CRACKING THE EGGSHELL PROBLEM: EXPLORING DISPOSAL PRACTICES, AWARENESS, AND SUSTAINABLE WASTE SOLUTIONS

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Abstract

This study examines the eggshell disposal practices of individuals in the food industry and households, addressing the central question: How do individuals typically dispose of eggshells? Using a qualitative research design, the researchers conducted semi-structured interviews with six purposively selected participants to gather rich, contextual narratives about their disposal behaviors. Thematic analysis revealed three key themes: (1) Accustomed Disposal Practices, where convenience and time pressures drive routine disposal into garbage bins; (2) Knowledge and Awareness Gaps, where participants lack understanding of eggshell recycling or reuse options and have limited perception of environmental impacts; and (3) Openness to Innovation and Change, where some individuals express tentative willingness to explore alternative uses, often rooted in family traditions or emerging environmental consciousness. These findings underscore the importance of targeted educational programs, local recycling initiatives, and community-based interventions in promoting sustainable organic waste management. The study aligns with Sustainable Development Goals 12 (Responsible Consumption and Production) and 13 (Climate Action), emphasizing the importance of integrating knowledge, behavioral support, and institutional backing to reduce waste and foster environmental stewardship. Recommendations include actionable recycling practices, educational initiatives, and future research expanding the generalizability of qualitative insights.

Keywords: *Awareness, Disposal Practices, Eggshell Recycling, Sustainability, Waste Management*

1.0 INTRODUCTION

The researchers observed, based on personal household experiences and reports from local television broadcasts and social media, that eggshells are often improperly discarded despite their potential usability. As a form of agricultural waste,

eggshells represent a valuable resource that is frequently overlooked, highlighting a general lack of awareness regarding their possible applications. Agricultural waste encompasses a wide range of by-products generated during food production and processing, including crop residues, animal manure, and food processing discards (Nagendran, 2011). Among these, eggshells represent a significant yet often overlooked component.

Globally, the disposal of eggshell waste poses environmental challenges due to its volume and the slow decomposition rate of shells, which can lead to pollution and increased waste management costs (Faridi & Arabhosseini, 2018). The Food and Agriculture Organization (FAO) estimates that approximately 6.4 million tons of eggshell waste are discarded in landfills annually (Ngayakamo & Onwualu, 2022). This substantial volume emphasizes the need for effective waste management strategies. In the Philippine context, Estrada, Santiago, Zialcita, and Beltran (2023) noted that the country generated approximately 63,280 metric tons of eggshell waste in 2019, highlighting the significant volume of waste resulting from the nation's high egg consumption. Building on this data, Cabuco,, et al. (2024) reported a sharp increase in eggshell waste, estimating an annual total of 4.24 million metric tons, which translates to about 4,020 metric tons per day. This dramatic surge is attributed to the continued growth of the poultry industry and the rising demand for eggs across both household and commercial food sectors in the Philippines.

Despite the potential applications of eggshells in various industries, they remain largely underutilized. While other agricultural by-products have found uses in sectors like construction and agriculture, eggshells are often treated as waste and discarded without consideration for their potential value (Fernandes & Litz, 2017) This underutilization represents a missed opportunity for resource recovery and environmental sustainability.

Both households and food industries, including local bake shops, fast-food chains, eateries, and street vendors, contribute significantly to eggshell waste generation. Studies have shown that these sectors produce substantial amounts of eggshell waste daily, which

often ends up in landfills due to inadequate waste management practices (Aditya, Stephen, & Radhakrishnan, 2021). The lack of awareness and infrastructure for proper disposal exacerbates the environmental impact of this waste stream.

While there is growing interest in the potential applications of eggshell waste, there is a scarcity of research focusing on experiences of household members and food industries workers regarding its disposal practices. Understanding the drivers and barriers to proper eggshell waste management is crucial for developing effective interventions and promoting sustainable practices. This gap in the literature highlights the need for studies that examine the socio-behavioral aspects of eggshell disposal.

This study is anchored on the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975) as cited in the book of (LaCaille, 2013), which posits that a person's behavioral intentions—shaped by attitudes and subjective norms—are the most immediate predictors of actual behavior. In the context of eggshell disposal, the themes that emerged from this study—Accustomed Disposal Practices, Knowledge and Awareness Gaps, and Openness to Innovation and Change—align with the key constructs of the TRA. Participants' habitual reliance on trash disposal reflects ingrained attitudes toward convenience and normative beliefs shaped by family practices and industry routines. Meanwhile, knowledge gaps highlight the absence of enabling beliefs that would lead to stronger behavioral intentions toward sustainable practices. Lastly, the theme of openness to change suggests the presence of evolving attitudes that may, with proper intervention, translate into more environmentally responsible intentions. Understanding eggshell disposal behavior through the lens of TRA provides a framework for designing educational and community-based interventions that influence attitudes, reshape norms, and ultimately encourage pro-environmental behavior among individuals in both households and food industries.

In response to the identified research gap, this study aims to explore eggshell disposal practices among individuals in the food industry and households. By conducting

in-depth interviews with stakeholders such as local bake shop owners, fast-food chain employees, eatery operators, street vendors, and household members, the study seeks to uncover the underlying issues that shape conventional eggshell disposal methods. The findings will inform the development of strategies to reduce eggshell waste and promote its beneficial reuse, contributing to environmental sustainability and resource efficiency.

2.0 METHODOLOGY

This study employed a phenomenological research design to explore the eggshell disposal practices of individuals in the food industry, including local bakeshops, fast-food chains, local eateries, and street vendors, as well as households. It aimed to understand how these participants interpret and make sense of this phenomenon within the context of their daily experiences. The phenomenology approach was selected because it allows for an in-depth understanding of human behaviors, motivations, and contextual factors, which are essential when investigating waste management practices shaped by socio-cultural and economic influences (Creswell, JW & Poth, 2025).

To gather data, semi-structured in-depth interviews were conducted with six purposively selected participants (Creswell J. W., 2013). Purposive sampling was used to ensure the inclusion of individuals directly involved in the generation and disposal of eggshell waste, allowing the researchers to target key informants with relevant experiences (Palinkas, et al., 2015). The interviews were designed to uncover participants' knowledge, attitudes, and practices regarding eggshell waste, as well as the factors influencing their disposal choices (Castillo-Montoya, 2016).

The participants in this study were purposefully selected based on carefully defined inclusion criteria to ensure they could provide meaningful and relevant insights into eggshell disposal practices. First, participants had to be individuals actively engaged in household cooking activities. Second, participants could also be owners, workers, or staff members from local food-related businesses. Third, all participants were required to be 18 years of age or older

to ensure they could provide mature and informed consent. Lastly, only individuals who were willing to participate in the study voluntarily.

To safeguard the identities of the participants, a code name was assigned following a systematic format: the letter "F" or "M" to signify female or male, respectively; the letter "P" to indicate "participant"; and a number representing their assigned sequence in the study (e.g., FP1 for Female Participant 1, MP2 for Male Participant 2). Table 1 presents the demographic profiles of the participants, using the assigned codes to ensure confidentiality while providing necessary background information for the analysis.

Table 1. *Demographic Profile of the Participants*

Code Name	Age	Sex	Origin/Employment	Academic Attainment
MP1	56	Male	Household Member	College Graduate
MP2	55	Male	Food Industry Worker	TESDA Diploma Completer
FP1	49	Female	Food Industry Worker	High School Graduate
FP2	55	Female	Food Industry Worker	College Level
FP3	46	Female	Food Industry Worker	College Level
FP4	18	Female	Household Member	College Level

An interview guide was carefully designed and developed, structured around the research question that this study intends to find answer. The interview guide used in this study, was subjected to validation by a panel of experts in content, research methodology, and language to ensure that the questions were appropriate, clear, and capable of generating data aligned with the research question as suggested by Castillo-Montoya (2016). The interview guide incorporated open-ended questions to encourage participants to provide rich, detailed descriptions of their experiences, allowing for deeper exploration of their perceptions and practices. Each interview lasted approximately 30 to 45 minutes and was conducted either in person or online, depending on the participant's availability and convenience. With participants' consent, all interviews were audio-recorded to ensure accurate transcription and analysis. To support a spontaneous and natural flow of conversation, the researchers

conducted the interviews in the regional dialect, allowing participants to express their ideas and experiences more freely and comfortably (van Nes, Abma, Jonsson, & Deeg, 2010). With six participants, the data gathered had already reached saturation—the point at which no new information emerged (Creswell & Poth, 2018). Therefore, the researchers decided not to recruit additional participants for the study.

For data analysis, thematic analysis was employed following the six-phase framework outlined by Braun and Clarke (2008). This approach involves familiarization with the data, generating initial codes, identifying themes, reviewing the themes, defining and naming them, and producing the final report.

During the coding process, the researchers identified participant narratives that were relevant to answering the research questions. These narratives were assigned codes, which served as representations of their underlying meaning. Once all significant narratives had been coded, similar or related codes were grouped to form categories. Finally, associated categories were clustered to develop overarching themes. Through this structured process of thematic analysis, the study yielded three major themes that capture the essence and meaning of the participants' lived experiences concerning eggshell waste disposal.

To ensure trustworthiness, several strategies were employed, including triangulation, in which all members of the research team independently coded the data. They then compared their codes and retained those they mutually agreed best represented the participants' narratives. To further enhance credibility, the final set of codes was reviewed and validated in consultation with their research adviser. The researchers also conducted member checking by immediately confirming with each participant whether the information gathered during the interview accurately reflected what they intended to share. This validation process was carried out after each interview to ensure the authenticity and accuracy of the participants' narratives and peer debriefing (Lincoln, YS & Guba, 1985).

The study adhered to the ethical guidelines outlined by Mirza, Bellalem, and Mirza (2023). Participants

were provided with informed consent forms explaining the study's purpose, procedures, confidentiality measures, and their right to withdraw at any time. Special care was taken to anonymize participant data to protect their identities, especially given the sensitivity of some discussions around improper eggshell disposal practices. The recorded data, which were stored on the researchers' mobile phones, were permanently deleted from the devices after transcription. This data protection measure was clearly communicated to the participants during the personal interviews to ensure transparency and uphold ethical standards regarding confidentiality and privacy.

3.0 RESULTS AND DISCUSSION

The research question of this study, ***"How do individuals from food industries and households typically dispose of eggshells?"***, was answered through the three themes: (a) Accustomed Disposal Practices, (b) Knowledge and Awareness Gaps, and (c) Openness to Innovation and Change. These themes emerged from a detailed data analysis of participant narratives, which were organized into corresponding codes and categories. Table 2 presents the excerpted narratives, codes, and categories that collectively shaped these three themes, offering a structured overview of the findings based on the data gathered in this study.

Theme1:AccustomedDisposalPractices

The first major theme emerging from the data is Accustomed Disposal Practices, which reveals that most individuals, whether in households or food industries, rely on routine, convenient methods for eggshell disposal. This theme includes two categories: Habitual Direct Disposal and Inherited Practices for Eggshell Reuse in Gardening.

Participants described how direct disposal has become their default. FP3 explained, *"We dispose of it directly in the trash cans,"* while FP5 admitted, *"We just throw it straight into the garbage can,"* adding, *"The easiest thing we can do is directly throw it away."* PM1, who works under time constraints in a bakery, added, *"It is the fastest way to dispose of it, especially due to the demand for cakes during the holiday season."*

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Others justified the behavior on the grounds of practical concerns, such as pests and odors. FP5 noted, "*It is often infested with ants… that's why the easiest thing we can do is directly throw it away.*" FP3 emphasized, "*That's why we pack it in a trash bag properly because– it can impact the environment, especially if it is near to us, it will surely smell.*"

Interestingly, the participants described alternative practices rooted in family traditions. FP1 recalled, "*And even before, in the old times, our mother says that we shouldn't throw the eggshells away and put them on her orchids.*" MP2 reflected, "*Instead of dumping it with other wastes, the best way is putting it on the plants.*" FP2 shared, "*It has been like that ever since; I got that practice from my parents years ago.*" These narratives align with findings by Montazzeri (2023), who reported that cultural and family socialization play a strong role in shaping pro-environmental habits, particularly in agrarian and household contexts.

The findings highlight two dominant influences on eggshell disposal behavior: the pressures of convenience and the persistence of cultural practices. Most participants default to directly discarding eggshells into trash bins due to routine, workload, and a lack of perceived alternatives. In contrast, a minority follow inherited traditions of reuse, such as applying eggshells to plants—practices passed down by parents or grandparents. These contrasting behaviors reflect the interplay between practical limitations and long-standing norms. As recent literature affirms, habitual waste behaviors are difficult to change unless interventions specifically address both environmental and situational constraints (Yuriev et al., 2024). When reuse is inconvenient or lacks institutional reinforcement, even positive intentions are unlikely to translate into sustainable action.

Framing these findings through the lens of the Theory of Reasoned Action (Fishbein & Ajzen, 1975), it becomes evident that behavioral intentions are influenced by attitudes (e.g., convenience over sustainability) and social norms (e.g., inherited family practices). For sustainable behavior to emerge, individuals must believe that environmentally responsible practices are both valuable and expected. This study contributes to SDG 12 and SDG 13 by showing that promoting sustainable waste behavior must combine culturally anchored practices with new, easily adoptable norms. Therefore, we recommend that barangay-led initiatives integrate traditional knowledge—such as using eggshells for plant care—into structured community recycling programs to normalize and simplify sustainable disposal behaviors.

Theme 2: Knowledge and Awareness Gaps

The second key theme identified is Knowledge and

Awareness Gaps, which highlights the lack of information, uncertainty, and minimal environmental literacy among participants regarding the reuse or recycling of eggshell waste. This theme encompasses two categories: a lack of Awareness about Recycling Potential and minimal knowledge of Environmental Impact.

Several participants admitted that they lacked the necessary information to make informed disposal decisions. MP1 explained, "*For now, since no one has told us what to use it for, whether they can be recycled or something. So, we do nothing at all.*" FP2 echoed, "*We don't know if it can still be utilized,*" while FP3 added, "*So, we don't get to use it (egg shells) for other purposes anymore.*"

While some showed a general awareness of local environmental concerns, this awareness was mainly limited to immediate issues, such as odor. FP3 commented, "*That's why we pack it in a trash bag properly because– it can impact the environment, especially if it is near to us, it will surely smell.*" FP5 acknowledged, "*It can be put in plants, but in such cases, it is often rare.*" A glimmer of openness emerged as FP5 reflected, "*Maybe, maybe it is not impossible that we can do it, so we just segregate it (eggshells).*" These responses align with recent studies showing that although many people are generally aware that their waste matters, they often lack concrete knowledge or practical support systems for recycling or reuse (Knickmeyer, 2020).

This theme reveals that information gaps, uncertainty, and low levels of environmental literacy are central barriers to sustainable eggshell disposal among households and small food businesses. The lack of precise knowledge on how eggshells can be reused or recycled reflects the absence of well-formed attitudes and normative guidance—conditions that are essential for behavior change. According to the Theory of Reasoned Action (TRA), individuals' behaviors are shaped by their intentions, which are influenced by their attitudes and perceived social expectations (Fishbein & Ajzen, 1975). In this study, participants' statements such as "*We don't know if it can still be utilized*" reflect not only limited understanding but also a lack of motivation and behavioral intention to act in an environmentally responsible manner. These findings are consistent with those of Yu, Zhu, and Zhai (2022), who argue that people are more likely to adopt pro-environmental behaviors when they understand not only what to do, but also why it matters and how their individual actions contribute to broader sustainability goals.

From the TRA perspective, closing the knowledge and awareness gap requires more than simple dissemination of information. It calls for culturally grounded, community-supported

interventions that increase both personal relevance and social validation of sustainable waste practices. This insight directly supports Sustainable Development Goals (SDGs) 12 and 13, which advocate for responsible consumption and climate action. To translate passive uncertainty into active environmental behavior, we recommend that local schools and barangay centers collaborate with environmental agencies to implement educational campaigns that demonstrate practical and straightforward reuse methods—such as crushing eggshells for garden use—to develop informed attitudes and foster intentional, sustainable waste management.

Theme 3: Openness to Innovation and Change

The third major theme identified in this study is Openness to Innovation and Change, which reflects participants' emerging interest in exploring alternative uses for eggshells and their cautious willingness to engage in segregation and other sustainable waste practices.

Some participants revealed that they were not entirely closed off to more sustainable uses of eggshells. MP1 reflected on advice passed down from his mother, sharing, "*Our mother says that we shouldn't throw the eggshells away, and to put them on her orchids.*" Similarly, MP2 explained, "*Instead of dumping it with other wastes, the best way is putting it on the plants.*" Although these practices are still rare, FP5 acknowledged, "*It can be put in plants, but in such cases, it is often rare.*"

A few participants expressed emerging openness toward segregation practices. FP5 shared a thoughtful consideration, saying, "*Maybe, maybe it is not impossible that we can do it so we just segregate it (eggshells).*" FP3 added, "*That's why we pack it in a trash bag properly because– it can really impact the environment.*" Yet, as FP4 admitted, "*So, we don't really get to use it (egg shells) for other purposes anymore,*" showing that although the openness exists, it has not yet consistently translated into action.

The findings under this theme suggest that there is a foundation of openness and curiosity among participants, even if concrete behaviors have not yet fully materialized. According to Bamberg and Möser (2007), environmental behavior change is strongly influenced by individuals' perceived behavioral control and their belief that their actions will have meaningful environmental impact. This means that interventions designed to encourage eggshell reuse or segregation need to not only provide practical guidance but also strengthen individuals' sense of efficacy and agency. Moreover, this openness aligns with the study's aim of identifying factors that can support the shift from habitual disposal to sustainable waste practices. If properly harnessed, these attitudes could help bridge

the gap between awareness and action (Schultz, 2014; Kollmuss & Agyeman, 2002). Thus, this study recommends that a community-based training programs that provide hands-on demonstrations and simple, guided practices for eggshell reuse and segregation to strengthen individuals' confidence and capacity for sustainable waste management may be launched. In the context of the SDG 12 and SDG 13, the implications are substantial. Promoting alternative uses and segregation of eggshell waste can reduce organic waste going to landfills, minimize methane emissions, and support circular economy initiatives. Figure 1 presents a graphical representation of the participants' constructed meanings and interpretations regarding eggshell waste disposal, as revealed in this study.

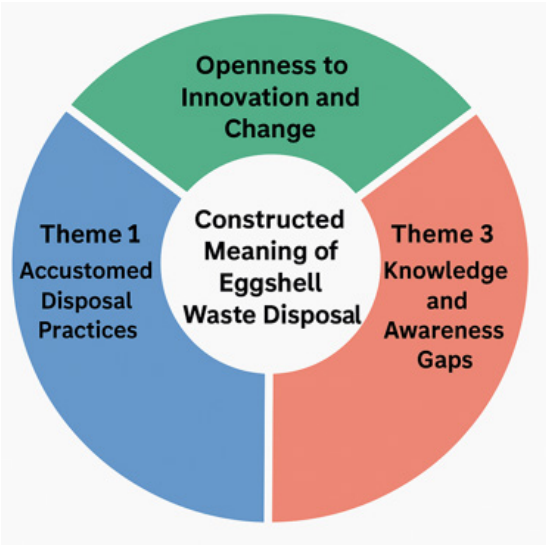

Figure 1. Comprehensive Graphical Representation of the Meaning of Eggshell Waste Disposal in this Study

4.0 CONCLUSION

Based on the findings, the researchers conclude that eggshell disposal practices are shaped by three key patterns: (1) a firm reliance on habitual direct disposal, where eggshells are routinely thrown into garbage bins due to convenience, workload, and lack of time; (2) significant knowledge and awareness gaps, where many individuals are uncertain about the recycling or reuse potential of eggshells and are unaware of their broader environmental impacts; and (3) an emerging openness to innovation and change, where some individuals, influenced by family traditions or personal reflection, show tentative interest in alternative uses such as gardening or segregation.

While most eggshells currently end up in landfills due to routine habits and limited

awareness, there is potential to shift these practices toward more sustainable pathways if individuals are provided with explicit knowledge, support systems, and opportunities for pro-environmental action. Addressing these behavioral drivers is essential for advancing local sustainability efforts and aligning household and industry practices with broader environmental goals, particularly those outlined under Sustainable Development Goals 12 (Responsible Consumption and Production) and 13 (Climate Action).

5.0 RECOMMENDATIONS

Based on the findings, the researchers recommend implementing community-based recycling initiatives that collect eggshell waste from both households and food businesses and transform it into usable products, such as soil enhancers or animal feed supplements.

For Instructional Purposes, it is recommended to integrate environmental education modules into local schools, community workshops, and food industry training programs that specifically address organic waste recycling, including the often-overlooked potential of eggshell reuse.

Given the qualitative nature of this study, the researchers recommend conducting future mixed-methods or quantitative research to validate and generalize the findings across a broader population. Additionally, longitudinal studies may explore how sustained interventions over time impact household and industry practices, providing stronger causal evidence for effective policy and program design.

6.0 LIMITATONS OF THE STUDY

This study is subject to several limitations that should be acknowledged. First, the use of a small, localized sample—limited to selected households and food industry workers within a specific geographic area—may restrict the generalizability of the findings to other contexts. While rich in qualitative detail, the results reflect the perspectives of a narrow group and may not capture the full range of eggshell disposal practices across diverse regions or cultural settings. Second, as with most qualitative studies, the potential for researcher bias exists in the interpretation of participant narratives, despite efforts to enhance trustworthiness through member checking and expert validation. Lastly, the study's transferability is limited, as the insights generated are highly contextual and may not directly apply to different populations without careful consideration of local norms, infrastructure, and environmental policies. These limitations suggest the need for broader, mixed-methods research to validate

and expand upon the findings.

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Appendix - *Excerpts of the Narratives, Codes and Categories that Comprise the Emerging Themes of This Study*

Narratives	Codes	Categories	Themes
FP3: "We dispose of it directly in the trash cans."	Throwing eggshells into the trash	Habitual Direct Disposal	Theme 1: Accustomed Disposal Practices
FP5: "We just throw it straight into the garbage can."			
FP5: "The easiest thing we can do is directly throw it away."			
PM1: "It is the fastest way to dispose of it, especially due to the demand for cakes during the holiday season."	Quick disposal due to workload or time demands		
FP5: "It is often infested with ants so the ants inside get stuck [in the kitchen]. That's why, the easiest thing we can do is directly throw it [eggshells] away."			
FP3: "That's why we pack it in a trash bag properly because– it can really impact the environment especially if it is near to us, it will surely smell."			
FP1: "And even before, in the old times, our mother says that we shouldn't throw the eggshells away, and to put them on her orchids.	Eggshell use from tradition	Inherited Practices for Eggshell Reuse in Gardening	
MP2: "Instead of… dumping it with other wastes, the best way to dispose of it is the one we inherited from our parents, which is putting it on the plants."	Applying family habits daily		
FP2: "It has been like that ever since, I got that practice from my parents years ago."	Long-term following family habits	Continuity of Family Habits Over Time	
FP5: Passing down waste disposal habits across generations			
MP1: "For now, since no one has told us what to use it for, whether they can be recycled or something. So, we do nothing at all."	Unclear reuse and recycling	Lack of Awareness about Recycling Potential	Theme 2: Knowledge
FP2: "We don't really know if it can still be utilized."			
FP3: "So, we don't really get to use it (egg shells) for other purposes anymore."			

FP3: "That's why we pack it in a trash bag properly because– it can really impact the environment especially if it is near to us, it will surely smell."	Odor and local concern	Minimal Knowledge of Environmental Impact	and Awareness Gaps
FP5: "It can be put in plants, but in such cases, it is often rare."	Infrequent alternative practice		
FP5: "Maybe, maybe it is not impossible that we can do it so we just segregate it (eggshells)."	Tentative segregation willingness	Emerging Openness to Waste Segregation Practices	
MP1: "Our mother says that we shouldn't throw the eggshells away, and to put them on her orchids."	Eggshells for gardening	Emerging Interest in Alternative Uses	Theme 3: Openness to Innovation and Change
MP2: "Instead of dumping it with other wastes, the best way is putting it on the plants."			
FP5: "It can be put in plants, but in such cases, it is often rare."			
FP5: "Maybe, maybe it is not impossible that we can do it so we just segregate it (eggshells)."	Willingness to segregate eggshell waste	Openness to Segregation and Future Practices	
FP3: "That's why we pack it in a trash bag properly because– it can really impact the environment."			
FP4: "So, we don't really get to use it (egg shells) for other purposes anymore."			