

ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

DOI: 10.52122/nisantasisbd.1474596

THE CURRENT STATUS AND ALTERNATIVE APPROACHES OF
INITIATIVES UTILIZING STALE BREAD AS A SUSTAINABLE RESOURCE

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ABSTRACT

Recent global economic and food security crises have arisen worldwide due to various factors, including widespread climate change, outbreaks of infectious diseases, interstate conflicts, and civil wars. However, approximately one-third of edible foods, amounting to approximately 1.3 billion tons annually, are lost or wasted globally. Among these wasted edible items, bread constitutes a significant portion of global food waste. Niğde city, located in the central Anatolia region of Türkiye, initiated the 'Stale Bread Collection Bin' project twice, in 2012 and 2018. This study aimed to assess how residents' bread consumption and waste patterns changed following the implementation of this project and to evaluate the utilization and effectiveness of the 'Stale Bread Collection Bin.' The study employed semi-structured, face-to-face, in-depth interviews with a total of 1,000 participants. To ensure the transition of such projects into sustainable and environmentally friendly initiatives, it is crucial to ensure that residents comprehend the necessity and justification of the project. Additionally, collaboration among specifically designated agencies, research institutions, and local industries is essential for achieving sustainable development goals, including the creation of eco-friendly outcomes and their recycling back into local communities.

Keywords: Food security, Stale bread collection bin, Niğde, Sustainability, Bread waste**Jel Codes:** N55, O13, P28, P48.SÜRDÜRÜLEBİLİR BİR KAYNAK OLARAK BAYAT EKMEĞİN KULLANIMINDA MEVCUT
DURUM VE ALTERNATİF YAKLAŞIMLAR

ÖZ

Son zamanlarda iklim değişimi, salgınlar, uluslararası çatışmalar ve iç savaşlar gibi nedenlerden dolayı dünya çapında ekonomik problemler ve gıda güvenliği krizleri ortaya çıkmıştır. Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) 2022 yılında dünya genelinde tahminen 691 ile 783 milyon insanın açlık çektiğini bildirmiştir. Buna rağmen yılda yaklaşık 1,3 milyar ton olan yenilebilir gıdanın tahmini olarak üçte biri israf edilmektedir. Bu ürünler arasında ise ekmek, küresel gıda israfının önemli bir bölümünü oluşturmaktadır. İç Anadolu Bölgesi'nde yer alan Niğde şehrinde 2012 ve 2018'de olmak üzere iki kez 'Bayat Ekmek Toplama Kutusu' projesi yürütülmüştür. Bu çalışmada, projenin uygulanmasının ardından kent sakinlerinin ekmek tüketme ve atma alışkanlıklarının nasıl değiştiğini anlamak ve 'Bayat Ekmek Toplama Kutusu' kullanımını-etkinliğini değerlendirmek amaçlanmıştır. Araştırma kapsamında toplam 1.000 katılımcı ile yarı yapılandırılmış, yüz yüze görüşmeler yapılmıştır. Bayat ekmek projesi, iki kez uygulanmasına rağmen beklenen başarı elde edilememiştir. Bu tür uygulamaların sürdürülebilir hale gelmesi için bölge sakinlerinin projenin gerekliliğini ve haklı sebeplerini anlamaları büyük önem taşımaktadır. Ayrıca sürdürülebilir kalkınma hedeflerine ulaşmak için ilgili kuruluşlar, araştırma kurumları ve yerel endüstriler arasındaki iş birliğiyle çevre dostu sonuçların yaratılması ve bunların yerel halka geri dönüşü gerekmektedir.

Anahtar Kelimeler: Gıda güvenliği, Bayat ekmek toplama kutusu, Niğde, Sürdürülebilirlik, Ekmek israfı**Jel Kodları:** N55, O13, P28, P48.**Geliş Tarihi/Received:** 27.04.2024**Kabul Tarihi/Accepted:** 01.08.2024**Yayın Tarihi/Printed Date:** 31.12.2024**Kaynak Gösterme:** Kang, S., & Ağbaba, D., (2024). "The Current Status and Alternative Approaches of Initiatives Utilizing Stale Bread as a Sustainable Resource". *Nişantaşı Üniversitesi Sosyal Bilimler Dergisi*, 2(12), 507-522

INTRODUCTION

The contemporary world is confronting an economic crisis due to global climate change, the COVID-19 pandemic, and the emergence of conflict between Russia and Ukraine. Notably, the war between Russia and Ukraine, both of which are world-class wheat exporters, has had a significant impact on global wheat export prices (TEPGE, 2023). The Food and Agriculture Organization (FAO) of the United Nations anticipates that global wheat production will reach 785.1 million tons in 2023, reflecting a 2.2% decrease (18 million tons) compared to the previous year (FAO, 2023). Moreover, Türkiye's wheat production was estimated to be 21.8 million tons during the same period (TÜİK, 2023). The self-sufficiency rate of wheat in Türkiye decreased from 108.7% in 2015 to 96.9% in 2020, while its import dependency rate increased from 19.76% to 38.94% (Yılmaz & Tomar, 2022). These changes are attributed to the reduction in wheat-arable land in Türkiye and the increased imports of wheat required by the food industry (Demirbaş & Atış, 2005; Yılmaz & Tomar, 2022). Wheat holds crucial significance as a staple grain in Türkiye and has profound social, cultural, and historical value for the Turkish people. It is considered an essential crop, symbolizing abundance and prosperity, and is also regarded as a sacred grain that should not be discarded or wasted on the ground (Özberk et al., 2016). Wheat is the most cultivated cereal in Türkiye, with 78.1% of the produced wheat consumed as food, 12.4% as feed, and 6.6% as seeds (TEPGE, 2022; TÜİK, 2023). The wheat used for food is predominantly employed in the production of bread, a dietary staple in Türkiye.

The country stands out as the world's foremost consumer of bread, with Turks obtaining more than half of their daily caloric intake from bread and grain products (Aktaş et al., 2023; Demirtaş et al., 2018; Gokalp, 2020; Gül et al., 2003; İkikat Tümer et al., 2019; Kalkan & Özarık, 2017; Özberk et al., 2016; Resmi Gazete, 2017). Research indicates that 40.1% of households in urban areas and 77.4% in rural areas make and consume bread on their own at home (Kalkan & Özarık, 2017). However, per capita daily bread consumption in Türkiye, which was 409 g in 1974, decreased to 360 g in 1984 and further decreased to 284 g in 2013 (TMO, 2013). Bread consumption in Turkish dietary habits has gradually decreased due to urbanization, increased social participation of women, a trend toward nuclear families, and a growing concern for health, while there is an increasing amount of bread waste. According to research conducted by the Turkish Grain Board (TMO; *Toprak Mahsulleri Ofis Genel Müdürlüğü*), in 2012, Türkiye discarded 6 million loaves of bread daily, amounting to a total of 2,17 billion loaves annually. The research findings prompted discussions on social, economic, and environmental issues associated with bread wastage. In response to these concerns, nationwide campaigns and projects were initiated on January 17, 2013, under the auspices of the Prime Minister of Türkiye, with the aim of addressing and improving the identified problems (TMO, 2013). However, despite the implementation of the project in 2013, a decade later, there was no comprehensive research on the achievements and consequences of nationwide campaigns and projects in Türkiye, including bread wastage (Demirtaş et al., 2018).

Environmental resource management is crucial for project execution. By integrating economic, social, and environmental considerations, this approach can optimize resource utilization and lead to sustainable outcomes (Ali & Kamraju, 2023). Discarded bread should be recognized as a valuable resource, and research should be undertaken to develop efficient recycling methods. To achieve this, conducting a socio-scientific study focusing on residents' awareness of stale bread, the quantity of bread waste generated, collection and management protocols, and disposal methods is imperative. Such research is crucial for enhancing resource management and recycling efficiency.

Recent studies related to bread waste tend to be dominated by engineering studies rather than social-scientific research (Christophersen et al., 2013; Dymchenko et al., 2023; Güzel, 2024; Jung et al., 2022; Kumar et al., 2023; Melikoglu & Webb, 2013; Narisetty et al., 2021a; Sigüenza-Andrés et al., 2024; Tacoli, 2012; Tufaner, 2021). In the field of social-scientific research, studies have predominantly focused on the consumption of bread and the amount of discarded bread in each study area (Arslan & Aydın, 2019; Akdemir, Keskin, Ünal, & Mıassı, 2020; Aygün, Başargan,

& Aktaş, 2020; Demirtaş et al., 2018; Dölekoğlu, Giray, & Şahin, 2014; Ertürk, Arslantaş, Sarıca, & Demircan, 2012; Gül et al., 2003; İkiat Tümer et al., 2019; Sarıca, Demircan, Ertürk, & Arslantaş, 2021). However, proactive and specific projects to reduce bread waste are exceedingly rare among these studies, and efforts to review and enhance existing projects by addressing and resolving their issues to develop sustainable solutions are nearly nonexistent. Therefore, this study aimed to examine how the residents of the study area dispose of stale bread, the collection and management processes of the project, and the final disposal methods. By identifying the problems and areas for improvement that arise during the project, it will be possible to find ways to transform temporary and formal projects into practically sustainable ones.

Since 2013, a project to install a 'Stale Bread Collection Bin' has been implemented in most parts of Türkiye to collect discarded bread and recycle it into animal feed. However, in most municipalities implementing the project, there are issues such as insufficient promotion for the 'Stale Bread Collection Bin,' a lack of personnel for management, neglect of management, and the abandonment of collection by stakeholders due to mostly mouldy bread, which is unsuitable even for animal feed. Additionally, a significant problem lies in the lack of research on alternative ways to utilize discarded bread beyond animal feed. Some municipalities are still carrying out the project; however, in most cases, the 'Stale Bread Collection Bin' is not being utilized effectively and is occasionally used as a substitute for regular trash bins (Photo 1).

To ensure the sustainability of projects aimed at reducing bread waste and utilizing discarded bread, it is necessary to educate and promote the local community to encourage its active participation. Additionally, efficient systems, accompanied by proper management, should be established, and research on diverse approaches to utilizing discarded bread as a resource should be conducted. By addressing these challenges and contributing to the understanding of bread waste dynamics, our study focuses on Niğde city. The city where the 'Stale Bread Collection Bin' Project was conducted twice, in 2012 and 2018, serves as a valuable case study for exploring the awareness and utilization of the bin among local residents. In 2017, before the 2018 project was implemented, a survey was conducted targeting 500 local residents to assess the current status of bread waste and to understand the necessity and relevance of the project. Subsequently, after the execution of the project in 2018, an additional survey was carried out with another 500 local residents to investigate awareness and utility regarding the 'Stale Bread Collection Bin'. These projects require not only environmentally friendly planning and design but also continuous monitoring of progress and a thorough diagnosis of any problems that may arise. Through ongoing feedback, the project can be enhanced and improved, ultimately leading to the success of the initiative as a sustainable and environmentally friendly project.

1. Study Area and Methodologic Considerations

Niğde Province is located in the Central Anatolia region of Türkiye and comprises six subdistricts: central Niğde, Altunhisar, Bor, Çamardı, Çiftlik, and Ulukışla (Figure 1). The total population of Niğde Province is 365,419 people (as of 2022), with approximately 62.76% residing in urban areas. Within Niğde Province, the central Niğde district, which was selected as the research area, has a population of 170,511 people, representing 46.66% of the total population of Niğde Province (TÜİK, 2022). This study exclusively focused on Niğde city within central Niğde district, where the 'Stale Bread Collection Bin' project was implemented. Niğde city underwent rapid urban development approximately 20 years ago, and high-density residential complexes are continuously being constructed in the city (Kocalar, 2019). In particular, there has been a significant increase in the construction of high-rise apartment complexes for residential purposes, extending from the city center to the suburbs. This has led to a distinct phenomenon of population migration and urban sprawl.

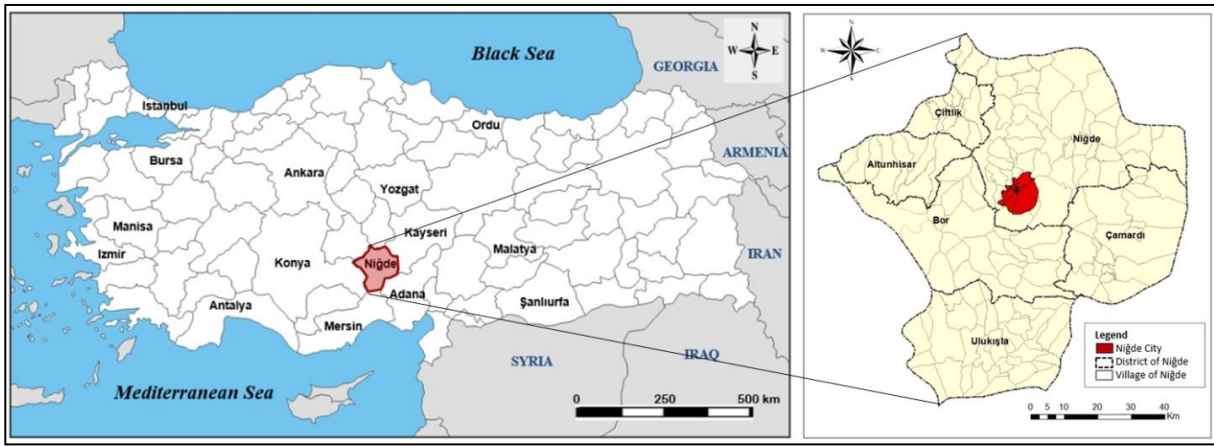


Figure 1. Location of the study area (Niğde city, Niğde Province).

Source: Mapping by the author (ArcGIS 10.2)

The municipality of Niğde distributed collecting bins for stale bread in densely populated residential areas twice: once in 2012 and once again in 2018. This initiative aims to prevent the waste of stale bread. Therefore, in this study, we conducted three visits to the Cleaning Affair Directorate of Niğde Municipality from 2019 to 2022 to investigate the content, progress, and issues related to the waste bread project. Additionally, considering that the population of Niğde City was 141,010 in 2017 when the study began, a sample size of 500 individuals was determined with a sampling error of 5.19% and a confidence level of 98%. The survey on residents' bread consumption and waste was conducted from July to September 2017. Subsequently, considering the reimplementation of the 'Stale Bread Collection Bin' project in 2018, this study conducted additional interviews with 500 participants from 2019 to 2022 (Figure 2).

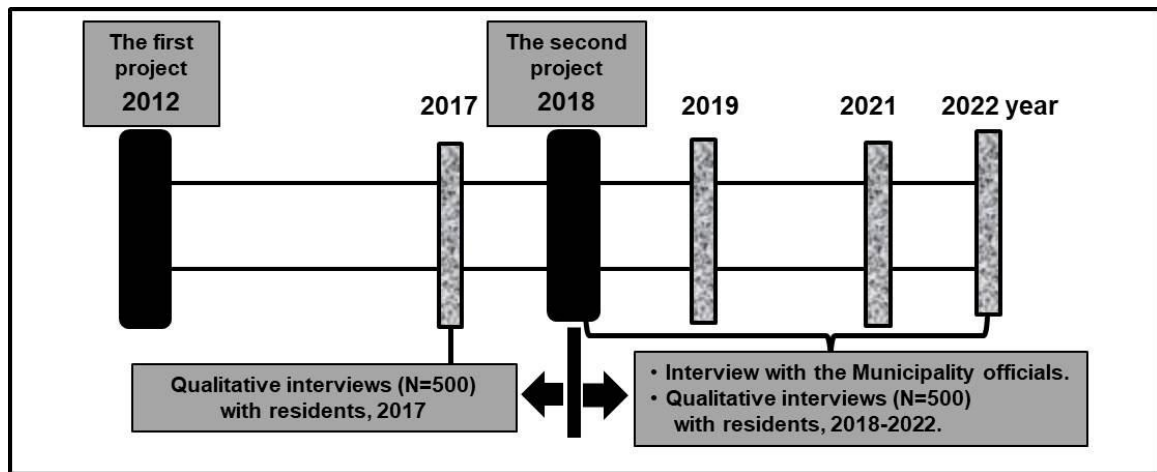


Figure 2. The survey period and methods of the study.

The objective of these interviews was to examine how residents' bread consumption and waste changed following the implementation of this project and to explore the utilization and effectiveness of the 'Stale Bread Collection Bin.' Therefore, the study conducted semi-structured, face-to-face, in-depth interviews with a total of 1,000 participants, with an average interview duration of approximately 15 minutes per person. In this study, the use of stale bread as an animal feed was considered not as waste but as a sustainable method for recycling resources. Recently, various studies have been conducted on the production of energy and chemicals from stale bread (Dymchenko et al., 2023; Narisetty et al., 2021b; Tufaner, 2021). Therefore, this study introduces research aimed at finding alternatives for the use of stale bread, a substance typically limited to animal feed. Furthermore, a case study from the Netherlands is presented, demonstrating the practical implementation of converting discarded bread into biogas and fertilizer. This could enhance the diversification and possibilities for the utilization of stale bread and serve as foundational information for the promotion of sustainable eco-friendly initiatives.

RESULTS

2.1. 'Stale Bread Collection Bin' Projects In Niğde City

In Türkiye, the TMO conducted the initial study on bread wastage in 2008. According to this study, which spans from 2008 to 2012, 6 million loaves of bread are discarded daily, totaling up to 2.17 billion annually in Türkiye. The standard weight of one loaf was 300 grams, and the price was 0.85 TRY in 2012 (Habertürk, 2013). When monetized, this figure reaches 16 billion TL (average exchange rate in 2012: 1 TRY = 1.80 USD). As a result of this research, a nationwide 'Bread Wastage Prevention Campaign' was initiated to prevent economic losses and enhance societal awareness regarding bread waste. Consequently, there was an 18% reduction in the daily amount of discarded bread in 2013 (TMO, 2013). Niğde Municipality initiated the distribution of the "Stale Bread Collection Bin" in residential areas to prevent stale bread waste in 2012 (Photo 1). The aim was to collect stale bread in these collection bins and provide it to local animal shelters or individuals raising livestock, thereby preventing bread waste and promoting its reuse as animal feed (Bor Haber, 2012).



Photo 1. The Stale bread collection bins were deployed by Niğde Municipality in 2012.
Source: (Bor Haber, 2012)

However, the results of interviews with the residents conducted in 2017 for this study revealed that even five years after the project implementation, only 48 out of 500 respondents were aware of the existence of the collection bins. The awareness and utilization of the project among residents were significantly low, with several identified issues requiring improvement. Nevertheless, the same project was reimplemented in 2018, retaining the same objectives and content as in 2012 (Haber Türk, 2018). Both projects initially aimed to collect stale bread in the bins for repurposing as animal feed instead of discarding it as household waste. The collected bread was intended to be supplied as feed to the municipality's animal shelter; however, due to the presence of mold or the unsuitability of the bread for use as feed, this supply plan could not be executed. In interviews with livestock farmers, it was also mentioned that the majority of the bread, infested with mold and already spoiled, was deemed unsuitable for use as livestock feed. Furthermore, if they wanted to use that bread as livestock feed, they had to individually collect the stale bread from the bins themselves. In the planning phase of the project, the initial decision was for the municipality to autonomously manage the collection and utilization of stale bread. Subsequently, as the project progressed, the company that won the tender for producing collection bins was tasked with collecting, delivering, installing, relocating, and maintaining the stale bread. However, the investigation confirmed the absence of continuous supervision and management by either the company or the municipality following the installation of the bins. To undertake the project, no additional department was established within the municipality, and no dedicated staff members were recruited. Instead, the tasks were incorporated into the existing

relevant department. Therefore, along with a shortage of personnel capable of sustaining, managing, and supervising the projects, an overarching environment was not established. In addition, when examining the geographical locations where the collection bins were installed, contrary to the initial plans, the bins were primarily situated in the commercial areas of the city center rather than in densely populated residential areas (Figure 3). Considering the trend of the urban population gradually shifting towards suburban areas and the rapid transformation of the residential pattern towards high-rise apartments, the selected location for the bins did not provide optimal accessibility for either residents or livestock farmers. Consequently, the bins have transformed into alternative substitutes for trash bins in the city center (Photo 2).

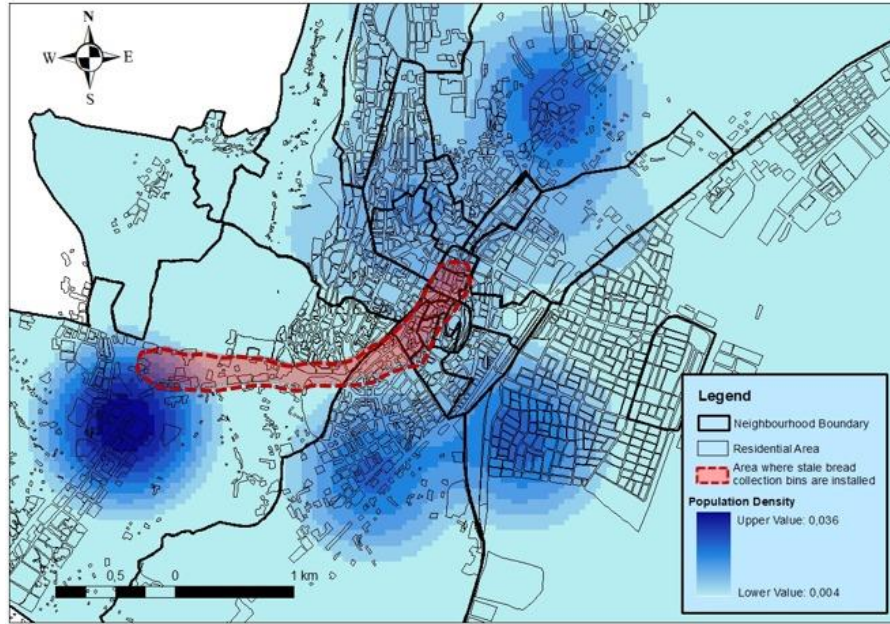


Figure 3. The area where stale bread collection bins are installed and the population density map of Niğde city.

Source: Mapping by the author (ArcGIS 10.2)



Photo 2. The stale bread collection bin, which was reinstalled in 2018, and the trash inside it.

Source: By author (25. 08. 2023)

2.2. The Status of Stale Bread in Niğde City

Food losses occur during various stages of the food supply chain, including production, post harvest, and processing. However, even within these stages, 'food waste' is reported to be

significantly connected to the behaviors of food retailers and final consumers. For cereals, approximately 40-50% of the total cereal food waste occurs during the consumer phase (Otterdijk & Meybeck, 2011; Parfitt et al., 2010). According to the 2018 food waste report in Türkiye, 11.7% of bread is discarded by consumers (İkikat Tümer et al., 2019). Therefore, this study investigated the amount of stale bread that occurred during a week among residents in the study area, with a specific focus on 'bread waste' (Table 1). Additionally, we examined changes in residents' disposal of stale bread, both before and after the implementation of the second 'stale bread collection bin' project in 2018 (Table 2). For each period, 500 residents were surveyed to observe any changes in how they dispose of stale bread. All interviews were conducted face-to-face, targeting residents in urban areas with high population density, particularly in apartment complexes and their surrounding areas where the bins are installed.

Table 1. The amount of stale bread that occurred during a week among the respondents (2017).

The survey content		
How much stale bread occurs in a week? (in a loaf)	N	%
No stale bread occurs	149	28
Half of a loaf from a quarter	20	5.8
One loaf	66	13.2
One and a half loaves	64	12.8
Two loaves	57	11.4
Three loaves	94	18.8
Four loaves	21	4.2
More than Five loaves	29	5.8
Toplam	500	100

* One loaf of bread weighed 250 grams (based on 2017 standards).

As shown in Table 1, out of a total of 500 respondents, 201 respondents, comprising 40.2% of the total, responded that they discard two or more loaves (over 500 g) per week that are stale or spoiled. Additionally, 50 respondents, constituting 10% of the total, indicated that four or more loaves (exceeding 1 kg) turned stale per week, rendering them unsuitable for consumption. Despite the observation that bread holds significance beyond mere food for individuals in Türkiye, encompassing historical and societal value, research conducted in 2017 revealed that 9.4%, equivalent to 47 out of 500 respondents, admitted to throwing bread in trash bins.



Photo 3. Discarded bread on the street (Aşağı Kayabaşı Neighborhood, Niğde City).

Source: By author (29. 04. 2023).

However, in the survey conducted subsequent to the initiation of the second 'stale bread collection bin' project in 2018, the number of respondents who stated that they threw bread in the trash bin dropped to 18 (3.6%). In comparison to 2017, there was an increase in the number of respondents who indicated their utilization of leftover bread as an ingredient in the preparation of other culinary dishes. Additionally, the number of respondents who dispose of stale bread separately in stale bread collection bins rather than in trash bins increased to 103 (20.6%) of all respondents, suggesting that projects initiated after 2018 had an overall positive impact on residents (Table 2).

Table 2. Methods of dealing with stale bread among the respondents.

The survey contents		Before the second project (2017)		After the second project (2018-2022)	
1	Does stale bread occur at your home?	N	%	N	%
	Yes	351	70.2	319	63.8
	No	149	29.8	181	36.2
	Total	500	100	500	100
2	When you have stale bread, how do you handle it?				
	No bread waste	149	29.8	181	36.2
	Used as an ingredient in food, such as meatballs	56	11.2	97	19.4
	Give it to a livestock farmer or someone who needs it	14	2.8	8	1.6
	Feeding stray animals (birds, dogs, etc.)	234	46.8	93	18.6
	Throw it into the stale bread collection bins	0	0	103	20.6
	Throw it into the trash can	47	9.4	18	3.6
	Total	500	100	500	100

Table 3. Survey on the participation of citizens in the stale bread collection Project.

The survey contents		2017		2018-2022	
1	Have you heard about the stale bread collection project in Niğde?	N	%	N	%
	Yes	48	9.6	200	40.0
	No	452	90.4	300	60.0
	Total	500	100	500	100
2	Do you think municipalities should collect stale bread?				
	Yes	475	95.0	467	93.4
	No	25	5.0	33	6.6
	Total	500	100	500	100
3	Would you participate in a campaign to collect stale bread?				
	Yes	466	93.2	437	87.4
	No	34	6.8	63	12.6
	Total	500	100	500	100

However, in the study area, a mere 48 (9.6%) respondents were aware of the existence of the stale bread collection bin in 2017. Subsequently, awareness increased to 200 (40%) respondents between 2018 and 2022; nonetheless, more than half of the respondents were unaware of its existence. Furthermore, 63 (12.6%) respondents stated that they would not dispose of their stale bread in the collected bins, even if such bins were installed specifically for stale bread (Table 3). Upon investigating the rationale behind this, they explained that even if stale bread is placed in a separate collection bin, it is not collected and is discarded due to mould growth. This underscores the fact that the bread gathered in these designated bins is not being effectively managed, thereby causing another environmental problem. In addition, there were reasons why the collection bins were not sufficient and evenly installed in the residential area, and there were no collection bins in their residential area.

As shown in Figure 3, the collection bins were primarily installed in commercial districts rather than in densely populated areas. Consequently, the accessibility of the collection bins for residents to dispose of their leftover bread, which occurs daily, is excessively low. This difference arises from the installation and planning of stale bread collection bins, which failed to account for the recent rapid urban sprawl phenomenon in Niğde city and the migration of the city's population to the suburbs due to the construction of residential apartment complexes in the suburbs. Therefore, new geographical locations for collection bins must be selected for sustainable and efficient collection and management.

2.3. Utilization of Stale Bread

The Niğde municipality has made several attempts to efficiently utilize discarded bread as animal feed to promote the recycling of food resources. However, these efforts have been unsuccessful due to the absence of alternative methods for collecting discarded bread and

feeding it to animals. Furthermore, a significant portion of the collected bread is often moldy or unsuitable for use as animal feed. Additionally, there is a lack of research on the utilization of stale bread, making it challenging to find successful case studies. In the case of the Netherlands, according to a report commissioned by the Dutch government, approximately one-fourth of the domestic food waste in the Netherlands is discarded bread. On average, citizens dispose of 9.2 kilograms of bread per year (Boztas, 2017). In addition, the practice of residents offering leftover bread to wildlife, such as pigeons, has inadvertently become a food source for rats, leading to vermin problems in communities. To address this issue, municipal councils have provided funding for a bread collection scheme aimed at disrupting a major food source for rodents. In response, businesses have placed specially designed containers on the streets to collect stale bread (Photo 4).



Photo 4. Stale bread collection bin in the Hague, Netherlands.
Source: The Guardian, by Henriëtte Guest, 2017.



Photo 5. The bread digester for renewable energy (Biogas) in the Netherlands.
Source: Enki Energy, by Stefan Blankenburg, 2016.

Through the process of grinding collected bread, combining it with water, and exposing it to bacteria, the resulting mixture transforms into methane. A loaf has the potential to generate sufficient fuel to operate a domestic gas burner for an hour. Consequently, the collected bread is transported to anaerobic digestion facilities owned by businesses, where it undergoes conversion into biogas or is utilized in fertilizer production (Blankenburg, 2016; Boztas, 2017) (Photo 5).

The growth of the world's population and the subsequent increase in food waste are recognized as global societal, economic, and environmental issues. As a result, there has been an increased focus on research related to the circular bioeconomy in recent years, which aims to integrate food waste into biological cycles (Dymchenko et al., 2023; Mak et al., 2020). The bioeconomy refers to the utilization of renewable biological resources and their conversion into value-added products, such as food, animal feed, biobased items, and bioenergy (Directorate-General for Research and Innovation & European Commission, 2012). Inedible food waste, such as discarded bread, can generate energy or produce chemicals (Dahiya et al., 2018). It is possible to utilize bread waste for ethanol production, and the byproduct of this process can be used as animal feed (Hirschnitz-Garbers & Gosens, 2015; Kumar et al., 2023). Bread contains sugar, protein, and other nutrients and serves as an ideal substrate for microbial fermentation. This process enables the production of a variety of renewable products, including chemicals, fuels, and bioplastics. The conversion of food waste or bread waste into chemical raw materials could be proposed as a solution to the global issue of increasing food waste resulting from the growth of the global population. By establishing a sustainable, safe, and stable source of fuel and chemical substances, this approach has the potential to positively contribute to resolving the problem of food waste disposal (Kumar et al., 2023). In addition, the biocircular economy can simultaneously create new employment opportunities while environmentally treating food waste and producing bioenergy. In this regard, Europe's bioeconomy is estimated to generate annual revenues of approximately 2 trillion euros and provide employment for more than 22 million people, accounting for approximately 9% of the entire European Union workforce (BECOTEPS, 2011; Directorate-General for Research and Innovation & European Commission, 2012). Moreover, biomass is recognized as a sustainable alternative resource for addressing environmental issues linked with fossil fuels and greenhouse gases (Kumar et al., 2023; Narisetty et al., 2021b). The provision of renewable, fermentable, carbon-rich, and cost-effective waste feedstocks is crucial for biomass. Consequently, waste materials with high sugar content capable of extracting fermentable sugars, such as food, bakery products, bread, fruits, etc., are needed. Recently, waste materials with high sugar contents have garnered considerable attention due to their potential for efficient utilization (Choi et al., 2015; Kumar et al., 2023; Liakou et al., 2018). Bread waste holds potential as a feedstock for sustainable biorefineries capable of generating high levels of platform chemicals. Nonetheless, there is still a dearth of research on the utilization of this waste in biorefineries, and additional exploration into waste-to-energy processes is essential. Furthermore, research on the social and economic aspects of the sustainable and efficient utilization of discarded bread should be complemented (Kumar et al., 2023).

CONCLUSION

In 2022, the Food and Agriculture Organization (FAO) of the United Nations reported that approximately 691 to 783 million people worldwide experienced hunger (FAO, 2022). However, globally, one-third of edible foods, totaling approximately 1.3 billion tons annually, are lost or wasted. In particular, in countries with medium- to high-income levels, a significant amount of edible food is discarded (Otterdijk & Meybeck, 2011). Among edible food items, bread waste accounts for a significant portion of global food waste (Kumar et al., 2023). Every year, more than 100 million tons of bread are produced worldwide, with the consumption rate reaching 129 million tons in 2016 (Jung et al., 2022; Kumar et al., 2023). However, approximately 10% (900,000 tons) of bread is discarded throughout the entire supply chain, from production to consumption. Consequently, numerous countries are currently making efforts to prevent such food waste, including bread, and to utilize resources more efficiently (Dölekoğlu et al., 2014).

Türkiye is one of the major wheat-producing countries worldwide and ranks among the countries with the highest bread consumption (Demirtaş et al., 2018). However, as previously noted, the rate of bread wastage is significantly elevated. Efforts are being made to utilize discarded bread throughout Türkiye, including in the study area, but successful results have not been achieved. Many recycling projects, referred to as environmentally friendly and sustainable development, often encounter significant challenges and fail to achieve successful outcomes due to various issues, such as inadequate management, lack of promotion and citizen education, and insufficient research and development compared to the initial plans of the projects (Debrah et al., 2022; Dinansyah Wiradimadja et al., 2023; Narisetty et al., 2021b).

The stale collection bin project, examined in this study, was implemented twice in the research area with identical content but failed to yield significant results. To ensure meaningful outcomes and sustained value from such projects, rather than being temporary or perfunctory, systematic and strategic planning, execution, review, and improvement based on resource management theories are imperative. Achieving sustainable environmental resource management requires projects to integrate social, economic, and environmental considerations in their planning and implementation. Additionally, continuous management and feedback mechanisms are necessary to address and improve any issues that arise. However, the study area revealed various challenges across all project stages, including planning, promotion, resident participation, management, and final disposal. Addressing these issues requires implementing specific improvements for successful resource management and utilization.

Based on the results of this study, when undertaking projects for sustainable resource management, it is important to consider the following aspects for examination and improvement. First, the selection and planning of project locations should be based on geographical and spatial suitability and feasibility. In particular, in resource collection processes such as the disposal of stale bread, the distribution of the population plays a critical role in location selection, and the dynamics of urban environments, such as urban sprawl, require thorough analysis. Second, the research findings revealed a significant lack of awareness and engagement among local residents regarding the project. The absence of involvement from residents poses a significant obstacle to the success of sustainable projects. Therefore, it is imperative for residents to comprehend the significance and objectives of the project. To achieve this, effective promotion and educational initiatives should be implemented to encourage their active and voluntary participation. Third, for projects of this kind, establishing a dedicated department or agency for project execution is crucial. In the study area, project tasks were delegated to existing departments, hindering the provision of specialized and systematic supervision and management. Therefore, specialized project management by a dedicated agency or department is necessary. This entity should oversee the collection, management, and disposal of resources, while also spearheading research and development efforts to create new resources. Finally, even if significant amounts of stale bread are collected through civic education and public relations, the sustainability of these projects depends on whether the final products derived from the stale bread are environmentally friendly, economical, and sustainable. Therefore, it is imperative to direct research and development efforts towards bioenergy solutions, such as biomass production and ethanol generation, to offer environmentally sustainable alternatives for repurposing stale bread. This requires collaboration among dedicated agencies, research institutions, and local industries to ensure that eco-friendly outcomes are recycled to benefit the local community.

Declaration of Support and Thanksgiving: We would like to express our gratitude to the referees for their valuable contributions to the article through their opinions and suggestions, and to the editor for managing the review process.

Author contribution: S.K. conceived and designed the study, conducted the data analysis and literature review, drew some maps and figures, and drafted the manuscript. D.A. contributed to the data collection and analysis, drew some maps and tables, and critically revised the manuscript for intellectual content. All the authors have read and approved the final version of the manuscript.

Declaration of interest: The authors declare no conflicts of interest.

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EXTENDED ABSTRACT

GENİŞLETİLMİŞ ÖZET

SÜRDÜRÜLEBİLİR BİR KAYNAK OLARAK BAYAT EKMEĞİN KULLANIMINDA MEVCUT
DURUM VE ALTERNATİF YAKLAŞIMLAR

Giriş ve Çalışmanın Amacı: Gıda israfı, küresel ölçekte ekonomik, sosyal ve çevresel bir sorun olarak öne çıkmaktadır. İklim değişikliği, salgın hastalıklar ve uluslararası çatışmalar gibi faktörler hem gıda güvenliğini hem de ekonomik istikrarı tehdit etmektedir. Özellikle ekme, hem temel bir besin kaynağı olması hem de kültürel ve sosyal anlamlar taşıması nedeniyle Türkiye’de büyük bir öneme sahiptir. Ancak, Türkiye aynı zamanda dünyada en fazla ekme israf eden ülkeler arasında yer almaktadır. Birleşmiş Milletler Gıda ve Tarım Örgütü’ne (FAO) göre, her yıl yaklaşık 1,3 milyar ton yenilebilir gıda israf edilmektedir. Türkiye’de ise 2012 yılı itibarıyla günlük 6 milyon adet ekme çöpe atılmaktadır. Bu durum, ciddi ekonomik kayıplara ve çevresel sorunlara yol açmaktadır. Ekme israfı, üretimden tüketime kadar olan tüm aşamalarda yaşanmakla birlikte, tüketici davranışlarının bu israftaki payı büyüktür. İç Anadolu Bölgesi’nde yer alan Niğde şehrinde 2012 ve 2018’de olmak üzere iki kez 'Bayat Ekme Toplama Kutusu' projesi yürütülmüştür. Bu çalışmanın temel amacı, Niğde’deki bu projelerin etkinliğini değerlendirmek, eksiklerini belirlemek ve sürdürülebilirlik açısından değerlendirmektir. Ayrıca, bayat ekmeğin çevre dostu yöntemlerle değerlendirilmesine yönelik alternatif yaklaşımlar sunmak hedeflenmiştir.

Kavramsal/kuramsal çerçeve: Literatürde gıda israfı ile ilgili çoğunlukla mühendislik temelli araştırmalar yer alırken, sosyal bilimler perspektifinden yapılan analizler sınırlıdır. Bu çalışma, sosyal bilimler odağında bir değerlendirme sunarak toplumsal farkındalık ve katılımın önemine dikkat çekmektedir. Bu bağlamda gıda israfı, sürdürülebilirlik ve toplumsal farkındalık kavramları ön plana çıkarılmıştır. Türkiye’deki araştırmalar, ekme israfının yüksek seviyelerde olduğunu ve bireylerin alışkanlıklarının bu sorunda önemli bir payı olduğunu göstermektedir. Ayrıca, ekme israfını azaltmaya yönelik projelerin çoğu, halkın düşük farkındalık seviyesi nedeniyle beklenen başarıyı sağlayamamıştır. Hollanda gibi ülkelerde bayat ekmeğin biyogaz ve gübre üretiminde kullanılması, israfı azaltma ve kaynakları geri dönüştürme açısından başarılı bir örnek teşkil etmektedir. Bu tür yaklaşımlar, Türkiye’deki projeler için bir model olarak değerlendirilebilir. Bu çalışma Niğde’den hareketle, ekonomik ve çevresel fayda sunan sürdürülebilir kaynak yönetimi için yenilikçi yaklaşımlar önermektedir. Bu öneriler, benzer sorunlar yaşayan diğer şehirler ya da ülkeler için de uygulanabilir sonuçlar sağlayacaktır.

Yöntem ve Bulgular: Araştırma kapsamında nitel ve nicel araştırma yöntemleri bir arada kullanılarak karma bir yöntem benimsenmiştir. Yarı yapılandırılmış ve yapılandırılmış yüz yüze görüşmelerle elde edilen verilerin toplanması iki farklı dönemde gerçekleştirilmiştir. 2017 yılında, 500 kişiyle proje öncesi farkındalık ve israf alışkanlıklarını anlamaya yönelik görüşmeler yapılmıştır. 2018-2022 yılları arasında, proje sonrası farkındalık ve katılım durumunu ölçmek için tekrar 500 kişiyle görüşülmüştür. Bu sayede toplam 1.000 katılımcı araştırmaya dahil olmuştur. Bayat ekme projesi, iki kez uygulanmasına rağmen beklenen başarı elde edilememiştir. 2017’de katılımcıların yalnızca %9,6’sı bayat ekme toplama kutularının varlığından haberdardı. 2018-2022 yılları arasında bu oran %40’a çıkmış olsa da katılım ve kullanım düzeyi son derece düşük kalmıştır. Görüşme ve anketlerden elde edilen veriler, projenin başarısızlık nedenlerini, halkın alışkanlıklarındaki değişimleri ve mevcut sorunları değerlendirmek amacıyla analiz edilmiştir. Ayrıca ArcGIS 10.2 coğrafi bilgi sistemleri programı ile Niğde şehrine ilişkin mekânsal analizler yapılmıştır. Çalışma sürecinde Niğde Belediyesi’nin Temizlik İşleri Müdürlüğü ile görüşmeler yapılmış ve projenin planlama, uygulama ve yönetim aşamaları incelenmiştir.

Sonuç ve Öneriler: Çalışmada, gıda israfının azaltılmasında ve bayat ekmeğin sürdürülebilir bir şekilde değerlendirilmesinde mevcut uygulamaların etkinliğini incelenmiştir. Bu bağlamda Türkiye’de özellikle ekme israfı ciddi bir sorun olarak öne çıkmaktadır. Yerel bir uygulama olarak Niğde’de yürütülen “Bayat Ekme Toplama Kutusu” projesi, israfı azaltmayı hedeflemesine rağmen sürdürülebilir bir başarı elde edilememiştir. Bu başarısızlığın ilk nedeni farkındalık ve katılım eksikliğidir. Proje öncesinde halkın büyük bir kısmı bayat ekme toplama kutularının varlığından haberdar değildi. Proje sonrası farkındalık artmış olsa da halkın katılımı ve projeye olan ilgisi sınırlı kalmıştır. Ayrıca projenin yönetiminde ve planlanmasında da eksiklikler tespit edilmiştir. Kutuların yanlış lokasyonlara yerleştirilmesi, özellikle nüfus yoğunluğu yüksek bölgeler yerine ticari alanlara konulması, erişimi zorlaştırmıştır. Projeyi planlayan ve uygulayan yerel yönetim içerisinde özel bir birim kurulmamış, görevler mevcut birimlere eklenmiştir. Toplanan ekmeğin büyük bir kısmı küflü olduğu için hayvan yemi olarak bile kullanılamamıştır. Alternatif değerlendirme yöntemleri (biyogaz üretimi gibi) araştırılmamıştır. Bu tür uygulamaların sürdürülebilir hale gelmesi için bölge sakinlerinin projenin gerekliliğini anlamaları büyük önem taşımaktadır. Ayrıca sürdürülebilir kalkınma hedeflerine ulaşmak için ilgili kuruluşlar, araştırma kurumları ve yerel endüstriler arasındaki iş birliğiyle çevre dostu sonuçların yaratılması ve bunların yerel halka geri dönüşü gerekmektedir.

KATKI ORANI BEYANI VE ÇIKAR ÇATIŞMASI BİLDİRİMİ

Sorumlu Yazar <i>Responsible/Corresponding Author</i>	Suk-Kyeong KANG			
Makalenin Başlığı <i>Title of Manuscript</i>	THE CURRENT STATUS AND ALTERNATIVE APPROACHES OF INITIATIVES UTILIZING STALE BREAD AS A SUSTAINABLE RESOURCE			
Tarih <i>Date</i>	31.12.2024			
Makalenin türü (Araştırma makalesi, Derleme vb.) <i>Manuscript Type (Research Article, Review etc.)</i>	Research Article			
Yazarların Listesi / List of Authors				
Sıra No	Adı-Soyadı <i>Name - Surname</i>	Katkı Oranı <i>Author Contributions</i>	Çıkar Çatışması <i>Conflicts of Interest</i>	Destek ve Teşekkür (Varsa) <i>Support and Acknowledgment</i>
1	Suk-Kyeong KANG	%60	Yoktur	Yoktur
2	Derya AĞBABA	%40	Yoktur	Yoktur