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Assessment of Food Waste and its Causes In Universiti Teknologi Mara Perak Branch, Seri Iskandar Campus, Malaysia

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Abstract

Food waste like other forms of solid waste, imposes economic, social and environmental impact on nations. This study assessed the quantity of food waste generated in Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, Perak, Malaysia. This topic is one of important issue of food waste has recently received much attention and has been given high visibility. The impacts of food waste include greenhouse gases (GHG) emissions and climate change, ecological affects, sanitation issues, water footprint and nutrient loss. The study adopted a four-stage methodological approach: Site selection, quantitative analysis, online survey and synthesis of results. Food waste generated across the three selected canteens for four weeks was measured directly. In addition, 225 copies of questionnaire were administered to students online and was analysed with SPSS by descriptive statistical analysis to determine mean, standard deviation, frequency and percentage. Findings from the study revealed that the mean quantity of food waste generated at the sampled canteens, ranged between 24.89Kg \pm 3.904 and 62.840 Kg \pm 4.091, while per capita food waste ranged between 20g to 70g per person/day. About 40% of respondents sampled in the study stated that they waste sauces and spread served them during meals, while 19.5% waste vegetables, 14.2% rice and 12.9% chicken or fish. The study identified limited lunch time, food taste, too much oil and large quantity of food served as some of the reasons for food waste. Thus, the major findings in this study identified the following as ways of reducing food waste in the dining halls: better estimation of portion size of meal on both students and stallholders since the dining halls operate on one-plate self-served buffet and staff service in some instances. The study recommends improvement in communication between local university students to know the type of meals the latter would want canteen operators to prepare. The future research should examine more public universities in the country. This capable to understand

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different solutions for the effects of the food waste problem on the environment and on the climate change.

Keywords: Food Waste, University, Canteen, Students

Introduction

Food waste constitutes a major economic, social and environmental challenge to both developed and developing nations. Reduction in the quantity of food waste is a key element in developing sustainable food system (Marangon et al., 2014). Food waste represents a monetary loss (Graham-Rowe et al., 2014), contributes towards increase in food prices, inaccessibility of food to the poorest and increases the number of malnourished people (Stuart, 2009). According to FAO (2014) report, the estimated environmental and social costs of food waste are USD 700 billion and USD 900 billion respectively. About 1.3 billion tonnes of food waste is generated annually, with a 44% projected increase between 2005 to 2025 (Thi et al., 2015). Thus, there is need to focus on quantification and management of food waste generation for both environmental and economic reasons (Eusuf et al., 2011; Abdelaal et al., 2019). Food waste occurs at all the stages of the food value chain, starting from post-harvest losses, processing, distribution and finally consumption, but the largest contributor to food waste are homes (EPRS, 2014; FAO, 2012 and 2013). About 40% of food waste in developing countries occur at post-harvest and processing levels, while in industrialized countries more than 40% of food waste occurs at retail and consumption levels (FAO, 2012; Ali & Ho, 2016; Ali et al., 2017). Ostergren et al (2014) noted that food waste at the consumption stage generates the largest carbon footprint due to the fact that it accumulates carbon footprint from previous stages. The consumption stage can be divided into retail and market, food services and household sectors (Abdelaal et al., 2019; Yaacob, et al., 2019). Households contribute most to food waste at the consumption stage, and majority of studies have focused on households (Beretta et al., 2013; Parizeau et al., 2015; Zhang et al., 2018; Jiang et al., 2018; Song et al., 2018; Ilakovac et al., 2020). Nevertheless, some other studies on food services sector have focused on canteens located in the University (Okeniyi & Anwan 2012; Rajan et al., 2018; Li & Quiang, 2018; Kasavan et al., 2020; Kasavan, Mohd Ali & Masarudin, 2020). All the above-mentioned studies on food waste in university canteens were conducted in other parts of the world. For example, Okeniyi and Anwan (2012), the study was conducted at Covenant University, Nigeria, Rajan et al (2018) in Canada, and Li & Quiang (2018) in China and Kasavan et al (2020) in Malaysia.

Food waste generation in Malaysia is relatively high and may pose future environmental challenge. In a survey conducted in 2012 by the National Solid Waste Management Department, food waste was reported as the most prevalent type of waste generated in Malaysia and that households accounted for about half of the total amount. The authorities are facing serious challenge in food waste handling and treatment in Malaysia, due to inability to separate food waste from municipal solid waste (Lim et al., 2016). The policy for food waste management in Malaysia is considered less efficient due to limited budgetary allocation by government (Thi et al., 2015). Also, non-regular and periodic documentation and analysis of data on food waste from local authorities has led to inaccurate database at national level (Moh & Manaf, 2014). Incineration and landfill are the most common ways of food waste disposal. However, the latter is more widely accepted method for managing food waste because it is cost effective and simple to apply (Lim et al., 2016). In Malaysia, food waste management through the landfill is becoming more difficult as most landfills have reached their carrying capacity (Moh and Manaf, 2014). Chuah and Singh (2020) have identified

knowledge and involvement in preventing food waste as some of the factors that could help in reduction of waste among university students in Malaysia. Evidence of a rigorous study on food waste generation in a Malaysian University is scanty. A more holistic study on total food service losses from canteens in a particular Malaysian university has received little attention, despite their potential contribution to food waste generation. Thus, this study aims to quantify food waste generated from canteens located in Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus, Perak, Malaysia. Some of the reasons given by students for food waste were equally examined, in order to propose measures that will mitigate the economic, social and environmental effects of food waste.

Methodology

This study took place in three dining halls (Kolej Indera Mulia dining hall, Kolej Indera Sakti dining hall, and Kolej Pasir Salak dining hall) located at Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, in year 2019. The choice of these three dining halls was based on their location and size. In any attempt to reduce food waste, the first step involves quantifying the wastage and trace the causes of wasting. Mass-balance built around existing data like waste treatment and users discard statistics is one of such methods. However, this method is effective when adopted to the whole supply chain (Abdelaal et al., 2019). For this study, on-site measurements were conducted to quantify food waste generated from the study area. Although laborious and time consuming, on-site measurements provide more accurate results and more insight on some factors that shape the waste management practices. In food services, wastage is generated at three different levels: storage, preparation and serving. For the purpose of this study, attention was focused on serving waste. Serving waste can further be categorized into plate waste (leftovers) and display waste, which is food that was prepared for consumption but never come in contact with the customer. Our attention in this study was focused on former (plate waste). The methodology (Figure 1) adopted in the study was the one introduced by the ‘Food Use for Social Innovation by Optimising Waste Prevention Strategies’ (FUSIONS) group (Scherhauser et al., 2015) and drivers, composition and recovery potential of food waste in a university campus (Abdelaal et al., 2019). However, some little modifications were made on the FUSIONS and Drivers, composition and recovery potential methodologies to fit the circumstances.

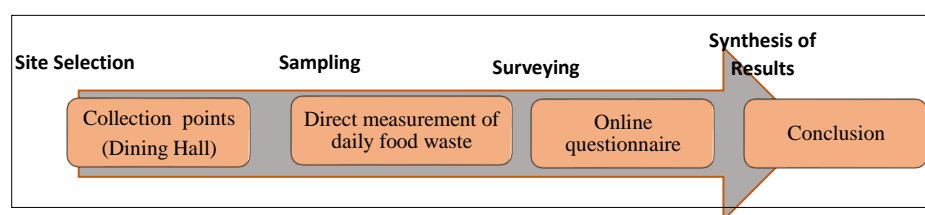


Figure 1: Methodology

Sources: Scherhauser et al (2015); Abdelaal, et al (2019)

Sampling Location

On site measurements took place at Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, Perak. It is located on 392.36 acres of land. The food service providers at the three hostels dining halls (Kolej Indera Mulia, Kolej Indera Sakti and Kolej Pasir Salak) operate canteens that serve the entire campus. These canteens provide services for both male and female students' residence in hostels. The dining halls in these three hostels have capacity to host about 7000 persons per day. The choice of the three hostels dining halls was based on

two reasons: First, the hostels have large dining sections with good car parks. Second, they are strategically located within the campus which makes accessibility easier for students and variety of meals are also provided. The three hostels dining halls hosted an estimated number of 2,173 persons per day, 1598 persons per day and 1548 persons per day respectively during the study period.

Sampling Methodology

At the three dining halls providing food services to the students, their kitchen consists of three sections: those cooking the food, those in charge of serving and collection of money and those responsible for cleaning and removing the plates after customers have finished eating. Since the main focus of this study is on serving waste, the operators of these canteens were informed about the study. This became necessary, because without their corporation, the data collection may be difficult. In each of the dining halls, provision for different waste bins were made (Figure 1) for food waste, recyclables, and other wastes (trash). The cleaners whose responsibility is to remove the plates after customers have finished eating were asked to drop the food waste in the designated bins. Six research assistants, two for each dining hall, helped in weighing the wastes each day. The weighing was done at night in order to capture data that reflects the reality. It is assumed that by night-time, wastes generated during breakfast, lunch and dinner would have been disposed into the bins. The collection period lasted for four weeks, specifically October 2019.

Measurement of Daily Waste Generation

The daily food waste generation from the dining halls was determined through direct measurement of the designated waste bins. The research assistants visited the designated bins at 9.00 pm and removed the wastes from polyethylene bags inserted into the bins. Since the focus of the study is on food waste, wastes generated in other bins aside food waste were not measured. The measurement was carried out with the use of a standard platform scale of 200 kg capacity. The measurement lasted for four weeks.

Instrument Development (Questionnaire)

The questionnaire comprised of two sections. Section A presents the demographic profile of respondents, while section B contains questions bothering on why food is being wasted, types of food wasted, percentage of food wasted, and ways food waste could be reduced. These questions are closed ended with options ranging from a – f. Through an online survey, 240 copies of questionnaire were purposefully administered to the students across all faculties. About 225 responded by filling the questionnaire. The main objective of the online survey was to identify (i) some of the reasons given by students for food wastage and (ii) ways they think food waste in dining halls could be reduced (ii) types of food wasted and (iv) the percentage of food wasted.

Data Analysis

All daily measurements taken across the three canteens were recorded in excel spread sheet for further analysis. The per capita food waste is a measure of the total food waste weighed divided by the number of persons served (Eq. (1) (Owojori et al., 2020): Per capita waste =

$$PCW = TF / NP * ND$$

where, PCW = per capita waste; TF= total food waste generated

NP = no. of persons; ND= no. of days

The data from the questionnaire was exported to Microsoft Excel 2010 where it was coded for further analysis in SPSS 20.0 software. Descriptive statistical analysis was performed to determine mean, standard deviation, frequency and percentage.

Results and Discussion

Mean Waste Generated Across the Dining Halls

Table 1 show that the average food waste weight calculated for Kolej Indera Mulia [KIM] was 24.89 ±3.904 per day, Kolej Indera Sakti [KIS], average food waste was 34.507 ± 2.493 while average for Kolej Pasir Salak [KPS] was 62.840 ± 4.091. Based on these results, it could be said that more food waste was generated in KPS per day, while KIM generated the least. This could be attributed to number of persons residing in the hostels and the proximity of each hostel to different faculties and departments. Non residence students buy food from the hostels especially during lunch period. Relative to the study of Abdelaal et al. (2019), on food waste from a university campus in the Middle East, the magnitude of food waste generated in this study was smaller. Abdelaal et al. (2019) reported food waste of about 329.5 kg/day or 80 tonnes per academic year from the studied outlets, while food waste for the present study was estimated at 122.2kg/day.

Table 1

Mean food waste generated per day

Composition	Mean (Kg) and Standard Deviation		
	Kolej Indera Mulia	Kolej Indera Sakti	Kolej Pasir Salak
Food waste	24.89 ± 3.904	34.507 ± 2.493	62.840 ± 4.091

In terms of daily food waste generated during the four-week period, results in Figure 2 reveal that for KPS daily food waste ranged between 52.4 kg to 60.2 kg, KIS ranged between 32.6 kg to 38 kg while KIM ranged between 18 kg to 30.8 kg. Based on these results, the highest daily food waste generated during the study period was 60.2 kg while the least was 18 kg.

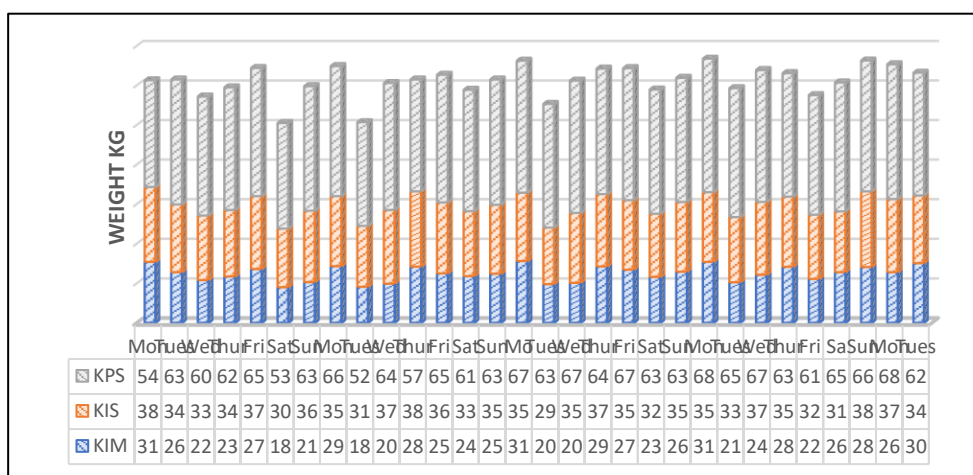


Figure 2: Daily food waste generation across the dining halls

KPS = Kolej Pasir Salak, KIS = Kolej Pasir Salak, KIM = Kolej Indera Mulia

Per Capita Food Waste

One of the major objectives of this study, is to quantify in terms of per capita food waste generated in the study locations, thus, results in Table 2 are examined. The highest per capita food waste was calculated for KPS (0.07 kg per person/day or 70g) followed by KIS (0.04 kg per person/day or 40g) and KIM (0.02 kg per person/day or 20g). What this result suggests is that per capita food waste ranged between 0.02 kg (20g) to 0.07 kg (70g) across the study locations. In their study on determinants of food waste in Chinese University canteens, Qian et al (2021) reported that the mean weight of food waste generated per student per meal was 61.3g (0.06 kg). In another study on six universities in Beijing, Wu et al (2019) found that the mean weight of food waste generated was 73.7g per capita per meal. In another study, Betz et al (2015) reported 90g food waste per meal in two food service units from education institutions in Switzerland. The variation in per capita food waste generation reported in this study with those studies conducted in China and elsewhere could be explained by the environment where the studies were conducted and the sample size. The present study represented students in a particular Malaysian University, whereas the study of Qian et al (2021) represented a nation-wide sample of students in Chinese Universities. Also, the level of economic development of a country determines the per capita food waste generated. Aschemann-Witzel et al (2019) noted that food waste becomes a serious problem as economic conditions in a society improves.

Table 2

Per capita food waste generation at the dining halls

Composition	Kg per person/Day		
	Kolej Indera Mulia	Kolej Indera Sakti	Kolej Pasir Salak
Food waste	0.02 kg (20g)	0.04 kg (40g)	0.07 kg (70g)

Reasons Given by Students for Food Waste

An online survey which targeted students' residence on campus and those living off campus was conducted. The survey was designed to identify the reasons given by students for food waste, type of food they waste, percentage of food they think is wasted and the ways food waste could be reduced on campus. The results in Table 3 show that 31.6% of respondents surveyed stated that their reason for food waste is limited lunch time, 29.3% stated that the food sold in the dining halls contain too much oil, thus they find it difficult to finish the food served them. Similarly, 15.6% of respondents stated that they waste the food because it is not tasty, while 14.7% said that the dining halls serve too much food than they can consume. In their study on food waste from a university campus in the Middle East, Abdelaal et al. (2019) noted that students ranked taste, and food quality high as some of the ways to reduce food waste on campus. The authors maintained that the high ranking of taste and food quality mirrored their importance in food waste reduction. In the present study, taste and food quality were mentioned as some of the reasons students waste food.

Table 3

Reasons given by students for wasting food

Items	Frequency	Percent
The canteens serve too much food than I can consume	33	14.70
The food combination is not alright	13	5.80
The food is not tasty	35	15.60
The food contains too much oil	66	29.30
The food contains too much sugar	7	3.10
Not enough time to eat the food	71	31.60
Total	225	100.00

Relationship Between Reason for Wasting Food and Food Waste Generated Across the Three Canteens

The results in Table 4 reveal the relationship between reason for wasting food and food waste generated at the three canteens. About 35% of respondents from Kolej Pasir Salak and Kolej Indera Mulia attributed limited lunch time as one of the reasons they wasted food. Also, too much oil in the food was another reason for food waste across the three canteens (Kolej Indera Sakti = 34.7%, Kolej Indera Mulia = 28.8%, Kolej Pasir Salak = 24.7%). Taste of the food was another reason given by respondents for wasting food in all the three canteens (Kolej Pasir Salak = 16.9%, Kolej Indera Mulia = 16.4% and Kolej Indera Sakti = 13.3%).

Table 4

Relationship between reason for wasting food and food waste generated

<i>Kolej</i>	Reason for Wasting Food	Frequency	%	Mean food waste generated	±
Kolej Indera Mulia	The canteens serve too much food than I can consume	9	12.3	24.89	± 3.904
	The food combination is not alright	3	4.1		
	The food is not tasty	12	16.4		
	The food contains too much oil	21	28.8		
	The food contains too much sugar	3	4.1		
	Not enough time to eat the food	25	34.2		
	Total		73	100.0	
Kolej Pasir Salak	The canteens serve too much food than I can consume	11	14.3	62.840	± 4.091
	The food combination is not alright	5	6.5		
	The food is not tasty	13	16.9		
	The food contains too much oil	19	24.7		
	The food contains too much sugar	2	2.6		
	Not enough time to eat the food	27	35.1		
	Total		77	100.0	
	The canteens serve too much food than I can consume	13	17.3	34.507	± 2.493

Kolej Indera Sakti	The food combination is not alright	5	6.7
	The food is not tasty	10	13.3
	The food contains too much oil	26	34.7
	The food contains too much sugar	2	2.7
	Not enough time to eat the food	19	25.3
	Total	75	100.0

Type of Food Wasted

When asked to mention the type of food they throw away or waste anytime they visit the canteens, 40% stated that they throw away sauces and spread, 19.5% stated vegetables, 14.2% said rice, 12.9% chicken or fish, 11% said none while 2.2% throw away noodles or pasta (Figure 3). Qian et al (2021) in their study reported that staple foods and vegetables are the largest components of food waste generated by university students in China. They recommend that canteen operators should interact with students in order to determine whether portion sizes of the staple foods and vegetables are too large, whether the taste is unsatisfactory, or any other possible factors that could have contributed to high wastage, so as to effectively reduce wastage of vegetables and staple food.

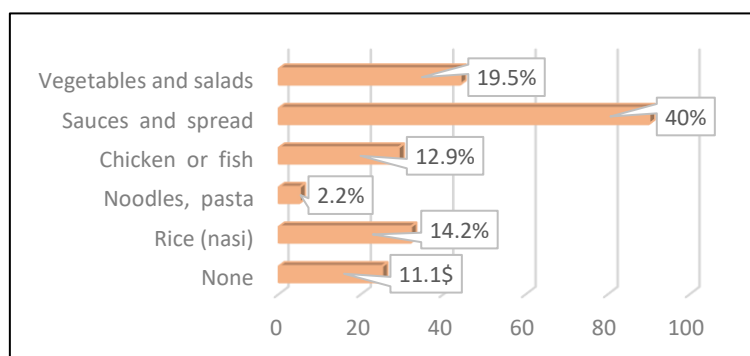


Figure 3: Type of food wasted

Perceived Percentage of Food Wasted

Another thing the study tried to examine was how the respondents perceived the percentage of food they waste. Thus, in the questionnaire, they were asked to rate the percentage of food they think is wasted any time they visit the school canteens. Results (Table 5) show that majority (64.4%) stated that they waste 15% or less of the quantity of food served them in the school canteens. About 12.9% said they waste between 16 to 30% of food, while 14.2% waste no food at all. As could be seen from the results, majority of respondents believe that the percentage of food they waste is 15% or less.

Table 5

Percentage of food wasted

	Frequency	Percent
15% or less	145	64.40
16 to 30%	29	12.90
31 to 50%	12	5.30
More than 50%	7	3.10
None	32	14.20
Total	225	100.00

Ways of Reducing Food Wastage on Campus

In terms of ways of reducing food waste, respondents were asked to highlight some of the ways they feel food waste among students could be reduced. Results (Figure 4) show that 35.1% said that better estimation of portion size of meal served could help in reducing food waste. What this suggests is that students should be cautious when serving their meals. In other words, they should be able to estimate the quantity of food they can be able to consume while serving the food. This is necessary because the canteens operate one-plate self-served buffet, which gives the customer opportunity to take the quantity he or she likes. Ellison et al (2019) in their study on efficacy of food waste reduction campaign in a university dining hall, reported that 40% of students admitted taking more food than they can eat in the dining halls – a reported behaviour that did not change after the education campaign. In other words, despite recognizing food waste as an environmental issue, students reported behaviour (actual behaviour) when it comes to food waste did not change. Again, 32.9% of respondents stated that canteens should improve quality of their food in terms of taste and composition. This is reflective of the reasons given earlier on in the preceding section for food wastage by students. About 45% respondents stated that the reason why they waste food in the canteens is because it contains too much oil and not tasty, while 23.6% stated that the university authority should monitor the activities of food service providers, in order to improve quality and reduce food wastage among students. Aside some of the points highlighted by the students as ways of reducing food waste, the study further recommend that the university authority should reassess the current timetable for lunch to guarantee students enough lunch time especially during weekdays. This is necessary because insufficient time for eating the meals was one of the reasons given by students in this study for wasting food. Also, canteen managers should serve sauces and spread with separate plates so that people might make a choice. Provision of smaller portion sizes at reduced price, would help reduce waste for students who do not consume large quantity of food. Finally, the university should conduct a discrete investigation on food preferences of students and communicate such to canteen managers in order to minimize food waste.

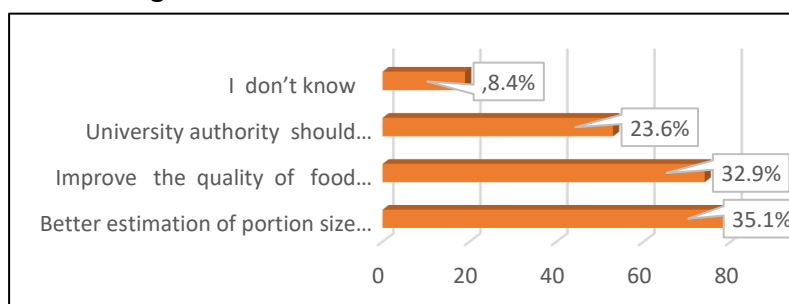


Figure 4: Ways of reducing food waste

Conclusion

Malaysia is a rapidly growing economy with a GDP per capita of 11,217.772 USD (www.ceicdata.com). The advancement in economy experienced in the last couple of decades has brought about wealth creation and better living standards for most of the country's population. This study examined the quantity of food waste generated in some selected dining halls located at Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus. The study found that mean quantity of food waste ranged between 24.89 ± 3.904 and 62.840 ± 4.091 , while per capita food waste ranged between 20g to 70g per person/day.

In terms of characterization of food waste, results from the study showed that 40% of respondents waste sauces and spread served them during meals, while 19.5% waste vegetables, 14.2% rice and 12.9% chicken or fish. Some of the reasons given by students for wasting food include limited time to eat the food, food contains too much oil, food not tasty and food served is too much. The significance of this research lies in quantifying the degree of food waste in one of the government universities in Malaysia and identifying ways of reducing it. Thus, the study identified the following as ways of reducing food waste in the dining halls: better estimation of portion size of meal on both students and stallholders since the dining halls operate on one-plate self-served buffet and staff service in some instances. Improvement in quality of meals in terms of taste and quantity of oil and spices added during meal preparation. Provision of smaller portion sizes at reduced price. Also, local university should assign more time for lunch break during weekdays. The study examined only one public university due time and financial constrain, future research should examine more public universities in the country.

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