn't eaten in time.                                                                                                                                                                                                                                                                                                                          |
|                   | 2013 | 17 M 844 thousand t of food end up in a trash can                                                                | The aim by 2020 to reduce this figure to 12 M 491 thousand t of wasted food per year.                                                                                                                                                                                                                                                                                                                                                                              |
| Finland           | 2012 | Households waste 63% of all purchased food                                                                       | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Australia         | 2009 | Households waste food in the amount of 5 billion USD per year                                                    | Wasted food amounts dependent on incomes of household members and the size of the households. Increasing income, wasting food amounts increase when household members' incomes increase, but decrease, if the number of household members increases. Four and more people households waste the most food per person. People who live alone waste the most.                                                                                                         |
| USA               | 2004 | Consumers waste 14% of the food or 590 USD per year per household. All households waste 43 billion USD per year. | 50% of discarded food is still fit for consumption. By reducing wasted food amounts at least by half, it is possible to reduce the negative effect on the environment by 25%.                                                                                                                                                                                                                                                                                      |
|                   | 2009 | On average, one American wastes 1400 kilocalories per day                                                        | The whole country wastes 150 trillion kilocalories per year, or 40% of all food stocks, while in 1974 the figure was only 28%                                                                                                                                                                                                                                                                                                                                      |
| USA               | 2012 | Waste 36 M t food or 115 kg per household member per year                                                        | Less than 5% of disposed food gets utilized.                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                   | 2014 | Of all cumulated trash, 14.5% is wasted food                                                                     | –                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Japan             | 2010 | Waste 19 M t food or 149 kg per capita. Households waste 2 to 4 M t per year                                     | From 5 to 8 M t of wasted food was still fit for the consumption<br>A big part of country's food is imported, and still one-third of food gets wasted.                                                                                                                                                                                                                                                                                                             |

Source: authors' construction based on works of Preparatory study ... 2010; Gustavsson et al. 2011; Household Food ... 2009; Watson 2013; Koivupuro et al. 2012; EPA 2012; Baker et al. 2009; Jones 2004; Hall 2009; US environmental protection agency 2014; Marra 2013; Focus less ... 2014

Wastage amounts are calculated differently in different conducted studies, for example, some studies calculate wastage as a percentage of all purchased food, or from the food, that previously was divided into groups, or wastage calculated in physical units (kilograms and litres) on national level, or how much of all discarded trash is food, or even calculate fasted food in calories or in terms of money resources, so it is difficult to compare this research.

#### 4. WASTE REDUCTION

Current food wastage issue analysis in the world doesn't allow to **create the optimal food waste reduction model** that would satisfy all parties. Judging by purely economic benefits, it isn't profitable for producers/traders that food would get less wasted, because that industry won't provide any profits/income, that's why often producers/traders are the ones that oppose any changes (namely political) that would result in food wastage reduction, because that producers'/traders' **incomes are proportionally related to the sold food amounts** and not to consumed food amount. The biggest positive impact on food waste reduction can be achieved by drawing consumers' attention to this problem, therefore people's informing must take place at all levels. If nothing is done in the context of this issue, in the future food wastage amounts could only rise, because that incomes of households only rise, but the household sizes decline, both these aspects have a positive impact on food waste rising. The theory of supply and demand explains well how food waste affects consumers and producers/traders and how two sides are affected by the potential reduction of wasted food amounts. But discoveries of consumer behaviour subdiscipline helps to understand the aspects that influence consumer behaviour regarding food purchase, storage and preparation in the context of food wastage. Food purchase decision is a carefully thought out and sequential action to meet needs of consumers and are affected by consumer's behaviour. The process of decision-making can take a long time or it can be a result of impulsive decision. Consumers' decision-making process consists of several stages, and after actual purchasing of the product, this process does not stop, because that purchase stage is then followed by several more very important stages of consumer behaviour, such as product consumption, storage, preparation and also wasting, if the product is not consumed on time (Darnton 2008).

#### 5. CONCLUSIONS

1. Everywhere in the world food isn't available equally and available food range differs. Leading producer-countries are the United States, Brazil, the Netherlands, Germany and France. Developed countries are often able to produce food products with a lower cost per kilogram or litre. Grown food varies by region, socio-economic level, eating habits, as well as seasonality and weather conditions.
2. Food supply changes due to population growth, eating habits, advances in technologies, welfare rise. Manufacture of food products, as well as its utilization, has negative effect on the environment. When unconsumed food is wasted and thrown away, not only the food itself gets wasted, but also all the resources that were invested in the food production, storage, processing, transport, as well as the preparation. The change of people's eating habits could drastically reduce the negative impact of wasted food on the environment.
3. Wastage amounts are calculated differently in different conducted studies, but there is a common connectedness, the higher are the average incomes of the countries' population, the more they waste their food. Incomes are proportionally related to the sold food amounts and not to consumed food amount. If nothing is done in the context of this issue, in the future food wastage amounts could only rise.

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