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The Effects of Local Food on Carbon Emissions: The Case of the Republic of Korea

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Abstract: This study addresses the urgent environmental issue of climate change, focusing specifically on the role of local food, which is produced and consumed locally, in helping to reduce carbon emissions by eliminating the need for long-distance transportation. Through quantitative analysis, this study elucidates the potential benefits of environmental impact achieved through the consumption of local food, i.e., the significant reduction in carbon emissions. Specifically, the consumption of local food has been found to yield an annual decrease of 2,421,296 tCO_2 emissions, representing 2.5% of the Republic of Korea's total greenhouse gas emissions from the transportation sector. This reduction further translates into an estimated economic value of USD 54.23 million (KRW 70.5 billion). These findings underscore the potential of local food consumption as a tangible strategy to overcome environmental problems. Moreover, the academic contribution of this study lies in its comprehensive analysis of the economic and empirical impacts of local food consumption on the environment. Moving forward, we propose policies such as supporting local food distribution networks, providing public education on local food, fostering local food industries, and implementing incentives to revitalize local food consumption.

Keywords: local food; food miles; carbon emissions; environment; carbon footprint

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1. Introduction

Climate change and global warming are currently the foremost international environmental issues. Their impacts manifest in diverse ways, including glacier reduction, desertification, rising sea levels, and ecological transformations worldwide. Notably, the frequency and intensity of extreme weather events and natural disasters have been on the rise in recent times.

The primary cause of these phenomena is greenhouse gas emissions. When gas particles enter the Earth's atmosphere, some trap heat, intensifying the greenhouse effect and causing a rise in global temperatures. This effect, wherein the planet's surface and troposphere warm due to gas particles, accelerates global warming and prompts climate change.

The Kyoto Protocol, an international treaty on climate change, regulates six major greenhouse gases. Their respective contributions are as follows: carbon dioxide (CO_2) accounts for 88.6%, methane (CH_4) for 4.8%, nitrous oxide (N_2O) for 2.8%, and other gases such as hydrofluorocarbons (HFC_s), perfluorocarbons (PFC_s), and sulfur hexafluoride (SF_6) contribute 3.8%.

Globalization and large-scale industrialization in the food industry have led to more food trade among nations and regions. Consequently, food products travel from their origins to reach their end customers across the globe. The problem lies in the increased energy consumption due to the transportation distance of food distribution. Vehicles such as airplanes, ships, trains, and trucks mainly rely on fossil fuels such as coal, oil, and gas. Consequently, carbon dioxide and other greenhouse gas emissions occur more frequently as a result of fuel consumption [1].

Food miles is a widely used concept in the study of environmental aspect, emphasizing the need to reduce greenhouse gas emissions, a major contributor to environmental issues. Food miles refers to the distance that food products (i.e., agricultural products, livestock, seafood, etc.) travel from their origin to the final consumers. Food miles is measured by multiplying the quantity of food transported (in tons) by the distance travelled (in kilometers). A higher value of food miles indicates increased environmental pollution resulting from pollutants such as carbon dioxide by the long-distance transportation of food. As a result, food miles is utilized as a global environmental indicator in countries and regions, such as the United States, the European Union, Australia, Canada, and others, as they allow for the tracking and calculation of the entire food distribution process [2].

Local food consumption is a prominent social effort to reduce food miles. Local food refers to food that is consumed within a region without long-distance transportation or multi-stage distribution processes [3,4]. Since local food limits the distance a product must be transported, the greenhouse gas emissions associated with transportation are relatively low or even non-existent. Therefore, consuming local food contributes directly to reducing greenhouse gas emissions and protecting the environment.

There have been several studies on food miles in Korea, such as [5–7]. Ref. [5] calculated the food miles and carbon dioxide emissions of imported food products in Korea, Japan, the United Kingdom, and France. Ref. [6] focused on beef and wine, determining and comparing their food miles and carbon dioxide emissions, with the authors asserting that carbon dioxide emissions' problems can be solved through local food consumption. Ref. [7] analyzed methods for measuring the food miles and carbon dioxide emissions of agricultural products.

However, despite the efforts of previous scholars, few studies analyzing the changes in food miles caused by using local food exist. Specifically, calculating and comparing the food miles and carbon dioxide emissions of local food is an important research topic in the context of sustainable environmental practices. Therefore, this study aims to calculate the food miles and carbon dioxide emissions associated with local food consumption and quantitatively evaluate their environmental impact.

2. Methodological Framework

2.1. Framework

In previous studies, local food is defined as localization, simplification of distribution process, and linkage between production and consumption, etc. and commonly mentioned as follows: regional concept, main agent, distribution process, etc. For this study, local food is defined as 'agricultural products that are produced, distributed, and consumed within a certain geographic area without multi-stage distribution processes'. It is specifically limited to agricultural products sold in local food direct markets. Moreover, local food direct markets refer to the representative local food policy in Korea. Lastly, the environmental effects of local food consumption are assessed by comparing the period before and after consumption at Korean local food direct markets.

Before considering the local food business, the classification of where food comes from begins with agricultural products consumed in a specific region and are classified into domestic and imported commodities. Next, after the consumption of local food, agricultural products can be categorized as local food, domestic but non-local food, and imported but non-local food. In other words, a certain proportion of the consumption of domestically produced and imported agricultural products is replaced by local food. Since the exact extent to which local food replaces domestic and imported commodities cannot be known, the proportion of domestically produced and imported agricultural products before the local food business is assumed as the replacement ratios, respectively. The formula developed by Annika Carlsson-Kanyama in 1997 considers both the weight of the food transported and the distance from the place of origin to the place of consumption. The calculation formula for food miles is 'consumption quantity (t) $\times$ distance (km)', and as the consumption of local food increases, the food miles decreases (Figure 1).

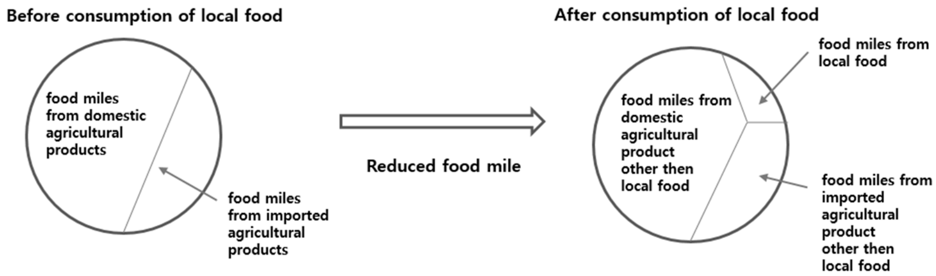

Figure 1. The change (decrease) in food miles before and after the consumption of local food business.

The equation for calculating the food miles of domestic agricultural products is as follows: 'Consumption volume of domestic agricultural products (t) × distance (km)'. In Korea, agricultural products are mainly moved from the place of origin to the wholesale market and then to the place of consumption. Therefore, the distribution path of domestic agricultural products is represented as place of origin–wholesale market–place of consumption (Figure 2). The consumption volume in the evaluation region is calculated by multiplying the total domestic supply of the target agricultural products and the proportion of the evaluation region population to the country's total population. The distance is calculated by dividing the distance from the origin to the wholesale market and the distance from the wholesale market to the consumption area. In this case, the major origin and the major wholesale market are based on the origin (production area) and wholesale market that account for up to 80% of the cumulative ratio of the Concentration Ratio (CR3) (Concentration Ratio (CR) refers to the proportion of transaction value held by a few large companies within the total transaction value of a specific industry. Generally, 'CR3' indicates an oligopoly when the combined market share of the top three companies is 75% or more. In this study, the major origin and the major wholesale market are determined based on origins and wholesale markets that reach 80% of the Concentration Ratio, considering them as the major production areas and hubs).

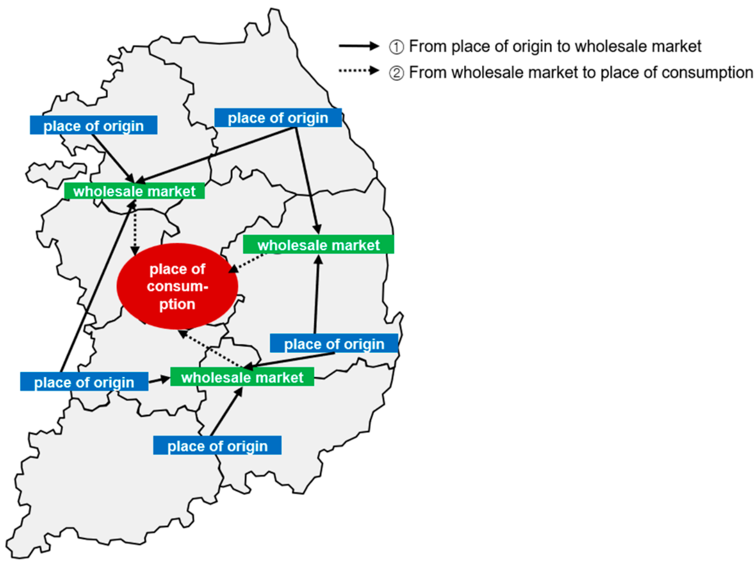

Figure 2. Overview of food miles calculation of domestic agricultural products.

The equation for calculating the food miles of imported agricultural products is as follows: 'Consumption volume of imported agricultural products (t) × distance (km)'. Imported agricultural products are moved from the exporting country (export port) to the domestic port and then to the wholesale market and then to the place of consumption. Therefore, the distribution path of imported agricultural products is represented as exporting country–domestic port–wholesale market–place of consumption (Figure 3). The consumption volume is calculated by multiplying the total domestic supply of imported agricultural products and the proportion of the evaluation region population to the country's total population. The distance is divided into three steps: the distance from the export country to the domestic port, the distance from the port to the wholesale market, and the distance from the wholesale market to the consumption area. In this case, the export country and the domestic port are based on the CR3 criteria, considering the cumulative weight of up to 80% of exporting countries and domestic ports, respectively. Additionally, the wholesale market encompasses all markets where imported agricultural products are imported.

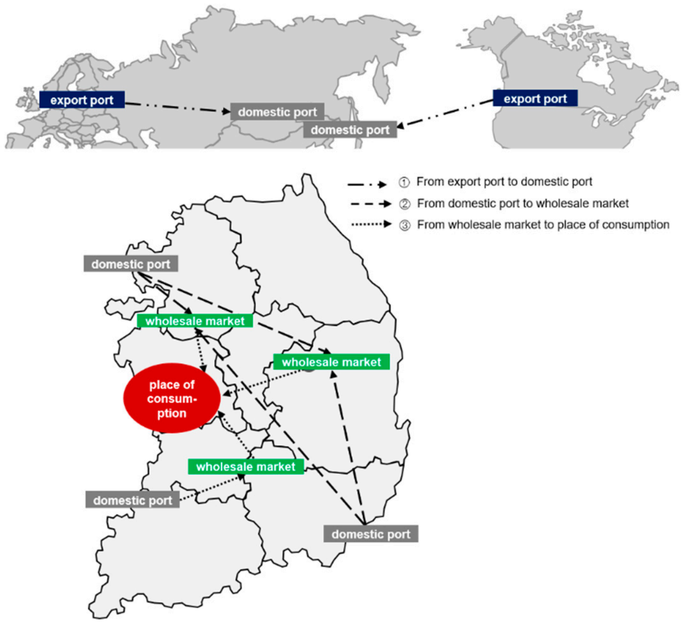

Figure 3. Overview of food miles calculation of imported agricultural products.

2.2. Rate of Change in Carbon Emission: CER

Equation (1) is used to measure the rate of change in carbon emissions of domestically produced and imported foods before and after the local food business in region r. A higher rate of change in carbon emissions in the evaluation region is considered a decrease in food miles.

$$CER^r = \frac{DCO^{r,b} - DCO^{r,a}}{DCO^{r,b}} + \frac{ICO^{r,b} - ICO^{r,a}}{ICO^{r,b}} \quad (1)$$

CER^r: Rate of carbon emissions change in region r;
$DCO^{r,b}$: Carbon emissions from distribution of domestic agricultural products before local food business in region r (tCO_2);
$DCO^{r,a}$: Carbon emissions from distribution of domestic agricultural products after local food business in region r (tCO_2);
$ICO^{r,b}$: Carbon emissions from distribution of imported agricultural products before local food business in region r (tCO_2);
$ICO^{r,a}$: Carbon emissions from distribution of imported agricultural products after local food business in region r (tCO_2).

$DCO^{r,b}$ is composed of the sum of carbon emissions ($DCO^{r,b}_{k,p,l}$) from the origin p to the wholesale market l for commodity k before the local food business and the carbon emissions ($DCO^{r,b}_{k,l,r}$) from the wholesale market l to region r (Equation (2)).

$$DCO^{r,b} = \sum_k \left(DCO^{r,b}_{k,p,l} + DCO^{r,b}_{k,l,r}\right) = \sum_k \left(DFM^{r,b}_{k,p,l} + DFM^{r,b}_{k,l,r}\right) \times E_{tr} \quad (2)$$

$DCO^{r,b}$: Carbon emissions from distribution of domestic agricultural products before local food business in region r (tCO_2);
$DCO^{r,b}_{k,p,l}$: Carbon emissions from the origin p to the wholesale market l for the domestically produced commodity k before the local food business (tCO_2);
$DCO^{r,b}_{k,l,r}$: Carbon emissions from the wholesale market l to the region r for the domestically produced commodity k before the local food business (tCO_2);
$DFM^{r,b}_{k,p,l}$: Food miles from the origin p to the wholesale market l for the domestically produced commodity k before the local food business (t·km);
$DFM^{r,b}_{k,l,r}$: Food miles from the wholesale market l to the region r for the domestically produced commodity k before local food business (t·km);
E_{tr}: CO_2 emission factor for trucks (tCO_2/t·km).

The food miles of domestically produced commodity k before the local food business can be calculated based on the distance from the origin p to the region r and the supply (Equation (3)).

$$\begin{gathered}\sum_k\left(DFM^{r,b}_{k,p,l}+DFM^{r,b}_{k,l,r}\right)\\=\sum_k\left[\sum_p\sum_l\left(DQ_{k,p,l}\times d_{k,p,l}\right)\times\frac{1}{\beta_{k,p}}+\sum_l\left(DQ_{k,l,r}\times d_{k,l,r}\right)\times\frac{1}{\beta_{k,l}}\right]\times\frac{DQ^r_k}{DQ_k}\\ where,\ DQ^r_k=\frac{DQ_k}{N}\times N^r\end{gathered}\tag{3}$$

$DQ_{k,p,l}$: Supply of the domestically produced commodity k from the origin p to the wholesale market l (ton);
$d_{k,p,l}$: Distance from the origin p to the wholesale market l for the domestically produced commodity k (km);
$\beta_{k,p}$: Proportion of wholesale market imports from major origins in the total supply of the domestically produced commodity k;
$DQ_{k,l,r}$: Supply of the domestically produced commodity k from the wholesale market l to the region r (ton);
$d_{k,l,r}$: Distance from the wholesale market l to the region r for the domestically produced commodity k (km);
$\beta_{k,l}$: Proportion of major wholesale market imports in the total supply of the domestically produced commodity k;
DQ^r_k: Supply of the domestically produced commodity k from the region r (ton);
DQ_k: Total supply of the domestically produced commodity k (ton);
N: Total population of the Republic of Korea; N^r: Total population of region r.

$DCO^{r,a}$ is composed of the sum of carbon emissions ($DCO^{r,a}_{k,p,l}$) from the origin p to the wholesale market l for commodity k after the local food business and the carbon emissions ($DCO^{r,a}_{k,l,r}$) from the wholesale market l to region r (Equation (4)).

$$DCO^{r,a}=\sum_k\left(DCO^{r,a}_{k,p,l}+DCO^{r,a}_{k,l,r}\right)=\sum_k\left(DFM^{r,a}_{k,p,l}+DFM^{r,a}_{k,l,r}\right)\times E_{tr}\tag{4}$$

$DCO^{r,a}$: Carbon emissions from distribution of domestic agricultural products after the local food business in region r (tCO_2);
$DCO^{r,a}_{k,p,l}$: Carbon emissions from the origin p to the wholesale market l for the domestically produced commodity k after the local food business (tCO_2);
$DCO^{r,a}_{k,l,r}$: Carbon emissions from the wholesale market l to region r for the domestically produced commodity k after the local food business (tCO_2);
$DFM^{r,a}_{k,p,l}$: Food miles from the origin p to the wholesale market l for the domestically produced commodity k after the local food business (t·km);
$DFM^{r,a}_{k,l,r}$: Food miles from the wholesale market l to region r for the domestically produced commodity k after the local food business (t·km);
E_{tr}: CO_2 emission factor for trucks (tCO_2/t·km).

The food miles of domestically produced commodity k after the local food business can be calculated based on the distance from the origin p to the region r and the supply (Equation (5)).

$$\begin{gathered}\sum_k\left(DFM^{r,a}_{k,p,l} + DFM^{r,a}_{k,l,r}\right)\\ = \sum_k\left[\sum_p\sum_l\left(DQ_{k,p,l} \times d_{k,p,l}\right) \times \frac{1}{\beta_{k,p}} + \sum_l\left(DQ_{k,l,r} \times d_{k,l,r}\right) \times \frac{1}{\beta_{k,l}}\right] \times \frac{\left(DQ^r_k - \left(QL^r_k \times \alpha_k\right)\right)}{DQ_k}\\ where,\ Q^{r,dm}_k = \frac{Q^{dm}_k}{N^{dm}} \times N^r\end{gathered} \tag{5}$$

$DQ_{k,p,l}$: Supply of the domestically produced commodity k from the origin p to the wholesale market l (ton);
$d_{k,p,l}$: Distance from the origin p to the wholesale market l for the domestically produced commodity k (km);
$\beta_{k,p}$: Proportion of wholesale market imports from major origins in the total supply of the domestically produced commodity k;
$DQ_{k,l,r}$: Supply of the domestically produced commodity k from the wholesale market l to the region r (ton);
$d_{k,l,r}$: Distance from the wholesale market l to the region r for the domestically produced commodity k (km);
$\beta_{k,l}$: Proportion of major wholesale market imports in the total supply of domestically produced commodity k;
DQ^r_k: Supply of the domestically produced commodity k from the region r (ton);
DQ_k: Total supply of the domestically produced commodity k (ton);
QL^r_k: The local food sales volume of the commodity k in the region r (ton);
α_k: Domestically produced commodities' market share of commodity k;
N: Total population of the Republic of Korea; N^r: Total population of region r.

$ICO^{r,b}$ is composed of carbon emissions ($ICO^{r,b}_{k,ex,h}$) from the export country ex to domestic port h for commodity k, carbon emissions ($ICO^{r,b}_{k,h,l}$) from the port h to the wholesale market l, and the carbon emissions ($ICO^{r,b}_{k,l,r}$) from the wholesale market l to region r (Equation (6)).

$$\begin{gathered}ICO^{r,b} = \sum_k\left(ICO^{r,b}_{k,ex,h} + ICO^{r,b}_{k,h,l} + ICO^{r,b}_{k,l,r}\right)\\ = \sum_k\left(IFM^{r,b}_{k,ex,h} \times E_{sh}\right) + \sum_k\left(IFM^{r,b}_{k,h,l} + IFM^{r,b}_{k,l,r}\right) \times E_{tr}\end{gathered} \tag{6}$$

$ICO^{r,b}$: Carbon emissions from imported products before the local food business in region r (tCO_2);
$ICO^{r,b}_{k,ex,h}$: Carbon emissions from the export country ex to domestic port h for the imported commodity k before the local food business (tCO_2);
$ICO^{r,b}_{k,h,l}$: Carbon emissions from domestic port h to the wholesale market l for the imported commodity k before the local food business (tCO_2);
$ICO^{r,b}_{k,l,r}$: Carbon emissions from the wholesale market l to the region r for the imported commodity k before the local food business (tCO_2);
$IFM^{r,b}_{k,ex,h}$: Food miles from the export country ex to domestic port h for the imported commodity k before the local food business (t·km);
$IFM^{r,b}_{k,h,l}$: Food miles from domestic port h to the wholesale market l for the imported commodity k before the local food business (t·km);
$IFM^{r,b}_{k,l,r}$: Food miles from the wholesale market l to the region r for the imported commodity k before the local food business (t·km);
E_{tr}: CO_2 emission factor for trucks (tCO_2/t·km); E_{sh}: CO_2 emission factor for ships (tCO_2/t·km).

The food miles of imported commodity k before the local food business can be calculated based on the distance from the export country ex to the region r and the supply (Equation (7)).

$$\begin{gathered}\sum_k \left(IFM^{r,b}_{k,ex,h} + IFM^{r,b}_{k,h,l} + IFM^{r,b}_{k,l,r} \right) \\ = \sum_k \left[\sum_{ex} \sum_h \left(IQ_{k,ex,h} \times d_{k,ex,h} \right) \times \frac{1}{\gamma_{k,ex}} + \sum_h \sum_l \left(IQ_{k,h,l} \times d_{k,h,l} \right) \times \frac{1}{\gamma_{k,h}} + \sum_l \left(IQ_{k,l,r} \times d_{k,l,r} \right) \times \frac{1}{\gamma_{k,l}} \right] \times \frac{IQ^r_k}{IQ_k} \\ where,\ Q^r_k = \frac{IQ_k}{N} \times N^r \end{gathered} \tag{7}$$

$IQ_{k,ex,h}$: Import volume of the imported commodity k from the export country ex to domestic port h (ton);
$d_{k,ex,h}$: Distance from the export country ex to domestic port h for the imported commodity k (km);
$\gamma_{k,ex}$: Proportion of import volume from major export countries in the total import volume of the imported commodity k;
$IQ_{k,h,l}$: Import volume of the imported commodity k from domestic port h to the wholesale market l (ton);
$d_{k,h,l}$: Distance from domestic port h to the wholesale market l for the imported commodity k (km);
$\gamma_{k,h}$: Proportion of import volume from major domestic ports in the total import volume of the imported commodity k;
$IQ_{k,l,r}$: Import volume of the imported commodity k from the wholesale market l to the region r (ton);
$d_{k,l,r}$: Distance from the wholesale market l to the region r for the imported commodity k (km)
$\gamma_{k,l}$: Proportion of major wholesale market imports in the total volume of the imported commodity k;
IQ^r_k: Import volume of the imported commodity k from the region r (ton);
IQ_k: Total import volume of the imported commodity k (ton); N: Total population of the Republic of Korea; N^r: Total population of region r.

$ICO^{r,a}$ is composed of carbon emissions ($ICO^{r,a}_{k,ex,h}$) from the export country ex to domestic port h for commodity k, carbon emissions ($ICO^{r,a}_{k,h,\ l}$) from the port h to the wholesale market l, and the carbon emissions ($ICO^{r,a}_{k,l,r}$) from the wholesale market l to the region r (Equation (8)).

$$\begin{gathered} ICO^{r,a} = \sum_k \left(ICO^{r,a}_{k,ex,h} + ICO^{r,a}_{k,h,l} + ICO^{r,a}_{k,l,r} \right) \\ = \sum_k \left(IFM^{r,a}_{k,ex,h} \times E_{sh} \right) + \sum_k \left(IFM^{r,a}_{k,h,l} + IFM^{r,a}_{k,l,r} \right) \times E_{tr} \end{gathered} \tag{8}$$

$ICO^{r,a}$: Carbon emissions from imported products after the local food business in region r (tCO_2);
$ICO^{r,a}_{k,ex,h}$: Carbon emissions from the export country ex to domestic port h for the imported commodity k after the local food business (tCO_2);
$ICO^{r,a}_{k,h,l}$: Carbon emissions from domestic port h to the wholesale market l for the imported commodity k after the local food business (tCO_2);
$ICO^{r,a}_{k,l,r}$: Carbon emissions from the wholesale market l to the region r for the imported commodity k after the local food business (tCO_2);
$IFM^{r,a}_{k,ex,h}$: Food miles from the export country ex to domestic port h for the imported commodity k after the local food business (t·km);
$IFM^{r,a}_{k,h,l}$: Food miles from domestic port h to the wholesale market l for the imported commodity k after the local food business (t·km);
$IFM^{r,a}_{k,l,r}$: Food miles from the wholesale market l to the region r for the imported commodity k after the local food business (t·km);

E_{tr}: CO_2 emission factor for trucks (tCO_2/t·km); E_{sh}: CO_2 emission factor for ships (tCO_2/t·km).

The food miles of imported commodity k after the local food business can be calculated based on the distance from the export country ex to the region r and the supply (Equation (9)).

$$\sum_k \left(IFM^{r,a}_{k,ex,h} + IFM^{r,a}_{k,h,l} + IFM^{r,a}_{k,l,r} \right)$$
$$= \sum_k \left[\sum_{ex} \sum_h \left(IQ_{k,ex,h} \times d_{k,ex,h} \right) \times \frac{1}{\gamma_{k,ex}} + \sum_h \sum_l \left(IQ_{k,h,l} \times d_{k,h,l} \right) \times \frac{1}{\gamma_{k,h}} + \sum_l \left(IQ_{k,l,r} \times d_{k,l,r} \right) \times \frac{1}{\gamma_{k,l}} \right] \times \frac{\left(IQ^r_k - \left(QL^r_k \times (1-\alpha_k) \right) \right)}{IQ_k} \tag{9}$$
$$where,\ Q^r_k = \frac{IQ_k}{N} \times N^r$$

$IQ_{k,ex,h}$: Import volume of the imported commodity k from the export country ex to domestic port h (ton);
$d_{k,ex,h}$: Distance from the export country ex to domestic port h for the imported commodity k (km);
$\gamma_{k,ex}$: Proportion of import volume from major export countries in the total import volume of the imported commodity k;
$IQ_{k,h,l}$: Import volume of the imported commodity k from domestic port h to the wholesale market l (ton);
$d_{k,h,l}$: Distance from domestic port h to the wholesale market l for the imported commodity k (km);
$\gamma_{k,h}$: Proportion of import volume from major domestic ports in the total import volume of the imported commodity k;
$IQ_{k,l,r}$: Import volume of the imported commodity k from the wholesale market l to the region r (ton);
$d_{k,l,r}$: Distance from the wholesale market l to the region r for the imported commodity k (km);
$\gamma_{k,l}$: Proportion of major wholesale market imports in the total volume of the imported commodity k;
IQ^r_k: Import volume of the imported commodity k from the region r (ton);
IQ_k: Total import volume of the imported commodity k (ton);
QL^r_k: The local food sales volume of the commodity k in the region r (ton);
$1-\alpha_k$: Imported commodities' market share of commodity k; N: Total population of South;
N^r: Total population of region r.

3. Results

3.1. Targets and Materials

This study analyzes the top 16 agricultural products (this study analyzed 16 agricultural products, excluding rice. In the Republic of Korea, rice is produced in every region. Thus, there is no primary origin for rice. Instead, rice is processed collectively at Rice Processing Complexes (RPCs) located and consumed locally, which is similar to the concept of local food) in the Republic of Korea across five regions (the Republic of Korea is divided into 82 country-level regions. Of these, we analyzed five regions for which we had data available) based on production volume (Table 1). Furthermore, the research period was focused on the year 2020.

Local food is defined as agricultural products purchased from locally direct markets within the residential area, whereas non-local food is defined as agricultural products purchased from other regions within the country or imported agricultural products.

The first step in the analysis is to calculate food miles, which is obtained by multiplying the distance from the place of production (origin) to the place of consumption by the quantity of food. In the second step, carbon emissions were calculated by multiplying the food miles by the carbon emission factor based on the mode of transportation. In the final step of the analysis, the carbon emissions calculated before and after the local food business were compared to evaluate the reduction in carbon emissions resulting from local food consumption. It is practically impossible to determine the exact locations of production and consumption sites along with distribution routes when calculating food miles. Therefore, based on the disclosed data, Table 2 was created to show the consistent criteria that were applied for calculating food miles in this study.

Table 1. Top 3 agricultural products' category by production volume.

Classification		1st Place		2nd Place		3rd Place	
		Category	**Production (ton)**	**Category**	**Production (ton)**	**Category**	**Production (ton)**
Food crops		Rice	3,506,578	Potato	553,194	Sweet potato	329,927
Vegetables	Fruit vegetables	Watermelon	466,529	Cucumber	335,596	Tomato	344,048
	Green vegetables	Chinese cabbage	2,242,640	Cabbage	313,236	Lettuce	96,774
	Root vegetables	Radish	1,178,631	Carrot	100,875	-	-
	Condiment vegetables	Onion	1,168,227	Garlic	363,432	Korean leek	314,685
Fruits		Citrus fruit	658,859	Apple	422,115	Peach	189,058

Source: Korean Statistical Information Service "Crop Production Survey" (2020) [8]; Food crops consist of rice, wheat, and barley, pulse crops (i.e., beans, small red beans, green grams, etc.), minor cereals (i.e., corn, buckwheat, etc.), and root and tuber crops (i.e., potatoes, sweet potatoes, etc.). Vegetables consist of fruit vegetables (i.e., watermelons, oriental melons, cucumbers, pumpkins, tomatoes, strawberries, eggplants, etc.), green vegetables (i.e., Chinese cabbage, cabbage, spinach, lettuce, java water-dropwort, etc.), root vegetables (i.e., radishes, carrots, burdock, taro, etc.), condiment vegetables (i.e., red peppers, garlic, Korean scallions, onions, ginger, etc.). Fruits consist of apples, Korean pears, peaches, grapes, citrus fruits, persimmons, etc.

Table 2. Criteria for application.

Theoretical Criterion	Applied Criteria on Study
Supply of domestic agricultural products	Production—import volume Consumption of region = (consumption of domestic agricultural products/total population of the Republic of Korea) × total population of region
Transportation distance of domestic agricultural products	Distance from major origin (city, county, district office [2]) to the point of sale (wholesale market) [3] + distance from the point of sale (wholesale market) to the place of consumption
Import volume	Import volume Consumption of region = (import volume/total population of the Republic of Korea) × total population of region
Transportation distance of imported agricultural products	Distance from the export country to the domestic port [4] + distance from the domestic port to the point of sale (wholesale market) + distance from the point of sale (wholesale market) to the place of consumption
Sales volume of local food	· Sales volume of local food
Transportation distance of local food	0 [1]

[1] Compared to non-local domestic agricultural products or imported agricultural products, transportation distance of local food is limited within the region and very short. Therefore, to simplify the model, this study assumes the distance to be '0'. [2] Generally, the reference point for determining the place of production or sale is measured based on a location that combines administrative functions (e.g., county or city hall, township or village office, etc.) and commercial activities [7,9,10]. [3] In the case of agricultural products, 'food miles' is commonly considered to be based on the distance from the place of production to the point of sale because of challenges in obtaining volume data of products' movement at each stage of the distribution process [11–14]. [4] If it is possible to identify the exact place of production (origin) within the export country, then the transportation distance with the export country is calculated from the origin to the export port. However, if it is impossible to identify the origin, then the exporting distance is calculated from the capital city to the port. On the other hand, for the importing country, the distance is calculated from the origin point to the domestic port closest to the capital city plus the distance from the point of entry to the capital [10,15,16].

Table 3 represents the decrease in food miles caused by the proportion of domestically sourced products in supply (α_k) and import quantities in supply ($1 - \alpha_k$) of specific agricultural products that were substituted by local food.

Table 3. Data for evaluating the decrease in food miles (α_k, $1 - \alpha_k$).

Product	Production Volume (ton) A	Export Volume (ton) B	Supply of Domestic Product (ton) C = A − B	Import Volume (ton) D	Total Supply (ton) E = C + D	Proportion of Domestic Products in Supply (ton) $\alpha_k = C/E$	Proportion of Import Products in Supply (ton) $1 - \alpha_k = D/E$
Chinese cabbage	2,242,640	24,413	2,218,227	643	2,218,870	1.000	0.000
Citrus fruit	658,859	5996	652,863	0	652,863	1.000	0.000
Watermelon	466,529	350	466,179	30	466,209	1.000	0.000
Cucumber	335,596	211	335,385	0	335,385	1.000	0.000
Sweet potato	329,927	357	329,570	42	329,612	1.000	0.000
Peach	189,058	508	188,550	0	188,550	1.000	0.000
Korean leek	314,685	0	314,685	1500	316,185	0.995	0.005
Radish	1,178,631	6943	1,171,688	7300	1,178,988	0.994	0.006
Apple	422,115	1952	420,163	2903	423,066	0.993	0.007
Onion	1,168,227	5622	1,162,605	40,100	1,202,705	0.967	0.033
Lettuce	96,774	715	96,059	8618	104,677	0.918	0.082
Garlic	363,432	3130	360,302	37,500	397,802	0.906	0.094
Cabbage	313,236	5996	307,240	38,424	345,664	0.889	0.111
Tomato	344,048	6709	337,339	43,367	380,706	0.886	0.114
Potato	553,194	1414	551,780	162,033	713,813	0.773	0.227
Carrot	100,875	197	100,678	96,400	197,078	0.511	0.489

Source: Korean Statistical Information Service "Crop Production Survey" (2020) [8], Ministry of Agriculture, Food and Rural Affairs "Agriculture, Forestry and Fisheries Export & Import Statistics" (2020) [17], Korea Customs Service Trade Statistics (2020) [18], Korea Agro-Fisheries & Food Trade Corporation KaTi (2020) [19].

As shown in Table 4, the major origin is determined as the origin where the cumulative proportion of the shipping volume reaches 80%.

Table 4. An example of major origin selection (the case of potatoes).

Rank	Region	Shipping Volume			Rank	Region	Shipping Volume		
		Volume (ton)	Proportion	Cumulative Proportion			Volume (ton)	Proportion	Cumulative Proportion
1	Gangwon-do Pyeongchang-gun	44,989	0.218	0.218	16	Jeollabuk-do Buan-gun	3020	0.015	0.663
2	Gyeongsangnam-do Miryang-si	12,998	0.063	0.280	17	Gyeongsangbuk-do Gimcheon-si	2961	0.014	0.677
3	Jeollabuk-do Gimje-si	11,099	0.054	0.334	18	Jeju-do Jeju-si	2835	0.014	0.691
4	Jeollanam-do Bpseong-gun	10,387	0.050	0.384	19	Gangwon-do Chuncheon-si	2767	0.013	0.704
5	Chungcheongnam-do Dangjin-si	9643	0.047	0.431	20	Gangwon-do Jeongseon-gun	2566	0.012	0.717
6	Chungcheongnam-do Seosan-si	8046	0.039	0.470	21	Gangwon-do Inje-gun	2303	0.011	0.728
7	Gangwon-do Hongcheon-gun	5018	0.024	0.494	22	Jeju-do Seogwipo-si	2269	0.011	0.739
8	Gyeongsangnam-do Changnyeong-gun	4878	0.024	0.518	23	Gyeongsangbuk-do Andong-si	2228	0.011	0.750

Table 4. *Cont.*

Rank	Region	Shipping Volume			Rank	Region	Shipping Volume		
		Volume (ton)	Proportion	Cumulative Proportion			Volume (ton)	Proportion	Cumulative Proportion
9	Gangwon-do Hoengseong-gun	4699	0.023	0.540	24	Gangwon-do Wonju-si	2111	0.010	0.760
10	Gyeongsangbuk-do Goryeong-gun	4468	0.022	0.562	25	Gyeongsangnam-do Changwon-si	1891	0.009	0.769
11	Gyeonggi-do Guri-si	3938	0.019	0.581	26	Gyeongsangbuk-do Uiseong-gun	1738	0.008	0.777
12	Gyeongsangbuk-do Gumi-si	3675	0.018	0.599	27	Gyeongsangbuk-do Yeongju-si	1735	0.008	0.786
13	Gyeongsangbuk-do Bonghwa-gun	3479	0.017	0.616	28	Gyeongsanbuk-do Sangju-si	1669	0.008	0.794
14	Jeollabuk-do Namwon-si	3430	0.017	0.632	29	Jeollanam-do Yeongam-gun	1625	0.008	0.802
15	Gangwon-do Gangneung-si	3320	0.016	0.648					

Source: Modified from Korea Agro-Fisheries & Food Trade Corporation Wholesale Distribution Information System (aT agromarket) (2020) [20]. The shipping volume with missing origin information has been excluded.

Table 5 represents that the major wholesale market was determined in the same manner as the major origin, in which the cumulative proportion of the wholesale market imports reaches 80%.

Table 5. An example of major wholesale market selection (the case of potatoes).

Rank	Wholesale Market	Shipping Volume		
		Volume (ton)	Proportion	Cumulative Proportion
1	Seoul Garak	82,935	0.401	0.401
2	Daegu Bukbu	19,998	0.097	0.498
3	Guri	12,084	0.058	0.556
4	Busan Eomgung	10,879	0.053	0.609
5	Busan Banyeo	10,234	0.049	0.658
6	Gwangju Seobu	10,013	0.048	0.707
7	Gwangju Gakhwa	9267	0.045	0.752
8	Seoul Gangseo	7950	0.038	0.790
9	Daejeon Ojeong	6272	0.030	0.820

Source: Modified from Korea Agro-Fisheries & Food Trade Corporation Wholesale Distribution Information System (aT agromarket) (2020) [20].

The data for calculating imported products' food miles are provided in Tables 6–8. The major export countries were selected based on their cumulative share of domestic import volume up to 80%.

Table 6. An example of major export country selection (the case of potatoes).

Rank	Export Country	Shipping Volume		
		Volume (ton)	Proportion	Cumulative Proportion
1	Unites States of America	109,208	0.674	0.674
2	Australia	13,055	0.081	0.755
3	Belgium	11,122	0.069	0.823
4	Netherlands	10,569	0.065	0.888
5	Canada	10,091	0.062	0.951
6	China	7169	0.044	0.995
7	Vietnam	819	0.005	1.000

Source: Korea Customs Service Trade Statistics (2020) [18].

Table 7. An example of major domestic port selection (the case of potatoes).

Rank	Wholesale Market	Shipping Volume		
		Volume (ton)	Proportion	Cumulative Proportion
1	Seoul Garak	5	0.833	0.833
2	Changwon Palyong	1	0.167	1.000

Source: Korea Customs Service Trade Statistics (2020) [18].

Table 8. An example of wholesale market selection (the case of potatoes).

Name of Port	Import Value (USD Thousands)	Proportion	Cumulative Proportion
Busan Port	116,505,748	0.365	0.365
Incheon Port	63,313,031	0.198	0.563
Pyeongtaek Port	30,800,933	0.096	0.659
Ulsan Port	24,779,162	0.078	0.737
Yeosu Port	19,875,344	0.062	0.799
Daesan Port	14,399,038	0.045	0.844

Source: Modified from Korea Agro-Fisheries & Food Trade Corporation Wholesale Distribution Information System (aT agromarket) (2020) [20].

The major domestic port is determined as the port where the cumulative proportion of import values reaches 80%.

All wholesale markets that handle imported agricultural products were included in this study.

3.2. Evaluation Results

The results of comparing the local food supply before and after its consumption are as follows. Agricultural products previously classified solely as domestic (non-local) and imported were subsequently categorized as domestic, imported, and local food following the consumption of local food. The weight of local food was determined by calculating the proportion of domestic and imported agricultural products in relation to the total agricultural product supply, with the sum of these values presented in Table 9.

Table 9. Agricultural products supply: comparison of before and after local food consumption.

Classification of Region	Before the Consumption of Local Food			After the Consumption of Local Food			
	Domestic (Non-Local)	Imported	Total	Domestic (Non-Local)	Imported	Local Food	Total
Region A	45,525	2217	47,742	43,321	2058	2363	47,742
Region B	121,043	5895	126,938	120,839	5880	219	126,938
Region C	47,380	2307	49,687	46,398	2251	1038	49,687
Region D	59,215	2882	62,097	57,760	2814	1531	62,097
Region E	115,910	5643	121,554	114,900	5608	1046	121,554
Total	389,073	18,944	408,018	383,218	18,611	6197	408,018

Table 10, found below, compares the changes in food miles before and after local food consumption. Region A experienced a decrease of approximately 1.92 million t·km, followed by a reduction of 130,000 t·km in Region B, 97,000 t·km in Region C, 880,000 t·km in Region D, and 570,000 t·km in Region E (Table 10).

Table 10. Food miles: comparison of before and after local food consumption.

Classification of Region	Before the Consumption of Local Food (t·km)			After the Consumption of Local Food (t·km)				Difference (B − A)
	Domestic (Non-Local)	Imported	Total (A)	Domestic (Non-Local)	Imported	Local Food	Total (B)	
Region A	22,745,100	14,088,523	36,833,623	21,697,636	13,214,731	0	34,912,367	▼1,921,256
Region B	38,905,366	36,613,676	75,519,042	38,844,608	36,547,103	0	75,391,711	▼127,331
Region C	23,756,112	14,639,774	38,395,886	23,152,667	14,272,441	0	37,425,108	▼970,778
Region D	21,372,528	17,907,899	39,280,427	20,911,181	17,493,464	0	38,404,645	▼875,782
Region E	48,503,336	35,324,143	83,827,479	48,093,077	35,163,326	0	83,256,403	▼571,076
Total	155,282,442	118,574,015	273,856,457	152,699,169	116,691,065	0	269,390,234	▼4,466,223

▼ denotes a reduction in carbon emissions following the consumption of local food compared to before the consumption.

Table 11 illustrates the levels of greenhouse gas (GHG) emissions before and after local food consumption, alongside the corresponding economic values (environmental benefits) calculated through the value of carbon. In Region A, there was a reduction of approximately 70,000 tCO_2 emissions following the consumption of local food. Similarly, in Region B, the decrease amounted to 5000 tCO_2; while in Region C, it was 40,000 tCO_2; in Region D, it was 20,000 tCO_2; and in Region E, it was also 20,000 tCO_2. The extent of emission reduction and the number of GHG emissions varied across regions, correlating with the total amount of local food consumed.

We utilized a weighted average value of USD 22.60 (KRW 29,386) (in this study, all monetary values in KRW were converted into USD using the average exchange rate of 1300 KRW/1 USD) per ton of carbon credits for the carbon valuation. The environmental benefits associated with consuming local food are as follows: approximately USD 1,494,323 (KRW 1943 million) for Region A; USD 122,381 (KRW 159 million) for Region B; USD 928,914 (KRW 1208 million) for Region C; USD 380,978 (KRW 495 million) for Region D; and USD 410,771 (KRW 534 million) for Region E. These findings demonstrate that the greater the consumption of local food, the more pronounced the environmental benefits are.

While this study selected five specific regions in Korea, it is believed that the environmental benefits to the nation will be even greater when scaled up to include the entire country.

The results of the carbon emission evaluations are found in Table 12 and are as follows. The rate of change in carbon emissions was the highest in region A, followed by region C, region D, region E, and region B.

Table 11. Changes in carbon emissions and the economic benefits resulting from local food consumption.

Classification of Region	Before the Consumption of Local Food (tCO_2)			After the Consumption of Local Food (tCO_2)				Difference (B − A)	Benefits (Value of Carbon) (USD 1000)
	Domestic (Non -Local)	Imported	Total (A)	Domestic (Non -Local)	Imported	Local Food	Total (B)		
Region A	5664	2,007,155	2,012,819	5,403	1,941,309	0	1,946,712	▼66,107	1494
Region B	10,164	3,363,600	3,373,764	10,149	3,358,201	0	3,368,350	▼5414	122
Region C	5915	2,132,458	2,138,374	5765	2,091,515	0	2,097,280	▼41,094	929
Region D	5322	1,881,385	1,886,707	5207	1,864,646	0	1,869,853	▼16,854	381
Region E	12,077	4,373,680	4,385,758	11,975	4,355,611	0	4,367,586	▼18,172	411
Total	39,142	13,758,279	13,797,421	38,499	13,611,282	0	13,649,781	▼147,640	3337

▼ denotes a reduction in carbon emissions following local food consumption compared to before consumption. The exchange rate of 1300 KRW/1 USD was applied.

Table 12. The results of carbon emission evaluations.

Classification	Region A	Region B	Region C	Region D	Region E
Rate of change in carbon emissions (%)	7.9	0.3	4.5	3.0	1.3

A correlation analysis was conducted to determine whether significant relationships between changes in carbon emission and the characteristics of the region exist. Table 13, presented below, shows that positive correlations between carbon emission changes and the total agricultural area, agricultural area of small farmers, total number of farmers, number of elderly farmers, number of female farmers, and number of full-time workers exist at a significant level. Moreover, a negative correlation was found between the region's total population and carbon emission changes.

Table 13. The results of correlation analysis between the changes in carbon emission and the characteristics of the region.

Characteristics	Correlation Coefficients with Rate of Change in Carbon Emissions
Total agricultural area	0.898 **
Area of small farmers	0.979 ***
Total number of farmers	0.948 **
Number of elderly farmers	0.994 ***
Number of young farmers	0.220
Number of female farmers	0.923 **
Number of full-time farmers	0.982 ***
Number of part-time farmers	0.321
Total population	−0.843 *
Number of wholesale and retail businesses	−0.616

*** (**, *) denotes coefficients are significant at 1% (5%, 10%) level.

Based on the above findings, the total agricultural area and the area of small farmers can be proportional to shipments to their local food direct markets, which means that carbon emissions from the consumption of agricultural products in the region can be reduced. In addition, regions with larger populations tend to have more wholesale and retail businesses, such as large discount stores and corporate supermarkets (e.g., mega supermarket chains), to account for urbanization and urban sprawl. As a result, the number of and use of local food direct markets in urban areas is relatively smaller than in rural areas, so the level of change in carbon emissions is judged to be low.

4. Discussion

Carbon emissions represent a significant contributor to environmental pollution, including climate change, with food transportation being a notable source. As environmental concerns like climate change and global warming are becoming more serious, this study aims to assess the role of local food as a way to reduce carbon emissions. We analyze food miles and carbon emission measurement methodologies for agricultural products, applying them to Korean agricultural goods to compare the environmental impacts of agricultural transportation.

In this study, several key terms were defined. First, local food was defined as agricultural products produced, distributed, and consumed within a specific geographical area, bypassing multi-step distribution processes. Second, the 'Local food direct market' was a representative local food business in Korea. Next, a series of quantitative tests were conducted to evaluate the environmental impact of local food by comparing it before and after the consumption at the 'local food direct market'. Moreover, the assessment encompassed the top 16 agricultural products' production in Korea. The results of these tests indicated that local food consumption led to an average reduction of 893,245 tons·km per region in food miles, which confirms previous studies' assertions that reducing food miles occurs with more local food consumption [21]. Given that the Republic of Korea has 82 cities, the nationwide reduction in food miles is likely even greater.

Furthermore, calculations of carbon emissions before and after local food consumption revealed an average reduction of 29,528 ton CO_2 per region. Extrapolating to the national scale, this reduction amounts to approximately 2,421,296 ton CO_2, accounting for 2.5% of the Republic of Korea's transportation sector's GHG emissions in 2022 (98 million tons). In particular, we found that the main factor affecting carbon emissions from agricultural distribution is the distance traveled by agricultural products. This is because agricultural products have much higher food miles by land and sea transportation. While this study focused on the top 16 agricultural goods, broader analysis suggests even greater carbon emission reductions across the entire agricultural sector. These reductions translate to a total of USD 3,337,345 million (KRW 4.3 billion) for five regions or USD 54.23 million (KRW 70.5 billion) nationwide in terms of carbon credit value. Therefore, it can be concluded that expanding local food consumption yields positive environmental and economic impacts by reducing carbon emissions, and this aligns with the claims of prior research as well [22].

There is an ongoing national focus and effort to reduce carbon emissions. Increasing the demand for local food can be a solution to reduce food miles, thus reducing carbon emissions and overcoming environmental problems. Empirical analysis demonstrates a direct correlation between increased local food consumption and reduced emissions across all regions, underscoring the urgency of prioritizing policies that promote local food demand. If the government fails to prioritize policies to expand local food demand, it may cause various problems, such as social problems and environmental costs.

The above findings underscore several implications for policies to promote local food consumption. First, the current distribution structure of Korean agricultural products revolves around a system where goods are centralized in large wholesale markets within metropolitan areas and then disseminated to local regions via intermediate distributors [23]. It is necessary to support a distribution environment by strengthening the local food distribution network, facilitating the distribution of agricultural products closer to the place of consumption. Second, it is important to promote and educate consumers to realize that local food consumption contributes to environmental protection and local economies. Third, to encourage increased local food consumption, it is essential to explore strategies that enhance consumer satisfaction and promote positive perceptions of local food stores. For example, in the case of product quantity management, despite the need to replenish defects or collect inventory, [24] mentioned that producers may not be able to display or sell their products smoothly because they are focused on farming. Therefore, it is necessary to find a way to systematically manage defective products and prepare a complementary system for claims due to defective products. Furthermore, to expand local food consumption, it is important to rationalize location selection and operation methods to increase accessibility from a consumer perspective rather than focusing on mandatory government acceptance of local food policies or expanding the number of local food stores. Additionally, various other policies can be considered, such as fostering the food industry using local food and providing benefits for local food consumption.

5. Conclusions

This study aimed to analyze the potential benefits of local food for environmental protection by evaluating the carbon emission impacts of locally produced and consumed local food. Based on the results, this study estimates and evaluates the food miles and carbon emission reductions resulting from local food consumption, offering insights into policy implications. The academic significance of this research lies in its pioneering approach to economically and empirically analyzing the environmental impact of local food consumption. While the findings provide valuable insights, further analysis encompassing a broader range of agricultural products and regions could yield more nuanced conclusions. This study encourages future research to explore these aspects for a comprehensive understanding of the environmental implications of local food consumption.

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References

1. Watkiss, P.; Schmith, A.; Tweddle, G.; McKinnon, A. *The Validity of Food Miles as an Indicator of Sustainable Development*; Final Report Prepared by AEA Technology Environment for DEFRA, London; AEA Technology: Harwell, UK, 2005.
2. Wynen, E.; Vanzetti, D. *No Through Road: The Limitations of Food Miles*; ADBI Working Paper No. 118; Asian Development Bank Institute: Tokyo, Japan, 2008.
3. Ministry of Agriculture, Food and Rural Affairs. *A Three-Year Promotion Plan for the Spread of Local Food*; Ministry of Agriculture, Food and Rural Affairs: Ridgetown, ON, Canada, 2019.
4. National Agricultural Cooperative Federation Local Food Direct Market Council. What Is Local Food. Available online: https://nhlocalfood.com/about/local-food.html (accessed on 13 March 2021).
5. Ju, O.J.; Lee, J.B.; Seong, M.; Kim, S.Y.; Ryu, J.Y.; Kim, D.G.; Hong, Y.D. Estimation of Food Miles and CO_2 Emissions of Imported Food. *J. Korean Soc. Atmos. Environ.* **2010**, *26*, 57–68. [CrossRef]
6. Seong, M.A.; Kim, D.G.; Lee, J.B.; Ryu, J.Y.; Hong, Y.D. Estimation of CO_2 mitigation potentials using food miles of domestic and imported food about beef and wine. *J. Clim. Chang. Res.* **2011**, *2*, 15–32.
7. Suh, K.W. An analysis of food miles and CO_2 emission of major agricultural products. *J. Korea Soc. Atmos. Environ.* **2012**, *28*, 706–713. [CrossRef]
8. Korean Statistical Information Service. *Crop Production Survey*; Korean Statistical Information Service: Daejeon, Republic of Korea, 2020.
9. National Institute of Environmental Research. *The Study on Food Mileage Relating to Nations' Dietary Life*; National Institute of Environmental Research: Singapore, 2010.
10. Gaballa, S.; Abraham, A.B. *Food Miles in Australia: A Preliminary Study of Melbourne, Victoria*; CERES Community Environment Park: Brunswick East, Australia, 2008.

11. Bernatz, G. Apples, bananas, and oranges: Using GIS to determine distance travelled, energy use, and emissions from imported fruit. *Res. Anal.* **2009**, *11*, 1–15.
12. Hill, H. *Food Miles: Background and Marketing*; ATTRA: Izmir, Turkey, 2008.
13. Pirog, R. *Food Miles: A Simple Metaphor to Contrast Local and Global Food Systems*; Newsletter of the Hunger and Environmental Nutrition (HEN) Dietetic Practice Group of the American Dietetic Association; American Dietetic Association: Chicago, IL, USA, 2004.
14. Pirog, R.; Van Pelt, T.; Enshayan, K.; Cook, E. *An Iowa Perspective on How Far Food Travels, Fuel Usage, and Greenhouse Gas Emissions*; Iowa State University: Iowa City, IA, USA, 2001; Volume 9.
15. Natural Resources Defense Council (NRCD). *Food Miles: How Far Your Food Travels Has Serious Consequences for Your Health and the Climate*; Natural Resources Defense Council (NRCD): New York, NY, USA, 2007.
16. Xuereb, M. *Food Miles: Environmental Implications of Food Imports to Waterloo Region*; Region of Waterloo Public Health: Waterloo, ON, Canada, 2005.
17. Ministry of Agriculture, Food and Rural Affairs. *Agriculture, Forestry and Fisheries Export & Import Statistics*; Ministry of Agriculture, Food and Rural Affairs: Ridgetown, ON, Canada, 2020.
18. Korea Customs Service. Trade Statistics. 2020. Available online: https://unipass.customs.go.kr/ets/ (accessed on 28 October 2022).
19. Korea Agro-Fisheries & Food Trade Corporation. KaTi. 2020. Available online: https://www.kati.net/index.do (accessed on 10 September 2022).
20. Korea Agro-Fisheries & Food Trade Corporation. Wholesale Distribution Information System (aT Agromarket). 2020. Available online: https://at.agromarket.kr/index.do;jsessionid=98872B5F9824280D35A5C673D7E1AB94 (accessed on 15 September 2022).
21. Striebig, B.; Smitts, E.; Morton, S. Impact of transportation on carbon dioxide emissions from locally vs. non-locally sourced food. *Emerg. Sci. J.* **2019**, *3*, 222–234. [CrossRef]
22. Schnell, S.M. Food Miles, Local eating, and community supported agriculture: Putting local food in its place. *Agric. Hum. Values* **2013**, *30*, 615–628. [CrossRef]
23. Jeong, E.; Kim, Y.; Heo, J. *Local Food Promotion Strategies and Policy Tasks for Local Economic Activation*; Korea Rural Economic Institute: Naju-si, Republic of Korea, 2016; p. R805.
24. Kim, Y.J.; Lee, S.H.; Park, J.J. Study on how to revitalize the local food business in Gyeonggi-do. *GRI Policy Brief* **2020**, *24*, 16–20.