



## Contribution of Quality Tools for Reducing Food Waste in University Canteen

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PAPER INFO	ABSTRACT
<p><b>Chronicle:</b> Received: 03 February 2019 Revised: 04 June 2019 Accepted: 07 June 2019</p>	<p>The aim of this paper is to implement the quality tools for reducing food waste in Woldia University (WU) canteen (Ethiopia). Universities are one of the main sources of food waste among food catering industries. In WU canteen, it is observed that most of the generated food wastes are goes to landfill. This has a direct impact on the environment. This paper proposes a methodology to tackle this problem. First, food items which contribute by 80% of food waste in the university are identified with the help of Pareto chart. Then the cause and effect diagram is used to identify the main causes or reason for these food items to be wasted. Finally, Quality Function Deployment (QFD) is implemented for reducing food waste through customer satisfaction. This reduces significant portion of food waste as the food waste in the canteen is directly related to customer satisfaction.</p>
<p><b>Keywords:</b> University Canteen. Quality Tools. Food Waste Minimization.</p>	

### 1. Introduction

The problem of food waste has become the increasing worldwide concern and it is related to environmental, economic, and societal problem. According to the Food and Agriculture Organization (FAO), about one third of the total mass of food produced (1.3 billion tons) are being lost or wasted annually [1]. At the same time, the significant number of global populations are vulnerable to food insecurity.

Food waste is defined as all the products discarded from food supply chain while preserves their nutritional value and complies with safety standards [2]. Food waste from meal catering services is generated through spoilage, meal preparation, unserved food or plate waste. The latter refers to both foods incompletely consumed as well as food served but untouched by the customer and is estimated to be ~ 14% of the per capita food waste in the EU27 [3].

In addition to societal and economic problem, the food waste has negative impact on the environment. According to [4], approximately 22% of the global warming potential in Europe is caused by the food

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DOI: 10.22105/jarie.2019.177566.1086

sector, including significant reactive nitrogen emissions [5]. Household food waste alone is estimated to account for ~7% global greenhouse gas emissions [6].

Food waste mitigation is a critical means of addressing current and future economic, social and environmental concerns, and to ensure enough food to feed the world's growing population in a sustainable way [7]. Several studies have discussed a reduction of food waste in school canteens. Pinto et al. [8] launched an education campaign to raise awareness of reducing plate waste, by establishing the connection between food waste and personal behavior at the school of agriculture canteen (University of Lisbon, Portugal). In their work, plate waste from canteen users was measured over a 10-day period and waste consumption index and per capita waste consumption were calculated to evaluate the level of satisfaction of the consumer and the related concern about the food waste, and was classified as bad. After this first stage, it was concluded that the users did not have strong conviction about avoiding food waste. Finally, an education campaign was implemented by displaying simple and affordable informative posters in strategic areas of the canteen with simple messages reminding not to accept food that they knew they would not eat. This led to a mean reduction in waste consumption index of 15%. Saputri et al. [9] assessed the quantity and composition of the food waste generated from vendors with different serving styles. This study was conducted at Mulawarman University, Indonesia from September to October 2017. The study includes vendors serving pre-made food, vendors serving *à la carte* food, and vendors serving both styles. Food waste was collected and quantified according to the food loss and waste protocol of the United Nations Environment Programme. In total, *à la carte* food vendors produced the highest amount of food waste (59 g/portion); vendors serving pre-made food produced the lowest amount of food waste (44 g/portion). Staple food was the most food being wasted followed by fruit and vegetables, which are accounted for 43% and 32% of wasted food, respectively. However, there was no significant difference between the food wastes generated from both types of service. Monitoring the management system in the kitchen is important to prevent disposing avoidable waste [9]. Falasconi et al. [2] investigated food waste in school catering services focusing on six schools located in the municipality of Verona (Italy). It aims to quantify the food waste, as a measure of food catering inefficiency, to identify the main causes, and to suggest a set of prevention and reduction interventions. The work shows a significant level of inefficiency in the school catering services, measured by the amount of food processed and still perfectly edible, but not served during the meals. On average, more than 15% of the overall processed food is wasted. Among the causes identified in this study, four of them were more relevant than others because of their implications and impact on prevention: The lack of attention to dietary habits, the rigid food procurement specifications, the menu composition, and the meal presentation. Lagorio, et al. [10] focused on a successful food waste reduction project in a school canteen in the north of Italy. The project aimed at addressing the education of students and their families towards a more appropriate food culture and environmental behaviors. Furthermore, the project had a concrete social outcome, directly supporting needy families. In this way, without any additional investment and without producing waste, the school canteen can nowadays serve both students and indigent families. Derqui et al. [11] identified the cause of food waste and unveiled the best practices towards its reduction. To achieve this goal, we have designed and developed a mixed methods research approach including semi-structured interviews with managers and staffs in school and catering firms and waste audits at four school canteens measuring waste from over 10,000 pupils' trays. We estimated overall food waste between 60 g and 100 g per pupil per day. Plate waste represented the highest source of waste, although a big disparity was found among the schools based on their different educational perspectives. The aim of this paper is to propose a methodology for reducing the food waste in University canteen in Ethiopia.

## 2. Case Study

This study is conducted on Woldia University canteen in Woldia campus (Ethiopia). In Woldia Campus, the University has two cafeterias which cater more than 11,000 students. The food wastes from the cafeteria is transported to nearby landfill around Woldia town; this contributes the environmental pollution. This paper introduces the contributions of quality tools for reducing food waste in university canteen (Ethiopia).

### 2.1. Data Collection

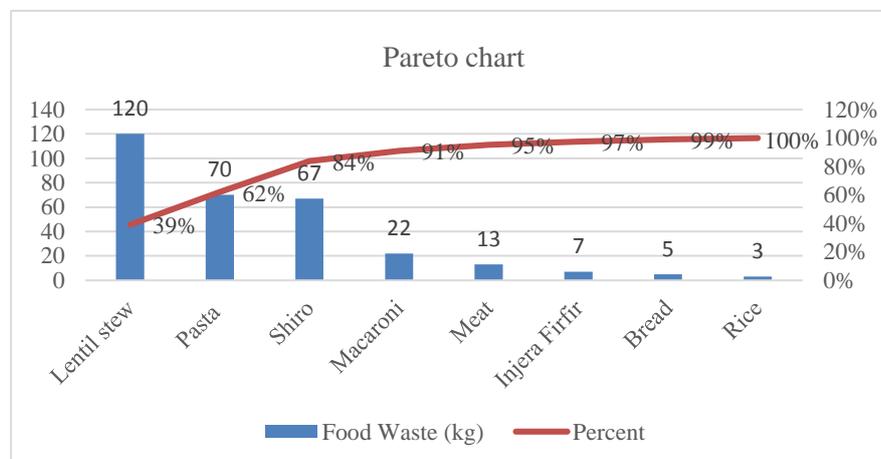
In data collection, the prepared but unserved food waste and table waste of all food item categories are collected for one-week period through the visual estimation. And it is pointed out that 75% of food waste in the canteen is unserved food and the rest, the 25% is the table waste. This indicates that it can be easily avoided by finding the reasons of food waste.

*Table 1. List of food waste proportion for each food items.*

No	Food item type	Food Wastage (kg.)	
		Unserved food waste	Left over or table waste
1	Pasta	55	15
2	Shiro	60	7
3	Meat	4	9
4	Rice	0.5	2.5
5	Bread	2	3
6	Injera Firfir	1	6
7	Macaroni	18	4
8	Lentil stew	90	30
Total = 307 kg.			

### 2.2. Pareto Chart

Pareto chart is a special type of histogram that can easily be apply to find and prioritize the quality problems, conditions, or their causes in the organization [12]. Pareto chart for the food waste data gathered from the university canteen is shown in Fig. 1.



*Fig. 1. Pareto analysis for food waste by each food item category.*

From the Pareto chart, it is observed that the significant portion of food waste in the canteen is recorded as lentil stew, Pasta, and Shiro with 120 kg, 70 kg, and 67 kg, respectively. This indicates that 80% of food waste problem in the canteen arises from these three food items. To analyze the main causes of the identified food waste, the cause and effect diagram is utilized as discussed in the next section.

## 2.2. Cause and Effect Diagram

Cause and effect diagram is a problem solving tool that investigates and analyses systematically all the potential or real causes that result in a single effect. On the other hand, it is an efficient tool that equips the organizations management to explore the possible causes of a problem [12]. The main causes of the identified food wastes are identified through interview and questionnaire. The researcher also observes the food preparation process for identifying the possible causes which may contribute to wastage of the particular food item and to validate the data gathered from respondents (students from different background, sex, etc.) during interview and questionnaire season. From Figs. 2-4, the cause and effect diagram of Lentil stew, Pasta, and Shiro is shown, respectively.

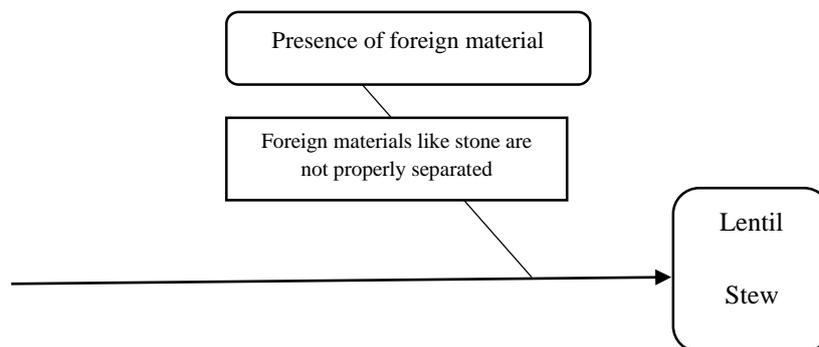


Fig. 2. Cause and effect diagram for lentil stew.

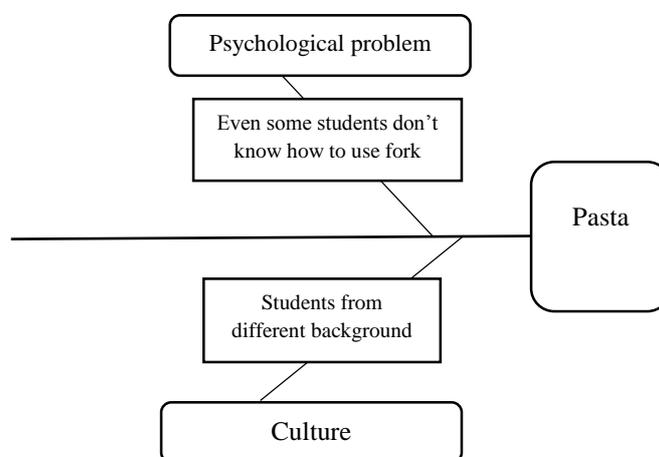
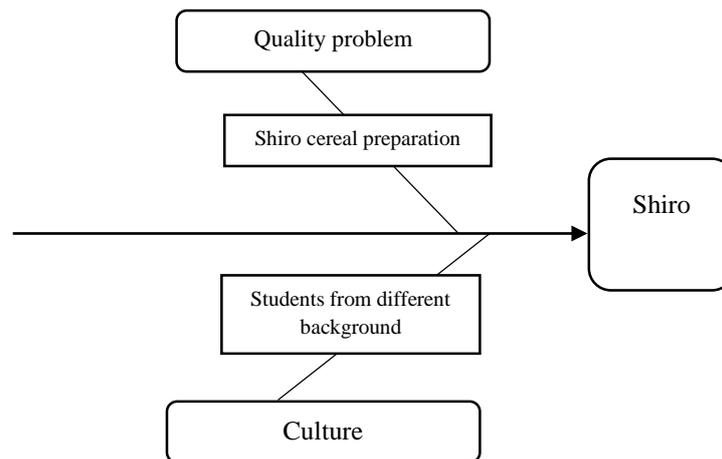


Fig. 3. Cause and effect diagram for pasta.



**Fig. 4.** Cause and effect diagram for shiro.

From observation, it is noted that the canteen management orders the number of foods to be cooked by considering total number of students those served in the university canteen. However, the number of students attend in the canteen at each service time is varied. Therefore, answering the reason for students to be absent in the service time will reduce the waste of prepared but unserved food which constitute the large proportion of food waste in the university canteen.

### 3. Quality Function Deployment (QFD)

QFD is a quality system that is used to make customers more satisfied by understanding the demands and needs of the customer. Companies will carry their organizations to their goals as far as they can ensure customer satisfaction. In other word, the success of a decision made by the company will depend on ensuring customer satisfaction [13]. From the previous section, it is found that most of food waste in the canteen are the unserved food waste which arises from dissatisfaction of customer. Therefore, applying QFD in the canteen will improve customer satisfaction at the same time reduce significant portion of food waste.

### 4. Conclusions

This study investigated the food wastes produced in WU canteen by using quality tools. Pareto chart was used to identify the vital few food items which contributes by 80% food waste in the university canteen. Then the main causes for the food waste generation of these food items were identified through cause and effect diagram coupled with structured questionnaire and interview. Finally, Quality Function Deployment was implemented to reduce the food waste through customer satisfaction. This reduced the food waste in the canteen significantly as the characteristics of food waste in Woldia University canteen is more related to customer satisfaction.

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