

Food Management During Hajj Using Lean Methodology to Fulfill the Pilgrims' and Umrah Performers' Food Needs, Rationalize Consumption and Preserve the Environment

Samah M. S. Hamdan^{1,*} and Saja A. Albliwi²

¹Management of Housing and Institutions Department, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia.

²Faculty of Economics and Administration, Department of Business Administration, King Abdul-Aziz University, Jeddah, Kingdom of Saudi Arabia

ABSTRACT

Hajj is an obligatory religious duty. It is one of the greatest and closest rituals to the Muslims' hearts. Saudi Arabia's government is exerting continuous efforts to serve the Pilgrims and Umrah Performers, provide them with their needs, especially quantities and qualities of food for maintaining good health and develop scientific and practical solutions for any emerging problems to achieves their security, safety, and well-being. Besides, enable them to perform their rituals with ease and tranquility. Therefore, the question of this research is to ensure the provision of nutritional needs appropriate with the different health conditions of the Pilgrims, where improper nutrition affects their health, physical fitness and hinders the performance of the rituals. Also, improper food rationalization leads to a massive surplus of the remaining food, thus inducing environmental pollution, accumulation of microorganisms, and the reproduction of insects that transmit toxins and diseases. This research aims to apply food management during Hajj using the Lean Methodology to ensure fulfilling Pilgrims' needs according to their health status, rationalizing the consumption, and preserving the holy rituals' environment against pollution. The research follows the descriptive and analytical approach; two questionnaires were used to obtain the results of the study. There was 20–40% waste food, their cost ranging between 1.3-3 million SR, which means considerable amounts in total and edible leftovers are not used optimally. Results of Pilgrims' response to the second part of the questionnaire to obtain proper nutrition and reduce waste of food indicated pilgrims' approval of most proposals had ranged between 75 - 100%. There were huge amounts in total and edible leftovers, which are not used optimally. Therefore, applying the Lean Methodology was a suggested step for Pilgrims and Umrah performers to achieve their nutritional needs and reduce food waste.

KEY WORDS: FOOD MANAGEMENT- HAJJ - LEAN METHODOLOGY - NUTRITION NEEDS - FOOD WASTE - ENVIRONMENTAL PROTECTION.

ARTICLE INFORMATION

*Corresponding Author: sabdelghani@kau.edu.sa

Received 13th July 2020 Accepted after revision 24th Sep 2020

Print ISSN: 0974-6455 Online ISSN: 2321-4007 CODEN: BBRCBA

Thomson Reuters ISI Web of Science Clarivate Analytics USA and Crossref Indexed Journal



NAAS Journal Score 2020 (4.31) SJIF: 2020 (7.728)

A Society of Science and Nature Publication,

Bhopal India 2020. All rights reserved

Online Contents Available at: <http://www.bbrc.in/>

DOI: <http://dx.doi.org/10.21786/bbrc/13.3/70>

INTRODUCTION

The large crowds of Pilgrims and Umrah Performers are in dire need of healthy, balanced, nutritious food that provides them with their nutritional needs. The Hajj or Umrah spiritual journey requires exerting physical effort comfortably, without headache, tension, anger, and exhaustion. Hence the key role of a balanced healthy diet, especially with changing sleep and mealtimes. Proper nutrition for Pilgrims and Umrah Performers is one of the essential factors for maintaining health and body strength, though it might also be one of the causes of its weakness and illness. Therefore, it is necessary to raise the level of food management and rationalize its consumption for pilgrims for their activity and prepare them to perform the rituals easily and smoothly without suffering from any weakness.

As low vitality or facing health problems resulting from malnutrition may not suit their health and physical condition, in addition to wasting quantities of food instead of utilizing them. Hajj travel agencies tend to provide very large quantities of food that exceeds the actual food needs of the Pilgrims and Umrah Performers, seeking to please them without consideration to the waste of food and the resulting health problems for the Pilgrims that lead to a decrease their ability to perform the rituals appropriately (Qanta et al., 2006; Bond et al., 2013). Consequently, it is necessary to raise the level of food management and rationalize its consumption for Pilgrims to renew their activity and prepare them to perform the rituals smoothly and easily without suffering any weakness, lacking vitality or facing health problems, nor wasting any quantities of food (Vankatesh and Memish, 2017 UNEP, 2019).

Food management begins with defining the goal towards proper nutrition for Pilgrims, which helps them to carry out the various rituals of Hajj with the necessary vigor, prevent several health problems that arise from providing them with inappropriate nutrition. Planning for the meals come in two parts. First: planning for proper nutrition, including determining the health conditions that must be met in each meal, in terms of specifying its quantity and components, to suit the different groups of Pilgrims (healthy, patients with chronic diseases such as hypertension, diabetes, kidneys, elderly persons, children, and pregnant women) and meet their bodies need of energy and nutrients, with a focus on micronutrients to increase the body's immunity and its ability to resist infection.

In addition to determining the places from which the components of the meals are purchased, selecting the most appropriate preparation and cooking methods that maintain the highest nutritional value of the meals provided. The methods of packaging, preserving, and storing that ensure handing over healthy meals, considering the compatibility if such meals with the dietary habits of the Pilgrims. Second: planning for food spending so that proper nutrition would be available at the lowest possible expenses; the more spending on food

items, operation costs increase and Pilgrims bear more expenses that could be avoided by adopting the methods and techniques of rationalizing spending on food during Hajj (Yamin, 2007 UNEP 2019). Food losses and waste is an emerging issue with huge environmental, social, and economic implications (WRAP, 2008; WRAP, 2012; FAO, 2013; HLPE, 2014; WRAP, 2020).

Meals management includes the method of distribution, manners of directing and guiding the Pilgrims to choose the types and quantities of food that are appropriate to their needs and health conditions optimally, to keep the energy required during the performance of Hajj and to avoid the occurrence of digestive disorders as a result of poor food selection or excessive eating. In addition to guiding them to how to preserve the leftovers and eat later or redistribute them to the needy, as well as to the healthy ways to get rid of the waste after consuming the meal (Shaikh-Omar et al., 2013).

Implementation and control in terms of adherence to the sound rules required for feeding Pilgrims by Pilgrims supervisors, tour guides, and the persons in charge of serving them in the relevant travel agency, in addition to allocating places for eating, away from the areas where Pilgrims sleep, adhering to the best methods of choosing, buying, preparing, cooking, canning, packaging, preserving and storing food, according to health conditions. Also, compliance with healthy practices in re-packaging, preserving, and transporting the edible leftovers for distribution to the needy and the healthy ways to get rid of food waste and non-edible remnants. Finally is the role of evaluation of each of the previous stages and re-examining them to identify the elements of success and failure in meals management, to assess the provision of the next meal by adopting and emphasizing the methods of success and avoiding the practices that led to obstacles in food management, replacing them with ways and means support better management (Jaralla et al., 1993; Yousef et al., 1995; Al-Mazrou, 2004).

Lean Methodology is a management philosophy that appeared in Toyota after the Second World War at the hands of the scientist Taiichi Ohno in Japan, because of the urgent need to cover the deficit in the capital. That methodology was based on reducing waste and making the possible use of available resources (Womack et al., 1990). The use of Lean Methodology started since 1990 on a large scale in various Japanese companies for the disposal of waste, surplus, and non-value-added activities in the operations, as well as to change the corporate culture towards continuous improvement and increased customer satisfaction (Pepper and Spedding, 2010). Lean Methodology can help companies to dispose several types of waste, the most famous of which are the seven types of waste: "movement", "unnecessary transportation", "overproduction", "over-operation", "time", "rework" and "inventory" (Ohno, 1988). Waste is disposed of by using a set of simple non-statistical Methodology and techniques, such as "Cause and Effect Map", "Value Stream Mapping", "5S", "Kaizen",

"Brainstorming", "SIPOC", "Checklist", and "5 Whys" (Antony et al., 2003).

Many experiences indicated the importance of applying Lean Methodology in both industrial and service companies, due to the positive results achieved in disposing of or reducing waste while best utilizing the available resources to increase production. The study by Bowen and Youngdahl (1998) used lean application in some restaurants in the USA to increase food preparation efficiency, increase customer satisfaction, and speed up the food preparation process. By using value chain analysis and JIT. It is thus reduced kitchen space by dispensing with unnecessary appliances, rapidly preparing food, and serving it at an appropriate temperature and high quality, harmony of employees in the performance of work, and increasing customer satisfaction. The obstacles contain great diversity in customer needs.

Engelund et al. (2009) used Lean application to increase the efficiency of food production, reduce food production steps, thus increasing production speed while maintaining quality, reduce the number of employees in the kitchen, and reduce waste of raw materials used in preparing food, thus reducing expenditures by using value stream mapping, 5S, and Kaizen. They are thus reduced the number of employees in the kitchen from 71 to 54, increasing the efficiency of food production steps, ensuring an enjoyable work environment for employees, and reducing waste in food products to 5% by switching to production on demand. The obstacles contain employees with different nationalities and languages, leading to difficulty in communication. Mohammad (2017) used Lean application to improve the operations related to the savings in the hotel, outperform competitors, and reducing operating expenses related to food production.

By using value stream mapping, which leads to increase customer satisfaction by understanding their needs, reduce the costs of food management operations by excluding unnecessary steps, improve the quality of food and beverages served by setting quality standards based on customer needs, and outperform competitors by providing high quality food at affordable prices. The obstacles contain convincing some administration employees of the importance of using Lean Methodology, failure of some employees to implement the proposed improvement, and difficulty finding the right time for all participating employees to start improving together.

The mentioned researches show the feasibility of using Lean Methodology for the service product to help reducing waste of foodstuff used in food, improve its quality, as well as lowering the Methodology, equipment, and devices required for speeding up the preparation process, reducing unnecessary steps to decrease the time and effort of the workers, in addition to achieving other benefits for the service consumer, including increasing

customer satisfaction in terms of food quality, price, temperature, cooking methods, food preferences, by using some simple Methodology. On the other hand, the experiments and studies that dealt with the application of Lean Methodology to reduce the waste of food quantities provided in places with large human gatherings, such as residential homes, hospitals, student housing, and school that provide meals.

There are several Methodology adopted in applying Lean Methodology, the most suitable tool to achieve the goal of this research in meeting the needs of Pilgrims and reducing food consumption is the use of the Deming Cycle (Plan-Do-check-Act cycle, PDCA) (Pratik and Vivek, 2017) which designed by the scientist Deming in 1951 to be one of the most essential Methodology used to achieve continuous improvement in production, as well as maintaining the sustainability of continuous improvement and learning from mistakes and previous experiences. The cycle consists of four main steps: Plan: the first step is planning, i.e., presenting the necessary strategies to improve quality after identifying the problem and collecting and analyzing the essential data; Do: implementing the plan and applying the change in a limited scale; Study: measuring and evaluating results and determining whether the improvement efforts were successful or not; and Act: if the results are successful, then adopt the improvement plan and apply it to other areas in the organization. If the results are unsuccessful, then amend the improvement plan (Johnson, 2002). Therefore, this research assumes that there was a failure to meet the nutritional needs of the food provided to Pilgrims during Hajj, with foodstuff improper to their health conditions.

METHODOLOGY

The descriptive and analytical methods were used to represent the obtained data in the present study.

Research Methodology: Two questionnaires were applied in this research. The first questionnaire: Meeting the nutritional needs with reducing food waste during Hajj and Umrah, was addressed to the organizers and guides of campaigns responsible for preparing for Hajj and Umrah tours. The number of (25) of the operators and tour guides, whose experience ranged from 4-35 years, with Pilgrims in their campaigns ranging from 400 – 2000 persons. The second questionnaire: Meeting nutritional needs while reducing food waste during Hajj and Umrah, was addressed on Pilgrims from both male and female, with age more than 20 years who performed Hajj from no more than 4 years. The questionnaire including questions about gender, age group, time from last Hajj, Pilgrims category, and their health status (Appendix 1). After obtaining the data, a proposal presented to apply Lean Methodology with the Deming Cycle to meet the nutritional needs of Pilgrims and reduce waste was induced (Appendix 2). Statistical analysis : Data are presented as frequencies and percent using SPSS.

RESULTS AND DISCUSSION

Applying the study Methodology on the Pilgrims, Hajj agencies, and their guides revealed that the waste food ranged from 20% to 40% of the total quantities of food, with a cost ranging between (1,300,000 – 3,000,000 SR), which means huge amounts in entire and edible leftovers are not used optimally. Food losses and waste is an emerging issue with huge environmental, social, and economic implications (WRAP, 2008; WRAP, 2012; FAO, 2013; HLPE, 2014; WRAP, 2020). It undermines the basis of food security (FAO, 2011; FAO, 2017; Smil, 2004; Kummu et al., 2012). The reduction of food waste is also considered crucial to decrease the food-related environmental footprints (FAO, 2011; Kummu et al., 2012; HLPE, 2014; UNEP, 2019). Indeed, food waste amounts to a significant depletion of resources (including both natural resources such land and water and other economic resources such as energy and capital) at global and local levels (FAO, 2011; Kummu et al., 2012; Bellù, 2016). Food waste also represents a considerable loss of money for all food supply chain actors, including producers and consumers (Rutten, 2013; Lipinski et al., 2016).

Table 1. Demographic characteristics of the study participants (n =250)

General characteristics	Frequencies (n=250)	Percent %
Gender Male	52	20.6
Female	198	79.4
Age groups		
20-29	28	11.1
30-39	72	28.6
40-49	87	34.9
50 Y and above	63	25.4
Time from last Hajj Less than 1 Y	95	38.1
One Y	99	39.7
Two Y	24	9.8
Three Y	28	11.14
Four Y	4	1.26
Pilgrims/category		
Category (A)	15	6.1
Category (B)	18	7.2
Category (C)	60	24
Category (D)	28	11.1
Category (E)	-	-
Category (F)	129	51.6
Health status No diseases		
Have diseases	140	56
	110	44
Data present as frequencies and percent (total number=250).		

In the present study, the results revealed that only 24% of Hajj Agencies were dependent on a resident nutrition

supervisor in the Agency, despite the importance of his presence. There is no one to guide the Pilgrims regarding the food suitable for them, in terms of quantity and varieties, according to their needs and health conditions. Only 12 % of the Hajj Agencies served special meals for those with chronic diseases, while for sensitive groups, like elderly and children, only 8% specific meals are taken into consideration. In this study, some of the cooking methods used and the types of food provided to Pilgrims cause digestive disturbances in 55.38% of them. Food waste and leftovers are spreading in the environment surrounding the camps at a rate of (70.8%) and in the areas of the holy sites, which leads to visual and environmental pollution, the spread of unpleasant odors, and hindering Pilgrims smooth movement during the performance of the rituals.

There is a controversy about the incidence of various diseases and health problems during the occasion of Hajj. However, gastrointestinal complaints (GID) were found to be one of the most typical disorders during Hajj (Khamis, 2008). The occurrence of foodborne diseases comprising food poisoning in Hajj in Saudi Arabia is commonly recognized just after or a certain period after taking the meal (Jaralla et al., 1993; Malik et al., 1993; Kurdi, 1995; Al-Awaidy and Fontaine, 1996; Gaulin et al., 2002; Al-Mazrou, 2004; Heymann, 2004). The outbreak of food poisoning directly or indirectly relates to food handlers (Angelillo et al., 2000; Maguire et al., 2000). Diarrheal diseases in pilgrims during Hajj performance might occur due to inappropriate standards of food hygiene, low storage of many foods. However, it was the third most common cause of hospitalization (Al-Ghamdi et al., 2003).

Results of Pilgrims' response to the second part of the questionnaire, "Pilgrims proposals to obtain proper nutrition and reduce waste of food" indicated that 20.6 % of the participants were males, and 79.4 % were female. The majority of the participants, 34.9 % were in the age group 40-49 Y, followed by 28.6 % in the age of 30-39 Y, then 25.4 % were 50 Y and above, while 11.1 % were in the age group 20-29 Y. Concerning the time from last Hajj the majority of Pilgrims, 77.8 %, were 1 Y or less, while 11.14 % were three Y, 9.8% were two Y, and only 1.26 % were four years from last Hajj. Regarding the disruption of Pilgrims per category the majority of the participants 51.6 % were in category (F), 24% were in category (C), 11.1 % were in category (D), 7.2 % were in category (B), while only 6.1 % were in category (A). Concerning health status 56 % of the participants were healthy and 44 % of the participants having diseases as diabetes, hypertension, liver diseases, renal diseases, and gastrointestinal diseases Table (1).

The results revealed that 75 - 100% of Pilgrims' approval of proposals items including:

- The presence of a supervisor or nutritionist in each Hajj agency to provide them with nutritional counseling.
- The necessity of having training courses in "optimal nutrition for Pilgrims " for supervisors in Hajj agency

- before the season of Hajj in sufficient time.
- Preparing special meals with considered the quantity of food for sensitive groups of Pilgrims as elderly, children, or they have health condition affected on their nutritional needs. These packaged and standardized meals can sell with low cost in fast food stores in the holy sites.
- Using healthy cooking methods in preparing foods for Pilgrims, such as steaming and grilling, avoiding fried foods and thick sauce food, as much as possible.
- Using large screens and signs spreading in the areas of the holy sites to advice regarding the need to rationalize food and reduce food waste.
- Recycling of food inedible leftovers in making fertilizers and animal feed.
- Avoiding repeating the food types that do not accept by Pilgrims to reduce the food waste.
- Focusing on fresh vegetables and fruits in the meal instead of rice and the various kinds of starches.

Table 2. The proposed steps to implement Deming Cycle and Lean Methodology to provide the Pilgrims' nutritional needs and reduce food waste

Stage	Aim	Example	Lean Methodology to be Used
Plan	1. Defining the problem 2. Analyzing the problem based on the information gathered	First Problem: Failure to meet food needs of the Hujaj, especially those with chronic diseases. Second Problem: Huge waste of food provided by travel agencies to Hujaj. 2. The results of the questionnaire indicate that 49% of the sample are dissatisfied with the quality of the food provided to them, while 80% of the sample agreed that there is food waste in most agencies. At this stage, a strategy must be proposed to collect real and correct information on the percentage of waste and its potential sources, arranging them according to priority.	<ul style="list-style-type: none"> Brainstorming Cause and Effect Map <ul style="list-style-type: none"> SIPOC Value Stream Mapping <ul style="list-style-type: none"> Checklist
Do	1. Suggesting an appropriate solution based on the data. 2. Implementing the proposed solution.	Based on the problem analysis, the appropriate solution is determined; such as using a list to understand the desires and needs of the Hujaj of the agency, identifying their health status, finding an appropriate way to provide them with appropriate quantities of food throughout Hajj period and avoiding fatty foods that cause indigestion, etc. (attached with the research are practical solutions for the application of Deming Cycle and Lean Methodology)	<ul style="list-style-type: none"> S5 Kaizen
Check	1. Evaluation of the results achieved. 2. Ensuring that goal has been reached.	At this stage, a comparison is made between previous and current data, such as the percentage of Hujaj satisfaction before and after proposing and implementing the suggested solution, as	

		well as the percentage of wasted food before and after implementing the suggested solution.	<ul style="list-style-type: none"> • Brainstorming • Checklist
Act	1- If the results are satisfactory, the solution shall be circulated, and if they are not satisfactory, the plan shall be reexamined.	Based on the previous step, if the solution is satisfactory and achieved tangible results, such as increasing the Hujaj satisfaction with the food provided by 50% or more, as well as reducing the percentage of wasted food by 50% or more, then the solution will be circulated to other agencies, learning from the mistakes that occurred during implementation, if any, and working on avoiding them in next times, till reaching the maximum percentage of Hujaj satisfaction and the minimum percentage of waste.	<ul style="list-style-type: none"> • Brainstorming • Cause and Effect Map

Appendix 1: Proposal of Pilgrims' questionnaire to obtain basic data required for food management by the agencies. (Should be translated according to the language spoken by the Pilgrims)

Pilgrims questionnaire
(To meet the nutritional needs of Pilgrims during Hajj and Umrah)

Dear Pilgrims
The Agency is keen to provide you with the proper nutrition appropriate during Hajj period, so please answer the following questionnaire for us to know your nutritional needs and health status to provide you with the appropriate diet that maintain your health.

Thank you and appreciate your cooperation,

Agency Name: _____

1. Gender: Male Female

2. Have you performed Hajj before? Yes No
If (Yes), how long has passed since that Hajj?
 One Year Two Years Three Years Four and more years

3. Age (Y)
 Children (2: 12 Y) Teenagers (13: 21 Y) Adult (22: 60 Y) Elderly (60 and above)

4. Do you suffer from any chronic diseases that require special diet?
 Diabetes
 Hypertension
 Ulcers
 Duodenal ulcer
 Colon problems
 Digestive problems
 Gallbladder and liver disease
 Gluten sensitivity
 Food allergy (Please mention)
 Other diseases (Please mention)

5. What are your favorite cooking methods?
 Grilling Boiling Steaming Roasting Saucing

6. What are your favorite types of food for breakfast and dinner meals?
 Beans and chickpeas Cheeses Eggs
 Croissants and pies Fruits Bread
 Fresh vegetables Jam and halva Others

7. What are your favorite types of food for lunch meal?
 Redmeat Poultry Fresh vegetables
 Cooked vegetables Fruits Bread
Rice and pasta Salads
 Other choices

Appendix 2: Lean Methodology application on food management by Hajj and Umrah travel agencies

	Plan	Do	Check	Act
Target	<ul style="list-style-type: none"> •Defining the problem. •Analyzing the problem based on gathered information. 	<ul style="list-style-type: none"> •Suggesting an appropriate solution based on data. • Implementing the proposed solution. 	<ul style="list-style-type: none"> •Evaluating the results achieved. •Ensuring that the target has been reached. 	<p>If the results are satisfactory, the solution shall be circulated and if they are not satisfactory, the plan shall be re-examined.</p>
Methodology	<ul style="list-style-type: none"> • Using attached questionnaire to spot the actual needs of the Hujaj belonging to the agency •Brainstorming. •Cause and Effect Map. <ul style="list-style-type: none"> • SIPOC • VSM • Checklist • 5 Why. 	<ul style="list-style-type: none"> •S5 (Sort, Set in Order, Shine, Standardize, Sustain) • Kaizen 	<ul style="list-style-type: none"> • Map of operations • Brainstorming • Checklist 	<ul style="list-style-type: none"> • Brainstorming • Cause and Effect Map
Methodology Guide	<ol style="list-style-type: none"> 1.Brainstorming: Collective thinking and attempt to come up with creative solution ideas to find at a specific problem, thinking about the pros and cons of the proposed solutions and choosing the best. 2.Cause and Impact Map: Or the “Fishbone”, is used to identify the potential causes of any problem by linking the effective causes and the resulting impact, with a focus on the causes in order to develop ideas and propose appropriate solutions to improve service delivery. 3.SIPOC: One of the operations design tools by determining and identifying the suppliers, inputs, processes, outputs and customers, thus setting standards and indicators to measure them, spot the defects and determine who is responsible for their occurrence. 4.Value Stream Mapping (VSM): A chart used to describe the process flow and the steps and procedures that the service goes through, which helps to clarify the operations accurately and thus the possibility of proposing amendments and improvements in service provision. 5.Checklist: Used to collect and classify data into groups with similar characteristics, which contributes to facilitating data analysis and thus identifying the problem and taking appropriate action to solve it. 6.5 Why: A tool used to find out the root cause of a problem or defect occurrence by asking several questions starting with “Why”. 7.S5 (Sort, Set in Order, Shine, Standardize, Sustain): A tool aimed at arranging the workplace, to ensure that the work is performed efficiently, effectively, and safely. This system focuses on putting everything in its designated place, maintaining the cleanliness of the workplace and making it easier for people to do their jobs without wasting time or being at risk. 8.Kaizen: A Japanese methodology that aims to get rid of waste at work, with a view to achieve continuous improvement. It includes all employees without exception and urges them to perform simple daily changes to get rid of waste of all kinds, which leads to improving work in the long run. 			

By implementing Deming Cycle with Lean Methodology, the basic problems of the research will be solved; the failure to meet the food needs suitable for Pilgrims, the great waste of food and its consequences, such as environment pollution, damaging the general view.

Besides, solving other problems such as the wasted place for storing surplus food, transporting waste to and from the camps, as well as the wasted efforts of the agency workers in providing quantities of food more than required, reducing pollution resulting from excess food

that is not disposed of properly, in addition to reducing waste in the human resources, materials and devices used in preparing food. Finally, reducing the funds wasted in processing, transporting, cooling, heating, and preparing food.

CONCLUSION

From the obtained results to activate the role of research in saving the waste of food provided to Pilgrims, a form has been designed that the Agencies are required to distribute to their Pilgrims before time of Hajj to undertake the required preparations. Such forms are to be filled out by each Pilgrims including food preferences, preferred cooking methods, food habits, the usual quantities of food consumed, health conditions, and food sensitively. This information could be used in application of Lean Methodology in the food management and the reduce its waste.

Therefore, it is recommended that Hajj Agencies should have a nutrition supervisor to determine the nutritional needs of the Pilgrims, their favorite food considering their health status. Besides, supervise safety and suitable food preparation stages, determine the quantities to be served, in a manner that achieves maximum benefit for Pilgrims with avoiding the waste as 'What cannot be measured cannot be improved'. In addition, paying attention to the suitable re-preservation and repackaging methods of edible food in each Hajj Agency in a good way, to be redistributed to the needy. Increasing investments about the need to rationalize food consumption and reduce waste, using screens to be scattered all over the holy places and the indicative panels on the roads.

REFERENCES

- Al-Awaidy, S.T. and Fontaine, R.E. (1996). An outbreak of salmonellosis among Filipinos in a private camp, Saudi Arabia. *Eastern Medit Health J*; 2(1): 107-14.
- Al-Ghamdi, S.M., Akbar, H.O., Qari, Y.A., Fathaldin, O.A. and Al-Rashed, R.S. (2003). Pattern of admission to hospitals during muslim pilgrimage (Hajj). *Saudi Med J*; 24(10): 1073-6.
- Al-Mazrou, Y.Y. (2004). Food poisoning in Saudi Arabia: Potential for prevention. *Saudi Med J*; 25(1): 11-14.
- Angelillo, I.F., Viggiani, N.M., Rizzo, L. and Bianco, A. (2000). Food handlers and food borne diseases: knowledge, attitude, and reported behavior in Italy. *J Food Prot*; 63(3): 381-5.
- Antony, J., Escamilla, J.L. and Caine, P. (2003). 'Lean Sigma', *Manufacturing Engineer*, 82 (2):40-42.
- Bellù, L.G. *Food Losses and Waste: Issues and Policy Options*; FAO: Rome, Italy, 2016.
- Bond, M., Meacham, T., Bhunnoo, R. and Benton, T.G. (2013). *Food waste within global food systems. A Global Food Security Report* (www.foodsecurity.ac.uk).
- Bowen, D.E. and Youngdahl, W.E. (1998). "Lean" service: In defense of a production-line approach', *International Journal of Service Industry Management*, doi:10.1108/09564239810223510. Engelund, E.H., Breum, G. and Friis, A. (2009). Optimisation of large-scale food production using Lean Manufacturing principles. *Journal of Foodservice*; 20 (1): 4-14.
- FAO. *Global Food Losses and Food Waste: Extent, Causes and Prevention*; FAO: Rome, Italy, 2011.
- FAO. *Food Wastage Footprint. Impacts on Natural Resources*; FAO: Rome, Italy, 2013.
- FAO. *The Future of Food and Agriculture: Trends and Challenges*; FAO: Rome, Italy, 2017.
- FAO. *The State of Food and Agriculture 2019. Moving Forward on Food Loss and Waste Reduction*; FAO: Rome, Italy, 2019.
- Gaulin C, Viger YB, Fillion L. An outbreak of *Bacillus cereus* implicating a part-time banquet caterer. *Can J Public Health* 2002; 93(5): 353-5.
- Heymann, D.L., editor. *Control of communicable diseases Manual* (469-73), 18th ed. Washington DC: American Public Health Association 2004; pp. 211-6.
- HLPE. *Food Losses and Waste in the Context of Sustainable Food Systems. A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*; HLPE: Rome, Italy, 2014.
- Jaralla JS, Khoja TA, Izmiry MA. Reports of bacterial food poisoning in Riyadh Region of Saudi Arabia: a one-year retrospective study. *Saudi Med J* 1993; 14: 46-9.
- Johnson, C. (2002), The benefits fo PDCA. *Quality Progress*, 35(5):120.
- Kurdi, T.S. (1995). Riyadh: Ministry of Health; *Guidelines for Gastroenteritis Management*; pp. 1-14. Khamis, NK. Epidemiological pattern of diseases and risk behaviors of pilgrims attending mina hospitals, Hajj 1427 h (2007 g). *J Egypt Public Health Assoc* 2008; 83(1-2): 15-33.
- Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O. and Ward, P.J. (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Sci. Total Environ*; 438: 477-489.
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R. and Searchinger, T. *Reducing food loss and waste. working paper, Installment 2 of "Creating a Sustainable Food Future"*. World Resources Institute: Washington, DC, USA, 2016.
- Maguire, H., Pharoah, P., Walsh, B., Davison, C., Barrie, D., Threlfall, E.J. and Chambers, S. (2000). Hospital outbreak of *Salmonella virchow* possibly associated with food handler. *J Hosp Infect*; 44(4): 261-6
- Malik, G.M., AlWabel, A.A. and Ahmed, M.B. (1993). *Salmonella* infection in Asir Region, Southern Saudi Arabia: Expatriate implications. *Ann Saudi Med*; 13(3): 242-5.
- Mohammad, A.A.A. (2017), Approaching the adoption of lean thinking principles in food operations in hotels in Egypt. *Tourism Review International*; 21(4):365-378.
- Ohno, T. (1988), *Toyota Production System: Beyond Large Scale Production*, Productivity Press, Productivity

Press, Portland.

Pepper, M.P. and Spedding, T.A. (2010). The evolution of Lean Six Sigma. *International Journal of Quality & Reliability Management*, 27(2):138–155.

Pratik, M. P. and Vivek, A.D. (2017). Application Of Plan-Do-Check-Act Cycle For Quality And Productivity Improvement-A Review. *International Journal for Research in Applied Science & Engineering Technology*. 5(1): 197-201.

Qanta, A. A., Yaseen, M. A. and Ziad, A.M. (2006). Health risks at the Hajj. *Lancet*;367(9515): 1008–1015.

Rutten, M.M. What Economic theory tells us about the impacts of reducing food losses and/or waste:

Implications for research, policy and practice. *Agric. Food Secur.* 2013,

Shaikh-Omar, O.A., Header, E.A. and Bukhari,H.M. (2013). Digestive Discomforts and Effect of Ingested Food in People Performing Hajj. *Journal of Basic & Applied Sciences*, 9: 341-347. Smil,V.(2004).

Improving efficiency and reducing waste in our food system. *Environ. Sci.* 1:17–26.

UNEP. The Critical Role of Global Food Consumption Patterns in Achieving Sustainable Food Systems and Food for all. A UNEP Discussion Paper; UNEP: Paris,

France, 2012.

Vankatesh, S. and Memish, Z. (2004). SARS: the new challenge to international health and travel medicine. *Eastern Mediterranean Health Journal*;10:655–662

WRAP. Household Food and Drink Waste in the UK 2012; Waste & Resources Action Programme (WRAP): Banbury, UK, 2012.

WRAP. Food Waste Trends Survey 2019: Citizen Behaviours, Attitudes and Awareness around Food Waste; Waste & Resources Action Programme (WRAP): Banbury, UK, 2020.

WRAP. The Food We Waste; Waste & Resources Action Programme (WRAP): Banbury, UK, 2008.

Womack, J.P., Jones, D.T. and Roos, D. (1990). The machine that changed the world, Rawson Associates/Macmillan Publishing Company, New York, USA.

Yamin, M. (2007). A Framework For Improved Hajj Management And Future Research. In: *Proceedings of International Engineering Convention Jeddah, Saudi Arabia, March 10-14.*

Yousef, M., Al-Saudi, D.A., Sheikh, R.A. and Lone, M.S. (1995). Pattern of medical problems among hajj pilgrims admitted to King Abdulaziz Hospital, Madinah Al Munawarah. *Ann Saudi Med*; 15: 619-21