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"Artificial Intelligence's Role In Environmental Sustainability Through Food Waste Management"

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Abstract:

Food waste is a significant global challenge contributing to environmental degradation, resource depletion, and economic losses. Artificial Intelligence (AI) offers innovative solutions to address this issue by optimizing food production, distribution, and consumption patterns. This paper explores the potential applications of AI in food waste management, including predictive analytics, demand forecasting, inventory optimization, and consumer behavior analysis. By leveraging AI-Powered technologies, stakeholders can reduce food waste at various stages of the supply chain, promote sustainable practices, and contribute to a more resilient and environmentally friendly food system.

Key Words: Waste Composition, Circular Economy, Artificial Intelligence

Introduction

The sustainable development goal 2 (SDG 2) of the United Nations aims at creating a world that is hunger-free by 2030. In order to keep up with the food demand, food production need to be 60% greater by the year 2050 compared to the food production in 2005/2007. The goal of food security must be a multidimensional approach that not only involves safeguarding safe and nutrition food but also lacking the problem of food waste. Reducing food waste may be a suitable resource conservation approach and can help meet future food demand with only a smaller rise in agricultural output.

Tackling the problem of food waste can significantly enhance food security on a global scale and reduce the adverse environment effects of agricultural.

Waste of food is global problem. Statistics from the food and agriculture organization show that nearly one- third or 1.3 billion tons of food produced for consumption is wasted or lost costing the global economy USD 936 billion annually. The United Nations food waste Index report shows that each year, 79kg food per

person on average is lost in high – income countries wasted food also contributes to about 8% of global green house gas emissions, these impacting the environment and eco system adversely. Apart from this wastage and loss of food cause food poverty and food price volatility thus resulting in social and economic impacts. Hence to enhance food security and reduce the adverse impact of agriculture on the environment, it is imperative to cut down on the wastage of food.

The UNEP food waste Index Report 2021 estimates that out of the 931 million tones are wasted by households, 244 million tons by food service establishments and 118 million tones by the retails sector. These feature emphasis is the need for innovative solutions to tackle the problem of food waste.

The problems of food wastage can be tackled using the circular economy concept. A circular economy is an approach to the efficient use of resources. Unlike the conventional lineal economy that produces, consumes and discards, the circular economy focuses on the 3Rs which stand for reduce, reuse and recycle. The circular economy concept can be applied to different stages such as food production, consumption and waste and surplus management Artificial Intelligence (AI) can support circular economy initiatives and be used to address the problem of food waste by altering food systems and changing the patterns of production and distribution of food.

AI aids in following ways.

- **Monitoring food production**: AI can analyze data on weather patterns and monitor crop yield and consumer demand to ensure precision agriculture and optimal food production.AI can monitor the weather, predict droughts and floods and optimize irrigation and pesticides/ herbicide applications, theirs impacting crop yield.
- **Optimizing supply chains**: AI can also minimize waste throughout a supply chain by predicting customer demand, optimizing inventory management and reducing over production. AI driver inventory systems can optimize stock levels and improve supply chain efficiency thus reducing waste.
- **Monitoring food quality**: Food quality can be impacted negatively by interruptions in the refrigeration chain, contamination of transport containers and incorrect storage. AI monitors food quality in terms of the expiration dates and storage conditions in real time to facilitate proactive measures to prevent waste.
- **Food Redistribution**: Using AI in food redistribution has the following benefits. AI can identify food surplus and connect with organizations that can redistribute the excess food, AI can make recommendations that ensure food is distributed in the right quantities to areas that need it the most, thereby reducing the wastage of food, AI can help improve the efficiency of food distribution system using algorithms to analyze data on supply and demand and AI can also be used in food nutrition estimation.
- **Consumer awareness**: AI powered apps can offer tips on meal planning, storage and ways to minimize wastage of food at home. With food waste becoming a global issue with social, environmental and

economic impacts, it becomes imperative for the entire world to implement the circular economy to support the waste reduction, recycling and redistribution of food. The application of AI in the food industry will play a crucial role in supporting the circular economy in the future. Thus continued investment in AI can fully support the circular economy and reduce food wastage in the world and in turn, aid in achieving SDG2.

Waste Composition:

Waste Composition refers to the classification of different types of materials found in municipal solid waste (MSW). It is determined through a waste audit where samples of garbage are collected, sorted into predefined categories and weighted. The largest components of global waste composition are food and green wastes, followed by dry recyclables such as plastic, papers, metal and glass.

Global waste composition (percent) Table 1.1

Material	Percent
Food and green	44%
Glass	5%
Metal	4%
Other	14%
Paper and Cardboard	17%
Plastic	12%
Rubber and Leather	2%
Wood	2%

World Bank Report 2023

Food Wastage in India:

India is a country of rich heritage with abundant culture flavors and cuisines. Yet it is grappling with a serious issue that impacts nearly 23 crore people living in the country – food wastage in India. The ministry of agriculture, India reported that nearly 50,000 INR crores worth of food gets wasted each year.

This alarming amount of food that is getting wasted every single day in a country. Where millions of people still go to bed hungry each night is an appalling reality that demands our immediate attention and action. Let's see the food wastage fact in India.

According to the UNEP'S (United Nations Environment Programmes) food wastage index report 68.7 million tons of food is wasted annually in Indian homes,in simple words it is about 55 kgs per person. India stands second worldwide in terms of household wastage of food only followed by China.

A report by the National Resource Defence Council(NRDC) 40% of the food produced goes uneaten in the US, whereas in Asia approximately 1.34 billion tones of food gets wasted, the main contributors being India and China.

Table 1.2

FOOD WASTE IN INDIA IS…….		
68.7 Million tones of food is wasted annually in India homes	**In simple word 50kgs per person**	**1/3rd of all food produced in India gets wasted or spoilt before it is even eaten.**

Food waste in India Statistics 2023

The FSSAI (Food Safety and Standards Authority of India) reported that 1/3rd of all food produced in India gets wasted or spoilt before it is even eaten. This is a very serious concern as it comes to show that people not only waste the food deliberately but aren't even aware of it.

Causes of food wastage in India:

Post- harvest Losses: Large quantity of food gets wasted even before it reaches the consumer's plate. Right after harvest, the food commodities begin to deteriorate in quality if they are not handled properly. This includes poor transportation facilities, Over loading in warehouses, the warehouses being maintained very poorly and finally improper handling during distribution.

Lack of Awareness: In the restaurants or at home most people think it is okay to waste food because they have paid for it. The restaurants or vendors will not be facing any loss as they are charging us, consumers, for the same, but the real cost is to the economy and the planet. The food that was wasted because we couldn't priority plan if we could consume it or not, would land in the trash, thus not being of any use to anybody.

Big fat wedding:- India is famously known for its ultra-grand weddings throwing extravagance where as possible but what it is not known for is that it is one of the leading causes of food wastage. Enormous amounts of food go to waste during such occasions. According to research, about 40% of the food prepared goes to waste is supply thrown away the wedding ends.

Market needs: One of the most problematic causes of food wastage these days in the usage of edible foods in markets such as cosmetics, Healthcare etc., When the food do not comply to the standards set by these markets they would straight up get rejected although, they are perfectly edible. This is a grave mistake that would cost the economy largely.

Food Waste Management and Environmental Sustainability:

The world continues to face environmental challenges, it has become essential to incorporate sustainable practices in all aspects of lives. The topic of sustainability has gained increasing importance in a global context with the increasing population, rapid urbanization and charging climate pattern, sustainable practices are crucial for the preservation of our planet. One area that has gained significant attention is food waste management, where the contribution of artificial intelligence (AI) has been revolutionary.

Food waste has become a significant issue globally, with an estimated 1.3 billion tons of food wasted each year. This not only has a significant economic impact but also has severe environmental consequences.

The production, transportation and disposal of wasted food contribute to green house gas emissions, Consumption of estimated that food waste and land use. It is estimated that food waste is responsible for 8% of global greenhouse gas emissions making it a significant contributor to climate change.

Artificial Intelligence and Food Waste Management:

AI refers to the simulation of human intelligence processes by mechanism, including learning reasoning and self-correction. When applied to food waste management. AI can analyze data, identify patterns and trends and make informed decisions to optimize the food supply chain, reduce waste and cut down on environmental impact.

One of the ways AI is contributing to sustainable food waste management is through smart inventory management with the use of AI powered sensors and cameras, food retailers can monitor their inventory in real time, reducing waste caused by overstocking and expiry of goods. This not only decreases food waste
But also results in a significant cost-saving for businesses.

Furthermore, AI also plays a crucial else in optimizing the transportation of food, with AI powered route optimization algorithms, delivery trucks can play their routes more efficiently reducing the time and distance traveled. This leads to a reduction in fluel consumption and emissions, making transportation of food more sustainable.

The most significant impact that AI has in food waste management is through its predictive capabilities. By analyzing data, AI can predict consume demand and adjust production accordingly, preventing overproduction and waste. The use of AI – powered sorting and grading technology also ensures that only high-quality food products reach the markets, reducing waste caused by spoiled or damaged products.

Moreover, AI is also being used in innovative ways to repurpose and recycle food waste one example is the use of AI-powered composting technology to turn food waste into nutrient-rich compost, which can be used in agricultural. This not only reduces the amount of waste sent to landfills but also provides a sustainable solution for soil enrichment.

Conclusion

In conclusion, the contribution of AI in sustaining the environment through food waste management is significant. By optimizing inventory, transportation and production and repurposing food waste, AI technology is playing a crucial role in reducing the environmental impact of the food industry. It is not only improving the efficiency of the supply chain but also promoting sustainable practices that are essential for the preservation of our planet. As the use of AI continues to expand, we can expect even more innovative solutions to combat food waste and contribute to a more sustainable future.

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