Food Miles and Applications

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Abstract**:** *This study investigates the expression of food miles in the literature review that occurs in the articles published in academic journals and books. Food mile is a concept which defines the distance between production point and consumer. Calculation of food mile is important to determine losses in food production and transportation. Studying food mile that causes hidden extra costs to food production contributes national economy, supports local producer, makes reaching fresh and cheap food simply. From literature investigations, it is seen that there is no study about food miles in Turkey which is one of the developing countries in the world. Turkey is known as an independent country about cereals. In recent years, import rate of cereals is growing more than production. To prevent dependence, studies should focus on food mile investigation of cereals. Increasing the local food production requires radical changes in entire supply chain. The concept of food miles is new for Turkey and studies should be planned for highly consumable foods such as cereals and these studies will contribute to national economy*

Keywords: *Food Mile, Cereal Import, Turkey*

1. Introduction

The concept of "food miles" – the distance that food items travel from the location where they are grown or raised to the location where they are consumed – has received an increasing amount of attention over the last decade. Most literature on the issue has sought to make a correlation between the distances traveled by food items and the greenhouse gases (GHG) emitted in their transport. Greenhouse gases are emitted through the burning of fossil fuels, and affect air quality and global climate change, which have an effect on human health.

Socio-cultural, political, geographical and climatic conditions have identified transport methods of food throughout human history. Import has always been there as a complement to local resources. In recent years, improvements in technology and transportation, and also globalization has made international trade the first method to meet needs of billions of consumers worldwide. At the beginning of the 21st century developed and developing countries had limited products in their own geographic and climatic conditions. Therefore, foodstuffs which was produced commercially has been increased and these foods have been shipped from one part to the other part of the world.

Global food system expresses different values for countries, businesses and consumers and has different challenges. Increase in energy costs and political issues in different regions of the world, climate changes (greenhouse gas emissions) and deterioration of agriculture / food supply areas are also critical at this point. All of these affects the sustainability of food and increases food safety related questions [1].

Conventional food supply method nowadays is production in a specific location and shipping to different regions. In this situation food is supplied to consumers after a long distance. Since food mile value is low, it contributes positively to freshness, flavor, nutrients, ecological sustainability, carbon footprint, traffic and strengthens local manufacturers by establishing cooperatives.

Studies about food miles is summarized in the literature review summary table below.

TABLE I: Literature Review Summary

STUDY	KEY FINDINGS
Paxton, A., 1994, The Food Miles Report: The Dangers of Long Distance Food Transport. Safe Alliance, London. [2]	The food miles concept was mentioned for the first time.
Carlsson-Kanyama, Annika., 1997, "Weighted average source points and distances for consumption origin-tools for environmental impact analysis." Ecological Economics 23(1997) 15-23.[3]	Weighted Average Source Distance (WASD) and Weighted Average Source Point(WASP) were defined by the Carlsson - Kanyama. Two case studies in the article showed practibility of method. The first was a comparison between the consumption origins of tomatoes and carrots and the second was a comparison beterrn grape consumption origins in 1965 and 1992.
Pirog R. vd., 2003, Checking the food odometer: Comparing food miles for local versus conventional produce sales to Iowa institutions, Leopold Center for Sustainable Agriculture.[4]	WASD was calculated to determine food miles. Food miles of high export rated 16 foods which were sold to Iowa were calculated and analyzed comparatively when they were supplied from local and conventional methods. Result of the study stated that the food mile concept should have been considered and the choices of consumers should have been guided by food mile.
Blanke M. M., Burdick B., 2005, Food (miles) for Thought Energy Balance for Locally-grown versus Imported Apple Fruit, ESPR – Environ Sci & Pollut Res, 125-127.[5]	The energy balance of locally grown and imported apples in Meckenheim Germany was studied. Less primary energy required for domestic apple fruit was discussed with respect to providing local employment, fruit orchards preserving the countryside, quality assurance systems for local fruit such as QS and EUREP-GAP, networking and other factors favouring regional production.The result of study stated that for local production of apple, workforce, quality control system, transportation from field to consumer had been also critical issues.
Xuereb M., 2005, Food Miles: Environmental Implications of Food Imports to Waterloo Region, Region of Waterloo Public Health.[6]	An investigation was handled to provide awareness about food miles and green house gasses in Canada Waterloo Region and support local production. WASD, WAER, GHG were calculated to determine the effects. Imports of 58 commonly eaten foods travel an average of 4,497 km to Waterloo Region. These imports accounted for 51,709 tonnes of GHG emissions annually, contributing to climate change and air quality, which both had an effect on human health. Since all of the studied food items could be grown or raised in Waterloo Region, a significant opportunity exist to reduce our contribution to global climate change and air pollution by replacing imports of the studied food items with food items sourced from Waterloo Region or South-western Ontario.
Pretty J.N., Ball A.S., Lang T., Marison J.I.L, 2005, Farm costs and food miles: An assessment of the full cost of the UK weekly food basket, Food Policy, 1-19.[7]	The study assessed a variety of scenarios for adoption of organic farming, localised food systems and sustainable transport to indicate the substantial potential to reduce environmental costs in the UK food system.Weekly food consumption cost in the United Kingdom were investigated. Farming was compared with the cost of food miles. When food was supplied from abroad, it brought hidden extra costs of £ 2.91 per week(more than 11.8 % of the total cost). Increasing the local food production requires radical changes in entire supply chain. At the same time , globalization will continue in the food system, therefore increasing local production will be though and affect net profit of product.

TABLE I (continued): literature review summary

STUDY	KEY FINDINGS
Saunders C., Barber A., 2008, Carbon Footprints, Life Cycle Analysis, Food Miles: Global Trade Trends and Market Issues, Political Science, 73-88.[8]	Carbon footprint, life-cycle analysis and food miles about foods which were consumed in New Zealand were investigated. It is suggested that investigators should have focused on not only food miles, but also carbon footprint.
Weber C. L., Matthews H. S., 2008, Food-Miles and the Relative Climate Impacts of Food Choices in the United States, Environmental Science and Technology, 3508-3513.[9]	Effects of food miles and climate changes on consumer choices were examined. The effect of food miles on sustainability of America's food consumption was investigated by using input-output life cycle evaluation. The study shows that some food types are much less GHG-intensive than others, any attempt to change consumer behavior based on only one dimension of food choice is unlikely to be effective..
Wynen E., Vanzetti, D., 2008, No Through Road: The Limitations of Food Miles, ADB Institute Working Paper No. 118 [10]	Study stated that the generally-accepted concept of food miles focused on primarily or exclusively on distance traveled. Even the more sophisticated version, which takes into account energy use and harmful emissions produced during transport, is misleading because reductions in these two factors may be offset by increased energy use and emissions in local production. A lifecycle analysis may address this problem, but still does not incorporate primary inputs such as labor, capital, and other intermediate inputs such as fuel and fertilizer with their polluting effects. Rather than restricting travel, a better approach would be to price all environmentally damaging inputs appropriately.
Coley D., Howard M., Winter M., 2009, Local food, food miles and carbon emissions: A comparison of farm shop and mass distribution approaches, Food Policy, 150-155.[11]	Food miles and carbon emissions of food production in USA were investigated. The findings suggested that if a customer drove a round-trip distance of more than 6.7 km in order to purchase their organic vegetables, their carbon emissions were likely to be greater than the emissions from the system of cold storage, packing, transport to a regional hub and final transport to customer's doorstep used by large-scale vegetable box suppliers. Consequently, some of the ideas behind localism in the food sector might need to be revisited.
Kissinger M., 2012, International trade related food miles – The case of Canada, Food Policy, 171-178.[1]	Annual import of Canada was evaluated with food miles. 30% of the agricultural and food commodities consumed in Canada are imported, resulting in 'food miles' of over 61 billion tonnes km, leading to annual emissions of 3.3 million metric tones of CO2. Of the various agriculture and food commodities studied, fruits and vegetables had the highest food miles related emissions.
Schnell S. M., 2013, Food miles, local eating, and community supported agriculture- putting local food in its place, Agric Hum Values, 615-628[12]	Study indicated that''Local'' food was not primarily about distance from the source of the food. Instead, it is much more about the establishment of connections between food consumption and food production, and firmly rooting these in a specific place. ''Local,'' then, unlike food miles, is not really a spatial concept at all. Food, for many, has become an important part of direct experience and sensory input in shaping their experience of place.

Studies in the literature underlines that labor, seasonality, green house emissions, carbon food print and flavor should be focused on as well as food miles. Increasing the local food production requires radical changes in entire supply chain. The concept of food miles is new for Turkey and studies should be planned for highly consumable foods such as cereals and these studies will contribute to national economy.

2. Definition and Calculation of Food Miles

"Food miles" is defined as the distance between growing destination of food and the consumer. Food miles has become important definition that defines distance from field to consumer for food professionals [4]. As stated in the Kyoto Protocol, the political importance of climate change is increasing and issues such as food mile are also gaining in value day by day [8]. The continually increasing trend about both of organic and locally grown foods in the U.S. and EU shows that consumers are more important about how their food is produced and where it comes from.

The concept of sustainability gains value nowadays. Food miles has become common on the concept of sustainability [9]. Various tools have been brought to bear to analyze the problems of sustainable agriculture, the chosen method often primarily depending on the way sustainability is viewed and the background of the investigator. As the environmental impacts of global agro-food systems have been exposed the concepts of 'local food' and 'food miles' have become powerful polemical tools in policy discourses built around sustainable agriculture and alternative food systems. To reduce food miles implies the need for food systems grounded in local ecologies and responsive to consumer demands for quality food, hence the growing literature on the benefits of a more localized food supply system [11].

A food mile is the distance food travels from where it is grown or raised to where it is ultimately purchased by the consumer or end user. It is relatively easy to calculate food miles for a single ingredient, unprocessed food product from the time it leaves the farm until it is purchased. To obtain the average food miles a certain food item travels from all sources to reach a certain city or community, it is necessary to calculate a Weighted Average Source Distance (WASD). The WASD from production source to consumption endpoint is a single distance figure that combines information on distances from producers to consumers and the amount of food product transported. The formula which is developed by Annika Carlsson-Kanyama in 1997 for the WASD is:

$$WASD = \frac{\sum(v(k) * d(k))}{\sum v(k)} \quad (1)$$

Where:
WASD: weighted averaged source distance(km)
k: different locations of the production origin
v: value ($) of imports from each location of production origin, and
d: distance (km) from each location of production origin to the point of consumption [4]

Most of studies in the literature made a correlation between distance to food and greenhouse gases (GHG). Greenhouse gases are emitted while burning of fossil fuels, and affect air quality, human health and global climate change.

The WAER is the average amount of GHG emissions (in kg) created by each kg of a food item in its travel from point of production to consumption. The formula was created by Lifecyles (2004).

$$WAER = \frac{\sum v(k)\, d(k)\, e(k)}{\sum v(k)} \quad (2)$$

Where:
WAER: Weighted average emissions value(g/ton)
k: Production location
v: value ($) of imports from each location of production origin
d: distance (km) from each location of production origin to the point of consumption
e: greenhouse gas (GHG) emission level (g/T-km) for mode of transport

Greenhouse emissions value(e) is according to the transportation method. Values of greenhouse (GHG) emissions by mode of transport (the "e" variable in the formula to calculate WAER) which are obtained from Environment Canada (2002) is shown in Table 1. Values represent the average amount of greenhouse gas emissions emitted by the four different transport modes. The GHG emissions are mostly carbon dioxide (CO_2), but also include nitrous oxide (N_2O) and methane (CH_4) converted into equivalent units of CO_2 based on their global warming potential.

TABLE II: GHG Emissions by Transport Mode [6]

Transport Mode	GHG emission levels (g per ton-km)
Air	1,101.0
Marine	130.3
Rail	21.2
Truck	269.9

The study used following formula to calculate how many tones of GHG emissions are created by imports of each selected food [6]:

$$GHG = WAER.c.i \quad (3)$$

Where:
GHG: Green house gasses(ton)
WAER: the average amount (kg) of GHGs emitted for each kg of a food item imported
c: the total consumption of the food item(kg)
i: the proportion that imports make up of domestic consumption (%)

3. Importance Of Future "Food Mile" Studies About Cereal In Turkey

Turkey's population is growing by steady rate, according to the data from the Turkish Statistical Institute. Figures for 2015 indicate a growth rate of 13.4, higher than the 13.3 of the previous year. The population grew by 1.45 million people in the past year to 78.741.053 according to official records. Figure 1 shows that population is growing by steady rate. This population growing trend affects food demand of Turkey directly.

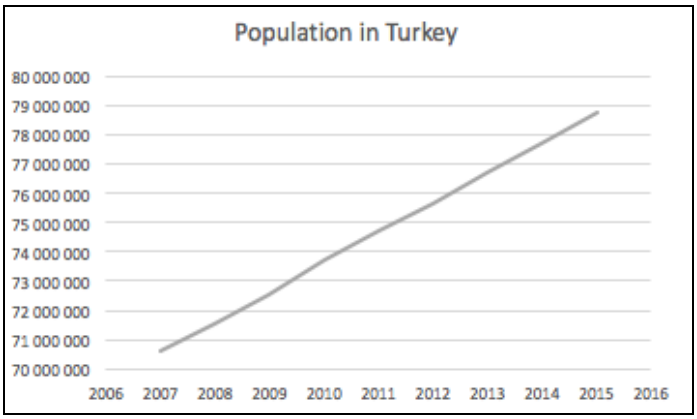

Fig. 1. Population in Turkey[13].

Total import of Turkey in US dollars is given in Figure 2. Imports are increasing in recent years. This is related with population growing rate and total production volume of industry in Turkey.

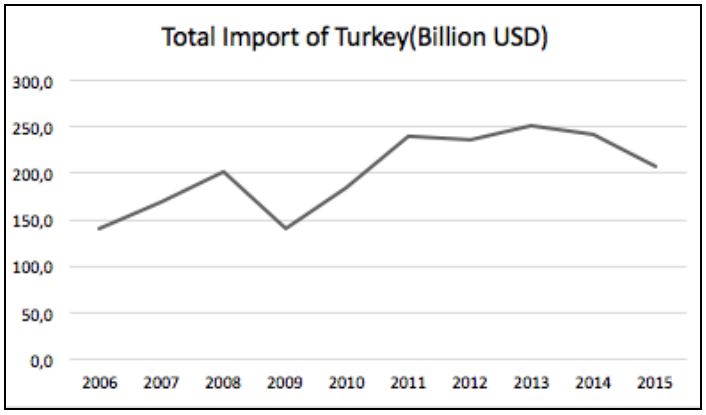

Fig. 2. Total Import of Turkey(Billion USD) [13].

Cereal import over total import in Turkey is depicted in Figure 3. Figure 3 shows that general aim of cereal import rate in total import is stable by years. Despite stability of cereal import rate, cereal import is growing according to increase in total imports. On the other hand, in 2015 there is approximately 2 times increase in cereal import comparing with the year before. Average percentage of cereal imports over total imports is 3,77% from 2008 to 2015. Although Turkey has been known to be self-sufficient in cereals. Figure 3 depicts that Turkey has gradually become import dependent in cereals. By increasing local production, import rate of cereals and also dependence in cereals will decrease.

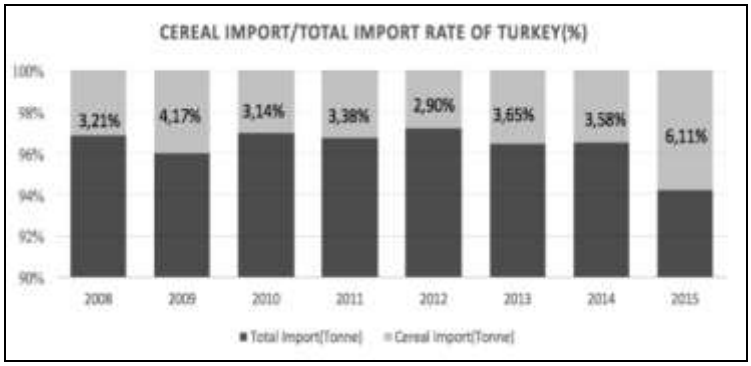

Fig. 3. Cereal Import(Tonne) over Total Import(Tonne) in Turkey[13].

Usable production and imports of cereals in Turkey is depicted in Figure 4. Usable production and also imports are increasing. But the growing rate of imports are greater than growing rate of usable production by years.

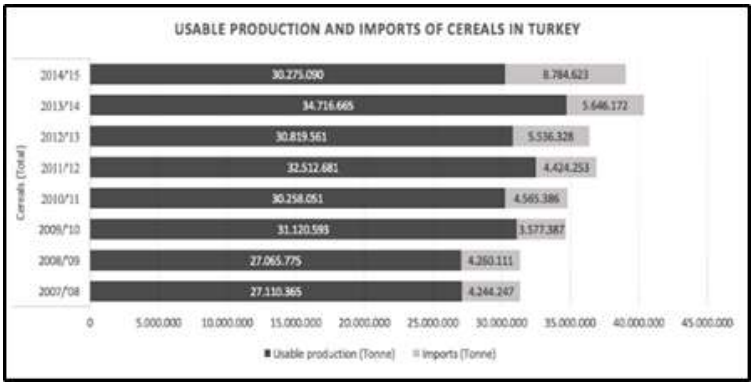

Fig. 4. Usable Production and Imports of Cereals in Turkey[13].

Cereal types which is imported from other countries are given in Figure 5. Since tonnage of cereal imports are focused, most four imported cereals are wheat, maize, barley and oat. Import of wheat and maize which has an important place in essential nutrients are approximately 90% of total cereal import.

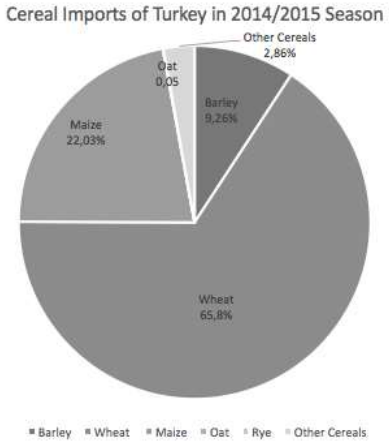

Fig. 5. Cereal Imports of Turkey in 2014/2015[13].

Wheat and maize import tonnages are shown in Figure 6 and Figure 7. Although in 2000/01 term, 2% of wheat need were supplied from import, in 2014/15 term 24,4 of wheat need were supplied from import. It is related with efficiency and cost of wheat production in Turkey. State aid about wheat production should be improved to support farmer. Maize need of Turkey is highly growing, for the reason that glucose usage rate instead of sugar for industrial food production plants are increasing. Rate of maize import over usable production is stable. For instance, in 2000/01 term, 25,3% of maize need were supplied from import, in 2014/15 term 25,1 of wheat need were supplied from import.

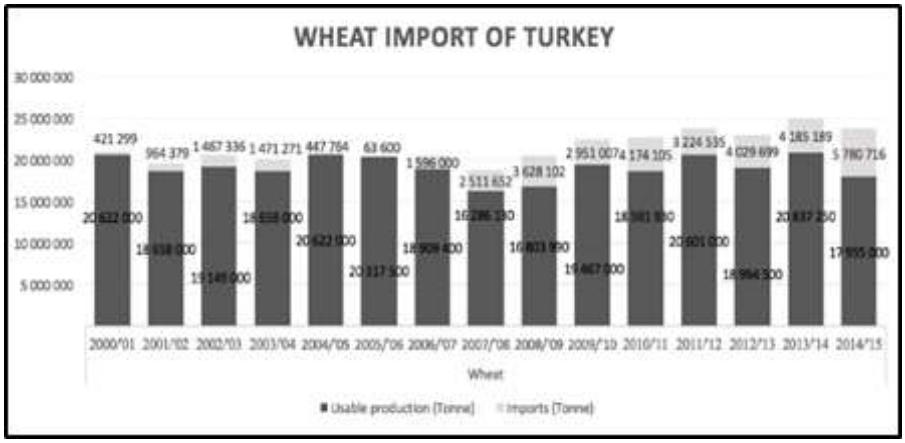

Fig. 6. Usable Production and Import of Wheat in Turkey[13].

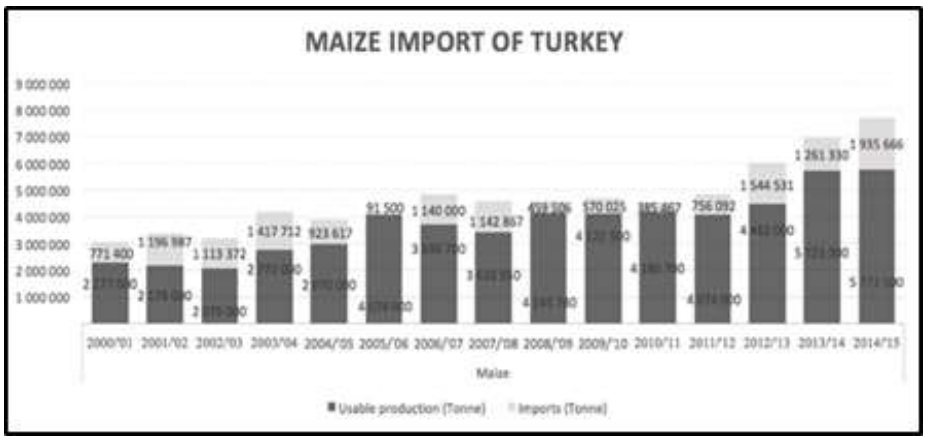

Fig. 7. Usable Production and Import of Maize in Turkey[13].

According to the import values in Turkey, food mile concept especially on cereals is recommended to be investigated. Application of this concept will affect positively to country economy. Supporting local production and optimizing distances between ports will prevent losses during transportation and production. Turkey saves energy and pollute less after application of food miles.

4. The Result and Discussion

There are several studies about food mile concept in the literature. In first years when food mile concept was newly discussed, food mile was only distance between production point and consumer. Actual studies in the literature underlines that labor, seasonality, green house emissions, carbon food print and flavor should be focused on as well as food miles. Studying food mile that causes hidden extra costs to food production contributes national economy, supports local producer, makes reaching fresh and cheap food simply.

Food mile approach has not been applied to consumable foods in Turkey, yet. By implementation of this concept, which has been developed in time by different researchers, alternative approaches will be determined for foodstuff in Turkey and that will contribute to Turkey economy. According to values from Turkish Statistical Institute, import rate of cereals in Turkey is increasing nowadays. For instance, approximately 20 percent of annual wheat need of Turkey are imported from other countries. To prevent dependence to other countries about

cereals, studies in Turkey should focus on this type of foodstuff. However, food mile, which is new approach for Turkey, is applicable and developable concept.

5. References

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