Developing a Comprehensive Framework for Food Waste Management in School: An ISM and MICMAC Approach

Siti Nurhafizah Saleeza Ramlee[1*], Megat Azman Megat Mokhtar [2], Siti Norashikin Mohamad Shaifuddin[2], Muhammad Izzat Nor Ma' arof [3], Zarina Kassim[4], Nurhaffiza Rahaman[1], Liley Afzani Saidi[1], Wan Su Emi Yusnita Wan Yusof [1], Siti Humaira Ramli[5]

[1]Department of Management, Faculty of Defence Studies and Management, National Defence University of Malaysia, 57000 Kem Sungai Besi, Kuala Lumpur, Malaysia.

[2]Center of Environmental Health and Safety Studies, Faculty of Health Sciences, University Technology MARA (UiTM), 42300 Puncak Alam, Selangor, Malaysia.

[3]Faculty of Engineering and Quantity Surveying (FEQS), INTI International University, Nilai, Malaysia

[4]Department of logistics,, Faculty of Defence Studies and Management, National Defence University of Malaysia, 57000 Kem Sungai Besi, Kuala Lumpur, Malaysia.

[5]Faculty of Art and Design, UiTM Puncak Alam, 42300 Puncak Alam, Selangor, Malaysia.

***Corresponding Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2025.909000649

Received: 22 September 2025; Accepted: 28 September 2025; Published: 24 October 2025

ABSTRACT

Food waste is a growing global challenge, and schools are a critical setting for fostering sustainable food management behaviors among future generations. This study aims to develop a comprehensive framework for food waste management among school students by integrating six key components: Awareness and Education Campaigns, Student Engagement and Empowerment, Improved Food Service and Meal Planning, Waste Tracking and Monitoring Systems, Composting and Redistribution Programs, and Policy, Collaboration, and Parental Involvement. The research objectives of this paper: (i) to identify and analyze the critical factors influencing food waste generation and management among school students, and (ii) to classify and validate these factors using the Interpretive Structural Modeling (ISM) and MICMAC analysis approach to design a structured framework. A mixed-method design was employed, beginning with a literature review and expert consultation to extract key factors. ISM was then applied to establish hierarchical relationships among the factors, while MICMAC analysis classified them according to their driving and dependence power. The findings reveal that Policy, Collaboration, and Parental Involvement, along with Awareness and Education Campaigns, are strong driving factors, forming the foundation for long-term change. Student Engagement and Empowerment, supported by Improved Food Service and Waste Tracking Systems, serve as linkage factors that reinforce behavioral change. Composting and Redistribution Programs emerge as dependent outcomes, highly influenced by the strength of the other components. The study concludes with a comprehensive framework highlighting interlocking strategies where policy initiatives and education drive systemic transformation, student engagement ensures participation, and technological and environmental initiatives sustain measurable outcomes. This framework provides practical insights for policymakers, educators, and school administrators, offering a structured pathway to reduce food waste and instill sustainable habits among school students.

Keywords: Food Waste Management, Sustainability Framework, School, Interpretive Structural Modeling (ISM), MICMAC Analysis

INTRODUCTION

Food waste management is a critical issue that intersects with environmental sustainability, economic efficiency, and social responsibility. Developing a comprehensive framework for food waste management among school students is essential to address this multifaceted challenge effectively. Early interventions in food waste behaviors are crucial, as wasteful habits formed during youth can persist into adulthood, making it imperative to target school environments for impactful change. School plate food waste contributes significantly to environmental degradation, with global estimates indicating substantial cropland use and greenhouse gas emissions associated with wasted food. Integrating food waste management into school curricula can foster a deeper understanding of food systems, sustainability, and the environmental impacts of waste among students (Feng, et al.,2024; Abadi, et al., 2025). This educational approach can bridge the psychological gap between students and their food consumption behaviors. Effective food waste management in schools requires the collaboration of multiple stakeholders, including families, communities, and policymakers. Engaging these groups can enhance the implementation and success of waste reduction strategies (Feng, et al.,2024; Sehnem, et al., 2023). Understanding the factors that influence students' food waste behaviors, such as moral attitudes, perceived behavioral control, and social norms, is essential for designing effective interventions. (Palmieri, & Palmieri, (2023); Mganga, et al., (2021). Educational programs that address these factors can promote more sustainable behaviors. dopting circular economy principles in school food waste management can provide viable solutions for waste reduction and resource efficiency. This paper adopted an integrated ISM-MICMAC approach to develop the comprehensive framework for food waste management among school students.

LITERATURE REVIEW

Food waste management in schools is a critical issue with significant environmental, economic, and social implications. Addressing this problem requires a comprehensive framework that incorporates educational interventions, behavioral strategies, and stakeholder engagement. This review synthesizes current research on food waste management strategies among school students, highlighting effective interventions and identifying gaps for future research. Studies demonstrate that cooked vegetables were the most wasted food category (between 66 and 83%) during school lunch (Giboreau et al., 2019), while raw vegetables were wasted more than main dishes, starchy products, dairy, fruit and desserts, showing nutrition deficit in children's diet (Aydin & Yildirim, 2021). Food waste causes different kinds of pollution that affect public health and social justice, while contributing to economic losses. The interventions to decrease food waste that have been extensively researched in academic settings include awareness and information campaigns, tray-less dining and portion size reduction (Obuobi et al., 2024). Research has demonstrated that didactic interventions, consisting of informing teachers and pupils and involving pupils in reducing FW, could bring about changes in the level of knowledge and attitude towards FW and in the amount of FW generated during the mid-morning break and lunch at schools (Martín-García et al., 2021). Additionally, studies have assessed change in school-based food waste after training and implementing the Smarter Lunchrooms Movement (SLM) strategies with school food service workers (Prescott et al., 2021). Research has examined various structural interventions to reduce food waste. Studies have tested four interventions (tasting spoons, awareness campaign, a plate waste tracker and a guest forecasting tool) designed to reduce food waste in school canteens (Heikkilä et al., 2022). The literature indicates that environmental modifications can yield positive outcomes, though results vary across different food categories and implementation contexts.

Education plays a pivotal role in reducing food waste among students. Studies have shown that educational campaigns can raise awareness and change attitudes towards food waste. For instance, a study in Italian primary schools found that lessons on the environmental consequences of food waste increased students' environmental concerns, although the impact on actual food waste behavior was short-term (Piras, et al.,2023). Similarly, an intervention in Australian schools that combined educational and skills-based activities led to a reduction in avoidable food waste (Boulet, et al.,2022). Behavioral interventions are essential for changing food waste habits. Effective strategies include displaying informational posters, can also influence students' behavior, although their effectiveness varies. (Dyrbye-Wright, et al., 2025); Pinto,(2018). Engaging multiple stakeholders is crucial for the success of food waste management programs. A study in Indonesia highlighted the importance of collaboration among social media administrators, university managers, and community members in educating

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

students about food waste (Melati, et al.,2024,). Similarly, a study in Romania emphasized the role of diverse stakeholders, including consumers, public administration, and NGOs, in addressing food waste through community-based system dynamics (Archip, et al., (2023). Developing a comprehensive framework for food waste management among school students requires a multi-faceted approach that includes educational interventions, behavioral strategies, and stakeholder engagement. Future research should focus on long-term sustainability, standardized measurement methods, and context-specific adaptations to ensure the effectiveness of food waste reduction programs in schools. By addressing these challenges, schools can play a pivotal role in promoting sustainable food consumption and reducing food waste.

METHODOLOGY

This research uses ISM and MICMAC analysis, with expert opinion included, to find and understand the connection between the strategies of food waste management among school students. Due to these procedures, a hierarchical link among the factors recognized by the experts will emerge. To better assist and resolve complicated problems or systems comprised of several aspects and their interplay, ISM was expanded by Warfield (1974) and Sage (1977). Strategies for group problem-solving that include organized discussion, such as the Nominal Group Technique (NGT), Focus Group Technique (FGT), brainstorming, focus groups, etc., are ideal for implementing ISM (Prasad et al., 2020). The research involved a comprehensive literature review and consultations with industry and academic experts to identify the key strategies that may influence food waste management in school. Six factors of "food waste management strategies" were identified and then "Interpretive Structural Modeling (ISM)" was conducted to map out the intricate network of relationships between these strategies. This analysis provides valuable insights into how each strategy interacts with the others. Further, MICMAC analysis helps categorize the identified factors. An organized hierarchical model may be constructed using the ISM method from a collection of variables or components that may have both direct and indirect effects on each other (Attri, Singh, & Mehra, 2017). Since ISM is a procedure that calls for interpretation and decision-making in groups, it might be considered interpretative. Since ISM simplifies the complicated system or issue's structure, it may be considered structural. Modelling is an integral part of ISM as each model or diagraph represents a different structure. A wide range of fields are making use of ISM, including manufacturing (Singh & Khamba, 2011), education (Muhammad Ridhuan et al., 2014), policy (Kumar et al., 2018), environment (Chandramowli et al., 2011), and the aviation industry (Pitchaimuthy et al., 2019).

The ISM process begins with the identification of variables related to food waste management. Six (6) expert interviews are conducted to determine the relevant variables and to establish contextual relationships among them (Sriwana, et al., 2019). The second stage involves developing a Structural Self-Interaction Matrix (SSIM), where experts define the contextual relationships between identified variables. The SSIM is then converted into a Reachability Matrix (RM). In constructing the SSIM, experts use four symbols to denote the type of relationship between variable pairs:

•V: Variable i influences variable j (but not vice versa).
•A: Variable j influences variable i (but not vice versa).
•X: Variables i and j influence each other.
•O: No relationship exists between variables i and j

Table 1: list of Expert

No.	Expert	Academic qualification	Field of expertise	Expert experiences
1.	Exp1	PhD	Environmental health and safety	10 years
2.	Exp2	PhD	Food safety	5 years
3.	Exp3	PhD	Waste management	6 years
4.	Exp4	Master	Environmental health and safety	16 years
5.	Exp5	Master	Food management	8 years
6.	Exp6	Master	Waste management	5 years

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

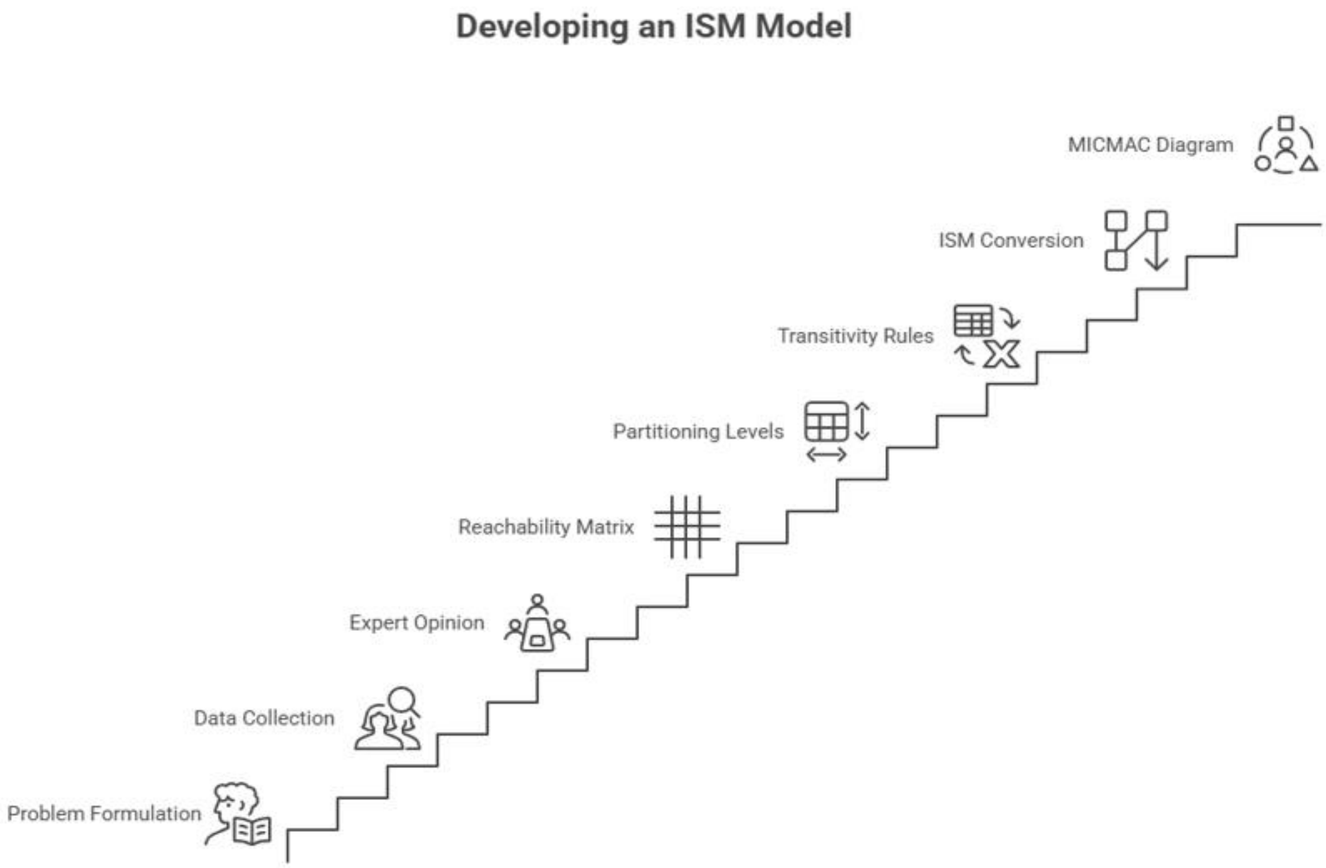

Figure 1: ISM steps

FINDINGS

This Structural Self-Interaction Matrix (SSIM) Table 2 maps the relationships between six key variables in what appears to be a school food waste reduction program. The matrix uses symbols to indicate how each variable influences others: "X" represents a strong direct relationship, "V" indicates the row variable influences the column variable, and "A" means the column variable influences the row variable. The analysis reveals a hierarchical structure where foundational elements like awareness campaigns and student engagement (variables 1-2) have broad influence across multiple other variables, improved food service and meal planning (variable 3) serves as a central connecting element that both influences and is influenced by other factors, while more operational elements like waste tracking systems and composting programs (variables 4-5) are primarily influenced by the earlier variables rather than driving change themselves. The policy and collaboration variable (variable 6) appears to be influenced by all other factors, suggesting it represents an outcome or overarching framework that emerges from the successful implementation of the other program components.

Table 2. Structural Self-Interaction Matrix (SSIM) for Critical Factors

Variables	1	2	3	4	5	6
Awareness and education campaigns		X	X	V	A	A
Student Engagement and Empowerment			X	X	V	A
Improved food service and meal planning				X	V	A
Waste tracking and monitoring systems					X	A
Composting and redistribution programs						X
Policy, collaboration, and parental involvement						

The Reachability Matrix (RM)(Table 3) shown here analyzes the interrelationships between six variables aimed at reducing food waste in what appears to be an educational or institutional setting. Each variable is assessed for its ability to influence others (driving power, shown in the rightmost column) and its dependence on other

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

variables (dependence power, shown in the bottom row). The matrix uses binary values (1 or 0) to indicate whether one variable can directly reach or influence another. "Policy, Collaboration, and Parental Involvement" emerges as the most influential factor with the highest driving power (6), suggesting it can impact all other variables, while "Student Engagement and Empowerment" and "Improved Food Service and Meal Planning" also show strong driving power (5 each). Conversely, "Policy, Collaboration, and Parental Involvement" has relatively low dependence (2), indicating it operates somewhat independently, while most other variables show moderate to high dependence (5-6) on the system's other components, suggesting they are more interconnected and rely on other factors for their effectiveness.

Table 3: Reachability Matrix(RM)

Variables	1	2	3	4	5	6	Driving power
Awareness and education campaigns	1	1	1	1	0	0	4
Student Engagement and Empowerment	1	1	1	1	1	0	5
Improved food service and meal planning	1	1	1	1	1	0	5
Waste tracking and monitoring systems	0	1	1	1	1	0	4
Composting and redistribution programs	1	0	0	1	1	0	4
Policy, collaboration, and parental involvement	1	1	1	1	1	1	6
Dependence Power	5	5	5	6	5	2	

The Level Partitioning (LP) Table 4 analysis reveals that all six elements in this food waste reduction system are completely interconnected and interdependent, as evidenced by identical reachability sets, antecedent sets, and intersection sets across all variables. Each element can reach all others (reachability set contains 1,2,3,4,5,6), is influenced by all others (antecedent set contains 1,2,3,4,5,6), and the intersection of these sets encompasses all elements, resulting in every variable being assigned to Level 1. This finding indicates a highly integrated system where awareness campaigns, student engagement, food service improvements, waste tracking, composting programs, and policy collaboration are so tightly coupled that they function as a unified whole rather than a hierarchical structure with distinct levels of influence. The absence of multiple levels suggests that effective food waste reduction requires simultaneous implementation and coordination of all these elements, as none can be considered a prerequisite or driver that should be prioritized before others.

Table 4: Level Partitioning (LP)

Elements (Mi)	**Reachability set R (Mi)**	**Antecedent Set A(Ni)**	**Intersection Set R(Mi) Ω A (Ni)**	**Level**
1	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1
2	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1
3	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1
4	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1
5	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1
6	1,2,3,4,5,6,	1,2,3,4,5,6,	1,2,3,4,5,6,	1

The MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) figure 2 diagram reveals that all six food waste reduction variables (1,2,3,4,5,6) are positioned in Quadrant III, which represents "Linkage Variables" characterized by high dependence power (6) and high driving power (6). This clustering indicates that all variables in the system are highly interconnected, possessing both strong influence over other elements and high sensitivity to changes in the system. The absence of variables in other quadrants (I - Autonomous, II - Dependent, IV - Independent) suggests there are no isolated factors, purely dependent outcomes, or independent drivers in this food waste reduction framework. This finding reinforces the earlier level partitioning results, confirming that awareness campaigns, student engagement, food service improvements, waste tracking systems, composting programs, and policy collaboration function as a tightly integrated network where each element simultaneously drives and depends on all others, making the system highly dynamic and requiring coordinated management of all components for effective implementation.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

MICMAC

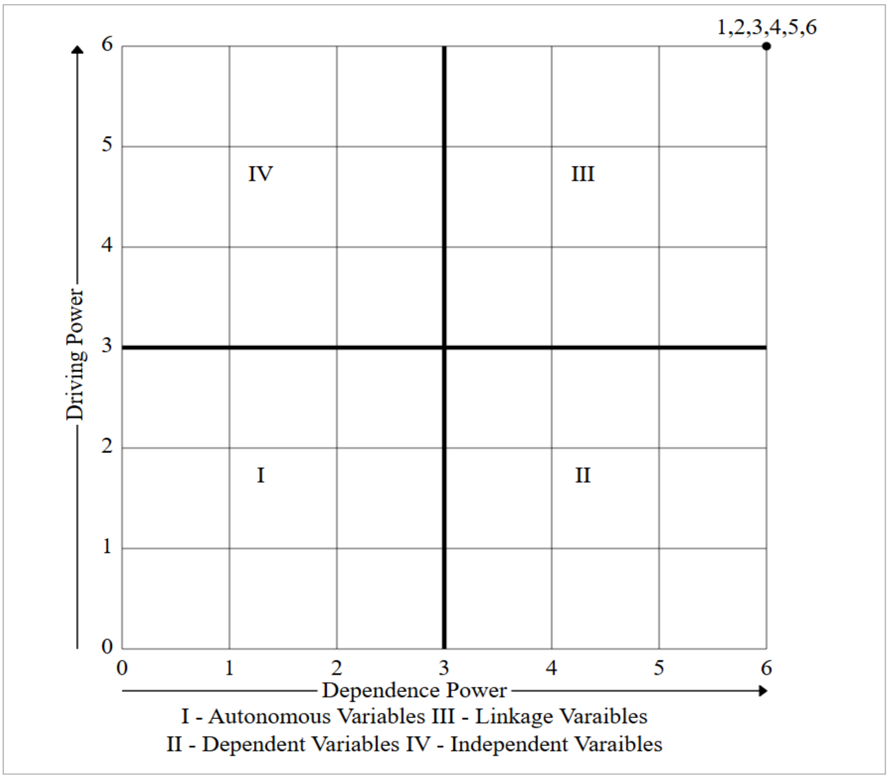

Figure 2: MIMAC Analyse

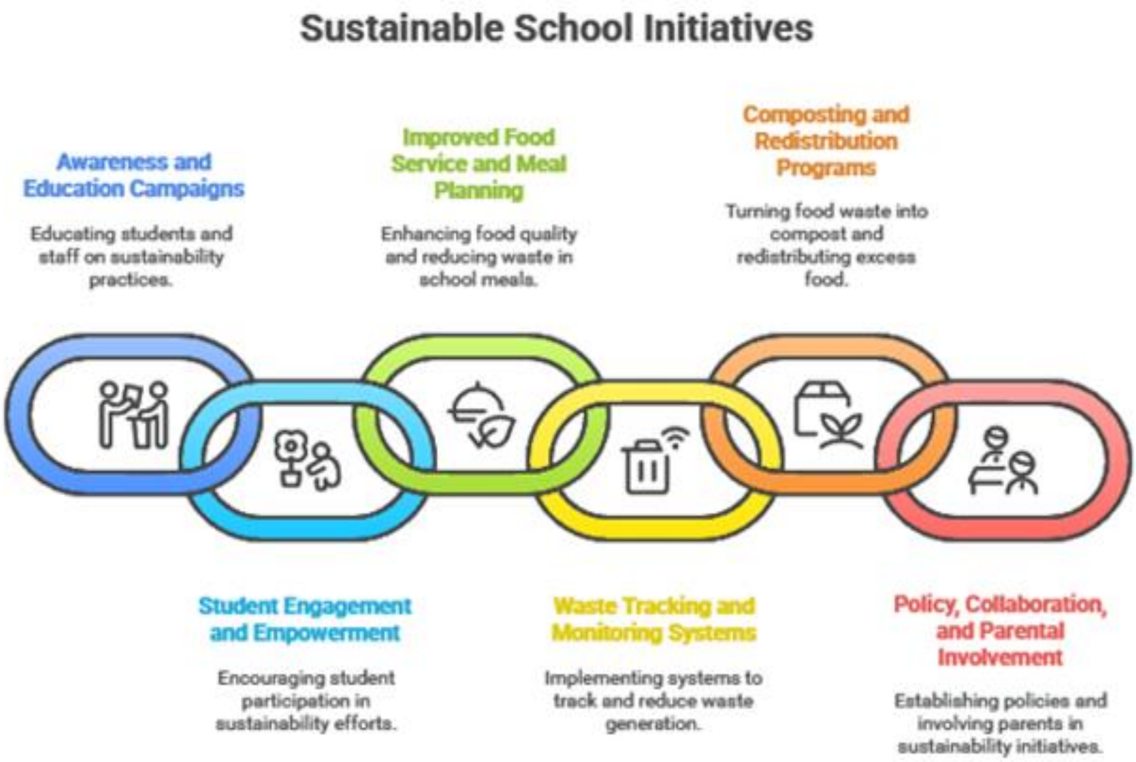

Figure 3: Sustainable school Initiatives

Figure 3 illustrates the interconnected nature of sustainable school food waste reduction initiatives through a chain-link visualization that reinforces the findings from the previous analyses. The six key components are represented as interlocking links: Awareness and Education Campaigns (educating students and staff on sustainability practices), Student Engagement and Empowerment (encouraging student participation in

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

sustainability efforts), Improved Food Service and Meal Planning (enhancing food quality and reducing waste in school meals), Waste Tracking and Monitoring Systems (implementing systems to track and reduce waste generation), Composting and Redistribution Programs (turning food waste into compost and redistributing excess food), and Policy, Collaboration, and Parental Involvement (establishing policies and involving parents in sustainability initiatives). The chain metaphor effectively demonstrates that these initiatives are only as strong as their weakest link, emphasizing that successful sustainable school food waste reduction requires all components to work together harmoniously. This visual representation aligns with the MICMAC analysis showing all variables as highly interconnected linkage variables, suggesting that breaking any single link would compromise the entire system's effectiveness in achieving sustainable food waste reduction goals.

DISCUSSION AND CONCLUSION

The findings of this research provide significant insights into the complex nature of food waste management in educational institutions, revealing a highly integrated system that challenges traditional linear approaches to intervention design. The ISM and MICMAC analysis demonstrates that the six identified variables - awareness campaigns, student engagement, food service improvements, waste tracking, composting programs, and policy collaboration - function as a unified ecosystem rather than independent factors. This finding aligns with previous research by Martín-García et al. (2021), who emphasized that didactic interventions involving both teachers and pupils could bring about changes in knowledge and attitudes towards food waste, suggesting the importance of comprehensive rather than isolated approaches.

The complete interconnectedness revealed in the level partitioning analysis, where all variables achieved Level 1 classification with identical reachability and antecedent sets, indicates that effective food waste reduction in schools requires simultaneous attention to all components. This finding challenges the conventional wisdom of prioritizing certain interventions over others and supports the holistic approach suggested by Heikkilä et al. (2022), who tested multiple interventions including tasting spoons, awareness campaigns, plate waste trackers, and guest forecasting tools, finding that environmental modifications yield positive outcomes when implemented comprehensively across different contexts.

The positioning of all variables in MICMAC Quadrant III as linkage variables with high driving power and high dependence suggests that the school food waste system is inherently dynamic and sensitive to changes in any component. This finding has important implications for intervention design, as it indicates that partial implementation or neglect of any single component could compromise the entire system's effectiveness. The research supports Prescott et al. (2021), who demonstrated that training interventions with school food service workers using Smarter Lunchrooms Movement strategies were most effective when implemented as part of comprehensive programs rather than standalone initiatives.

The theoretical framework of Structural Strain Theory provides additional context for understanding why comprehensive approaches are necessary. The theory's emphasis on the disconnect between culturally prescribed goals and socially acceptable means helps explain why food waste reduction efforts must address multiple structural factors simultaneously. Students may understand the importance of reducing food waste (cultural goal) but lack the means, awareness, or systemic support to achieve this goal effectively, creating strain that can only be addressed through coordinated interventions across all identified variables.

The proposed framework for food waste management in schools integrates six interdependent components that together provide a systemic pathway for reducing food waste and cultivating sustainable habits. However, translating this framework into practice presents several challenges. Schools often operate under resource constraints, with limited financial capacity, infrastructural support, and human resources to implement comprehensive waste management systems. Moreover, competing academic priorities and rigid institutional routines may hinder the integration of new initiatives into daily practice.

To address these challenges, the framework may be operationalized in a phased implementation strategy. Initial emphasis could be placed on Awareness and Education Campaigns and Policy, Collaboration, and Parental Involvement, as these require relatively fewer financial resources but yield strong foundational impacts. Once awareness and support structures are established, schools can gradually introduce Student Engagement and

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

Empowerment initiatives through student clubs, competitions, or integration into curricula. In the next phase, low-cost waste tracking methods (e.g., manual logs or mobile-based reporting) can be adopted before scaling up to digital monitoring systems. Finally, Composting and Redistribution Programs can be piloted in selected schools with external collaboration such as partnerships with local NGOs, municipal authorities, or food banks before broader adoption

The research findings also highlight the critical role of policy, collaboration, and parental involvement as demonstrated by its high driving power in the reachability matrix. This aligns with existing literature suggesting that sustainable change in educational institutions requires stakeholder involvement beyond the school environment. However, the finding that this variable also shows interconnectedness with all other components reinforces that policy changes alone are insufficient without corresponding improvements in awareness, student engagement, food service quality, monitoring systems, and waste management programs.

FURTHER DIRECTIONS

Future research should focus on developing implementation strategies that account for the highly integrated nature of school food waste reduction systems revealed in this study. Longitudinal studies are needed to examine how simultaneous implementation of all six identified variables affects food waste reduction outcomes compared to sequential or partial implementation approaches. Such research would provide empirical validation of the theoretical framework developed through ISM and MICMAC analysis and offer practical guidance for educational institutions seeking to implement comprehensive food waste reduction programs. Investigation into the cultural and contextual factors that influence the interconnectedness of these variables across different educational settings represents another critical research direction. While this study establishes the theoretical framework for understanding variable relationships, future research should examine how factors such as school size, socioeconomic demographics, geographic location, and existing infrastructure affect the strength and nature of these interconnections. Such research would enable the development of context-specific implementation strategies while maintaining the comprehensive approach indicated by the current findings.

The development and validation of measurement instruments specifically designed to assess the integrated nature of school food waste reduction initiatives presents an important methodological advancement opportunity. Current research often evaluates interventions in isolation, but the findings of this study suggest that measurement approaches should account for the synergistic effects of multiple simultaneous interventions. Future research should develop metrics that capture system-level changes rather than component-level outcomes, providing more accurate assessments of program effectiveness.

Research into the economic implications of comprehensive versus partial implementation approaches would provide valuable insights for educational administrators and policymakers. While the current study establishes that all components are necessary for effective food waste reduction, future research should examine the cost-benefit relationships of different implementation strategies, including the potential costs of partial implementation failure versus the investment required for comprehensive programs. The role of technology in facilitating the integration of the six identified variables represents an emerging research area with significant practical implications. Future studies should explore how digital platforms, mobile applications, and automated monitoring systems can support the coordination and integration of awareness campaigns, student engagement, food service improvements, waste tracking, composting programs, and policy implementation. Such research could lead to the development of technological solutions that make comprehensive implementation more feasible for educational institutions with limited resources.

REFERENCES

1. Abadi, M. N. P., Basrowi, R. W., Gunawan, W. B., Arasy, M. P., Nuriah, F., Sundjaya, T., ... & Nurkolis, F. (2025). Unraveling Future Trends in Free School Lunch and Nutrition: Global Insights for Indonesia from Bibliometric Approach and Critical Review. Nutrients, 17(17), 2777
2. Archip, B. C., Banatean-Dunea, I., Petrescu, D. C., & Petrescu-Mag, R. M. (2023). Determinants of food waste in Cluj-Napoca (Romania): a community-based system dynamics approach. International Journal of Environmental Research and Public Health, 20(3), 2140.

3. Aydin, A. E., & Yildirim, P. (2021). Primary school children's responses to food waste at school. British Food Journal, 124(4), 1077-1095. https://doi.org/10.1108/BFJ-06-2021-0608
4. Boulet, M., Grant, W., Hoek, A., & Raven, R. (2022). Influencing across multiple levels: The positive effect of a school-based intervention on food waste and household behaviours. Journal of Environmental Management, 308, 114681.
5. Cohen, J. F., Richardson, S., Austin, S. B., Economos, C. D., & Rimm, E. B. (2013). School lunch waste among middle school students: Implications for nutrients consumed and food waste costs. American Journal of Preventive Medicine, 44(2), 114-121.
6. Cohen, J. F., Richardson, S., Parker, E., Catalano, P. J., & Rimm, E. B. (2014). Impact of the new US Department of Agriculture school meal standards on food selection, consumption, and waste. American Journal of Preventive Medicine, 46(4), 388-394.
7. Dyrbye-Wright, O., Stull, V. J., Grabow, M. L., & Patz, J. (2025). Strategies to Curb Food Waste on University Campuses: A Scoping Review. Journal of Sustainability Research, 7(2).
8. Feng, L., Luo, R., Liu, X., Prescott, M. P., Li, W., Song, J., & Yang, Y. (2024). Global school plate waste estimates highlight the need for building a sustainable food education system. Nature Food, 5(10), 860-868.
9. Giboreau, A., Schwartz, C., Morizet, D., Kanard, F., Nicklaus, S., Fischler, C., & Hartmann, C. (2019). Measuring food waste in a school canteen using the quarter-waste method. Journal of Visualized Experiments, 153, e59026.
10. Heikkilä, L., Reinikainen, A., Katajajuuri, J. M., Silvennoinen, K., & Hartikainen, H. (2022). Testing interventions to reduce food waste in school catering. British Food Journal, 124(1), 250-265.
11. Kodors, S., Zvaigzne, A., Litavniece, L., Lonska, J., Silicka, I., Kotane, I., & Deksne, J. (2022). Plate waste forecasting using the Monte Carlo method for effective decision making in Latvian schools. Nutrients, 14(3), 587.
12. Martín-García, A., Gómez-Navas, A., Nolasco, A., & Piqueras-Fiszman, B. (2021). Promoting food waste reduction at primary schools. A case study. Sustainability, 13(2), 600.
13. Mganga, P., Syafrudin, S., & Amirudin, A. (2021). A survey of students' awareness on food waste problems and their behaviour towards food wastage: A case study of Diponegoro University (UNDIP), Indonesia. In E3S Web of Conferences (Vol. 317, p. 01071). EDP Sciences.
14. Melati, I. S., Wahjoedi, Mukhlis, I., & Wahyono, H. (2024,). Strategic Steps for Zero Waste: A University Student-Driven Approach to Food Waste Management Through Actor Analysis. In International Conference on Green Energy and Environment Engineering (pp. 73-87). Cham: Springer Nature Switzerland.
15. Molinos Solsona, M. (2024, April). Reducing our school's carbon footprint through composting the canteen food waste. In EGU General Assembly Conference Abstracts (p. 4734).
16. Sehnem, S., Godoi, L., Simioni, F., Martins, C., Soares, S. V., de Andrade Guerra, J. B. S. O., & Provensi, T. (2023). Management food waste in municipality schools: an analysis from a circular economy perspective. Logistics, 7(2), 20.
17. Obuobi, B., Zhang, Y., Agyeman, F. O., Kesse-Guyot, E., Feng, S., & Appiah, G. (2024). Interventions for reducing food waste and behavioural change among students in higher education institutions – A systematic review. Cleaner and Responsible Consumption, 13, 100170.
18. Palmieri, N., & Palmieri, S. (2023). The educational civic path in southern Italy: What determines behaviors toward food waste among students in Campania region?. Journal of International Food & Agribusiness Marketing, 35(5), 695-725.
19. Piras, S., Righi, S., Banchelli, F., Giordano, C., & Setti, M. (2023). Food waste between environmental education, peers, and family influence. Insights from primary school students in Northern Italy. Journal of Cleaner Production, 383, 135461.
20. Prescott, M. P., Cleary, R., Bonanno, E., Costello, C., Ang, I. Y., & Otten, J. J. (2021). Food waste in schools: A pre-/post-test study design examining the impact of a food service training intervention to reduce food waste. Nutrients, 13(7), 2358.
21. Prescott, M. P., Otten, J. J., Cleary, R., & Schwartz, M. B. (2024). Strategies to address food waste in K-12 schools: A narrative review. School Nutrition Association Journal, Spring 2024Pinto, R. S., dos Santos Pinto, R. M., Melo, F. F. S., Campos, S. S., & Cordovil, C. M. D. S. (2018). A simple awareness campaign to promote food waste reduction in a university canteen. Waste management, 76, 28-38.

22. Smith, S. L., & Cunningham-Sabo, L. (2014). Food choice, plate waste and nutrient intake of elementary-and middle-school students participating in the US National School Lunch Program. Public Health Nutrition, 17(6), 1255-1263.
23. Sriwana, I. K., Menanno, M., Arkeman, Y., Marimin, M., Shafiq, M., & Islam, M. A. (2019). Supply improvement of cacao agro-industry using an Interpretive Structural Modelling (ISM): A case study of cacao supply from Indonesia. Proceedings of the Summer School Francesco Turco, 424-430.
24. Yen, D. A., Cappellini, B., & Dovey, T. (2022). Primary school children's responses to food waste at school. British Food Journal, 124(13), 109-125.