A Survey of Students' Awareness on Food Waste Problems and Their Behaviour Towards Food Wastage: a Case Study of Diponegoro University (UNDIP), Indonesia.

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Abstract. Worldwide about one-third of the food produces end up trashed or loss. Potential group said to waste more food include consumers of young age(youth). Higher learning institutions is hosting majority of this group. This study-based on the survey of 100 students at the University of Diponegoro in Semarang (Indonesia), aims at investigating student's awareness on food waste problems and their behaviour towards food waste by deploying the framework of the Theory of planned behaviour. Structural model (PLS-SEM) approach applied to explore relationship between individual awareness, attitudes, concern, Norms, Intention and behaviour towards food waste. The important of performance map analysis developed to enable observation of important dimensions which influence correct behaviour towards food waste. Results confirm the importance of using extended model of planned behaviour. Student awareness on environmental and social, economic consequences of food waste, and perceived behaviour control were the main drivers to motivate student's intention to avoid or reduce food waste, while positive behaviour towards food waste were found to be determined by Subjective norms, concern on food waste and perceived behaviour control. Finally, the study implication for raising student's awareness on food waste problem and its impacts, and improving correct behaviour toward food waste are discussed.

1 Introduction

In the 21st century, where there is the modernization of food provisioning infrastructures has dramatically changed food consumption practices which turn out to be a global problem in food systems, food waste has become one of the prevailing and unsolved problems to which the world still pays full attention and looking for better ways to resolve. Given the fact that about one-third of the food produced in the world end up trashed or lost [1] is obviously

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unbearable. Food waste has posed potential consequences in the Environment, Social as well as Economic realms [2]which needed to be addressed considering its urgency. The United States of America, considered as one of the biggest food wasters, disposing approximately 277 kg of food per person yearly while the United Kingdom (UK) threw away avoidable food waste equal to £13billion per year [3]. At the same instant, we cannot dwell on the notion that only developed countries are responsible for food waste at the consumption phase but also developing countries should be given equally important attention on food waste at this level, [4], reported that according to Economist Intelligence Unit(EIU) 2016, Indonesia as one among of these countries(developing countries) had become the second-largest food wasters behind Saudi Arabia which is estimated to dispose approximately of 300kg of food per person yearly which surpasses the quantity of food waste with the so-called developed countries. This problem is specifically sensitive in countries like Indonesia in which Millions of people are still suffering from malnutrition [5]. On the other hand, studies suggest that consumers of a young age usually tend to waste more food [6]. Therefore, this group needs to be paid more attention and monitored carefully Hence, this current study chose students at Diponegoro University (UNDIP) as representative of young people to students' awareness of food waste problem and its impacts, and their behaviour towards the food waste. It is essential to engage University students regarding the fact that knowledgeable individuals are more likely to engage in waste reduction behavior [7].

Previous work of literature agreed that food waste is a complex behavior and there is no single framework to explain this concept as a whole [8]. However, some studies suggest several things to consider when developing a model for analyzing food waste behavior such as the context in which particular behavior occurs, individuals' awareness of Food Waste, Individual attitudes towards food waste, individual habits, the Subjective norms, and perceived behavioral control [8, 9]. Therefore, this study used a Theory of Planned Behaviour (TPB) introduced by [10] to develop a conceptual framework model. The planned behavior model is implemented using Partial Least Square Structural Equation Modelling (PLS-SEM) approach as referred by previous works of literature to be used for analyzing waste behavior and consumer behavior in different contexts [11]. Specifically, this study has two main goals include; Firstly, to examine whether the TPB can be implemented and approved to determine the validity and reliability of the causal relationships between each component of the theory "classical components" namely Intention, Attitude, Social Norms, and Perceived Behavioural Control and the correct (positive) behavior towards food waste and the extended components of awareness on consequences of food waste problem. The objective is to identify if and to what extent students' awareness (Environment and Social, Economic) on food waste problems and its impact can affect their intention and behavior towards Food Waste. Secondly, to establish and evaluate the Importance of performance Map Analysis (IPMA) to identify construct(variable) with a low level of importance and high/low level of performance between exogenous and endogenous latent construct in the TPB model. This analysis is done to facilitate various discussion understudy and draw a various conclusions that can enable different stakeholders such as higher learning institutions, Non-government Organizations, Government bodies, and policymakers to implement different activities and policies that aim at raising awareness and ensuring reduction and prevention of food waste problems in their areas of jurisdiction. As explained before, food waste behavior is a complex topic [8]. Hence, this study deployed the Theory of planned behavior (TPB) to address the issue. it is known that the anticipation from causal relationships based on literature is to test different hypothesis under study. Therefore, a general statement for the main hypothesis in this study is that "food waste behavior may be affected directly or indirectly by Moral attitude, concern on food waste, subjective norms, perceived behavior control, Individual awareness on environment and social consequences of food waste, Individual awareness on economic consequences of food waste, and intention".

2 Methods

2.1 Sampling, data collection technique, and analysis

The sample for this study involved 100 undergraduate students from Diponegoro University, Indonesia. Students were taken from three different faculties in three different study programs namely Environmental Engineering (Faculty of engineering) 32 students, Communication science (faculty of social and political science) 36 students, and Food technology (faculty of Animal and Agriculture science) 32 students respectively. The stratified proportionate random sampling technique was used to obtain the sample size of the number of students who participated in this study from each program. The survey was implemented in the period between February and March 2021 through online questionnaires (google form) as a tool for data collection sent in via WhatsApp group and email to request information needed for this study. The questions were translated to Bahasa Indonesia facilitate understanding of the questions by participants during data collection and then translated back to English for data analysis. Data analysis was conducted using Structural Equation Modeling with the Partial Least Squares (PLS-SEM) technique. The model was analyzed and executed in SmartPLS 3.0 software [12]. The demographic data were analyzed descriptively by using IBM SPSS software version 20. The respondents were asked to indicate their extent of agreeing or disagree regarding several statements under the study in a 5-point Likert scale ranging from 1=strongly disagree to 5 = strongly agree.

3 Research results and discussion

3.1. Demographic characteristics

This segment involved the information related to students' particulars such as gender, age, faculty, and study program. The sample involved 100 participants, the results show that 54% were female students, and 46% male students participated in this study. The majority of students age ranging between 18-21 which signify 66% of all participants in the study, followed by 20% aged between 22-25 and finally 14% aged between 26 and above respectively. Furthermore, the results show that 32% of the students were taken from the faculty of engineering studying environmental engineering, 36% were students taken from the faculty of social and political science studying communication science, and 32% of students from the faculty of Agriculture and Animal science studying food technology.

3.2 Model evaluation and assessment

To evaluate Partial Least Square Structural Equation Models (PLS-SEM) for this study, Measurement model assessment and structural model assessment were conducted to validate the quality and eligibility for using the PLS-SEM. The results for the measurement model were attained as per the study [13], [14], and [15] as shown in Table 1 and Table 2 respectively.

Table 1. Construct Validity and Reliability.

Constructs	Measures	Loadings	Composite Reliability	AVE	Cronbach's Alpha	Rho_A	Results
Z1: Moral	MA1	0.922	0.953	0.954	0.966	0.876	Reliable
Attitude	MA2	0.969					Reliable
	MA3	0.907					Reliable
	MA4	0.946					Reliable
Z2: Individual	IC3	0.910	0.738	0.755	0.884	0.791	Reliable
Concern on							
FWB	IC4	0.869					Reliable
Z3: Subjective	SN2	0.940	0.847	0.857	0.929	0.867	Reliable
Norms	SN3	0.922					Reliable
Z4: Perceived	PBC2	0.864	0.705	0.711	0.871	0.772	Reliable
Behaviour							
Control	PBC3	0.893					Reliable
Z5: Awareness on	AES2	0.922	0.768	0.793	0.895	0.810	Reliable
Environmental	AES3	0.877					Reliable
and Social consequences FWB							
Z6: Awareness on Economic Consequences	AECO1	0.716	0.805	0.806	0.871	0.628	Reliable
FWB	AECO2	0.797					Reliable
	AECO3	0.815					Reliable
	AECO4	0.837					Reliable
Z7: Intention							
to avoid	INT2	0.929	0.782	0.815	0.900	0.819	Reliable
food waste	INT3	0.880					Reliable
Z8: Correct							
Behaviour	CB1	0.879	0.820	0.830	0.892	0.735	Reliable
towards food							
waste	CB2	0.883					Reliable
	CB3	0.808					Reliable

Note: Indicator items (10) with factor loadings below 0.5 were removed: Including MA 5, IC1, IC2, SN1, PBC1, AES1, AES4, AES5, AECO5, INT1.

Table 2. Fornell and Larcker Test for Discriminant Validity.

Constructs	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
Z1: Moral Attitude	**0.936**							
Z2: Individual Concern on FWB	0.500	**0.890**						
Z3: Subjective Norms	0.600	0.582	**0.931**					
Z4: Perceived Behaviour Control	0.428	0.436	0.455	**0.878**				
Z5: Awareness of Environmental and Social consequences FWB	0.598	0.431	0.574	0.723	**0.900**			
Z6: Awareness of Economic Consequences FWB	0.856	0.563	0.688	0.685	0.826	**0.792**		
Z7: Intention to avoid food waste	0.374	0.426	0.432	0.642	0.410	0.542	**0.905**	

Z8: Correct Behaviour towards food waste	0.557	0.395	0.582	0.837	0.746	0.732	0.550	**0.857**

Note. The diagonals are the square root of the AVE of the latent variables and indicate the highest in any columns and or rows.

The structural model was evaluated by looking at the Predictive relevance (Q^2), the R^2, Path coefficient (Beta), and corresponding t-values, as suggested by the previous researchers [14]. To assess the predictive relevance (Q^2) of the structural model, the Blindfolding[2] the procedure was undertaken with the omission distance of 7, and the results through Cross Validated Redundancy, show that the Q^2 value for two endogenous latent constructs bears the value greater than zero (0.348 and 0.518), Z7 and Z8 respectively. This suggests that the model satisfied the requirements and it is acceptable. The R^2 values for the two endogenous latent constructs namely Intention to avoid food waste(Z7) and correct behavior towards food waste(Z8) were found to be 0.504 and 0.786 respectively. This observation was carried out to assess the predictive accuracy of all exogenous latent constructs in the model on target endogenous latent constructs. Following this result of (R^2) value, it indicates that the amount of shared variation for the two endogenous latent constructs is adequately attained. This result can be considered substantial and acceptable in depicting the explanatory power of the model regarding the context of this study [16].

3.3 Causal (path coefficient) relationship in the model

To assess the significance and relevance of the direct relationship that exists between the latent constructs in the model. Path coefficient(β) determination was conducted through Bootstrapping procedure with 5000 subsamples bootstrapped at two-tailed tests which also generate 95% confidence interval bias-corrected as shown in Table 3. The path model consists of 8 constructs which include Moral Attitude(Z1), Individual Concern on FWB(Z2), Subjective Norms(Z3), Perceived Behaviour Control(Z4), Awareness on Environmental and Social consequences FWB(Z5), Awareness on Economic Consequences FWB(Z6), Intention to avoid food waste(Z7) and Correct Behaviour towards food waste(Z8). The results show that six (6) out of thirteen (13) hypotheses developed in the model were significant at 1%(P<0.01), 5%(P<0.05), and 10%(P<0.1) respectively. As suggested by [13] the recommended *t*-value for two-tailed tests is 2.58 (significance level = 1 percent), 1.96 (significance level = 5 percent), and 1.65 (significance level = 10 percent).

The results show that students' lack of or with moral attitude has no significant and direct effect on their intention to reduce or avoid food waste and correct behavior towards food waste. On the other hand, individual concern toward food waste and Subjective norms were found to have a significant and direct negative and positive effect on correct behavior towards food waste at (β=-0.131, t=1.934, p<0.1) and β=0.212, t=2.673, p<0.01 respectively, while not significant on intention to avoid or reduce food waste. The results imply that individual concern among students on food waste affects negatively their performance of correct behavior towards food waste. This is to say that lack of concern on food waste (FW) among student results into poor performance of correct(positive) behavior towards food waste and hence accelerate food waste generation. The results also indicate that Subjective norms play a vital role in modifying students' behavior towards food waste. This role was observed by

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[2] Blindfolding is the procedure that involves the sample re-use technique for calculating Stone-Geisser's Q^2 value, it allows every n^{th} data point of the target constructs(endogenous) indicator in the model to be eliminated in a single blindfolding round. Meaning that it omits and predicts every data point of the indicators used in the outer model (measurement model) of a certain latent variable [17] For purpose of this study, we used omission distance(D)=7.

highlighting different activities and practices that are performed from time to time by individuals students in their households and with family and friends.it implies that the role played by family members and friends influences motivating positive behavior towards food waste. Therefore, the family plays a key actor role to shape and facilitate the behavior of young people in performing good practices when it comes to food waste behavior. Students perceived behavior control was found to play a significant role in intention and correct behavior toward food waste. The results show that there is a direct and significant effect of perceived behavior control on intention to avoid or reduce food waste and as well as correct behavior towards food waste at ($\beta=0.585$, $t=3.323$, $p<0.01$) and at ($\beta=0.657$, $t=2.937$, $p<0.01$) respectively. The implication of these results entails that there is a significant effect of Individual efficacy based on their perception to undertake desired positive behavior towards food waste as well as intention to avoid or reduce food waste. This result can act as a baseline to initiate each individual at the family level or a community to bear full responsibility for the amount of waste that he/she produces. Furthermore, awareness of the consequences of food waste was found to play an important role in students' intention to avoid or reduce food waste. The results show that student awareness of environmental and social consequences of food waste has a direct and significant negative effect on student's intention to avoid or reduce waste while awareness of economic consequences on food waste has a direct and significant positive effect on the intention to avoid or reduce food waste at ($\beta=-0.468$, $t=2.053$, $p<0.05$) and ($\beta=0.572$, $t=2.050$, $p<0.05$) respectively, while not significant on correct(positive) behavior towards food waste. This result entails that the level of students' awareness on matters related to the environment and social impacts of food waste produces a negative influence on their intention towards food waste. Lack of awareness can decrease their motivation to reduce or avoid food wastage. Awareness of the economic consequences of food waste among students has a significant influence on their motivation to avoid food wastage. This means that economic factors can act as a good driver to modify students; behavior and intention towards food waste. Finally, the results show that there was no evidence that students' intention to avoid or reduce food waste has a significant direct effect on correct behavior towards food waste.

Table 3. The results of the statistical relationship in the model.

| Hypothesis	Relationship	Std Beta	SD	t-value	P Values	95%CI LL	95%CI UL	Decision
H1	Z1->Z7	-0.193	0.248	0.778	0.437	-0.532	0.074	unsupported
H2	Z1->Z8	0.203	0.205	0.992	0.321	-0.026	0.669	unsupported
H3	Z2->Z7	0.084	0.097	0.868	0.385	-0.056	0.261	unsupported
H4	Z2->Z8	-0.131	0.068	1.934	0.053*	-0.244	-0.027	Supported
H5	Z3->Z7	0.107	0.126	0.845	0.398	-0.066	0.350	unsupported
H6	Z3->Z8	0.212	0.079	2.673	0.008***	0.131	0.436	Supported
H7	Z4->Z7	0.585	0.176	3.323	0.001***	0.331	0.881	Supported
H8	Z4->Z8	0.657	0.224	2.937	0.003***	0.180	0.847	Supported
H9	Z5->Z7	-0.468	0.228	2.053	0.040**	-0.771	-0.203	Supported
H10	Z5->Z8	0.174	0.366	0.476	0.634	-0.105	0.965	unsupported
H11	Z6->Z7	0.572	0.279	2.050	0.040**	0.176	1.101	Supported
H12	Z6->Z8	-0.111	0.185	0.599	0.549	-0.435	0.184	unsupported
H13	Z7->Z8	0.006	0.080	0.070	0.944	-0.133	0.130	unsupported
		R^2	Q^2					
	Z7	0.504	0.348					
	Z8	0.786	0.518					

Note: ***P<0.01, **P<0.05. *P<0.1

R^2(Intention to avoid food waste(Z7) =0.504, Correct behaviour towards food waste(Z8) =0.786)

Predictive relevance Q^2 (Intention to avoid food waste(Z7) =0.348, Correct behavior towards food waste(Z8) =0.518)

3.4 Importance of Performance Map Analysis (IPMA)

To extend the results of PLS-SEM, the Importance of Performance Map Analysis (IPMA) was constructed. The importance of performance map analysis was established to observe and analyze the relative importance of constructs in explaining other constructs in the structural model. The IPMA compares the differences of the total effects of the constructs in the model through graphical representation (chart), whereby the measure of importance for each construct on the endogenous variable is represented by (x-axis) while the measure of performance is represented by (y-axis). The degree of importance-performance between two target endogenous variables namely Intention to avoid or reduce food waste (Z7) and Correct behavior towards food waste (Z8) with the rest of all exogenous variables in the extended model of the TBP was observed. The results from the graphical representation see chart Fig. , indicate to explain student Intention to (avoid or reduce) food waste(Z7), a low level of importance is characterized by Awareness of Environmental and social consequences(Z5) while on the other hand, an outstanding high level of importance dimension represented by Perceived behavior control (Z4) and Awareness on Economic consequences of food waste behavior (Z6).
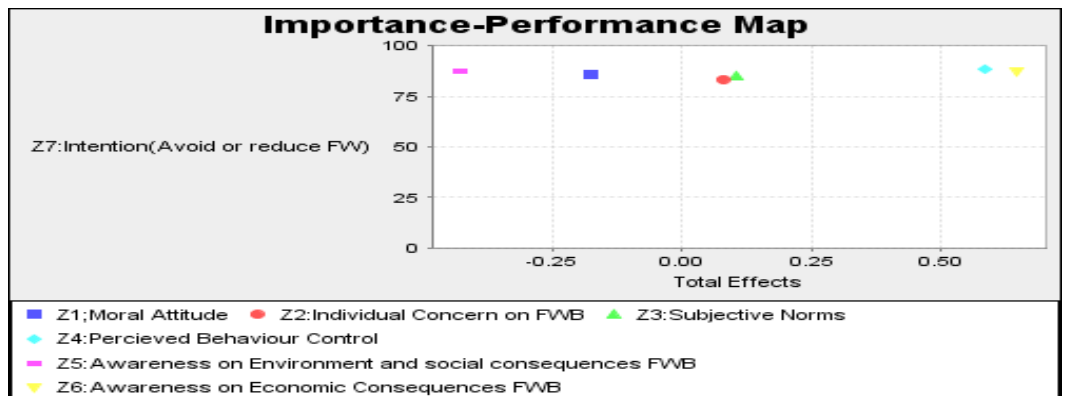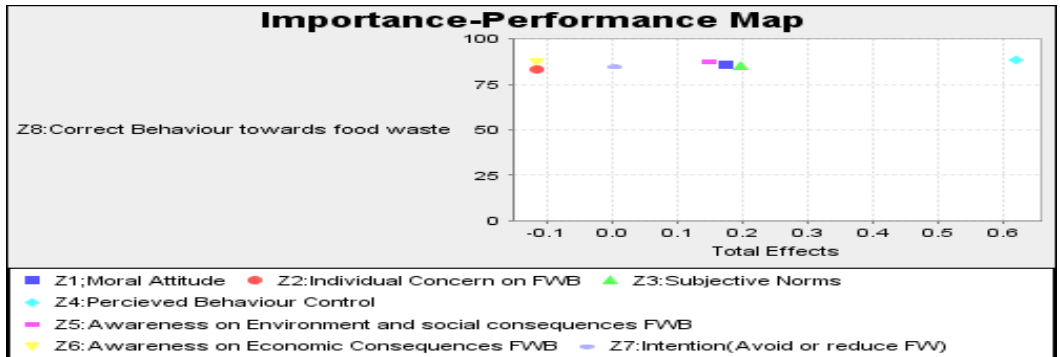

Note: X-axis represents importance, Y-axis represents performance.
Fig. 1. Intention to (avoid or reduce) food waste behaviour.

On the other hand, the results from the graphical representation see chart Note: X-axis represents importance, Y-axis represents the performance

Fig. , indicate that to explain student behavior towards food waste, a low level of importance is attributed to Awareness of economic consequences(Z6), and Individual concern on food waste behavior(Z2), While an outstanding high level of importance dimension represented by student perceived behavior control(Z4) followed by Subjective Norms(Z3) and Awareness on environmental and social consequences(Z6), respectively.

Note: X-axis represents importance, Y-axis represents the performance

Fig. 2. Correct behaviour towards food waste (IPMA).

These results yield an important observation of the contribution of different latent constructs(dimension) in the TPB model which lead to the desired intention and behavior towards food waste among students based on performance and importance. The results found that Perceived behavior control (Z4) and Awareness of Economic consequences of food waste behavior (Z6) are the main determinants and dimensions responsible for students' intention to avoid or reduce food waste, on the other hand, student perceived behavior control (Z4), Subjective Norms (Z3) and Awareness on environmental and social consequences (Z6) are the main determinants of correct behaviour towards food waste. In other words, these constructs were found to represent the high level of performance and importance on two observed endogenous latent constructs namely intention (Z7) and behavior towards food waste (Z8).

4 Conclusion remarks

Finally, this study concludes that awareness on environmental and social consequences as well as economic consequences on food waste problem is still needed to be emphasized and promoted in learning institutions such as universities, and other government and non-government bodies since it was found to impose both negative and positive effect in motivating individual intention to avoid or reduce food wastage as well as modifying their behavior towards food waste. The results of the current study provide piecemeal and lucrative information to different stakeholders for designing campaigns and organizing programs that aim at reducing food waste at the institutional level and household level.it also encourages the establishment of a food waste reduction regulatory approach such as laws, by-laws, policies, and standards that aim at inducing food waste reduction and prevention behavior through penalty provision for actors such as retailers, restaurants, and others who do not conform with the established regulations. The results from this research also confirmed the essential role played by behavioral theories such as TPB in determining and explaining food waste behaviors.

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