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Sustainable Food Systems for Reducing Food Waste and Loss

[1] Dr. Rajan Nair, Kerala Institute of Marine Science, India.

[2] Devika Reddy, Kerala Institute of Marine Science, India.

Abstract: Globally, the population is expanding quickly. There are currently 7.7 billion people on the planet (Revision of World Population Prospects, 2019), and an additional 130 million are added year. The United Nations Population Division (2019) projects that, at the current rate of population increase of 1.05%, there will be around 11 billion people on the planet by the end of this century. It is difficult to understand such enormous numbers, and the figures themselves show that we are on the verge of what some theorists have dubbed the "over-population." Both significant economic growth and a demographic dividend could result from population expansion. Conversely, an unchecked progression could seriously endanger the development as a whole. Despite the tremendous advancements of the last century, food waste remains a major global issue with significant effects on the economy, ecology, and society. We examine innovative instruments, policy measures, and behavioural changes aimed at reducing food waste. We also go into the challenges and subtleties of programs aimed at reducing food waste, like the need for structural changes and the impact of consumer behaviour. Five subheadings, covering topics including food recovery, circular economy tactics, and sustainable agriculture, provide a comprehensive overview of the intricate issue of food waste.

Keywords: Consumer Behaviour; Circular Economy; Sustainable Agriculture; Food Waste Reduction; and Sustainable Food Systems and Recovery.

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I. Introduction

There is an urgent crisis in the world: millions of tons of nutritious food are being lost or wasted every day when hunger is affecting more and more people. 32% of food produced on a global basis is estimated to be wasted, with 13.2% lost between harvesting and retailing, and 19% lost in households, food service, and retailing (Flanagan et al., 2019). The 2024 International Day of Awareness of Food Loss and Waste promotes the importance of funding to mitigate food wastage, promote sustainable development, and address climate change. Food loss and wastage imperil the sustainability of our food systems, wasting resources such as land, water, energy, labor, and capital (Alexander et al., 2017). Additionally, lost food leads to greenhouse gas emissions, climate change, and increased food prices, undermining food security and availability. Since our food systems cannot be resilient if they are not sustainable, integrated strategies to reduce food loss and waste must be implemented. Both locally and worldwide, action is needed to maximize the utilization of the food we produce. New technology, innovative solutions (such retractable mobile food processing equipment and e-commerce platforms for marketing), this transformative shift requires the implementation of new operational procedures and best practices to control food quality and minimize food loss and waste (Adelodun et al., 2024).

'A food system considers all of the components (people, infrastructure, institutions, processes, inputs, and so on) and activities involved in the production, processing, distribution, preparation, and consumption of food as well as the results of these activities, such as the environmental and socioeconomic impacts.'

II. Review of Literature

Food loss takes place when food is diverted, damaged, discarded, or lost in the supply chain, thereby decreasing the quantity available for consumption (FAO, 2014). Food waste is primarily caused by the lack of coordination among stakeholders. Poor infrastructure, post-harvest methods, and production processes result in premature food loss. Further, excessive food intake leads to environmental degradation and health complications, with 2 billion individuals worldwide experiencing overweight or obesity. The food sector

consumes 30% of the world's energy and emits 22% of greenhouse gases. Circular economy solutions can contribute to SDGs 2 and 12 by mitigating food waste and encouraging sustainable consumption. Sustainable packaging can improve shelf life, minimize waste, and encourage responsible consumption (SDG 12). Food waste leads to climate change (SDG 13). Shifting global trends in food consumption, fueled by urbanization, income increases, and dietary change, will create more GHG emissions. Losses along the supply chain cause food waste, with high rates of loss occurring at the consumption phase in high-income countries. The food service sector produces 25% of consumer waste and more than 75% of it is unnecessary. Quantification of food waste is important since it offers a baseline and a diagnosis for rectifying the situation. While some papers examine the difficulties involved, many others provide strategies for carrying out this quantification (Schuster & Torero, 2016; Vittuari et al., 2019; Bond et al., 2013).

With an emphasis on two key solutions—involving employees and keeping an eye on food waste—this group includes all waste reduction initiatives that are carried out, directed, or enforced by management overall. Employee dedication is highlighted as being essential to success, and recommendations are provided to promote goal achievement and increase awareness of the harm that waste causes to the environment and society. They offer several suggestions on how to encourage this dedication, like highlighting the detrimental impacts of food waste on the environment and society or congratulating individuals who succeed (Goh and Jie, 2019).

III. Research Design

The general mechanism of the investigation is described by the research design. It clearly outlines every step and technique used to carry out the systematic research in order to achieve the study's goal or goals.

Pilot Study

The purpose of the pilot study is to determine whether or not the major study is possible. Before moving on in detail, it offers an opportunity to make any necessary adjustments. 20 rural and 15 urban households participated in pilot research to determine:

- The reaction of respondents to the questionnaire
- The respondents' clarity towards the items included in the questionnaire
- The viability of the suggested data analysis techniques Although the researcher discovered some ambiguity at certain spots, the survey was successfully completed with minor adjustments.

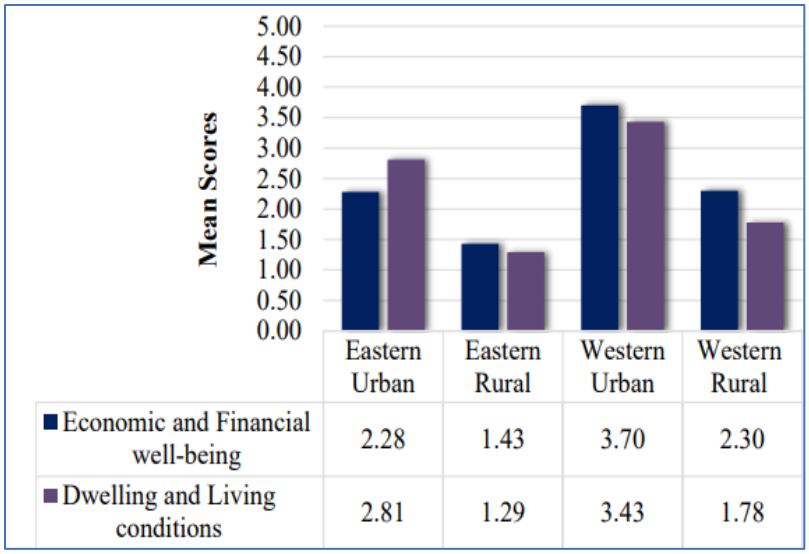
3.1. Impact on the Food System

The FAO estimates that 1.6 billion tonnes of "primary product equivalents (Bajželj et al., 2020)" are wasted worldwide. A total of 1.3 billion tonnes of food were squandered for the edible portion of this.

The environmental effect of food waste increases as it moves along the supply chain, taking into account the energy and resources put into production, transportation, storage, and preparation. When food waste is disposed of in landfills, it produces large quantities of methane, a powerful greenhouse gas with a higher global warming potential than carbon dioxide. For those who don't know, high levels of greenhouse gases, such as CO2, methane, and chlorofluorocarbons, warm the earth's atmosphere and absorb infrared light, causing climate change and global warming (Areche et al., 2022).

IV. Analysis

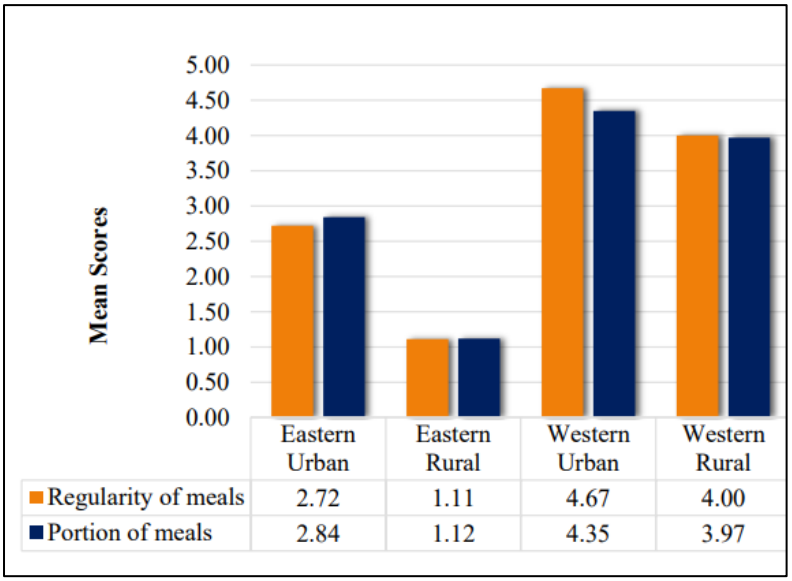
In the current world, transnational corporations have significant influence over the food chain. Farmers and consumers are harmed by this system, which concentrates authority in the middle of the supply chain, where companies regulate the flow of food from producers to consumers.



	Eastern Urban	Eastern Rural	Western Urban	Western Rural
Economic and Financial well-being	2.28	1.43	3.70	2.30
Dwelling and Living conditions	2.81	1.29	3.43	1.78

Figure 1: Overall Satisfaction Level Regarding Economic and Financial Well-Being and Dwelling and Living Conditions

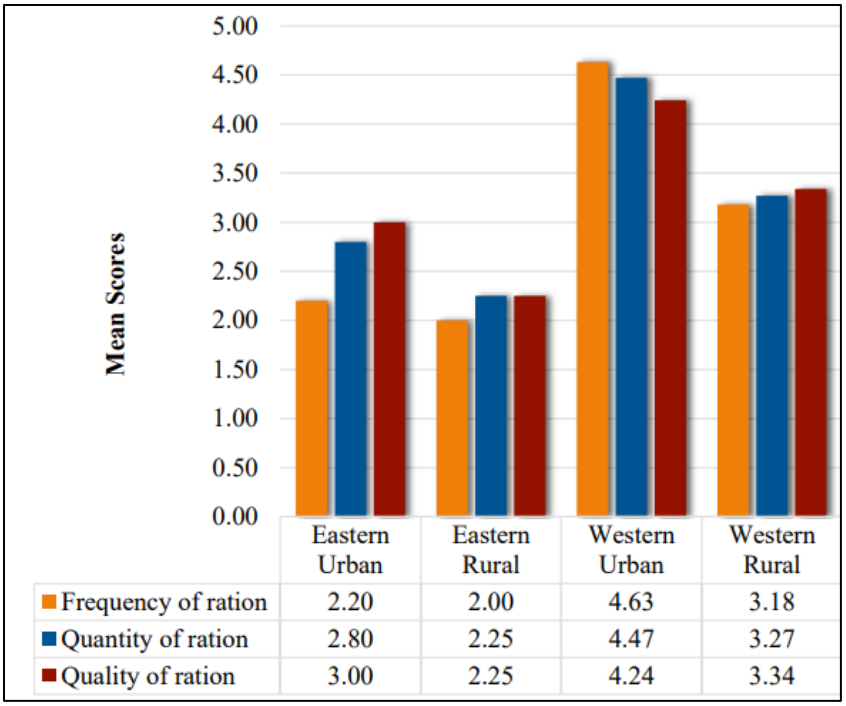
Even while the traditional food system is more affordable and simpler to get, their food may not be the best for the environment or the health of customers. Poverty and marginalization are linked to both undernutrition and obesity. Such a situation has been called the "double burden of malnutrition." Fast food restaurants, tiny convenience stores, and "corner" businesses may be widely available in low-income neighbourhoods, but there aren't any supermarkets that offer a wide range of healthful foods.



	Eastern Urban	Eastern Rural	Western Urban	Western Rural
Regularity of meals	2.72	1.11	4.67	4.00
Portion of meals	2.84	1.12	4.35	3.97

Figure 2: The Level of Satisfaction Regarding Food Consumption Patterns

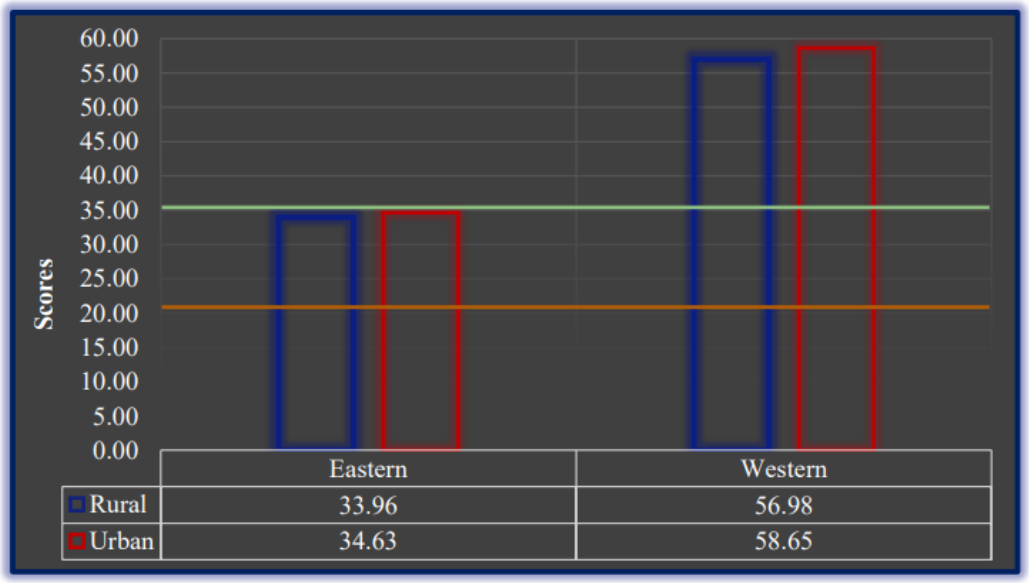
Due to differences in management and farming practices, small farms are typically more sustainable than large farming enterprises. Industrial agriculture, which is mostly dependent on monoculture, replaces human labour by employing more fossil fuels, fertilizers, pesticides, and machines. However, as smallholders' farms are combined into larger enterprises, it is anticipated that by 2100, there would be half as many active farms as there are now. Small farmers around the world frequently live in poverty and have limited control over the global food chain. Smallholder farms have drastically decreased in wealthy, industrialized nations, despite producing a wider variety of crops and including more non-crop biodiversity.



	Eastern Urban	Eastern Rural	Western Urban	Western Rural
Frequency of ration	2.20	2.00	4.63	3.18
Quantity of ration	2.80	2.25	4.47	3.27
Quality of ration	3.00	2.25	4.24	3.34

Figure 3: Overall Level of Satisfaction of Beneficiaries Regarding the Ration Received Through the Public Distribution System

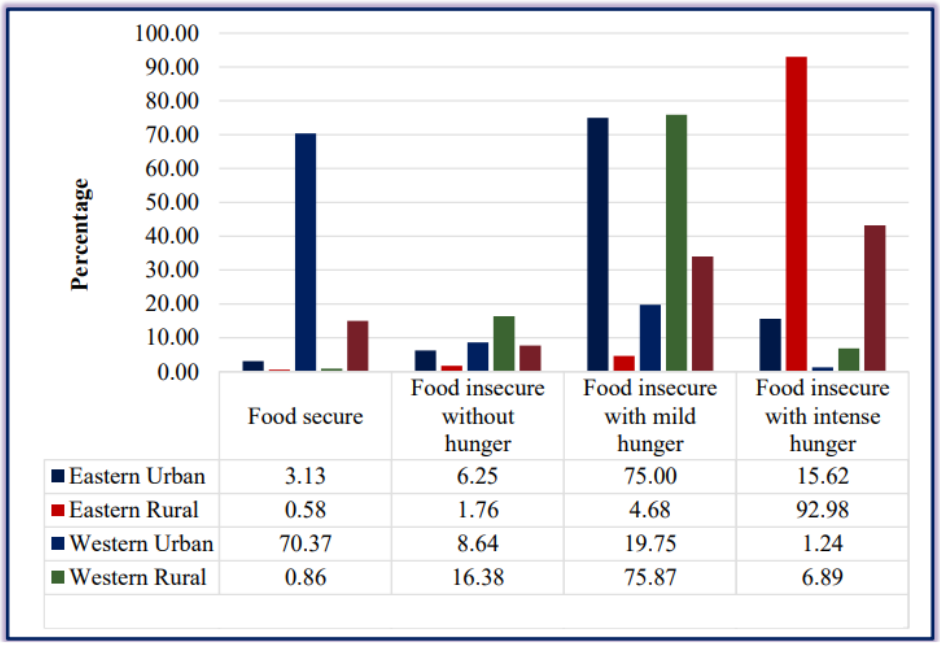
Food production may be shifted to regions with lower economic expenses (labour, taxes, etc.) or less stringent environmental restrictions in order to cut production costs in an increasingly global market. These regions are typically farther from consumer markets. For example, most salmon marketed in the United States are produced off the coast of Chile, even though they are not native to Chilean coastal waters. This is primarily due to Chile's less stringent laws governing fish feed. In less developed nations, the loss of indigenous food systems due to globalization of food production may have detrimental effects on ecosystems, cultures, and public health.



	Eastern	Western
Rural	33.96	56.98
Urban	34.63	58.65

Figure 4: Food Consumption Score

Furthermore, the inherent structure needed to support sustainable modes of food production and consumption is absent from the current traditional food system. Consumers and private companies are primarily responsible for the decision-making processes associated with this system.



	Food secure	Food insecure without hunger	Food insecure with mild hunger	Food insecure with intense hunger
Eastern Urban	3.13	6.25	75.00	15.62
Eastern Rural	0.58	1.76	4.68	92.98
Western Urban	70.37	8.64	19.75	1.24
Western Rural	0.86	16.38	75.87	6.89

Figure 5: Level of Households' Food Security

People are expected to willingly, and frequently without outside incentives, put out effort to educate themselves about sustainable behaviours and particular product choices. The availability of public information is essential to this educational endeavour. As a result, even in situations when there are significant drawbacks, consumers are urged to alter their production and consumption choices due to moral considerations and occasionally health benefits.

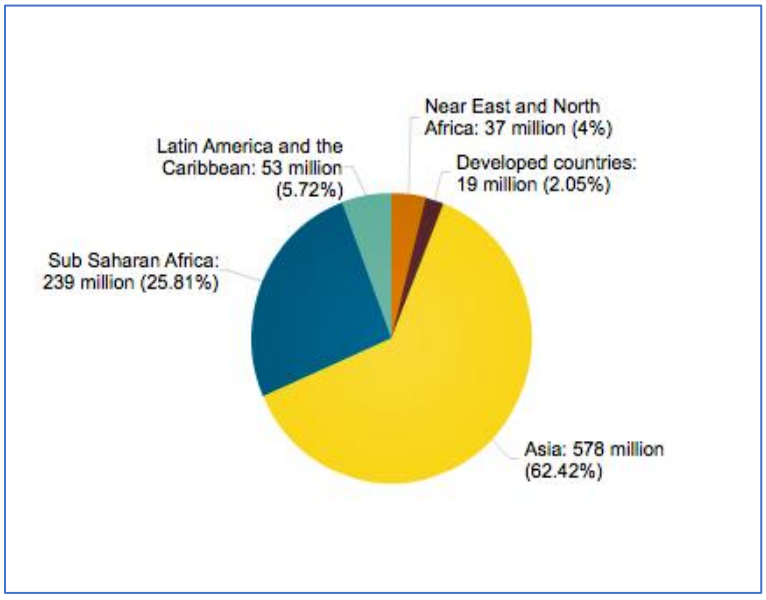


Figure 6: Strategies to Alleviate Food Security

Agricultural pollution is the term used to describe the biological and abiotic effects of farming operations that damage local ecosystems, taint the environment, or hurt people and their financial interests. There are a number of possible sources of pollution, including air pollution, non-point source pollutants, which are more diffuse and occur at the landscape level, and point source water pollution, which originates from a particular discharge point. The presence or absence of management strategies has a significant impact on the amount and impacts of these pollutants. The environment can be seriously harmed by the use of fertilizers and pesticides in global agricultural practices, as well as by the care and housing of animals. Poorly run animal feeding facilities, excessive grazing, lowing, fertilizer, and inappropriate, excessive, or poorly timed pesticide usage are a few examples of faulty management methods.

V. Conclusion

Reducing food losses focuses on supply chain losses, including post-harvest losses, as well as consumer and retail food waste. As more food reaches people in need, this helps to reduce hunger and malnutrition worldwide. Furthermore, it promotes sustainable production and consumption practices by reducing environmental impacts such as greenhouse gas emissions, water use, and land degradation. Additionally, it offers financial advantages and complies with social responsibility and ethical standards while saving money for manufacturers, merchants, and customers. To do this, governments, businesses, and individuals must be inspired to take action through inventions, legislation, and behavioural shifts. Programs to monitor progress and set reduction targets have been established by numerous nations and organizations. Reducing food loss and waste is essential to achieving several goals, including eradicating hunger (SDG 2), advancing sustainable agriculture (SDG 2), fostering economic growth (SDG 8), and addressing climate change (SDG 13). This demonstrates how environmental, social, and economic sustainability initiatives are interdependent. Sustainable farming and production practices are essential for preventing food waste at its source, safeguarding natural resources, and promoting ecological resilience. Collaboration between farmers, producers, lawmakers, and consumers is essential to advancing sustainable practices and building a more resilient and sustainable food system.

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