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FOOD SECURITY AND FOOD LOSSES: A PRODUCER TO PROCESSOR PERSPECTIVE

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ABSTRACT

This paper presents an exploratory analysis of the challenges faced by producers and processors in the agriculture produce supply chain in order to reduce food losses. Using data from secondary sources and by deploying a web-questionnaire to respondents within the food industry, this exploratory study identifies the key factors that contribute to post harvest food losses and the barriers and the enablers to reduce them. The findings are utilised and a framework is developed proposing solutions to those challenges. Future research directions are also identified.

INTRODUCTION

Food supply chain and particularly food security has received a great deal of attention lately due to issues related to scarcity of natural resources, population growth, fluctuating food prices, changing consumer habits and climate change etc (FAO, 2011). It has been estimated that between 25% and 50% of food produced is lost or wasted along the supply chain and does not reach consumers, depending on its position in the supply chain (FAO, 2010; Lundqvist et al, 2008). Reducing food losses can increase grain supply, food availability and food security without wasting any other resources such as land, labour, water and inputs (The World Bank, 2011; APO, 2006).

According to a recent study conducted by the FAO titled 'Global Food Losses and Food Waste' (Gustavsson et al, 2010), "food is lost or wasted throughout the supply chain, from initial agricultural production down to final household consumption". The authors suggest that food losses and waste in developing low income countries are related to the upstream supply chain (farm to processor), whereas the losses in the affluent world are related to the downstream supply chain (retailer to final consumer). This research provides an exploration of challenges with food losses in the upstream chain. The purpose of this paper is to identify the challenges producers and processors face in reducing food losses and proposes ways to address these challenges.

FOOD SECURITY & FOOD LOSSES

The World Food Summit (1996) was the first to define food security as "availability at all times of adequate world food suppliers of basic food stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices". In recent times, food security is defined as "*A situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (FAO, 2011). Food security comprises of four elements: food availability, food access, food utilisation and food stability (Defra, 2009). This research focuses on the aspect of food availability and its effect on food security. Food availability is the consistent availability of sufficient quantity of food. Improving food availability can increase food security (Yang et al, 2009). As much as it is important to increase the production of food to feed an ever increasing population, it is of utmost importance to utilise the currently produced food (available food) effectively and without wasting it.

From the literature reviewed it can be observed that there are a number of different interpretations defining food waste and food loss (Hodges et al, 2010; Kader, 2005; Williams et al, 2011; Atanda et al, 2011; WRAP, 2009). The World Economic Forum (2011) defines food loss as upstream loss in agriculture and transport prior to processing, and food waste as food fit for human consumption that is wasted in all further downstream parts of the value chain. Others refer to food loss as decrease of edible food mass throughout the supply chain from farm to fork or from production to

consumption which is actually the same (Kader, 2005; Sharma et al, 2011; Paull et al, 1997). In some cases food waste is termed as food loss occurring at the end of the food chain (Hodges et al, 2010; The World Bank, 2011). Food waste is food loss occurring during the retail, final consumption and post-consumption stages due to the behaviour of retailers and consumers (FAO, 2011; Parfitt et al, 2010). This research aims to address the food losses problem as one that occurs from producers to processors and does not consider any other entities or the consumers' side.

KEY FACTORS CONTRIBUTE TO FOOD LOSSES

Through an extensive literature review the main factors contributing to food losses between producers and processors are formed and can be classified into environmental, product related, process related, management related, and industry related factors. Table 1 lists the categories of factors affecting food losses, and also presents the different components in each category and the relevant literature identified.

Categories of factors	Different Factors affecting food losses	Authors
Environmental factors	seasonality, catastrophic failures, weather patterns, disease & insect infestation.	Basavaraja et al, 2007; Hodges et al, 2010; FAO, 2006; Mena et al, 2011; WRAP, 2011
Product related factors	highly perishable, shelf life, inappropriate packaging, product damage during transportation.	Kantor et al, 1997; Paull et al, 1997
Process related factors	inappropriate warehouses, inappropriate transportation, lack or inappropriate, equipment.	Kantor et al, 1997; FAO, 2011; Paull et al, 1997; Stuart, 2009
Management related factors	poor demand forecasting, inventory management, lack of knowledge about how to handle the crops, relationship factors among partners.	Defra, 2006; Mena et al, 2011; FAO, 2011; Kader, 2005; FAO, 2006
Industry related factors	international and national food policies, food safety and food quality standards.	Kader, 2010; Paull et al, 1997; FAO, 2006; Mena et al, 2011

Table 1. Generic factors contributing to food losses

The factors to be examined first may include those related to management issues. The management issues can be directly addressed by the chain members. For example, food chain members can influence inventory management and demand forecasting in faster pace than any other industry related factors such as food policies and food quality standards.

DESCRIPTION OF THE PROBLEM

Food losses inhibit worlds' food security. Food availability needs to be increased; however there are major constraints such as scarcity of natural resources and availability of land for production. Reducing food losses seems to be an important way to increase food security without requiring or wasting any other resources. Although there are

studies available to understand this issue, the rate of reduction in losses is still very low. The problem of food loss is quite well represented in industrial reports; however there is a lack of empirical academic research. Identifying the challenges (key factors contributing to food losses and the barriers) producers and processors face in reducing food losses helps in proposing a framework to overcome them.

RESEARCH METHODOLOGY

The research stems from two research questions:

RQ1: What are the challenges faced by the upstream entities in the agriculture produce supply chain to reduce food losses?

RQ2: How can the value chain provide the necessary processes to reduce food losses?

A qualitative approach was conducted in two stages. The first stage involved secondary data analysis in the form of an extensive literature review examining journal papers, industry reports and websites of professional organisations. The second stage consisted of a web-survey questionnaire deployed via 'surveymonkey' to respondents within the upstream segment of the food supply chain. The respondents were producers, processors, marketeers, manufacturers, retailers, consultants and managers from the food sector. The respondents were represented in a 'Linkedin' group of the same subject. The survey aimed to identify the perceptions of the food chain members with regards to the following issues:

- The key factors identified in the literature to contribute to food losses,
- The main barriers that supply chain entities face in reducing the food losses;
- what are the most appropriate practices that the supply chain entities perceive as important in reducing food losses.

RESULTS & ANALYSIS

Participants of the conducted web-survey were currently based in India (38.1%), Europe (23.8%), Eastern Europe (9.5%), South East Asia (9.5%) and USA (4.8%). Although, forty six respondents attempted the questionnaire, on an average thirty respondents attempted most of the key questions.

Key factors contributing to food losses

The questions were formed in a 5 point likert scale format. Based on the key factors contributing to food losses identified through the extensive literature review, respondents were asked to choose the impact of each factor (from no impact to high impact) for their products. The analysis shown in table 2 has depicted the results in three columns instead of five. Table 2 shows that two factors (weather patterns and catastrophic failures) have been identified by the respondents as being important for considering food losses.

To what extent do you think the following environmental factors influence the level of food losses of your product/s?					
Answer Options	No or Low Impact %	Average Impact %	Above average or High Impact %	Rating Average	Response Count
seasonality	33	30	37	3.20	30
catastrophic failures (e.g. in warehousing or transportation equipment)	33	10	57	3.43	30
weather patterns (e.g. temperature fluctuations)	20	20	60	3.60	30
disease and insect infestation	20	33	47	3.37	30

Table 2: Environmental factors influencing post harvest food losses

Table 3 depicts the perspectives of the respondents with regards to process related factors. Inappropriate transportation (60%) and Inappropriate warehouses (57%) were

identified as being factors influencing food losses. This also highlights the requirement of appropriate assets within the upstream food supply chain.

To what extent do you think the following process related factors influence the level of food losses of your product/s?

Answer Options	No or low impact %	Average impact %	Above average or high impact %	Rating Average	Response Count
inappropriate warehouses	17	27	57	3.77	30
inappropriate transportation	13	27	60	3.80	30
inappropriate or lack of equipment to handle crops	23	33	43	3.27	30

Table 3: process factors affecting post harvest food losses

Table 4 depicts the influence of management factors (within the supply chain) on the extent of food losses. Product damage during transportation and lack of knowledge in handling food were the significant factors which had a high impact on the level of food losses. This also highlights the challenges of training and availability of skilled people within the upstream food supply chain. Relationship and communication among supply chain partners' featured as having a low impact on the level of food losses.

To what extent do you think the following management factors influence the level of food losses of your product/s? (Please tick

Answer Options	Low or No Impact %	Average Impact %	Above average or High Impact %	Rating Average	Response Count
poor demand forecasting	17	40	43	3.37	30
poor inventory management	17	40	43	3.53	30
product damage during transportation	20	27	53	3.60	30
lack of knowledge about how to handle food products	17	33	50	3.40	30
relationship factors among partners (e.g. lack of effective communication)	43	20	37	3.10	30

Table 4. Key factors contributing to post harvest food losses

Barriers in reducing food losses

The questions were formed in a 5 point Likert scale format. Based on the key factors contributing to food losses identified through the extensive literature review, respondents were asked to choose whether they agree or disagree with the factors listed out as barriers to reduce food losses. The analysis shown in table 5 has depicted the results in three columns instead of five. Thirty respondents completed this section of the questionnaire. Although the table depicts a number of factors as having a high value of agreement, the most striking are: lack of basic infrastructure (80%), lack of appropriate transportation means (67%), lack of knowledge to reduce food losses (67%), lack of coordination among partners (67%). Although the previous table depicted that relationship among partners to be of low impact, considering table 3 and table 4, it is evident that the two most barriers are:

1. Lack of appropriate infrastructure (including storage and transport).
2. Lack of coordination and skills (including training) across supply chain entities.

It is difficult to reduce food losses of your product due to the following reasons	Disagree %	Maybe %	Agree %	Rating Average	Response
Lack of financial incentives	30	17	53	3.33	30
Lack of knowledge to reduce food losses	13	20	67	3.77	30
Lack of knowledge about the societal impacts of food losses	10	30	60	3.70	30
Lack of knowledge about the environmental impacts of food losses	13	23	63	3.70	30
Lack of knowledge about the economic impacts of food losses	13	23	63	3.83	30
Lack of appropriate technology	13	23	63	3.80	30
Lack of basic infrastructure (e.g. warehouses)	17	3	80	4.00	30
Lack of appropriate transportation means	13	20	67	3.73	30
Lack of national policies towards reducing food losses	17	27	57	3.63	30
Lack of appropriate national legislation	27	27	47	3.33	30
Lack of governmental support	20	37	43	3.37	30
Lack of management commitment	17	30	53	3.47	30
Lack of information exchange among partners	20	30	50	3.37	30
Lack of communication among partners	7	37	57	3.63	30
Lack of coordination among partners	7	27	67	3.70	30
Lack of cooperation among partners	10	37	53	3.50	30
Lack of collaboration among partners	7	43	50	3.50	30

Table 5. Barriers in reducing post harvest food losses

Enablers in reducing food losses

The questions were formed in a 5 point likert scale format. Based on the key factors contributing to food losses identified through the extensive literature review, respondents were asked to choose whether they agree or disagree with the factors listed out as barriers to reduce food losses. The analysis shown in table 5 has depicted the results in three columns instead of five. Twenty six respondents completed this section of the questionnaire. Although the table depicts a number of factors as having a high value of agreement, the most striking are: Development of better infrastructure (e.g. warehouses, logistics) (81%), Training provision to chain members (81%), Adoption of international and national food quality standards (73%), Increase of information exchange among partners (e.g. shared IT systems) (73%), Better coordination among partners (73%), Better cooperation among partners (69%), Creation of value adding activities to deal with unsold products (69%), Collaborative forecasting among partners (69%), Investments in technology (69%).

Reduction in Food losses can be achieved by the following practices	Disagree %	Maybe %	Agree %	Rating Average	Response Count
Development of better infrastructure (e.g. warehouses, logistics)	12	8	81	4.12	26
Investments in technology	12	19	69	3.88	26
Provision of more financial incentives to smallholder producers and processors	19	23	58	3.62	26
Training provision to chain members	12	8	81	3.92	26
Creation of formalised contractual agreements	15	27	58	3.65	26
Increase of governmental and institutional support	15	38	46	3.46	26
Adoption of international and national food quality standards	15	12	73	3.81	26
Adoption of international and national food safety standards	15	19	65	3.73	26
Collaborative forecasting among partners	8	23	69	3.81	26
Increase of information exchange among partners (e.g. shared IT systems)	8	19	73	3.88	26
Creation of collective marketing groups	23	27	50	3.54	26
Creation of value adding activities to deal with unsold products	15	15	69	3.85	26
Better communication among partners	4	31	65	3.77	26
Better coordination among partners	4	23	73	3.92	26
Better cooperation among partners	4	27	69	3.88	26
Better collaboration among partners	4	38	58	3.77	26
Governmental and institutional collaboration with chain members	15	42	42	3.50	26

Table 6. Enablers in reducing post harvest food losses

From the analysis it is evident that there are three factors important from the aspect of enablers:

1. Better infrastructure
2. Better coordination among supply chain partners
3. Better skills, training and information sharing

DISCUSSION

The challenges faced by producers and processors in the agriculture chain towards reducing food losses are related to the key factors contributing to food losses and the key barriers to reduce them. Taking into consideration the secondary source analysis and the survey results, recommendations to overcome challenges in reducing food losses are proposed and a framework for systemic thinking is created (Figure 1). In order to reduce food losses the management and process related practices need to be considered:

Coordination, cooperation, collaboration: Coordination involves more efficient communication among partners with regards to how they should work and act together (Lozano, 2007). Cooperation is about sharing goals and objectives, while collaboration involves creating common plans and sharing responsibilities (Denise, 1999). Collaboration among food chain members is speculated to be an initial step to address key factors contributing to food losses (Mena et al, 2011). Better relations and collaborative action could enable reduction in food losses (WRAP, 2011).

Transparency: Transparency in the form of information exchange and collaborative forecasting emerges as a significant way for the development of better relationships among partners.

Human management: Human management in terms of training provision and creation of formalised contractual agreements found to accelerate food losses reduction. Managing humans in ways that facilitate food production and simultaneously control relationships appears to be a crucial way in reducing food losses.

Technology & infrastructure development: Investments in technology are considered to be essential for better processing of food and better management of processed food (Hodges et al, 2010). Development of better infrastructure is a crucial step for reducing food losses including creation of better warehouses and logistics development such as cold chain facilities and handling equipment (Choudhury, 2006). Both technological and infrastructural improvements are needed for a holistic solution to the food loss problem.

Alternative ways to process food: Creation of value adding activities and formation of collective marketing groups in order to process unsold food are proposed as ways to reduce food losses (FAO, 2011). The respondents of the web-survey indicated that value adding activities and collective marketing groups could possibly enable food losses reduction.

All possible ways to reduce food losses mentioned above need to be considered in relation to the existing international and national food safety and quality standards.

CONCLUSION & FURTHER RESEARCH

This paper has presented insights from a qualitative exploratory study conducted to identify the challenges faced by the upstream food chain members towards reducing food losses. The survey has identified the barriers affecting the reduction in food losses. The survey has also been successful in identifying the enablers to overcome the barriers and there is consistency between the identified barriers and enablers.

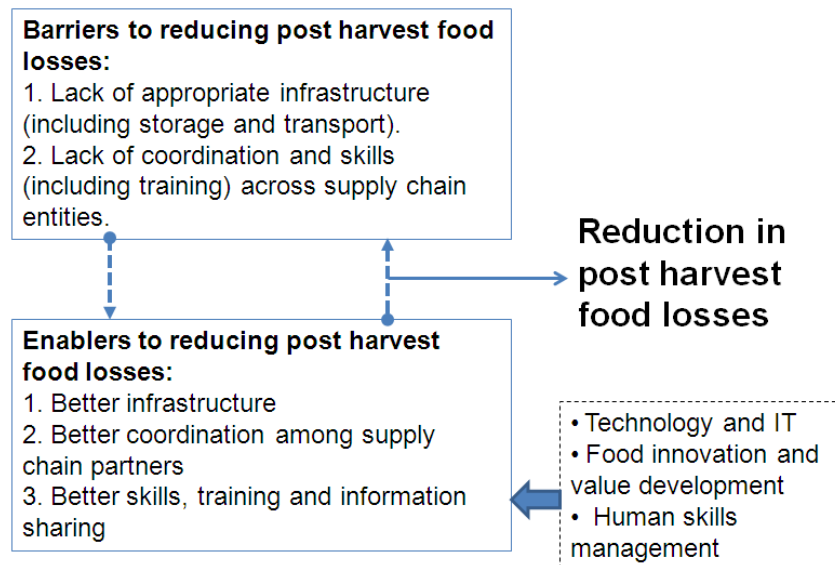


Figure 1. Framework for systemic thinking towards reducing post harvest food losses

The paper also presents a research framework to address reduction in food losses. The main limitation of this study is that the respondents of the web-survey could not be controlled in terms of appropriate sampling. However, the exploratory nature of the questionnaire overcomes this limitation to some extent. In the future it will be beneficial to conduct the survey with purposeful sampling so that the appropriate respondents can be identified and surveyed. The framework needs to be operationalised and the connections between various factors need to be tested for better implementation of food loss reduction programmes.

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