

Economic Reasons behind Adulteration Issues in Fish Supply Chain in Bangladesh

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Abstract: Food safety is one of the main concerns in any food supply chain. Since the last decade adulteration has become widespread in fish supply chain in Bangladesh. Use of formalin, toxic industrial dye and use of animal waste have been identified in several government inspections. The study reviewed relevant literature in order to summarize the knowledge of previous research regarding this issue. A suitable methodology was developed and justified in order to collect qualitative data through the interviews of relevant sector experts, fish traders and fish farmers. Through the results from the analysis of qualitative data, a problem tree analysis was conducted in order to identify the underlying reasons behind the food adulteration issue in fish supply chain in southern region of Bangladesh. The study found that the main three factors behind the adulteration issue are high post harvest loss, lack of government monitoring, and high profit motives.

1. Introduction

Food safety has become an important topic in modern age (WHO, 2015). The term food safety can be defined as a scientific discipline that describes proper method of handling, processing and storing of food to prevent food borne illness (Satin, 2004).

Fish is a highly perishable product. Depending on the marketing and distribution, it takes around 5 hours - 2 days to reach to the final consumers (Alam, 2010). Therefore, it is necessary to take proper steps in order to preserve it until it reaches the final consumers. Due to lack of proper post-harvest management practice and transportation problem, huge quantity of fish gets destroyed every year (Alam, 2010). To prevent this loss some traders and farmers use harmful chemical, mainly formalin, to preserve the fish for longer period of time (DoF, 2011; Yeasmin, Reza, Khan, Shikha & Kamal, 2010). In Bangladesh first formalin treated fishes was identified in 2006 (Islam, Mahmud, Aziz, Sarker & Nasreen, 2015).

Government inspections have identified the use of formalin, toxic chemicals and industrial dye in fish in order to increase the shelf life (Goon, Bipasha & Islam, 2014). Various government agencies, NGOs and other business institutions so far failed to properly address this adulteration issue (Alam, 2010). Food experts predict that this issue will have a severe impact on human health if not properly resolved. One reason for this might be that they are targeting the wrong problems

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and failed to address the main underlying reasons behind the problem. To develop a solution for this problem, it is necessary to analyze this problem and find out the underlying reasons for this problem. If it is possible to design solution targeting this underlying reasons, it will be possible to bring a sustainable solution.

This research tried to find out the underlying reasons behind this issue. It will help others to develop right solution for the problem.

The remainder of this paper is organized as follows: the critical analysis of different literature which is relevant to the aim and objective of the study; Methodology of the study describing and establishing the most suitable methodology for the research work in order to achieve the research objectives; Result and Discussion focusing on analysis of data and conducting the problem tree analysis; at last Conclusion emphasizing on conclusion and recommendations from this study. It also includes its limitations and emerging fields for future research.

2. Literature Review

2.1.1 Adulteration in Fish Supply Chain

The Federal Food, Drug, and Cosmetic (FD & C) Act (1938) provides a detail definition of adulterated food. According to the law,

“food is adulterated if the food is meets any one of the following criteria: (1) It bears or contains any "poisonous or deleterious substance" which may render it injurious to health; (2) It bears or contains any *added* poisonous or *added* deleterious substance (other than a pesticide residue, food additive, color additive, or new animal drug, which are covered by separate provisions) that is unsafe; (3) Its container is composed, in whole or in part, of any poisonous or deleterious substance which may render the contents injurious to health; (4) It bears or contains a pesticide chemical residue that is unsafe. (Note: The Environmental Protection Agency [EPA] establishes tolerances for pesticide residues in foods, which are enforced by the FDA.); (5) It is, or it bears or contains, an unsafe food additive; (6) It is, or it bears or contains, an unsafe new animal drug; (7) It is, or it bears or contains, an unsafe color additive; (8) It consists, in whole or in part, of "any filthy, putrid, or decomposed substance" or is otherwise unfit for food; (9) It has been prepared, packed, or held under unsanitary conditions (insect, rodent, or bird infestation) whereby it may have become contaminated with filth or rendered injurious to health. (10) It has been irradiated and the irradiation processing was not done in conformity with a regulation permitting irradiation of the food in question” (Frank & Hahn, 2003).

2.2 Underlying Reasons behind the Food Adulteration Issues

Various socio-economic, cultural, and regulatory reasons may be liable for these aforesaid food adulteration problems in fish supply chain (Abu Noman, 2013). On the basis of various literatures, the following table has been constructed describing different underlying reasons of food adulteration in fish supply chain.

Table 1: Underlying Reasons behind adulteration issue in fish supply chain in Bangladesh

Reasons	Details
A cheap method to prevent Post harvest Loss	Post-harvest loss is common in Bangladesh. According to different research, average post harvest loss in fisheries sector is around 12/5% and in addition to this there is quality loss. (Alam, 2010; BICAS, 2003). To prevent this post harvest loss one of the cheap method is to use formalin and other toxic chemical which helps to keep this fish fresh for a long time.
Lack of technical knowledge	Farmers in our country lack the technical knowledge to preserve the fish after the harvesting (Alam, 2010). Most of the farmers in Bangladesh are small scale poor farmers who do not have any formal or technical education. Even the large farmers lack the proper technical knowledge. This lack of proper technical knowledge contributes in use of waste material in fish culture, improper handling after post harvest and use of formalin and other toxic elements.
lack of ice box, unavailability of ice, high price of ice, lack of cold store to keep unsold fish.	Due to unavailability of electricity most of the rural parts of Bangladesh do not have proper icing facility for fish. Due to unavailability the price of ice is high. Again, There a shortage of ice boxes (Alam, 2010). Another main problem in the market of Bangladesh is there is lack of cold storage in the market place. As a result, there is no proper way to preserve unsold fish. Due to this reason traders use formalin and other chemical which keep the fish fresh for 6-7 days (Apu, 2014).
Lack of awareness	Both the customer and the fish traders lack the awareness regarding food adulteration. Most of the traders do not aware of the danger of using these harmful chemical. On the other hand customers are also not properly aware of this issue. They also lack the knowledge to identify adulterated fish in the market. So, its easier for the traders to deceive them (Afsana, 2015).

Lack of government initiative	The issues of food safety and wholesomeness or quality of food are mentioned under the mandates of several ministries. But these give an idea of lack of explicit mention or only indirect and limited mention particularly in the production stage. Secondly, while a large number of organizations are involved there is neither coordination nor any effective coordination mechanism among them. Even within the same organization there does not appear to be any cohesive view regarding procedures and penalties for the same offence by officials from same organization. This is due to lack of proper and coordinated training (Bids, 2014).
Lack of policy framework	The main weakness of the policies related to food safety is the lack of an integrated food safety framework or food control system. Food laws and regulations are mostly outdated and fragmented. Even the new Safe Food Act 2013 is not free from this as it is basically modeled on the Pure Food Ordinance of 1959 (Bids, 2014).
Incentives for and against Adulteration and Contamination	There are strong economic incentives behind adulteration through various means for such activities. Such incentives include low prices of the adulteration chemicals one reason of which being low import tariffs on them in general sometime being almost nil (Bids, 2014).
Inadequate Penalties	Considering the extent of harmfulness of food adulteration, penalties mentioned in law is insufficient. For an example, The penalty for food adulteration is maximum term of six months of imprisonment or up to a maximum fine of BDT 1000 which is equivalent to EUR 10.77. Considering the gravity of the offences this punishment is not hard enough (Ali, 2013).

In a summery it can be said that there are two sides behind this adulteration issue. At first, there is lack of government initiative and gap in current law. Current laws are not integrated and it does not include sufficient provision of penalties against the practice of food adulteration. As a result it could not discourage the farmers and traders to avoid this practice.

Secondly, lack of proper equipment, facility and technical knowledge from the traders and farmer's side are contributing to this issue. As a result, in some case, farmers and the traders are forced to use these types of toxic chemical. In addition to this lack of awareness of farmers, traders and consumers are helping in aggravating the issue.

2.3 Problem Tree Analysis

Problem tree is an analytical tool that widely used in the field of project management and is particularly popular among various development agencies (Ammani, Auta & Aliyu, 2010). Problem tree analysis helps to identify different symptoms, problem/constraints and the root causes and after that develop the cause-effect relationship between these symptoms, problems and root cause (Aus aid, 2003).

2.3.1 Problem Tree

One of the important parts of problem tree analysis is to construct a problem tree. Problem tree is a diagram that shows the causal effect relationship between symptoms, problems and root cause. (Ammani *et al.* 2010). This diagram helps to visualize the relationship between problem and its causes (UNEP, 2005).

2.3.2 Method of Problem Tree Analysis

There are two methods for conducting a problem tree analysis (Aus aid, 2003)

(i) The focal problem method

In this method, at first, a core problem is identified through brainstorming and after that cause and effect analysis is conducted on the base of that focal problem.

(ii) The 'objectives oriented' method

In this method, at first, a broader development goal is identified through brainstorming. After that constraint to achieve this objective is identified and cause and effect analysis is conducted on the base of that constraint.

Both approaches are considered valid and use of these approaches depends mainly on individual preference and circumstances (Aus aid, 2003). In this research, a problem is already identified and the purpose of this research is to find out the underlying reasons of this problem. So, a focal problem method will be appropriate for this study.

2.3.3 Process for Conducting Problem Tree Analysis

Several development organizations and journal articles described different process for problem tree analysis. Some of these processes are UNEP Five Step Process, Five Step Process suggested by Ammani, Auta & Aliyu, Aus Aid Process, DFID Six Steps Process.

Process described by UNEP (2005) and Ammani *et al.*, (2010) are almost similar one. The main difference is that UNEP (2005) process suggests to analyze 4-5 problem. As just one problem is identified for this research, the process described by Ammani *et al.*, (2010) will be most suitable for the research.

3. Methodology

To achieve the objective of this study an 'In-depth' interview of members of fish value chain was taken. To conduct the study a non-probability sampling was followed. All the respondents all this study are part of fish value chain. The respondents are chosen from the following three categories to get a fair and more real scenario: farmers, fish traders and sector experts which is a feature of quota sampling. At the same time, due to the time and other resources limitations this study only considered participants from each category which were convenient to access. The number of respondents of the study is 15. Based on the requirement of this study a problem tree analysis was conducted to the analyze data.

4. Result and Discussion

4.1 Introduction

This chapter provides a summary of the findings and the detail problem tree analysis.

4.2 Fish Supply Chain and different problems

4.2.1 Fish Supply Chain of Bangladesh

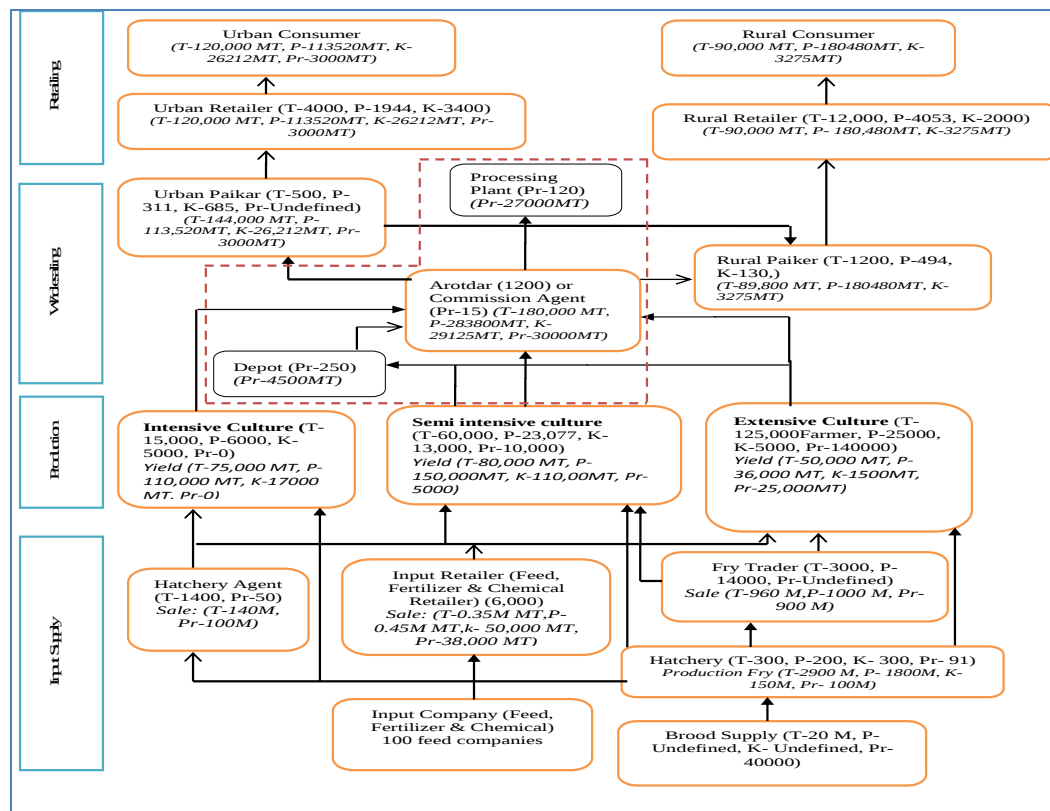


Figure 3: Fish Supply Chain of Bangladesh

4.2.2 What are the main problems of this supply chain?

Traders and farmers answered this question from their own perspective and mentioned mainly the problems that they face.

4.2.3 Is there any adulteration issue in this supply chain?

Almost all the respondents except one trader confirmed the existence of adulteration issue. Fish supply chain experts mentioned that whenever long distance travelling is involved, adulteration becomes a regular practice. They also mentioned that most of the adulteration occurs in the trader level as they are responsible for long distance transportation. These traders lose money if post harvest loss occurs in long distance travel.

Farmers in respondents groups also confirmed the use of harmful chemical for preservation purpose. But they denied any involvement in it. According to them, these adulterations occur in trader's level.

One of the fish traders agreed with the above mentioned statements and said that he use formalin in order to preserve the fish for longer period of time. Other trader totally declined the existence of using harmful chemical for preservation. But they failed to mention how he preserves his fish for longer period of time.

4.2.4 How severe is the issue?

Almost all the respondents agreed upon the severity of the issue. One expert mentioned that, due to proper data it is not possible to quantify this adulteration issue but he suspect that almost all the fish that comes to main city area through long distance travel are adulterate to some extent.

One trader stated that ice traders used to mix formalin with the ice. It makes the ice last longer and also helps to preserve the fish for longer period of time. So whenever ice is used to preserve fish, it becomes contaminated with formalin.

All the traders and farmers mentioned that fish that goes to local market are most of the time formalin free as post harvest loss is very minimal there. Again now some traders transport live fish from northern region to city area. This live fishes are also contamination free.

4.2.5 In which stage of the supply chain this adulteration occurs? Which actors are involved in this issue?

All the respondents agreed on the fact that adulteration occurs during the long distance transportation in order to prevent the post harvest loss. Both the experts and the farmers mentioned that farmers do not have to use any preservatives in the fish as they have to transport it for a short distance and they always sale the fish at the day of harvesting. On the other hand traders are responsible for long distance transportation and sale it to city market. Traders mentioned that some time it takes 2/3 day in order to reach it to the final consumer. As fish is highly perishable product, traders in this stage use formalin and other chemical to preserve it.

From the interview, it is certain that rural wholesalers, urban wholesalers and urban retailers are mostly involved in adulteration. On the other hand involvement of farmers is very minimal in this issue.

4.2.6 Why is this problem still not solved?

According to the respondents the main reasons for which this issue still exists are:

The Government failed to implement any coordinated effort in order to monitoring or controlling the issue. Most of the effort of the government is based on short term and occasional. There is no integrated effort to bring a sustainable solution for this.

Secondly, government and private sector still focusing on the production side of supply chain. As a result farmers and traders lack the access to infrastructure, tools and post harvest management information.

Thirdly, traders and the customer, main actors and the sufferer of this issue, are still not aware of the extent of harmfulness of this issue. As a result there is no pressure from market system to solve the issue.

4.3 Problem Tree Analysis

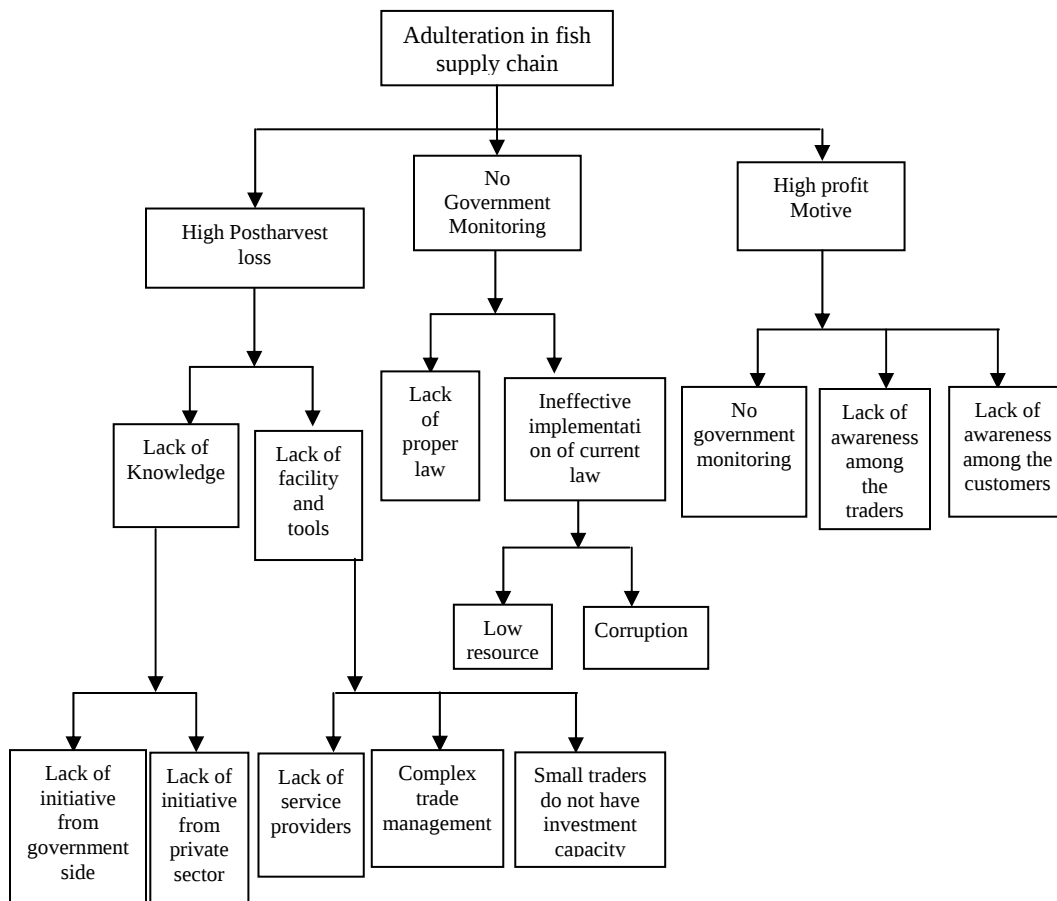


Figure 3: Problem Tree Analysis

4.3.1 High Post Harvest Loss

Post-harvest loss in fish value chain is quite high and average loss is around 12.5% (Alam, 2010). In addition to this, there are quality losses which range from 2.3% to 25% (Alam, 2010). To reduce this post-harvest loss, different harmful chemicals like formalin are used.

All of the respondents mentioned post-harvest loss as the main reason for using formalin and other harmful chemicals. The respondents mentioned that farmers are responsible for short distance travel (from point of capture to nearby fish wholesale market) where post-harvest loss is minimal. After that, they sell it to the traders and most of the post-harvest loss occurs after that point. So it's the traders who are in risk for the post-harvest loss and they are the actors who mainly use these chemicals. The traders in the respondent panel also acknowledge this fact.

The main reasons for post-harvest loss are:

- Lack of knowledge and skill: farmers and traders lack the modern post harvest knowledge and skill. They do not know the modern techniques to preserve the fish. Lack of knowledge and skill arise from failure from both government and private sector to provide them the information and knowledge.
- Farmers and traders usually receive knowledge and skill related training and information from two source: Government and different private agro business companies. Most of the experts in respondents group mentioned that still now government focused on production side of fish value chain and they disseminate little information regarding post-harvest management. On the other side, agro business companies have very small amount of products regarding post-harvest management and as a result their focus is also on production side.
- Lack of Facility and Tools: Another thing require for proper post-harvest management requires facility/infrastructure and tools like icing facility, cooling system, insulated packaging materials etc. Farmers and traders in our country lack these facilities. Basic reasons behind this are lack of service providers in market to provide this service in fish sector, and complex trade management system where all the infrastructure are controlled by government. In addition to this most of the traders in Bangladesh are small and they lack the investment capacity to build these facilities.
- All the experts mentioned in the interview that it is very risky venture to establish cold storage facility for the private sector due to shortage of electricity in rural areas. Again all the trader management system and the infrastructure facility in fish market are controlled by government which discourage private sector to invest. And at last all most all the traders in fish value chain are small traders who lack the capacity to invest by themselves. All of these factors contributed in lack of facility and tools for proper post harvest management.

4.3.2 No Government Monitoring

All the value chain expert in the respondent panel mentioned that strict government monitoring and control mechanism can reduce the food adulteration in fish value chain but this strict monitoring and control mechanism does not exist in Bangladesh. From the literature review it was found that there are several agencies including Bangladesh Standard and Testing Institution (BSTI), Directorate of Consumers Rights Protection (DCRP) and local government bodies with responsibilities to monitor and control food adulteration. Except some occasional and irregular visit to different market, these agencies failed to monitor and control the situation (The Daily Star, 2012). The main reasons for failed government monitoring are:

- Lack of proper law: The main weakness of the policies related to food safety is the lack of an integrated food safety framework or food control system. Food laws and regulations are mostly outdated and fragmented. Even the new Safe Food Act 2013 is not free from this as it is basically modeled on the Pure Food Ordinance of 1959 (bids, 2014). The issues of food safety and wholesomeness or quality of food are mentioned under the mandates of several ministries. But these give an idea of lack of explicit mention or only indirect and limited mention particularly in the production stage.
- Ineffective Implementation of Current Law: While a large number of organizations are involved there is neither coordination nor any effective coordination mechanism among them. Even within the same organization there does not appear to be any cohesive view regarding procedures and penalties for the same offence by officials from same organization (bids, 2014).

Most of the traders mentioned that they do not face any regular inspection and even if there are some irregular inspections, there is no follow up. Market experts mentioned that penalties for food adulteration are very minimal. As result traders get away with minimal penalties and it failed to stop them from using harmful chemicals.

- Again government lack resources to implement the laws. Experts pointed that number of people in inspection is very low to cover different rural parts of Bangladesh and these people do not have proper training regarding food adulteration issues. Again the food testing facility is very minimal in Bangladesh. Value chain experts mentioned that it is one of the main reasons behind ineffective implementation of current law.

4.3.3 High Profit Motive

One of the most important factors for determining the price of the price of fish is its look. If it looks fresher, its price tends to be higher. This is one of the main reasons why the traders use formalin, different industrial dye and other harmful chemicals to make it look fresh and attractive. The basic reasons behind this are:

- Lack of awareness among the traders side: Traders lack the awareness regarding the effect of these harmful chemicals. As a result they tend to use these.

Government agricultural extension service mainly focused on production side and as a result most of the training and information dissemination programs are aimed at farmers level only. But from the findings of the study it is clear that most of the adulteration occurs at traders level. All the traders respondents in the study mentioned that they did not receive any training or information regarding the harmful side of using these chemicals and they do not aware about the extent of harmful effect of these chemicals.

- Lack of awareness among the consumers: The consumers of Bangladesh are still not aware regarding this usage of harmful chemical and their effect. As a result, while buying fish, they do not consider these factors and they always look for colourful and fresh looking fish.

Expert in the respondents group mentioned that consumers in Bangladesh do not have proper idea regarding the extent of adulteration in fish supply chain. Currently different newspapers and news channels are publishing different articles but it reaches only a certain consumer group who use this media. Even the consumer who have these information are not fully aware about the extent of effect these chemical can have in their body.

5. Conclusion

Through this work, all the initial objectives conceived for this work have been satisfied, and the following conclusions are drawn from this study:

- Adulteration is one of the main problems in fish supply chain of Bangladesh. Use of harmful chemical to preserve the fish is a widespread practice. Adulteration mainly occurs in three ways: use of waste in fish farming, use of harmful chemicals and use of toxic dye.
- Due to proper data it is not possible to quantify this adulteration issue but it is suspected that almost all the fish that comes to main city area through long distance travel are adulterate to some extent. Ice traders use to mix formalin with the ice. It makes the ice last longer and also helps to preserve the fish for longer period of time. So whenever ice is used to preserve fish, it becomes contaminated with formalin. Fish that goes to local market are most of the time formalin free as post harvest loss is very minimal there. Again now some traders transport live fish from northern region to city area. This live fishes are contamination free.
- Rural wholesalers, urban wholesalers and urban retailers are mostly involved in adulteration. On the other hand involvement of farmers is very minimal in this issue.
- The main reason for using harmful chemicals and toxic dye is high post harvest loss. As most of the fish produced in this area transported to far city area, it requires long distance transportation. Long distant transportation increase the risk of post harvest loss and thus traders use harmful chemical to preserve it.
- Next reason to use lack of government monitoring and controlling. Laws regarding the food contamination are outdated and there is no strong provision of punishment in the law to

discourage the actors involved in adulteration. There are also lack of resources and lack of coordination among the government agencies to implement the laws.

- Third reason is high profit motive of the traders. Most of the consumers and the traders lack awareness regarding the severity of the harmful effect of these chemicals. As a result, traders tend to use these to make the fish look fresh. Consumers also lack the awareness to properly identified adulterated fish. And in many case they buy it even if they know the chance of adulteration.

Recommendations

On the basis of literature review and the interviews conducted, the report suggest following recommendations:

- Government agricultural extension service should also focus on forward market part of the fish supply chain and start providing post-harvest management related information and training. On the other side private agricultural companies should also include post-harvest management information in their communications. NGOs can come forward in this issue and convince the private sector in this issue.
- Government should focus on establishing cold storage and cold chain facility in local levels. Again they can strengthen local trade association so that they can also contribute here. Again government should facilitate and encourage private investment.
- Government should consider revising and updating the food adulteration law. It should include strict punishment to discourage the use of harmful chemical. In addition to this government should increase resource in order to implement efficient implementation of the law.
- NGOs, consumer right agencies should start promotional activities in order to create awareness among the traders and consumers. They should focus on the harmful effect of using these chemical and ways of modern post harvest management practice.
- Currently many donor agencies work with government agricultural extension department in order to provide farming related technical knowledge. They should also include post-harvest management in their agenda.

There are several areas of future research that a researcher can pursue taking this study as a starting point. There are many prospective research fields those can be emerged from this study: First a further quantitative study will help to quantify data and provide more concrete information on the extent of different variables; and second, a study to find out the proper solution will help the policy makers to design proper solution for the problem.

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