Urban Community Engagement to Reduce and Prevent Food Waste at Household Level

Whisnu Febry Afrianto1*, Taufiq Hidayatullah2, Laeli Nur Hasanah3, Rivandi Pranandita Putra4, Rindang Diannita5, Ratih Anggraini6

1Ecosystem and Biodiversity Indonesia (Ecosbio), Jl. Merapi 02/01, Datengan, Grogol, Kediri, 64151, Indonesia
2Agricultural Development Polytechnic of Medan, Jl. Binjai Km. 10, North Sumatra, Indonesia
3Departement of Nutrition, Faculty of Science and Technology, Universitas PGRI Yogyakarta.Jl. IKIP PGRI I Sonosewu No.117, Yogyakarta, Indonesia.
4Pre-Harvest Department, Indonesian Sugar Research Institute. Jl. Pahlawan No 25, Pasuruan, East Java, 67126, Indonesia
5Occupational Safety and Health Department, Faculty of Health Science, Universitas Darussalam Gontor. Jalan Raya Siman, Ponorogo, East Java, 63471, Indonesia
6Departement of Tourism, Faculty of Economy, Universitas International Batam, Jl. Gadjah Mada, Sei Ladi, Batam, Kepulauan Riau, 29422, Indonesia

*Corresponding Author:
Email: whisnu.afrianto@gmail.com

Abstract.
Indonesia faces a food waste problem, particularly at the household level. Food waste causes negative impacts on several aspects such as environment, society, and economy. Ironically, at the same time, Indonesia also has a serious hunger problem. Through community development programs, we aimed to empower households in recycling their food waste by eco enzyme and their awareness through an online challenge. Eco enzyme is an affordable and useful method to recycle food waste being a liquid product with many benefits such as insect repellent, organic fertilizer, general cleaner, air purifier, and laundry cleaner. The total participants of the eco enzyme workshop were 57 people. On the other hand, through an online campaign #MelawanFoodWate, 101 users took action to be conscious customers in shopping behavior. These activities were in collaboration with several stakeholders to ensure the success of the program. These programs can be considered an initiation to develop Food Smart City that focuses on the community-based movement and circular economy.

Keywords: Eco enzyme, food waste, household, online campaign, urban communities

I. INTRODUCTION

According to the Food and Agriculture Organization of the United Nations (FAO), about one-third of the food produced does not end up on our plates. It even is thrown to the trash [1]. The Economist & Intelligence Unit [2] stated that Indonesia is the second-largest country after Saudi Arabia, which produces food waste and food loss in the world. This phenomenon may leads to an adverse impacts on the economy, the environment that contributes to greenhouse gas emissions, as well as nutrition losses [3];[4];[5];[6];[7];[8].From 60% of total waste in Indonesia, only 7.5 of them are

https://ijcsnet.id
being processed [9]. However, the precise data about it is still limited in developing countries, such as Indonesia [10]. The total food waste in developing countries is lower than in developed countries. For example, the comparison of the amount of food waste between Europe, North America, and South/Southeast Asia is estimated at 95 kg, 115 kg, and 11 kg per annum, respectively [11]. At household level, they contribute approximately half of the total food waste [12];[13];[14];[15].

Consumer behaviour that is easily tempted with shopping promotion or product’s discount of triggering food waste at the household level [16]. Indonesia ranks 70 out of 119 countries with index hunger score 21.9, behind other Southeast Asia countries such as the Philippines, Cambodia, Thailand, Malaysia, and Vietnam [17]. World Food Programmes [18] reported that 19.4 million of Indonesian people facing malnutrition issues. In addition, the percentage of stunted children under five years old was 29%. This number of stunting was equal to 63% of total stunted children in Southeast Asia [19]. The gap between food waste and hunger problems can threaten food security in a country [20]. Research reports show that food waste can be significantly decreased by campaign and action to change the behaviour of customers [21];[22]. To develop a way of reducing food waste, particularly at the household level, we have realized community engagement through online and offline methods. The community development programs aim to empower households for recycling food waste in simple ways and improve awareness through an online challenge.

II. METHODS

2.1. Community Engagement Framework

Urban communities were being our focal target in this program as they often produce a greater amount of food waste than rural citizens at the household level (Figure 1). To cover this issue, we developed a workshop and campaign for urban communities to manage their food waste. The following four parameters were used as pillars of our programs, i.e.:

1. Availability: The physical availability of the material used
2. Accessibility: Programs should be simple and considerate the socio-economic aspects of participants
3. Utilization: The programs bring positive impacts to the community
4. Sustainability: Programs can be sustained and reduplicated

The success of the four parameters can be achieved by collaboration with as many stakeholders related (Figure 2). As the first step, we performed stakeholders mapping with conducting to differentiate, identify, investigate, and categorize the link between relevant stakeholders. We use the matrix of interest-influence that has four criteria (i.e., victims, stakeholders who can make differences, stakeholders who need to be made more responsible, and bystanders). Two axes were used based on the process of contrasting and comparing the selected initiative. A matrix for stakeholder analysis was formulated with the x-axis of used approaches, conventional (left) and digital.
(right), as well as y-axis of main categories, non-governmental organization (NGO’s) (top) and startups/private sectors (bottom) [23].

**Fig 1.** Outcomes of programs to urban community engagement

The curriculum used in the workshop was The Golden Circle theory [24]. We started with the question of "why" (questions of the purpose). It is crucial to ensure participants understand the danger of food waste, as seen from environmental, social, and economic perspectives. Therefore, they know the reasons why they should make the eco enzyme and participate in the online challenge. The second was the question of "how" (questions of the process). This was correlated with the production process, application, tips, and do-do not regarding eco enzyme and online challenge. The last was the question of "what" (questions of the product). In this part, the participants can understand the benefits of the eco enzyme and the online challenge.

2.2. **Do It Yourself: Eco-enzyme**

We organized a workshop to train urban citizens regarding eco-enzyme. We conducted this workshop in @america, Jakarta. Eco-enzyme, which can also be called as a garbage enzyme, is the fermentation of fresh produce waste at home invented in 2006 by Dr. Rosukon Poompanyong, the founder of the Organic Agriculture Assosiation of Thailand (OAT), as his effort to fight global warming. Eco -enzyme is a vinegar-like liquid can be obtained after three months of fermentation process using

https://ijcsnet.id/
organic solid waste [25]; [26]. Decomposing fruits and vegetables to eco enzyme can be alternative to reduce greenhouse gases (methane and nitrous oxide) [27]; [28].

### 2.3. Online Challenge

#MelawanFoodWaste challenge (Figure 3) was conducted by using the Campaign #ForChange mobile phone application, which can be downloaded in Google Play Store or App Store. Campaign #ForChange is a platform connecting public, communities, and funders regarding social issues. The challenge was conducted in September 2019 to April 2020 and introduced by three events such as (1) tanipanen launching, (2) 20 social actions for 2020, and (3) Happiness Festival. The procedures of the challenge were:

1. Download Campaign #ForChange in Playstore or Appstore.
2. Click “Challenge #MelawanFoodWaste”.
3. Upload pictures of a shopping to-do list prior to going to the supermarket. It can be a daily, weekly, or even monthly list.
4. Encourag people to reduce food waste in caption column with making a shopping to-do list before going to the supermarket.
5. Share the post to encourage the other people for joining this challenge.

![Fig 3. Poster of challenge #MelawanFoodWaste in Campaign #ForChange](https://iicsnet.id/)
3. Mix all ingredients into a bottle of mineral water.
4. Close a bottle of mineral water and leave it for three months in a sheltered space.
5. Open the container every once a week to release the trapped gasses and to prevent an explosion.
6. After three months, the color of eco enzyme will be a dark brown color with a vinegary smell.
7. Filter the liquid from the organic waste residue. This waste residue can be used for fertilizer and the liquid component for the eco enzyme.

**Table 1.** Enzyme from Fruits and vegetables waste

| Enzyme | Fruits and Vegetables | References |
|--------|----------------------|------------|
| Amylase | Cabbage, potato and pumpkin, mosambi, pomegranate, pineapple, papaya, citrus, tomato | Neupane & Khadka, 2019; Rasit et al., 2019; Rahman et al., 2020 |
| Lipase | Cabbage, potato, pumpkin, pomegranate, citrus, tomato | Neupane & Khadka, 2019; Rasit et al., 2019; Rahman et al., 2020 |
| Protease | Cabbage, potato and pumpkin, citrus, tomato | Rasit et al., 2019; Rahman et al., 2020 |
| Caseinase | Mosambi, pomegranate, pineapple, papaya | Neupane & Khadka, 2019 |

Eco enzyme has great potency as biocatalytic and antimicrobial solution [33]; [34]; [35]; [36]; [37]. Investigation of antimicrobial activities showed that eco-enzyme inhibited Escherichia coli, Staphylococcus aureus, Rhizobium leguminosarum, Salmonella Typhi, Shigella spp., and Pseudomonas aeruginosa [38]; [39]; [40]. A variety of eco enzyme from fruits and vegetables waste also contains several enzymes such as amylase, protease, cellulase, lipase, and caseinase (Table 1) [41]; [42]; [43]. Eco enzyme can be used as an insect repellent, organic fertilizer, general cleaner, air purifier, and laundry cleaner [44]; [45]; [46]; [47]. In India, there was a campaign called “mana ooru mana neeru”, which aimed to clean water bodies by using eco enzyme.

Three months after campaign, there was a significantly change in the dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD) of the pond added with eco enzyme [48]. It experiments using eco enzyme as an addition to sewage water, the condition of sewage water changed clean [49]. Eco enzyme can reduce the percentage of COD of 77%, total suspended solids (TSS) of 87%, total phosphorus (TP) of 99%, volatile suspended solids (VSS) of 67%, and total ammonia nitrogen (TAN) of 91% [50]. The eco enzyme also significantly reduced
solids from 884 to 745, pH from 6.7 to 7.2, suspended solids from 121 to 47 hardness, and chlorides [51].

3.2. Online Challenge #MelawanFoodWaste

Up to January 2020, the total of internet users in Indonesia reached + 175.4 M, and this number increased by +17% between 2019 and 2020. In average, Indonesian users spend 7 hours 59 minutes of their time each day to access the internet, which is longer than globally [52]. This fact can be an opportunity, particularly in a social campaign to reach massive audiences and boarder scope. For instance, several countries organize food waste campaigns, such as WRAP in the United Kingdom with "Love Food Hate Waste" and the collaboration of the United Nations Environment Programmes (UNEP), FAO, and Messe Dusseldorf with "Think. Eat. Save" [53].

![Figure 4. Workshop DIY Eco enzyme with citrus peels and apple pomace](image)

101 users took action in the online challenge #MelawanFoodWaste. We counted six users who took double action. Besides, five users come from organizations, so we did not count it. If it is categorized by gender, 62% of users were female, and 40% of users were male (Figure 5). It depicts that shopping is still a female’s domestic stuff. The users were dominated by millennials and gen Z. Generally, they are a digital generation and also have a concern in social issues [54]. In the stage of awareness, users posted the shop list in the application where people mostly wrote in a note in their handphone (Figure 6). This campaign was also crowdfunding action, whereas every action will convert to IDR 5,000 and every 100 users will receive an additional IDR 500,000. The utilization of the result of crowdfunding depends on the community.

![Figure 5. Percentage of users in the online challenge #Melawan Food Waste based on gender](image)
This campaign is necessary because individual awareness is a critical factor preventing food waste [55]; [56].

![Shopping list of users in application of Campaign#ForChange](image)

**Fig 6.** Shopping list of users in application of Campaign#ForChange

IV. CONCLUSION

Some activities to improve awareness of the urban community on food waste issues in Indonesia had been done through eco enzyme offline workshop and online challenge #MelawanFoodWaste. As 57 participants of the eco enzyme workshop and 108 users, the online campaign has involved in both activities. The result of crowdfunding will be used to support our other social activates. It is recommended for the cities government and related stakeholders to establish a system of Food Smart City. Under this system, waste is managed by (1) a circular economy concept that processes organic waste to the other utilizations such as energy, compost, and feeding livestock, (2) food bank to distribute surplus food to marginal communities, and (3) citizen empowerment to recycle or process their food waste to reduce food waste.

V. ACKNOWLEDGMENTS

These social activities were bolstered by @america and campaign.com. They provided facilities and funding to organize the programs.

REFERENCES

[1] Gustavsson, J., Cederberg, C., Sonesson, U., Otterdijk, R. Van, & Meybeck, A. (2011). Food loss and food waste: Causes and solutions. In Food Loss and Food Waste: Causes and Solutions. Rome, Italy: Food and Agriculture Organization of the United Nations.

[2] The Economist & Intelligence Unit. Food Sustainability Index 2017. (2017). Emilia-Romagna, Italy: Barilla Center for Food and Nutrition.

[3] Visschers, V.H.M, Wickli, N., Siegrist, M. (2016). Sorting out food waste behaviour: a survey on the motivators and barriers of self-reported amounts of food waste in households. Journal of Environmental Psychology.
[4] Cronje, N., der Merwe, I.V., & Muller, I.M. (2018). household food waste: a case study in Kimberley, South Africa. Journal of Consumer Sciences, 46, 1–9. doi.org/10.1016/b978-0-08-100596-5.03368-0

[5] Schaner, K., Dobernig, K., Gozet, B. (2018). Food waste matters - a systematic review of household food waste practices and their policy implications. Journal of Cleaner Production, 182, 978–991.

[6] Berjia, S., Mrdalj, V., El bilali, H., Velirovic, A., Blagojevic, Z., Bottalico, F., Debs, P., & Capone, R. (2019). Household food waste in Montenegro. Ital. J. Food Sci. 31(2), 274–287. doi.org/10.14674/IJFS-1276

[7] Chalak, A., Abiad, M.G., Diab, M., & Nasreddine, L. (2019). The determinants of household food waste generation and its associated caloric and nutrient losses: the case of Lebanon. PLoS One 14(12), 1–18. doi.org/10.1371/journal.pone.0225789

[8] Von Massow, M., Parizeau, K., Gallant, M., Wickson, M., Haines, J., Ma, D.W.L., Wallace, A., Carroll, N., & Duncan, A. M. (2019). Valuing the Multiple Impacts of Household Food Waste. Frontiers in Nutrition, 6(143), 1-17. doi.org/10.3389/fnut.2019.00143

[9] CNN. (25 April, 2018). Riset: 24 Persen Sampah di Indonesia Masih Tak Terkelola. Retrieved from https://www.cnnindonesia.com/gaya-hidup/20180425101643-282293362/riset-24-persen-sampah-di-indonesia-masih-tak-terkelola

[10] Oelofse, S., Muswema, A., & Ramukhwatho, F. (2019). Household food waste disposal in South Africa: a case study of Johannesburg and Ekurhuleni. South African Journal of Science, 114(5), 1–6.

[11] Gustavsson, J., Cederberg, C., Sonesson, U., Otterdijk, R. Van, & Meybeck, A. (2011). Food loss and food waste: Causes and solutions. In Food Loss and Food Waste: Causes and Solutions. Rome, Italy: Food and Agriculture Organization of the United Nations.

[12] Schaner, K., Dobernig, K., Gozet, B. (2018). Food waste matters - a systematic review of household food waste practices and their policy implications. Journal of Cleaner Production, 182, 978–991.

[13] Stancua, V., Haugaarda, P., & Lähteenmäki, L. (2016). Determinants of consumer food waste behaviour: two routes to food waste. Appetite, 9, 7–17. doi.org/10.1016/j.appet.2015.08.025.

[14] van der Werf, P., Seabrook, J.A. & Gilliland, J.A. (2019). Reduce food waste, save money: testing a novel intervention to reduce household food waste. Environment and Behavior, 1–33. doi.org/10.1177/0013916519875180

[15] Visschers, V.H.M, Wickli, N., Siegrist, M. (2016). Sorting out food waste behaviour: a survey on the motivators and barriers of self-reported amounts of food waste in households. Journal of Environmental Psychology, 45, 66–78. doi.org/10.1016/j.jenvp.2015.11.007

[16] Chalak, A., Abiad, M.G., Diab, M., & Nasreddine, L. (2019). The determinants of household food waste generation and its associated caloric and nutrient losses: the case of Lebanon. PLoS One 14(12), 1–18. doi.org/10.1371/journal.pone.0225789

[17] von Grebmer, K., Bernstein J., Patterson, F., Miriam, W., Chéilleachair, R.N, Foley, C., Gitter, S., Ekstrom, K., & Fritschel, H. (2019). 2019 Global Hunger Index: The

https://ijcsnet.id/
challenge of hunger and climate change. Bonn: Concern Worldwide and Welthungerhilfe.

[18] World Food Programme (WFP). (2017). Indonesia Country Strategic Plan (2017 – 2020). Rome, Italy: World Food Programme.

[19] Food and Agriculture Organization of the United Nations (FAO). (2018). Asia and the Pacific Regional overview of food security and nutrition: accelerating progress towards the SDGs. Bangkok, Thailand: Food and Agriculture Organization.

[20] Cronje, N., der Merwe, I.V., & Muller, I.M. (2018). Household food waste: a case study in Kimberley, South Africa. Journal of Consumer Sciences, 46, 1–9. doi.org/10.1016/b978-0-08-100596-5.03368-0

[21] Annunziata, A., Agovino, M., Ferraro, A., & Mariani, A. (2015). Household food waste: a case study in Southern Italy. Sustainability, 112(4), 1–13. doi.org/10.3390/su12041495.

[22] van der Werf, P., Seabrook, J.A. & Gilliland, J.A. (2019). Reduce food waste, save money: testing a novel intervention to reduce household food waste. Environment and Behavior, 1–33. doi.org/10.1177/0013916519875180

[23] Sinha, S.K. (2014). Identifying Stakeholders in the Ganges Basin to Reconcile Conservation and Competing Land Uses and Processes in the Landscape. Proceedings of the International Symposium on River Biodiversity: October 2014, 56–68.

[24] Sinek, S. (2009). Start with Why, How Great Leaders Inspire Everyone to Take Action. New York, USA: Penguin Group.

[25] Arun, C. & Sivashanmugam, P. (2015a). Investigation of biocatalytic potential of garbage enzyme and its influence on stabilization of industrial waste activated sludge. Process Safety and Environmental Protection 94, 471–478. doi.org/10.1016/j.psep.2014.10.008

[26] Tang, E. F., & Chung, T.W. A study of the garbage enzyme’s effects in domestic wastewater. International Journal of Environmental, 5(12), 887–892.

[27] Arun, C. & Sivashanmugam, P. (2015a). Investigation of biocatalytic potential of garbage enzyme and its influence on stabilization of industrial waste activated sludge. Process Safety and Environmental Protection 94, 471–478. doi.org/10.1016/j.psep.2014.10.008

[28] Arun, C. & Sivashanmugam, P. (2015b). Identification and optimization of parameters for the semi-continuous production of garbage enzyme from pre-consumer organic waste by green RP-HPLC method C. Waste Management 44, 18-33. doi.org/10.1016/j.wasman.2015.07.010

[29] Dhillon, G., Kaur, S., Brar, S.K., Gassara, F., & Verma, M. (2012). Improved xylanase production using apple pomace waste by Aspergillus niger in Koji Fermentation. Engineering in Life Sciences, 12(2), 198–208. doi.org/10.1002/el.sc.201100102

[30] Dhillon, G.S., Brar, S.K., & Verma, M. (2011). Bioproduction of hydrolytic enzymes using apple pomace waste by a. niger: applications in biocontrol formulations and hydrolysis of chitin/chitosan. Bioprocess and Biosystems Engineering, 34(8). 1017–1026. doi.org/10.1007/s00449-011-0552-9

https://ijcsnet.id/
[31] Villas-Bôas, S., Esposito, G.E., & Mendonca, M.M. (2002). Novel lignocellulolytic ability of Candida Utilis during solid-substrate cultivation on apple pomace. World Journal of Microbiology and Biotechnology, 18(6), 541–545. doi.org/10.1023/A:1016350612380

[32] Ismail, A.M.S. (1996). Utilization of orange peels for the production of multienzyme complexes by some fungal strains. Process Biochemistry, 31(7), 645–650. doi.org/10.1016/S0032-9592(96)00012-X

[33] Rahman, S., Haque, I., Rajiv, C.D.G., Barooah, P., Sood, K., & Choundhury, B. (2020). Characterization and FPLC analysis of garbage enzyme: biocatalytic and antimicrobial activity. Waste and Biomass Valorization. doi.org/10.1007/s12649-020-00956-z

[34] Neupane, K., & Khadka, R (2019). Production of garbage enzyme from different fruit and vegetable wastes and evaluation of its enzymatic and antimicrobial efficacy. Tribhuvan University Journal of Microbiology, 6(1), 113–118. doi.org/10.3126/tujm.v6i0.26594

[35] Rasit, N., Fern, L.H., & Ghani, W.A.W.A.B. (2019). Production and characterization of eco enzyme produced from tomato and orange wastes and its influence on the aquaculture sludge. International Journal of Civil Engineering and Technology, 10(3), 967–980.

[36] Saramanda, G., & Jyothi, K. (2017). Antimicrobial activity of fermented citrus fruit peel extract. Journal of Engineering Research and Application, 7(11), 2248–962225. doi.org/10.9790/9622-0711072528

[37] Arifin, L., Wibisono, Syambarkah, A., Purbasari, H.S., Ria, R., & Puspita, V.A. (2012). Introduction of eco-enzyme to support organic farming in Indonesia. Asian Journal of Food and Agro-Industry, 71–78.

[38] Rahman, S., Haque, I., Rajiv, C.D.G., Barooah, P., Sood, K., & Choundhury, B. (2020). Characterization and FPLC analysis of garbage enzyme: biocatalytic and antimicrobial activity. Waste and Biomass Valorization. doi.org/10.1007/s12649-020-00956-z

[39] Neupane, K., & Khadka, R (2019). Production of garbage enzyme from different fruit and vegetable wastes and evaluation of its enzymatic and antimicrobial efficacy. Tribhuvan University Journal of Microbiology, 6(1), 113–118. doi.org/10.3126/tujm.v6i0.26594

[40] Saramanda, G., & Jyothi, K. (2017). Antimicrobial activity of fermented citrus fruit peel extract. Journal of Engineering Research and Application, 7(11), 2248–962225. doi.org/10.9790/9622-0711072528

[41] Neupane, K., & Khadka, R (2019). Production of garbage enzyme from different fruit and vegetable wastes and evaluation of its enzymatic and antimicrobial efficacy. Tribhuvan University Journal of Microbiology, 6(1), 113–118. doi.org/10.3126/tujm.v6i0.26594

[42] Rasit, N., Fern, L.H., & Ghani, W.A.W.A.B. (2019). Production and characterization of eco enzyme produced from tomato and orange wastes and its influence on the aquaculture sludge. International Journal of Civil Engineering and Technology, 10(3), 967–980.

[43] Rahman, S., Haque, I., Rajiv, C.D.G., Barooah, P., Sood, K., & Choundhury, B. (2020). Characterization and FPLC analysis of garbage enzyme: biocatalytic and antimicrobial activity. Waste and Biomass Valorization. doi.org/10.1007/s12649-020-00956-z

https://ijcsnet.id/
Verma, N., Bansal, M.C., & Kumar, V. (2011). Pea peel waste: a lignocellulosic waste and its utility in cellulase production. BioResources, 6(2), 1505–1519.

Tang, E. F., & Chung, T.W. A study of the garbage enzyme’s effects in domestic wastewater. International Journal of Environmental, 5(12), 887–892.

Dhiman, S. Eco-enzyme-a perfect house-hold organic cleanser. International Journal of Engineering Technology, Management and Applied Sciences, 5(11), 19–23.

Sayali, J.D., Shruti, S.C., Shweta, S.S., Sudarshan, P.E., Akash, D.H., & Shrikant, P.T. (2019). Use of eco enzymes in domestic waste water treatment. International Journal of Innovative Science and Research Technology, 4(2), 568–570.

Penmatsa, B., Sekhar, D.C., Diwakar, B.S., & Nagalakshmi, T.V. (2019). Effect of bio-enzyme in the treatment of fresh water bodies. International Journal of Recent Technology and Engineering, 8(1), 308–310.

Dhiman, S. Eco-enzyme-a perfect house-hold organic cleanser. International Journal of Engineering Technology, Management and Applied Sciences, 5(11), 19–23.

Rasit, N., Fern, L.H., & Ghani, W.A.W.A.B. (2019). Production and characterization of eco enzyme produced from tomato and orange wastes and its influence on the aquaculture sludge. International Journal of Civil Engineering and Technology, 10(3), 967–980.

Verma, N., Bansal, M.C., & Kumar, V. (2011). Pea peel waste: a lignocellulosic waste and its utility in cellulase production. BioResources, 6(2), 1505–1519.

Kemp, S. (30 January, 2020). Digital 2020: Global Digital Overview. In Global Digital Insights. Retrieved from https://datareportal.com/reports/digital-2020-global-digital-overview

Porpino, G. (2016). Household food waste behavior: avenues for future research. Journal of the Association for Consumer Research, 1(1), 41–51. doi.org/10.1086/684528.

Fourhooks. (26 April, 2015). The Generation Guide - Millennials, Gen X, Y, Z and Baby Boomers. Retrieved from http://fourhooks.com/marketing/the-generation-guide-millennials-gen-x-y-z-and-baby-boomers-art5910718593/

Messner, R., Richards, C., & Johnson, H. (2020). The prevention paradox: food waste prevention and the quandary of systemic surplus production. Agriculture and Human Values. doi.org/10.1007/s10460-019-10014-7

Rajshree, Y.A., Yadav, A., Malhotra, N.H., Gupta, N., & Puhp, P. (2019). Validation of eco-enzyme for improved water quality effect during large public gathering at river bank. International Journal of Human Capital in Urban Management, 4(3), 181–188. doi.org/10.22034/IJHCUM.2019.03.03

https://ijcsnet.id/