

ASSESSMENT OF FOOD SAFETY KNOWLEDGE AMONG FRESH PRODUCE GROWERS AND EXTENSION WORKERS BEFORE AND AFTER TRAINING IN NEPAL

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ABSTRACT

Access to safe food, including safe fresh produce, is essential to ensure healthy food and diets for the households and communities. However, there is limited awareness of food safety at household levels in Nepal. Food safety educational programs bridge the knowledge gap in addressing food safety. A pre- and post- assessment study was conducted during food safety trainings in five cities of Nepal to understand and evaluate the effectiveness of the trainings. Data from 102 fresh produce growers and 100 extension workers was collected through pre- and post- training responses. Questionnaires featuring 15 food safety statements were administered to the participants before and after the training. Then subsequent comparative analysis was done using the Wilcoxon signed ranks test, Mann Whitney test and Kruskal-Wallis test. The scores across subgroups: gender, age, respondent type and location were evaluated to test the significant differences. We found that the median knowledge score (indication of the knowledge or awareness level) elevated from 9.00 to 11.00 after the training. Our analysis suggested a statistically significant increase in food safety knowledge following the trainings ($p < 0.001$). We found significant differences in the pre- and post-knowledge scores by gender ($p < 0.001$), respondent type ($p = 0.005$) and location ($p < 0.001$). Our findings suggest that the targeted trainings to growers and extension workers could be an effective tool in enhancing food safety knowledge.

Keywords: Food safety, Interventions, Risk, Stakeholders, Vegetables

1. INTRODUCTION

Food safety is a critical aspect of sustainable food systems, ensuring access to safe and nutritious food for consumers (WHO, 2023). The widespread concern for food safety in fresh produce is attributed to the global surge in production, distribution, and consumption, coupled with inconsistent adherence to good agricultural practices (Olaimat & Holley 2012; Machado-Moreira et al., 2019). The World Health Organization (WHO) has emphasized the importance of food safety practices in ensuring healthy lives in Nepal (WHO, 2023).

Unsafe fresh produce consumption is associated with an increasing number of foodborne illnesses (Callejon, 2015). Studies have unveiled contamination of vegetables with several categories of microorganisms like Bacteria including *Bacillus*, *Staphylococcus*, *Salmonella*, *Shigella* and *Pseudomonas* spp, *Giardia* cysts, Hookworms, Coliforms (Ghimire et al., 2020; Shrestha & Rai, 2014; Ankita & Shrivastava, 2012). Microbial contamination of the fresh

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produce results from unsafe production and handling methods, like using polluted water for irrigation and unhygienic handling practices (Khadka et al., 2017). In Nepal, unsafe handling of fresh produce put consumers' health at risk for food-borne illnesses (Ghimire et al., 2020). This embarks the collaborative responsibility of the government agencies, agriculture extension agents and farmers to enhance food safety and promote a sustainable and healthy food supply chain benefitting both farmers and consumers alike.

Gaining food safety knowledge is essential as it could potentially minimize the outbreak of food-borne diseases (Jianu & Golet, 2014). Targeted food safety educational programs are an effective tool to address food safety challenges (Chen et al., 2022; Scott et al., 2009). Accelerating educational program among diverse stakeholders in the production system should be a priority for Nepal (Khanal et al., 2023). In this context, Nepal has started to take steps toward food safety management practices but it is still in infant stage.

To ensure the safety of agricultural products and a safe food supply, good agricultural practices (GAP) has been suggested as an effective tool for implementation during the on-farm production as well as post-production processes (FAO, 2016). Food handlers should understand the safe handling of the fresh produce before selling at local markets (WHO, 2023). However, there is limited awareness on food safety practices in Nepal, particularly among women suggesting their greater participation in outreach and extension activities including training programs (Khanal et al., 2023). Moreover, at farm level, there is seldom use of food safety precautions in Nepal (Bagale, 2023). To equip farmers with the knowledge and skills necessary to reduce contamination risks a food safety training program was delivered in five major cities of Nepal. A survey was administered on the training participants to assess knowledge on pre- and post-training. This comparative evaluation seeks to understand the transformative potential of the educational program.

2. METHODOLOGY

2.1. STUDY DESIGN AND SITES

This study was carried out from September 15 to October 8, 2023 across five cities of Nepal. Itahari, Kohalpur, Bharatpur, Pokhara, and Kathmandu were the selected location of the trainings.

The structured approach employed in the project titled “Market-Led Food Safety in Nepal: Harnessing Production Incentives and Consumer Awareness”, implemented in Nepal by Agriculture and Forestry University as a part of a project from Feed the Future Innovation Lab for Food Safety in Nepal led by Tennessee State University with funding from the United States Agency for International Development (USAID) was outlined for this study. Prior to the commencement of the training, formal letters were dispatched to government and private organizations, urging the participation of agriculture extension agents and fresh produce growers to represent their respective locations. Government organization included Prime Minister Agriculture Modernization Project (PMAMP), Agriculture Knowledge Center (AKC), agricultural offices under municipalities and private organizations included private farms involved in fresh produce production.

Targeted organizations were informed about the objectives of the food safety-training program. Government offices in close geographic proximity to each training site were strategically chosen during the selection process based on their convenience and access to training site. Additionally, farmers representing diverse locations within each training site were selected by respective offices. The food safety training program for fresh produce growers was subsequently delivered during distinct time periods. This approach not only ensured that stakeholders in agriculture would participate in a representative manner, but it also improved the training effectiveness and coverage.

2.2. SELECTION OF THE PARTICIPANTS

Organizations were requested to send one agricultural extension agent and one fresh produce grower as participants for the training. From the response of the formal requests, we finalized the total number of respondents from each location (Table 1).

Table 1. Location specific number of participants in the food safety training

Location of the training site	Number of participants (n=202)
Itahari	39 (19.3)
Kohalpur	38 (18.8)
Chitwan	39 (19.3)
Pokhara	44 (21.8)
Kathamandu	42 (20.8)

Note: Figure in the parenthesis indicate percentage.

2.3. DESCRIPTION OF THE TRAINING

The training included five different sessions where each session comprised an hour-long presentation on different aspects of food safety. Display of posters and question answer discussion were incorporated in between the sessions. The poster session focused on important information and issues regarding the food safety in Nepalese context.

2.4. SURVEY

A set of questionnaires consisting of the same question set was assigned to the participant before and after the training to the same individual. The questionnaire was collected separately before and after the training sessions.

2.5. SCORING SYSTEM USED

There were 15 statements regarding the food safety on fresh produce for assessing food safety knowledge with a maximum possible score of 15. One mark was assigned for each correct answer and zero mark was assigned for wrong answers. The total scores before and after the module was obtained by adding the score of fifteen statements. Similar approach was applied by Jha et al. (2013). The topics to be included in the questionnaire were developed based on food safety issues in Nepal. Inputs were also obtained from experts of the respective field. Knowledge scores were compared before and after the training. Knowledge level of the respondents was categorized as poor, moderate and high based on the mean and standard

deviation (S.D). Score less than six were categorized as poor ($< \text{Mean} - \text{S.D}$), score between 6 and 12 were categorized as moderate ($\text{Mean} - \text{S.D}$ to $\text{Mean} + \text{S.D}$) and scores above 12 were categorized high level knowledge ($> \text{Mean} + \text{S.D}$).

2.6. STATISTICAL ANALYSIS

After the training, knowledge scores were again measured using the same questionnaire. The collected data were analyzed using SPSS (Statistical package for the social sciences) version 20 for Windows. The knowledge scores before and after the training was tested for normality of distribution using Shapiro Wilk test. The score distributions were not found to follow a normal distribution and hence non-parametric tests were used to compare subgroups of respondents. Median was calculated as a measure of central tendency, difference of pre and post training knowledge scores was analyzed using Wilcoxon signed ranks test whereas relation between difference on pre and post knowledge score with gender, age, and participant type were compared using Mann Whitney test and difference on pre and post knowledge score and training location were compared using Kruskal-Wallis test.

3. RESULTS AND DISCUSSION

3.1. RESPONDENT DEMOGRAPHICS

Out of the 202 participants 50.5% were fresh produce growers and 49.5% were agricultural extension agents. The majority (68.8%) of the participants were female. Most of the participants (69.3%) were from the adult group category of 30 years or above and 30.7% belongs to the age category of below 30 years. Furthermore, 44% participants were participated in the Pokhara training followed by Kathmandu (20.8%), Itahari (19.3), Chitwan (19.3) and Kohalpur (18.8%) training. Table 2 shows the demographic characteristics of the respondents.

Table 2. Demographic characteristics of the respondents

Sub groups	Number (n=202)
Gender	
Male	63 (31.2)
Female	139 (68.8)
Age (years)	
Below 30	62 (30.7)
30 or above 30	140 (69.3)
Respondent type	
Fresh produce growers	102 (50.5)
Agricultural extension agent	100 (49.5)
Location of the training site	
Itahari	39 (19.3)
Kohalpur	38 (18.8)
Chitwan	39 (19.3)
Pokhara	44 (21.8)
Kathamandu	42 (20.8)

Note: Figure in the parenthesis indicate percentage.

3.2. KNOWLEDGE SCORE

The knowledge scores before and after the training is depicted in the Table 3. The median knowledge score obtained by participants before and after training was 9.00 and 11.00, respectively. The scores before and after the intervention were compared using Wilcoxon signed ranks test. The knowledge score obtained during the two different phase was significantly different at 1% level of significance (alpha value 0.001). This signifies the effectiveness of the training as participants have higher knowledge on food safety after the attainment of the training.

Table 3. Knowledge score of the participants before and after training

Knowledge score	Median knowledge score	Wilcoxon p value
Before training	9.00	0.001
After training	11.00	

3.3. THE KNOWLEDGE SCORES OF RESPONDENTS OF DIFFERENT SUBGROUPS BEFORE AND AFTER TRAINING

Knowledge score of the respondents based on the gender, age, type of the respondents and location is depicted in Table 4.

Table 4. Comparison of median scores among different subgroups of respondents before and after training

Characteristics	Median score		Median score difference	p value
	Before	After		
Gender				Mann Whitney U test
Male	10.00	11.00	1.00	0.113
Female	9.00	11.00	2.00	
Age (Years)				Mann Whitney U test
Below 30	10.00	12.50	2.50	0.547
30 or above 30	9.00	11.00	2.00	
Respondent Type				Mann Whitney U test
Fresh produce growers	8.00	11.00	3.00	0.078
Extension workers	10.00	12.00	2.00	
Location				Kruskal-Wallis test
Itahari	10.00	12.00	2.00	0.214
Kohalpur	10.00	11.50	1.50	
Chitwan	8.00	11.00	3.00	
Pokhara	8.00	10.50	2.50	
Kathamandu	10.00	11.00	1.00	

Gender

The scores for knowledge were higher for male (11.00) as compared to the female (9.00) before training but the difference was not statistically significant. The low level of knowledge of female before training compared to their counterpart may be due to the fact that females are not familiar with the food safety information in their day to day life. This finding aligns with the broader context of Nepal's patriarchal social structure, where men typically have greater mobility and higher educational attainment compared to women. This is reflected in nationwide literacy rates, standing at 83.6% and 69.4% for males and females, respectively (Atreya, 2007; GoN, 2023). There is no significant difference on pre and post training knowledge score in relation to gender. Similar findings observed in study of Aditya et al. (2023) where female were less aware about food safety as compare to male, suggesting the efficacy of a gender-responsive approaches in outreach programs. The scores improved from 9 to 11 for female and from 10 to 11 for male. This finding is similar with the study of Sakore et al. (2023) where gender has no significance difference on food safety knowledge. But this finding contradict with the study of Pokhrel et al. (2015) where significant gender difference in food safety practices was observed.

Age

The knowledge score was higher among the age group of below 30 respondents (10.00) before training as compared to the above 30-age group (9.00). Same was the case for post training knowledge score where knowledge scores increased among lower age group (12.50) as compared to higher age group respondents (11.00) but the change was not significant. This finding is similar with the study of Sakore et al. (2023).

Type of the respondents

The knowledge score was higher among the agricultural extension workers (10.00) before training as compared to the fresh producer growers (8.00). Same was the case for post training knowledge score where knowledge scores improved significantly among fresh producer growers (11.00) as compared to extension agent (12.00). The observed improvement in knowledge scores among fresh produce growers emphasized the critical role of targeted outreach activities. It suggests that tailored training initiatives specifically designed for individuals engaged in agriculture, like fresh produce growers, can be instrumental in bridging knowledge gaps.

Location

Before training there was significant difference on participants' knowledge score on food safety with respect to training (p -value =0.023). Participants from Chitwan and Pokhara possess low level of knowledge on food safety before the training with scores of 8.00 each. However, participants' from Itahari, Kohalpur and Kathmandu possess more knowledge than that of the Pokhara and Chitwan with knowledge score of 10.00 each. But after training there was no significance difference on knowledge score among the participants with respect to training sites. After training, participants knowledge score of the Pokhara and Chitwan improved significantly with the score of 11.00 and 10.50, respectively. Knowledge score of

the participants from Kathmandu valley was found highest after the training with score of 12.00 followed by participants from Kohalpur (11.50).

3.4. KNOWLEDGE LEVEL OF THE RESPONDENTS AFTER TRAINING

The food safety knowledge level of the respondents after the training is depicted in the table (5). The mean and standard deviation of knowledge score of the respondent after training were 11.08 and 2.30, respectively. Majority of the respondent (72.3%) possess average level of knowledge on food safety followed by good level (14.9%), and poor (12.9%). This indicates that there is still room to improve the stakeholders’ understanding of food safety in the fresh produce systems. Similar food safety interventions are required to enhance the food safety knowledge among the respondents to ensure continuous improvement in food safety knowledge among farmers and extension workers. These findings contradict with the study of Sakore et al. (2023) and Kubde et al. (2016). Similar findings depicted in the Takalkar and Kumavat (2011) study where majority of the respondent possess average food safety knowledge.

Table 5. Food safety knowledge level of respondents after training

Knowledge level (Score)	Frequency
Poor (<6)	26 (12.9)
Moderate (6 to 12)	146 (72.3)
High level (>12)	30 (14.9)
Total	202 (100)

Note: Figure in the parenthesis indicate percentage.

4. CONCLUSION

Food safety training and outreach interventions seem to be an effective tool to enhance the knowledge of the fresh produce growers and extension workers. The overall improvement in the median knowledge score after the trainings suggest that the outreach interventions are valuable. However, there is still a room for improvement in food safety knowledge among fresh produce growers and extension agents as majority of the participants reached an average level of food safety knowledge after the training.

DECLARATION

The authors declare no conflict of interest.

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