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Addressing Food Waste in Balochistan-A Critical Risk Assessment for SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Change) and to establish a Sustainable Food System through EIA (Environmental Impact Assessment)

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Abstract: It cannot be denied that food waste is one of the critical environmental problems. This problem is not limited to rich and developed countries, but is found in all parts of the world. However, according to the Food and Agriculture Organization of the United Nations (FAO), more than 800 million people suffer from hunger and malnutrition in the world. Food waste refers to food intended for human consumption that is lost and wasted. It is not only about the food that consumers do not end up in the restaurant and that is thrown away at home, but also about the raw materials and products that are lost during the fabrication, harvesting or during transport and storage. Food waste can occur anywhere in the supply chain. About a third of the world's food supply is lost or wasted, potentially up to 40% of the world's food supply each year. Food waste has significant effects on the environment, global and national economies, food security and nutrition. Thus, the purpose of this review is to critically explore food wastage as an invisible environmental crisis in the province of Balochistan and to identify its associated environmental impacts in order to devise mitigation measures with the help of EIA (environmental impact assessment) to ensure its sustainable consumption and production patterns for the coming generations i.e. promoting SDG 12 (responsible consumption and production) and fight climate change i.e. SDG 13 (climate action).

Keywords: Food insecurity; Balochistan; Waste management; Sustainability; Greenhouse gases.

1 Introduction

Pakistan, officially known as the "Islamic Republic of Pakistan," is a country in South Asia. It positions as the fifth-most crowded country universally, with a populace surpassing 212.2 million and stands firm on the foothold of the second-largest Muslim-majority nation [1]. Pakistan is the 33rd largest country area wise [2]. As a developing nation, Pakistan is striving to boost its economic progress and keep pace with the rapidly growing economies in the region.

However, it grapples with significant environmental challenges, including food and water shortages, energy crises, pollution of air and water, and the depletion of natural resources [3, 4]. Food, a fundamental necessity for the survival of all living beings, is produced in sufficient quantities globally. Yet, due to poor practices and over consumption, an imbalance has emerged [5]. In Pakistan, a considerable portion of the population goes to bed hungry.

Many individuals are deprived of food due to poverty, and they end their day without a meal [6]. As fellow humans, it is our moral duty to assist those in need. Sadly, instead of addressing hunger, much food is wasted. Food is commonly discarded at weddings, homes, parties, and hotels. People often serve themselves more than they can eat, particularly at social events [7]. A positive change would be if individuals developed the habit of taking only as much food as they can consume, minimizing waste [8].

Food is also wasted when hotels and restaurants prepare more than necessary, fearing they might run out if guests order specific dishes. Instead of letting the excess go to waste, it would be far better to distribute it to those in need, especially the many people who go without food for days [9]. An example that our mothers giving leftover food to the housemaid so her children can eat well, which is a kind gesture that also helps reduce food waste [10].

While mothers can manage food waste at home, efforts need to be scaled up to make a broader impact and address global hunger effectively. According to the United Nations Food and Agriculture Organization (FAO), developing countries waste 40% of their food, and globally, 1.3 billion tons of food is wasted each year [11]. Nearly a billion

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people face hunger, with one-third of them being children. Children die every second due to malnutrition [12].

In Pakistan, an estimated 36 million tons of food is wasted annually [13]. The Global Hunger Index 2016 classifies Pakistan as a country with a serious hunger problem. In response, various individuals and organizations, recognizing this issue, are working to prevent food waste by recovering edible food that would otherwise be discarded and distributing it to those in need [14].

These organizations engage in activities known as food rescue, food recovery, food sharing, gleaning, and other similar efforts to ensure that food reaches those who cannot afford to buy it [15].

Fig. 1: Environmental impact assessment of food waste in Balochistan to establish SDG 12 (Responsible consumption and production)

2 Food Wastage In Balochistan

Balochistan, with Quetta as its central urban hub, is largely dependent on agriculture, including the cultivation of crops, fruits, and livestock farming [16]. Despite the region's agricultural significance, various inefficiencies across the food supply chain contribute to considerable food waste which are as follows:

- **Pre-harvest Losses**: Due to the region's vulnerability to climate extremes such as droughts, as well as pest infestations, crops are often lost before harvest [17].
- **Post-harvest Losses**: Inadequate infrastructure for storage and transportation, coupled with a lack of cold storage facilities, results in significant spoilage after harvest, particularly for perishable items like fruits and vegetables [18].
- **Consumer Behavior**: In cities like Quetta, cultural norms and a lack of awareness regarding food conservation lead to wastage at the household and retail levels. Large amounts of food are discarded during events and gatherings, while improper storage results in spoilage [19].

This creates a challenging paradox where food insecurity persists in the region, even though a substantial portion of food is lost due to inefficiencies and waste.

Fig. 2: Food waste during (a) Pre-harvest (b) Post-harvest and (c) Consumer behaviour in Balochistan

3 Environmental Impact Of Food Waste In Balochistan

Food waste presents a significant environmental challenge, particularly in regions like Balochistan, where natural resources are already strained. This section explores how food waste exacerbates environmental degradation, with specific attention to key areas such as greenhouse gas emissions, water depletion, soil health, and biodiversity [20].

- **Greenhouse Gas Emissions:** In Balochistan, food waste contributes to climate change through the release of methane gas, a powerful greenhouse gas [21]. When organic waste like food is dumped in landfills, it undergoes anaerobic decomposition, producing methane. This gas is approximately 25 times more effective than carbon dioxide at trapping heat in the atmosphere [22]. Due to limited waste management infrastructure in Balochistan, a large portion of food waste ends up in landfills or open-air dumps, where it is left to decompose unchecked. This significantly contributes to the province's carbon footprint, amplifying the global warming crisis [23]. Moreover, open dumping or burning of food waste, a common practice in rural areas of Balochistan, leads to not only methane but also the emission of harmful particulates and toxins that pollute the air and harm local ecosystems [24]. These practices highlight the need for improved waste management solutions.

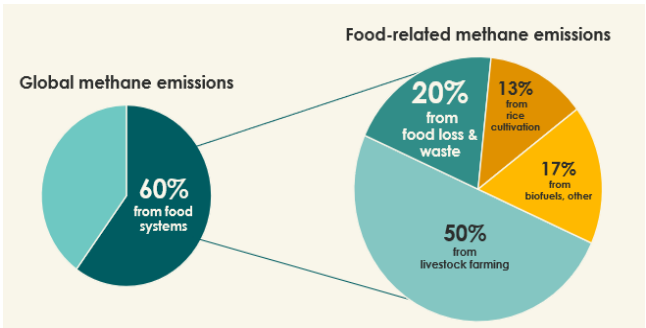

Fig. 3: Emission of methane gas, a powerful greenhouse gas from food waste in Balochistan

- **Water Resource Depletion**: Balochistan suffers from acute water shortages, and agriculture is the largest consumer of water, using an estimated 70-80% of the available supply [25]. Given this context, the wastage of food translates directly into the wastage of vast amounts of water. Water-intensive crops like fruits, especially

apples and pomegranates, form a crucial part of the region's economy [26]. However, due to spoilage during transport and inefficient market practices, a significant portion of these crops is lost before reaching consumers [27]. For instance, the cultivation of apples and pomegranates demands extensive irrigation, but when a portion of these crops is wasted, the substantial water used in their growth is also wasted [28]. This issue is particularly alarming in Balochistan, where groundwater levels are rapidly depleting and surface water sources are limited. Given the province's semi-arid climate, the unsustainable use of water resources to grow food that never gets consumed is a dire concern, adding to the already critical water crisis [29].

Fig. 4: Water Resource Depletion from food waste in Balochistan

- **Soil Degradation**: Baluchistan's agricultural sector faces the added burden of soil degradation, a consequence worsened by food waste [30]. When food is wasted, more pressure is placed on farmers to cultivate additional land to make up for the loss, leading to continuous cropping without giving the soil time to recover [31]. This intensive farming without proper land management depletes soil nutrients and increases erosion, reducing the land's overall fertility [32]. In many cases, the region's arid climate combined with unsustainable farming techniques has led to desertification, which makes once-arable land unsuitable for future agricultural use [33]. Poor irrigation practices, overuse of chemical fertilizers, and monoculture farming have further exacerbated the problem, reducing the soil's ability to retain water and making it more vulnerable to wind and water erosion [34]. The cycle of producing more food to replace wasted crops, coupled with the degradation of land, places a continuous strain on the province's already fragile ecosystems [35].

Fig. 5: Soil Degradation of Agricultural lands in Balochistan by food waste

- **Loss of Biodiversity**: Food waste also indirectly contributes to the loss of biodiversity in Balochistan. The expansion of agricultural activities to make up for food lost to waste often comes at the expense of natural habitats [36]. To increase food production, farmers may clear forests, grasslands, or other ecologically sensitive areas, leading to habitat destruction. This practice has dire consequences for local wildlife, many of which are already endangered due to the region's harsh environmental conditions [37].As natural habitats are converted into farmland, local species face displacement, and many struggles to survive. The loss of biodiversity is not just an ecological issue but also an economic one, as the depletion of local flora and fauna can disrupt ecosystem services such as pollination and soil regeneration, which are vital to sustainable agriculture [38]. Additionally, the introduction of chemical inputs to maximize food production often results in the contamination of soil and water sources, further harming local biodiversity and causing long-term ecological damage [39].

Fig. 6: Food waste indirectly contributes to loss of biodiversity by habitat destruction in Balochistan

- **Food Insecurity**: Despite the vacuity of food, a significant portion of Baluchistan's population faces food instability. Regions within the fiefdom are linked as some of the most food- deprived areas in Pakistan [40]. The beginning issue stems from hamstrung food distribution systems and high situations of food waste [41]. While food is being discarded, numerous individualities, particularly in pastoral and marginalized areas, don't have harmonious access to nutritional food [42].

Fig. 7: Food Insecurity in Balochistan

- **Economic Losses**: Food waste leads to substantial profitable challenges for original growers and dealers in Balochistan, numerous of whom calculate heavily on

husbandry for their livelihoods [43]. Corruption during harvesting, transportation, and storehouse directly reduces the quantum of marketable yield, dwindling income for growers [44]. Smallholder growers, who frequently have limited access to proper refrigeration, packaging, and transport, are hit particularly hard, as a portion of their yield is lost before it reaches the request. This profitable strain extends across the force chain, from farmers to retailers, contributing to poverty and aggravating profitable inequalities in the region [45].

- **Inadequate Waste Management**: Quetta and other civic areas in Balochistan face challenges in managing organic waste, including food waste [46]. The lack of proper waste operation systems results in clogged drainage systems and hygienic conditions, as food waste attracts pests and causes public health hazards [46]. Also, unsustainable practices similar as open burning and magpie jilting of waste further deteriorate air quality and contribute to environmental declination. These practices not only harm the terrain but also produce fresh social and health- related burdens for original communities [47].

Fig. 8: Inadequate Waste Management in Balochistan

4 Purpose Of Eia

The goal of this Environmental Impact Assessment (EIA) is to thoroughly analyze the environmental effects of food waste in Balochistan. This involves:

- **Evaluating Environmental Effects**: Assessing how food waste impacts the environment by contributing to issues such as landfill accumulation, methane gas emissions, soil contamination, water pollution, and other ecological concerns in the area [48].
- **Examining Current Practices**: Investigating and documenting the existing methods for managing food waste in Quetta and Balochistan. This includes reviewing how food waste is currently handled, processed, and disposed of, as well as evaluating the efficiency and effectiveness of these methods [49].
- **Recommending Mitigation Strategies**: Proposing strategies and solutions to reduce the negative environmental impacts of food waste. This encompasses suggesting improvements to current practices, introducing new waste management techniques, and recommending policy changes to enhance food waste reduction and management efforts [50].

The intent is to deliver a comprehensive understanding of the present situation, highlight the environmental challenges associated with food waste, and provide actionable recommendations to effectively address these issues

5 Scope Of Eia

This EIA covers several critical aspects of food waste management and its environmental impacts in Balochistan:

- **Management of Food Waste**: Analyzing how food waste is managed from its origin to disposal. This includes examining the processes and systems used for food waste collection, sorting, recycling, and disposal [51].
- **Environmental Consequences**: Evaluating both direct and indirect environmental effects of food waste. This involves assessing the impact on landfills, air and water quality, soil health, and local ecosystems [52].
- **Recommendations for Improvement**: Exploring and proposing strategies and solutions to enhance food waste management. This includes identifying effective practices, recommending new technologies or methods for waste reduction, and suggesting policy changes to improve food waste management and reduce its environmental impact [53].

By addressing these areas, the EIA aims to provide a detailed analysis of food waste issues in Balochistan and offer practical recommendations to promote environmental sustainability and better resource management in the region [54].

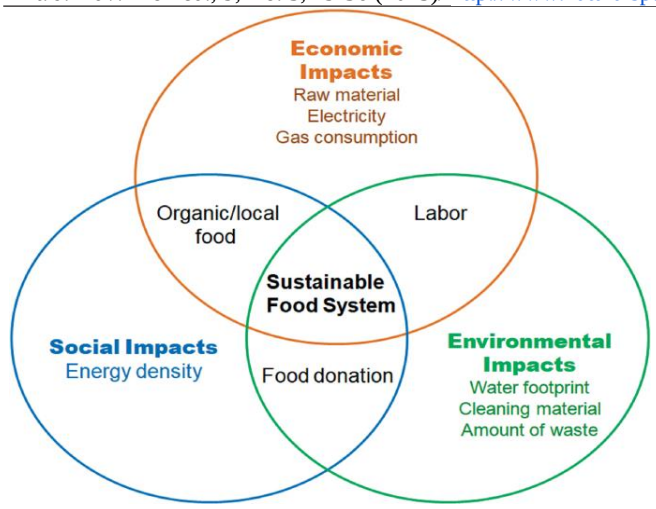

Fig. 9: Role of Environmental Impact Assessment (EIA) to thoroughly analyze the environmental impacts of food waste in Balochistan

6 Mitigation Measures To Overcome Food Waste In Balochistan

- **Efficient consumption and Meal planning:** By planning meals and buying only what is needed, individuals can prevent food from spoiling or needlessly. Proper storage: Proper food storage, such as freezing, can help extend its shelf life and reduce waste. Creative use of waste can minimize waste and repurposing food into new meals can help reduce waste [55].
- **Reduce waste at source for Sustainable agriculture:** Encouraging sustainable agricultural practices that reduce overproduction can help limit waste at source [56]. Smarter food distribution: Improve food distribution systems to avoid overcrowding and spoilage, especially in developing countries, where food loss occurs during transport and storage [57].
- **Recycling of food waste by Composting:** Instead of sending food to landfills, composting organic waste can return it to a soil rich in nutrients, reducing methane emissions and improving soil health [58]. Anaerobic digestion process breaks down food waste to produce biogas and nutrient-rich sludge, reducing emissions and providing renewable energy [59].
- **Consciousness Educational campaign:** Educating consumers, businesses and farmers about the environmental costs of food waste can encourage behavioural changes [60]. Clean up expiration labels: Confusion between "best before" and "use by" labels can lead to unnecessary waste. Clearer labelling can help consumers better understand when foods are truly inedible [61].
- **Technology and innovation Apps Rescue Food:** Technologies that connect surplus food from restaurants or food stores with people in need can prevent waste. Precision agriculture: Using technology to produce the right amount of food to meet demand can reduce overproduction [62].

If we successfully can overcome food waste, the positive environmental impact are as follows:

- **Reduction of greenhouse gas emissions:** Reducing food waste in landfills means a significant reduction in methane emissions, a powerful greenhouse gas. This would help slow down climate change and reduce the overall carbon footprint of food production [63].
- **Conservation of natural resources:** Reducing food waste means that fewer resources, such as water, energy and land, are wasted. For example, agriculture uses a large amount of water, and reducing food waste saves water and energy at every stage, from cultivation to transport [64].
- **Reduce the need for deforestation:** Reduced demand for food production means there is less pressure to clear forests for agriculture. This preserves biodiversity and protects ecosystems from deforestation, thus helping to maintain the balance of natural habitats [65].
- **Lower pollution levels:** With less food waste, there is a reduction in the use of fertilizers, pesticides and fossil fuels in food production, leading to cleaner air, water and land [66].
- **Increase food security:** By using the food we produce efficiently, more food would be available to feed people, thereby reducing hunger and increasing global food security [67].

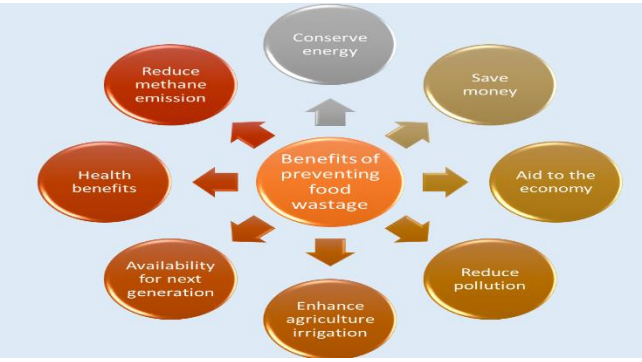

Fig. 10: Reduction in food waste results in positives environmental impact

7 Conclusion

Thus, the Environmental Impact Assessment (EIA) of food waste in Balochistan reveals a significant and often overlooked issue with serious implications for the environment and public health. This assessment highlights how food waste contributes to resource wastage, land degradation, and greenhouse gas emissions. Food waste results in the loss of valuable resources, including water, energy, and agricultural inputs. In a region

like Balochistan, where water scarcity is a major concern, the waste of water used in food production exacerbates environmental stress and unsustainable practices. The decomposition of food waste in landfills produces methane, a potent greenhouse gas that accelerates climate change. Inadequate waste management infrastructure in Balochistan exacerbates methane emissions, contributing to the region's vulnerability to climate change. Moreover, the improper disposal of food waste can lead to soil and water contamination. In Balochistan, leachate from decomposing food waste can infiltrate groundwater, affecting water quality and posing health risks. Soil contamination from food waste residues also impacts agricultural productivity and ecosystem health. The socio-economic implications of food waste are also significant. For many families is struggling with economic hardship, the waste of food represents a substantial financial loss and highlights inefficiencies in food distribution and consumption. Addressing food waste could improve economic stability by optimizing food use and reducing associated costs. To mitigate these issues, a comprehensive approach is necessary. Enhancing waste management practices, such as promoting composting and waste separation, can reduce the volume of food waste in landfills. Public awareness and education about the impacts of food waste can encourage more responsible consumption and disposal practices. Policy and regulation supporting food waste reduction, including incentives for food donation and better waste management, are also crucial. Additionally, community initiatives can play a key role in addressing food waste through food recovery and redistribution efforts. Looking ahead, addressing food waste in Balochistan requires ongoing collaboration between government bodies, businesses, and the community. By implementing innovative solutions and fostering a culture of sustainability, the region can address the environmental impact of food waste and work towards a more sustainable and resilient future.

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