African Journal of Food Science and Technology (ISSN: 2141-5455) Vol. 14(10) pp. 01-017, October, 2023
DOI: http:/dx.doi.org/10.14303//ajfst.2023.047
Available online @https://www.interesjournals.org/food-science-technology.html

Research Article

Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda

Ruth Martha Mirembe[1]*, Archileo N. Kaaya[1], Denis Male[1], Shirley Kansabe[1], Stephen Lwasa[2], Daisy Kemigisha[2], David Kalule Okello[3], David Musoke[4], Tom Gill[5], David Russel Ader[5], Annie Carter[5] and Carrie Ann Stephens[5]

[1]Department of Food Technology, Nutrition and Bioengineering, Makerere University, Kampala, Uganda

[2]Department of Agribusiness and Natural Resource Economics, Makerere University, Kampala, Uganda

[3]National Agricultural Research Organization (NARO), NaSARRI, Uganda

[4]Department of Disease Control and Environmental Health, Makerere University, Kampala, Uganda

[5]Department of Agricultural Leadership, Education and Communications, University of Tennessee, United States of America

Email Id: mruthmartham@gmail.com

Abstract

The quality and safety of peanuts have been highly compromised in Uganda due to inadequate handling along the value chain. Furthermore, assessment of quality and safety has proved to be expensive, necessitating cheaper alternatives that can be used. This study aimed at using photovoice, a community participatory research technique, to evaluate on-farm and postharvest handling practices that influence the quality and safety of peanuts along the value chain. Thirty rural youth in Nwoya and Tororo districts of Uganda were trained in photovoice and given smartphones to take photos of what they understood by peanut quality and safety over two peanut growing seasons. Data from focus group discussions conducted every two months was analysed using content analysis in Atlas-ti-version-6. Factors that influenced peanut quality and safety along the value chain were reported under five themes; agronomic practices, pest and disease management, processing, storage, and marketing. Photovoice was able to address the risk factors that exposed peanuts to adverse contamination levels which could be prevented and controlled in communities. Furthermore, the peanut quality and safety burden in Uganda is still great and needs urgent and appropriate interventions, especially post-harvest.

Keywords: Peanut, Quality, Safety, Photovoice, Youth, Uganda

INTRODUCTION

Uganda`s agriculture sector is dominated by smallholder farmers on average each holding about 2.5 acres of land with a high proportion dependent on subsistence agriculture, especially among women and youth (NPA, 2020). Furthermore, Uganda is considered the food basket in the East African region due to its potential to provide a variety of foods in abundance for both domestic and export markets (FAO, 2018). According to the FAO (2019) report, the sector absorbed 54% of youth (18-30 years) compared to 31% of adults (31-64 years). However, UBOS (2020) reported that among the 47% of youth in employment, only 29% were employed in subsistence agriculture and 12% were neither working nor in school. In addition, Mukembo et al. (2020) also stated that the shift of youth from agriculture

Received: 03-Oct-2023, Manuscript No. AJFST-23-116751; **Editor assigned:** 05-Oct-2023, Pre QC No. AJFST-116751 (PQ); **Reviewed:** 19-Oct-2023, QC No. AJFST-23-116751; **Revised:** 24-Oct-2023, Manuscript No. AJFST-23-116751 (R); **Published:** 31-Oct-2023

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

was a global challenge and more distressing for developing countries like Uganda which relied on subsistence farming to meet their food production demands. In regards to food security, Mwesigwa & Mubangizi (2019) stated that as a result of rural-urban migration, youth people abandoned agricultural activities an issue that negatively affected food security since youth formed the largest proportion of Uganda`s population. The FAO (2017) report highlighted the main reasons for the low participation of youth in agriculture as; poor economic diversification, development of private sector, under-development of rural areas, and low productivity and returns from subsistence farming. As a remedy, USAID (2016) reported that Ugandan youth are drawn to modern techniques and tools and also seek business opportunities in agricultural value chains. Therefore, there is need to encourage youth to stay in agriculture by making the sector intellectually stimulating and economically rewarding as suggested by Veettil et al. (2021).

Photovoice is a community participatory research technique where participants use photos to discuss a theme of interest. Participants are introduced to a theme before photo taking and thereafter discuss the photos they have taken after a specified period (Lal et al., 2012). According to Yang et al. (2020), the visual nature of photovoice provided a more appealing and interactive means for youth with low literacy levels to participate in social actions and community enhancements. Furthermore, in a study to assess the health risks in urban slums in Kampala, Uganda, Ssemugabo et al. (2021) reported that photovoice actively encouraged youth to participate in solving community challenges through counselling, sensitization and mobilisation for action. In a study where photovoice was used to evaluate a college preparation program, youth reported that photovoice inspired their thinking and encouraged the free sharing of thoughts with others during the student photography gallery walks, narratives, and group discussions (Hunter et al., 2020). Given the remarkable roles in activating youth participation in different fields, photovoice can also be employed in agricultural value chains in Uganda to encourage youth participation in the sector. The technique can be used by youth to promote recommended practices and address challenges and risks associated with different crops as they transit along the value chain in communities.

Peanuts (Arachis hypogaea) commonly known as groundnuts, are consumed worldwide as an important source of protein for households and are the second most important legume after beans in Uganda (Okello et al., 2018). Furthermore, peanuts are a vital source of income in developing countries contributing significantly to livelihoods and food security (Mugisha et al., 2014). Since they require low inputs during production, peanuts are advantageous to smallholder subsistence farmers in Uganda especially those from northern and eastern parts of the country where poverty levels are considered high (UNICEF, 2013). However, the legume is susceptible to Aspergillus flavus and Aspergillus parasiticus moulds which produce aflatoxins in food (Sharma et al., 2021). Thus, peanuts are one of the main sources of human exposure to aflatoxins. Aflatoxins are among the most potent mycotoxins, carcinogenic and teratogenic compounds produced due to fungal infection and growth in crops such as peanuts, maize, cottonseed, and tree nuts (Fountain et al., 2015).

Generally, aflatoxin analysis employs laboratory-based methods which are expensive, labour-intensive and time-consuming (Wacoo et al., 2014). Besides, farmers in Uganda are not even aware of aflatoxins and their contamination levels in their produce. Omara et al. (2020) reported that low levels of aflatoxin awareness, poor pre-, peri and postharvest activities, poor government legislation, and low levels of education among value chain actors contributed to the proliferation of this plague. Some of these peanut quality and safety challenges can be dealt with using photovoice, especially in rural communities. Photovoice has been reported to create awareness at individual and community levels through photo discussions and exhibits respectively ((Han & Oliffe (2016); (Ronzi et al., 2016); Seitz & Strack, (2016)). This could help reduce the low levels of knowledge about peanut quality and safety in communities. Adekeye et al. (2014) also noted that photovoice was accessible to anyone who could handle a camera, with low educational levels and English proficiency thus a user-friendly tool in communities. According to Nykiforuk et al. (2011), photovoice provided a rich platform for a nuanced understanding of community issues by researchers thus providing room for appropriate interventions on social problems. Capturing community perspectives about peanut quality and safety can provide more insights for immediate and/or appropriate interventions. In addition, Woodgate et al. (2017) stated that photovoice contributed to enhanced ease of communication and promotion of activities which was attained through producing and engaging with visuals. Such a profound aspect of photovoice could be beneficial to peanut quality and safety since photovoice could be used as an easier option for promotion of recommended quality and safety practices among communities. While working with women to address breast cancer, Capewell et al. (2020) stated that photovoice provided a low-cost and easy to implement methodology which enabled women to provide about their experiences thus contributing knowledge to improve clinical practice. Given the expensive techniques available for aflatoxin testing (Wacoo et al., 2014), high cost of aflatoxin testing in Uganda (220,000 Ugshs. per sample) (UNBS, 2018) and lack of testing labs in rural areas (Omara et al., 2020), photovoice could provide a low-cost assessment technique in rural communities. Therefore, this study aimed

at using of photovoice among rural youth farmers to assess on-farm and postharvest handling practices that influence peanut quality and safety along the value chain in Uganda.

MATERIALS AND METHODS

Study population

The population under study was rural youth farmers (18-35 years) from Nwoya and Tororo districts who were engaged in various peanut activities along the value chain. According to the UBOS (2017a) report, among the 5.8 million households engaged in agriculture, more than 69% of households derived their livelihoods from subsistence farming as the main occupation with 65% of the working population consisting of subsistence farmers. Youth constituted 55% of the labour force in the agricultural sector in Uganda with females contributing 60% of the youth labour fraction in agriculture (UBOS, 2019). In addition, 26.7% of households in Nwoya district were headed by youth (UBOS, 2017a) whereas, in Tororo district, youth-headed households constituted 22.8% (UBOS, 2017b). Tororo is a border district where a lot of trade takes place and was in a transition from growing old peanut varieties to new high-yielding varieties (Jelliffe et al., 2018). Nwoya district, on the other hand, is one of the locations in northern Uganda that experienced shocks due to the civil war that lasted for about two decades from 1986 (Nukakora, 2014). Furthermore, Nukakora (2014) reported that displacement, and little ability to cope with life-threatening factors such as high poverty levels and drought as consequences of the war in the region and adoption of agriculture. Therefore, based on the situations in both districts, there was the need to improve their peanut value chains thus considered as a niche for this study.

Study design

A longitudinal study that covered two peanut seasons in a year was conducted from December 2020 to September 2021. Qualitative data was obtained using photovoice, a community participatory research technique, following the procedures described by Musoke et al. (2015).

Selection of study participants

In both districts, the participants were selected from youth farmer groups which were already engaged in Feed the Future project activities. Feed the Future is the United States government`s Food and Nutrition Security Initiative with various funding support to the United States Agency for International Development (USAID) for field-based research into food and nutrition security activities underway across Latin America, Africa and Asia. Since Uganda is a target country of this initiative, this research was conducted and designed with Ugandan communities in Nwoya and Tororo districts and implemented by Makerere University, the National Agricultural Research Organization (NARO), and the University of Tennessee (USA).

The study recruited thirty rural youth farmers (fifteen from each district) who were consistent peanut value chain actors, male and female aged 18-35 years. In Nwoya district, youth working with ZOA (Dutch-based International NGO) and Local Seed Business (LSB) were considered whereas in Tororo, youth engaged with the Integrated Seed Sector Development (ISSD) Uganda program and Tororo District Farmers Association (TODFA) were considered. Nwoya youth were grouped according to three existing local seed business youth groups where they belonged (NGE CANI, MA ICAYO AYE KONYI, CAN MIYO DIRO) whereas, in Tororo, youth were grouped according to their sub-counties (Rubongi, Osukuru, Morukatipe, Akadot, Kwapa, Molo, and Merikit). Under those divisions in each district, youth who fulfilled the criteria below were considered to be included in the study;

- Direct involvement of youth or their parents in peanut production and farmer groups
- Roles played along the peanut value chain
- Years of participation in the peanut value chain
- Ability to use or learn how to use phones and take quality photos
- Ability to carry out our assigned tasks
- High level of commitment and obedience
- Ability to speak and at least understand English

Furthermore, youth participants were stratified based on their age (18-26 years & 27-35 years) and sex (male & female). Based on the age category of youth in Uganda as per youth policy (18-35 years), there was a need to cater for extremities. Sex was also considered as a stratum because there was a need to empower the girl child at her youth stage. After the sampling exercise, thirty rural youth farmers (fifteen youth from each district) were considered for this study. Also, the number of participants was based on the sample size mainly used in photovoice studies (7-10 people) as indicated by Wang (2006) and data saturation principles as presented by Sarfo et al. (2021). The selected youth provided their verbal and written consent to participate in the study.

Photovoice procedure

The application of photovoice followed procedures used by Musoke et al. (2018). After recruiting the youth participants, they were trained by the research team. The training was conducted at specified locations that were convenient for the youth participants to reach in time from their respective districts. The youth were taught about;

- Good agronomic and proper postharvest handling practices carried out along the peanut value chain
- Peanut value chain (inputs, production, processing and distribution, marketing and consumption).
- Photovoice concept and method. This involved educating the youth on how photos could be used to record community strengths and weaknesses to later inform change and policy
- Ethics of photography such as providing their consent before taking photos, and asking for consent from people in the community before taking their photos. Two consent forms were provided to the participants. These included; a photograph consent form, and an acknowledgement of release form. Anonymous participant identifications (number, sex, district e.g., 2FN – Participant 2, female, Nwoya district) were generated for each participant for confidentiality purposes.
- Practising how to use smartphones (how to care for a smartphone, how to use it and how to take quality photos). A demonstration on how to take clear photos was done and practised until all photos taken were at appreciable levels.

The training lasted for one day in each district. After training, the youth were provided with smartphones (Android Techno POP F2; 480x960 pixels resolution) and were given a guiding question, 'What do you understand by peanut quality and safety along the value chain?' as they took the photos. The participants joined a WhatsApp group for their respective districts for better communication between the participants and the researchers. Furthermore, the participants used these platforms to ask questions at any time during the photo-taking process. Youth coordinators in respective districts were requested to follow up and support participants in cases of difficulties, especially regarding charging phones in their communities.

After receipt of smartphones, the youth participants were given the assignment to take photos for two peanut seasons in a year putting into consideration the guiding question mentioned above. They were tasked to take photos of input dealing, production and harvesting practices, post-harvest handling, storage and distribution, processing, marketing and consumption. The youth were encouraged to be imaginative and creative during the photo-taking process. They were not restricted on the number of photographs to be taken, as long as they were related to the guiding question. Furthermore, the youth were requested to have their phones at all times so as not to miss any opportunity to take a photo in the community. Participants were also strictly reminded to take photos only in their respective districts and must always ask for consent before taking photos of people and their property.

Initially, focus group discussions (FGDs) were to be conducted every two months after taking photos of the value chain. However, due to the COVID-19 lockdown in Uganda from June 2021 to August 2021, the two months of FGD conduction were not achieved after April. During the lockdown, supervision of the youth was mainly via youth coordinators in the respective districts and WhatsApp. The former were residents in the respective districts. Six (3 FGDs per district in February, April and September 2021) were conducted in both districts to collect photos and address emerging challenges that were constraining the youth during the photo-taking process. All photos taken by the youth participants were collected and discussed in a photovoice FGD which comprised all participants, youth coordinators and researchers during the field visits. A consensus was reached by the attendees about every new issue which was captured through photo discussion. One researcher transferred photos to the laptop before the discussions and another researcher facilitated the discussion of photos by the participants. Furthermore, the researcher did note-taking to keep a record of the discussions.

During the photovoice FGDs, each participant was requested to talk about the photos they took and how the photos related to a particular section of the peanut value chain. The discussions were structured and guided by the SHOWeD format as used by Ottmann & Crosbie (2013). SHOWeD according to Bashore et al. (2017) stood for the following; what do you SEE? What is HAPPENING? How does it relate to OUR lives? WHY does the situation exist? and what can we DO about it? After presenting each photograph, other youth participants were also given a chance to talk about the photos either by asking questions or discussing it in another way they felt related to the guiding question. The discussion of photos was conducted in both English and the local languages depending on the participant and district. All proceedings of the photovoice FGDs were audio-recorded and later transcribed verbatim by the researcher.

Data analysis

The qualitative data obtained from the photovoice FGDs were analysed using Atlas ti version 6.0.15 software. The recordings were transcribed verbatim and coded inductively. The codes were later grouped and broader themes were obtained which related to what the youth were able to capture while they used photos to relate to peanut quality and safety along the value chain. All the issues that emerged from the study are described in the result section and illustrated with selected quotations and photographs taken by the youth participants.

Results

Using photovoice, rural youth working along the peanut value chain collected information on various aspects

of peanut quality and safety that were vital to them. Table 1 below presents a summary of the demographic characteristics of the participants. Data presented in this section were generated from six FGDs conducted in both Nwoya and Tororo districts (three FGDs per district) during which participants discussed the motivation behind the photos they took and how they interpreted them. The FGDs were held every two months to cater for seasonal changes and also to motivate the youth to take more photos of what they understood about peanut quality and safety. Analysis of the data generated five main themes about peanut quality and safety among youth in Nwoya and Tororo districts. These were; agronomic practices, pest and disease management, storage, processing and marketing.

Agronomic practices

From the photos presented and photo discussions, participants noted different agronomic practices that affected the quality of peanuts while in the garden.

Late harvest led to pod damage and rotting of peanuts

Participants stated that peanut harvesting was normally carried out by uprooting. However, it was reported that farmers who harvested late used hand hoes because the soil was hard due to the dry spell. As a result, pods were damaged because farmers could not accurately estimate the area around the stool (Figure 1). In addition, participants reported that due to late harvesting, some peanuts started germinating from the garden, and some pods moulded and even started rotting due to late harvests (Figure2).

This one is interesting (Figure 1) because these peanuts, in the season of last year, people mostly used hoes for uprooting the peanuts. What we normally get after using hoes…the hoes cut some seeds. So, if you are to keep these seeds for planting in the next season, you're more-or-less getting rotten seeds which reduce the percentage of growth…So, that's the danger of uprooting peanuts with a hoe - Participant 10, male, Nwoya district.

Yeah, I took this picture (Figure 2) to show us that if you harvest your peanut late, this is the outcome of late harvest, aflatoxins. As you can see now, the peanut is about to start rotting. This is the result of late harvesting - Participant 9, male, Nwoya District.

Pods can also be damaged during weeding

Similarly, participants reported that excessive pod damage was also experienced when long hand hoes were used for second weeding which led to rotting and growth of moulds on peanuts. To minimize the damage, participants stated that some farmers opted to use chemicals such as fennut (Nwoya) and dimethoate (Tororo) or short-hand hoes which they considered to reduce pod damage during the activity.

To me, weeding with herbicide gives less root disturbance to the peanuts. It doesn't disturb the roots - Participant 3, male, Nwoya District.

Pests and diseases compromise the quality of peanuts in the gardens

Participants reported that infestation of the crop by pests reduced yield and affected the quality of peanuts. Pests included; wild animals (monkeys, squirrels, rodents, elephants especially in Nwoya around the Murchison Falls game park), ruminants, termites, mole rats, and aphids

Table 1. Demographic characteristics of study participants.

Demographic characteristic	Variables	Number of participants
District	Tororo	15
	Nwoya	15
Sex	Female	11
	Male	19
Marital status	Married	16
	Single	14
Highest level of education (last class attended in school)	Primary	3
	Secondary	21
	Tertiary (diplomas/ bachelors)	6
Roles carried out along the peanut value chain*	Input dealers	3
	Production (garden work)	29
	Storage and distribution	20
	Processing/ value addition	5
	Wholesale and retail	5
Years of participation in the peanut value chain	1-5 years	9
	6-10 years	9
	11-20 years	8
	More than 20 years	4

*There is an intersection between the roles of the participants: one participant could be involved in various roles along the peanut value chain

Figure 1. Peanuts pods cut as a result of harvesting using hand hoes during the dry spell (Photo credit: Participant 10, male, Nwoya District).

Figure 2. Peanuts rotting due to late harvest (Photo credit: Participant 9, male, Nwoya District).

among others. As shown in Figure 3, participants reported that mole rats utilized the bushy boundaries and ate up the pods when they were still in the garden.

Diseases of peanuts such as rosette virus disease, in particular, were reported to cause a lot of losses to farmers especially those who planted red-beauty variety. Participants stated that farmers could lose 100% of their crops due to this disease.

So, recently, you can see that the peanut has not given a good yield. In most places, in Tororo, I don't think Red Beauty has been doing well. Most farmers plant red beauty and the whole garden just gets diseases. So, I think the soil recently has not been good for Red-beauty - Participant 5, male, Tororo District.

Despite knowing a lot about pests and diseases affecting peanuts, some participants reported that they were not aware of some of the pests that attacked their gardens even though they made an effort to manage them (Figure 4).

In this picture (Figure 4), I took the pest I found on the peanut… in our language, we call it "amor". I don't know much about it but they have been disturbing our peanut a lot - Participant 9, male, Nwoya District.

Storage

It was reported that the quality of peanuts was highly compromised during storage. Participants reported instances that accelerated the rate of deterioration of peanuts during storage either at home or in community stores (bulking centres) as presented below.

The storage techniques and place affected the quality of peanuts

Participants reported different techniques of how they stored their peanuts at home. These included; storing peanuts over the fireplace, on wooden pallets, in jerrycans and directly on the floor. Participants noted that the latter practice encouraged the absorption of moisture from the floor which favoured germination and moulding during storage. However, instead of storing the peanuts directly on the floor, farmers who lacked pallets were said to use their beds to preserve the integrity of their produce as shown in Figure 5.

So, I met a farmer, who had already dried her peanuts, she had packed... imagine she had sacrificed her bed. She had to lay the mattress down... she got the bed and laid the peanuts for better storage. She removed the mattress and

Figure 3. The presence of burrows in the garden indicated mole rat infestation of peanuts (Photo credit: Participant 1, female, Tororo District).

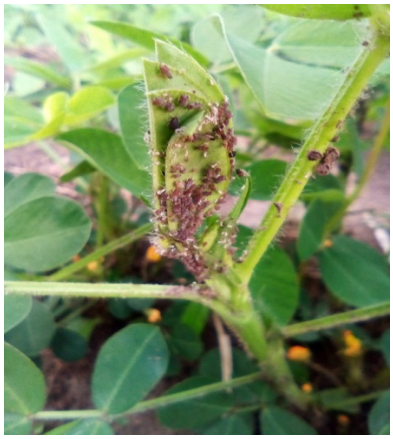

Figure 4. The farmer was not aware of the name of the pest that disturbed his garden during the dry season but used Cychlor 55 EC for spraying on the peanuts (Photo credit: Participant 9, male, Nwoya District).

Figure 5. Farmer used her bed as a pallet to preserve the integrity of her produce after harvest (Photo credit: Participant 7, female, Tororo District).

slept down. She didn't want the peanuts to get spoilt from the ground - Participant 7, female, Tororo District.

Some participants reported that farmers in Tororo used jerrycans to store peanuts. Proponents of the practice claimed that it prevented pest infestation during storage thus protecting their produce. However, participants refuted this rationale because they believed that storage of peanuts in jerrycans prevented air circulation leading to fermentation and moulding.

So, on my side, storing peanuts in such a storage utility (jerrycans) to a certain extent affects the peanuts` longevity and also the quality especially when the peanut moisture content is a bit high because with the drying of the commodity, the more it stays in the store, the more air it

comes along to make it dry. Now, for that situation (storage in jerrycans) when it is tied, the vapour evaporating, will keep on accumulating and will cause fermentation after a long time. You may find when moulding occurs, the peanut may not even germinate to a given percentage... I have ever experienced that when you find a farmer has not dried the peanut properly but puts it in the jerrycan not knowing that it is going to get spoilt to the point that when they plant, the peanut doesn't germinate very well - Participant 2, male, Tororo District.

In conclusion, participants reported that farmers who stored peanuts in their homes were highly affected by pests due to poor management of their stores. However, group-owned stores were reported to practice good store management as presented in Figure 6 which preserved the integrity of the product during storage. A participant presented a photo that portrayed their group`s storage practices.

Yeah, as you can all see from her photo, if she compares hers with the majority of the people, you find that this one is a bit okay because one, she packs on a pallet, and also the way the bags have been put we can see that at least there is space in between which can give good aeration for the seeds, even the windows as you can see, it is good and also near the wall, it is free, there is nothing packed so tight at the wall so it gives good aeration. And you can even move around to check your peanuts in case there is any rat, in case there is any pest that might be in contact, you can easily know and avoid them. So, she thinks this is the best storage practice. In addition to that, this is the peanut that she has been producing, and as she told us earlier, they have a store as a group. But this peanut is hers alone, the one that she produced - Participant 3, female, Nwoya District.

Processing

Participants reported that different unit operations carried out during peanut processing contributed highly to the quality of the final product. Below, are processing operations reported that affected peanut quality.

Peanuts for seed should be hand-shelled

Although shelling was carried out using either hands or machines, participants suggested that peanuts intended for seed should be hand-shelled. They argued that shellers caused a lot of breakage to the peanuts which was not desirable for those intended for seed.

Also, the challenge with that one (shelling with machines) … you cannot use it for peanuts which you are going to plant. This is because, it breaks/ squeezes the peanut so it is mostly used for peanuts which will be used for processing e.g., odi, peanut powder and the rest but not for seed - Participant 5, male, Tororo District.

Traditional grinding methods produced safer peanut products than modern technologies

Based on Figure 7, participants reported that communities preferred to use traditional grinding methods (grinding stone, pounding using a mortar and pestle) rather than using modern machines. This was because people considered peanuts processed using machines to contain metallic fragments from the wearing of machines which could affect their health.

To me also it is not good for human health because that machine when you grind, there are some particles that the machine grinds with the peanuts and mixes it. So, when you eat, I think people will start feeling either stomach problems or they get problems in their appendix - Participant 7, male, Nwoya District.

In addition, some participants reported that peanut processing using machines was highly adulterated with other flour hence their preference for traditional grinding methods.

Figure 6. Farmer displayed good store arrangement in a group-owned store (Photo credit: Participant 3, female, Nwoya District).

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

So, this is in the processing node and marketing… one challenge about the product is that some retailers/ producers want to make bigger profits so they mix peanut powder with posho flour - Participant 5, male, Tororo District.

The quality and safety of peanuts were affected by the drying technique

Participants reported different techniques for drying peanuts. These included; drying on bare ground, ground smeared with cow dung, windrow, use of tarpaulin, cemented floors, animal skin and papyrus mats. Among the different drying techniques practised, participants noted a high risk of aflatoxin contamination in peanuts dried on bare ground and windrow (rows of peanuts laid in the garden for 3-5 days before plucking) (Figure 8).

Let me add something there. This one is a risk as you were talking about windrow because when it rains, there's a risk of getting aflatoxin. After all, it starts rotting under those peanuts. So, it exposes the peanuts to the risk of aflatoxin - Participant 1, female, Nwoya District.

Another reason why people don't use windrow… when peanut is piled in large heaps, they start fermenting. When they are stored in heaps without stripping, they start fermenting due to the heat generated. So, it's better to put them in a shade and sparsely heaped to avoid fermentation - Participant 2, male, Tororo District.

At length, participants discussed the application of windrow drying despite the high risk of aflatoxin contamination, especially in the rainy season. They argued that it made plucking pods from the haulms easy and removed the soil from the peanuts.

So, as we can see, that is already harvested peanuts from her garden and she has put them that way because of two major reasons. One, when it rains on them, the soils in between the peanuts will be removed and the peanuts will be clean. Also, putting it that way after harvesting makes it easy for the pods to be removed because it will take like 2 or 3 days in the garden to get a bit dry... at least within the 3 days, it will somehow be dry, which makes it easy for the pods to be removed - Participant 3, female, Nwoya District.

Some farmers were reported to dry their peanuts on the ground smeared with cow dung because they believed that the technique was safe.

Traditionally we believe the use of cow dung is safe - Participant 1, male, Tororo District. She just dried directly on the ground without smearing or putting anything. When I asked her why she was doing this, she told me she didn't have money to afford a tarpaulin. For me, I was of the view, that if you can afford cow dung, it can be better - Participant 3, male, Tororo District.

Figure 7. A woman preparing peanut paste at home using the traditional grinding stone (Photo credit: Participant 1, female, Nwoya District).

Figure 8. Windrow drying method commonly practised by Nwoya communities after harvest (Photo credit: Participant 2, female, Nwoya District).

The farmer is drying the peanuts locally and we can see that this method of drying peanuts on bare ground is common. She convinced me that she smeared the ground with cow dung to make the place fine to eliminate the soil that would intrude on the peanuts. She convinced me that cow dung can make the collecting of the peanuts to be effective just like someone using tarpaulin - Participant 6, male, Tororo District.

Not only was cow dung smeared on drying grounds, but participants also reported that it was smeared to block the openings that usually exist in winnowing baskets as shown below in Figure 9.

There are some types of winnowing baskets they make with no holes but that type when they smear it, means the holes are big so they smear it to fill the gaps to avoid seeds like simsim falling. Yeah, just to protect in the winnower - Participant 7, male, Nwoya District.

Although farmers still use drying techniques that compromise quality, participants stated that some farmers had adopted the use of tarpaulins to dry their produce after harvest. They stated that this was a good practice that preserved the integrity of produce during drying.

Dirty processing environments encourage contamination

Generally, participants reported that peanuts were processed in unhygienic conditions as shown in Figure 10 which encouraged contamination of the products. They noted that some processing machines were rusted and out of service even though they were still in use by processors. These were said to increase the chances of contamination of the products during and after processing thus compromising the quality and safety of the peanut products.

So, this is a grinding machine and we can see where the powdered paste is…so you can see the hygiene of the place…the hygiene of the place is not good. you can see the peanuts… the place looks rusted…some kind of rusted ends, but the peanuts are just placed here. There is a possibility of germs transferring from the dirty place to the paste… the place is very dirty as you can see not because of the phone but the place is very dirty in a real sense - Participant 1, male, Tororo District.

Marketing

From the photo discussions, participants reported the quality and safety aspects they considered before choosing different peanut products in the market. Aspects

Figure 9. Winnowing basket smeared with cow dung (Photo credit: Participant 2, female, Tororo District).

Figure 10. Processors processing peanuts from a dirty processing environment (Photo credit: Participant 1, male, Tororo District).

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

presented below concerning peanut variety of preference by consumers in the marketplace and packaging materials used.

Red beauty variety was preferred based on its colour and taste by consumers

Participants reported that consumers preferred red beauty to serenuts because it had an attractive colour and was "sweeter". Not only did the consumers prefer red beauty but also farmers. Participants stated that farmers preferred growing red beauty because its colour attracted consumers and didn't take long in the garden thus a ready market for their produce.

… because of its taste (Red-beauty) … they are sweeter than other varieties… it does not take too much time in the garden, 3 months (90 days) compared to other varieties like serenut 14, serenut 5 - Participant 6, male, Nwoya District.

On the other hand, participants also reported that processors preferred using red beauty because products obtained from the variety were considered to be of better quality by consumers than products from Serenut varieties. Therefore, red beauty was preferred and its price was higher than other peanut varieties in the marketplace.

So, when I was in the general market, I was trying to assess why red beauty is more expensive than others… then they told me, the management of these crops differs and the quality more so if you look at the products red beauty gives and the others you find that red beauty produces more high-value products than the serenuts. And also, the yielding capacity of serenuts has higher chances of yield so if you look at red beauty, its chances of giving you a very high yield are so minimal, that`s because I think they are sold expensive, and they also require a lot of attention more on fieldwork, tilling, weeding, spraying. It is a variety which is on the market; a white (muzungu) cannot enjoy serenut but prefers this red beauty. I think that's the knowledge behind the pricing strategy - Participant 6, male, Tororo District.

Packaging materials determine the quality of the products by consumers

Participants reported that there were two main packaging materials used for peanuts in their markets; transparent polyethene bags and tins. The former was the commonly used packaging for all peanut products (roasted peanuts, omunyige, peanut paste, and peanut powder) whereas the latter was only used for peanut paste (locally known as odi). The tins used to package peanut paste were said to have previously contained other items such as drugs, detergents and hydrogenated fat (Kimbo) (Figure 11) and participants believed that this would affect consumers` health.

This is where they sell the Odi, I visited one of the trading centres and this is the facility… farmers process, pack and sell so those tins differ but the question I flashed back to the sellers is that I asked them about the recycling technique of these tins because for me I got scared. I saw some labelled Omo, Panadol, Kimbo, so I failed to… so they told me they thoroughly wash it to make sure they are safe for customer consumption - Participant 6, male, Tororo District.

In regards to their packaging, participants stated that they preferred omunyige to peanut powder and paste because it was easy to identify any form of adulteration in the product and they didn't blow human air in it during packaging. They argued that given the current pandemic, blowing human air, especially in peanut paste packaged in transparent polythene bags was a nuisance and the product was not fit for consumption.

When you see it… is swollen like this, you think there is a lot, but not for omunyige… that's why most people prefer

Figure 11. Peanut paste packaged in containers previously used for hydrogenated fat "Kimbo" (Photo credit: Participant 5, female, Tororo District).

omunyige because there is nowhere you are going to blow in it - Participant 5, male, Tororo District.

Yes, so according to your choice, with issues of the coronavirus (COVID-19), I better go for omunyige because there is no air in it and it can mix the sauce very well without a doubt - Participant 1, female, Tororo District.

On the issue of shelf life, it was noted that most of the peanut packages lacked indications for product longevity. Even though participants who were involved in the seed business community fair said that their packages had "best before" dates, they didn't know how the dates were generated.

Discussion

The various issues which were captured and reported by the participants using the photovoice technique under peanut quality and safety are well known and have been identified in other research. However, since they still exist, they must be re-emphasized and re-informed to the concerned stakeholders until something is done to improve the food quality and safety situation among agricultural produce and the country at large. Findings from this research complement work done by Mirembe et al. (2023) who assessed the feasilbility of using photovoice technique as an assessment technique for peanut quality and safety among rural Uganda youth farmers. This study demonstrates the implementation of the technique along the peanut value chain depicting food quality and safety concerns which are inherent in the peanut value chain in Uganda. The issues captured using the photovoice technique covered all the nodes of the value chain which indicated that for peanut quality and safety to be improved, it should be handled right from the production further to other nodes as they feed into each other; so that the final consumer gets a wholesome food which improves health and contributes to the daily livelihood.

Agronomic practices

The production of high-quality and wholesome peanuts begins at the farm since the producer is an important component within the production process; peanut quality is established at the farm level. Implementing good agricultural practices (GAP) during on-farm production and post-production processes resulting in safe agricultural products is of enormous importance for ensuring a safe food supply (FAO, 2016). In the current study, with the aid of photos, participants complemented and discouraged some agronomic practices which were carried out by farmers in their communities since they believed that they either contributed to improving or diminishing the quality of the peanuts at harvest respectively.

During harvesting, participants noted that due to the dry spell, farmers were forced to harvest their produce using hand hoes which later damaged the pods. Mechanical damage to kernels/ pods makes them susceptible to invasion by storage moulds and aflatoxin concentrations in such kernels have been detected to be high compared to uninjured pods/ kernels (Torres et al., 2014). Therefore, harvesting by hand is regarded as the best harvesting option, especially for small gardens to reduce the injury of pods. Furthermore, participants noted that late harvest was also a result of farmers failing to predict the harvesting time of their crops. Some peanuts were also reported to have germinated from the garden and moulding was spotted on some pods. These observations by the participants properly align with MAAIF's (2019) report which stated that aflatoxin contamination in Uganda has been enhanced by late harvesting leading to germination which opens the pods and allows moulds to enter. In a review of mycotoxin contamination in Uganda, Lukwago et al. (2019) recommended timely harvesting as one of the strategies that should be advocated to reduce aflatoxin contamination of crops thus training of farmers is crucial in this regard. Training farmers on how to control aflatoxins at the garden level during harvesting aligns with the WHO (2018) effort of using an integrated approach to controlling aflatoxins at all stages from the field to the table thus reducing its risk.

Not only was mechanical damage to pods reported during harvesting but also weeding, especially at the second weeding. Ojelade et al. (2018) noted that hoe weeding damaged the brittle branches, roots and peanut pegs formed underground. Even though hand weeding either using hands or hoes is the predominant and traditional weed control practice by smallholder farmers, lately, they have started to adopt the use of herbicides in their gardens due to reduced labour and the desire to reduce time in the garden (Gianessi & Williams 2011). However, farmers have not yet ascertained the knowledge about which herbicide is supposed to be used in a given weed-crop situation, deficiency and scarcity of weed science personnel and uncertainty as to the availability of herbicides as noted by Falade & Labaeka (2016). Andersson & Isgren (2021) also noted that peanuts were the most sprayed crop by farmers in Uganda even though farmers were not aware of the particular chemicals they were using since they just used what was provided at the shops when they went to buy. According to Okello et al. (2013), peanuts can't compete effectively with weeds particularly 3 to 6 weeks after sowing; therefore, weed management is critical from both yield and quality perspectives.

Pest and disease management

Participants noted that farmers were challenged by several pests which reduced the quality of their produce.

Physical damage to the pods by pests favours the invasion of aflatoxin-producing moulds in the damaged regions of kernels (Kombiok et al., 2012). Crops destroyed by wild animals, especially in Nwoya are still problematic since aflatoxins not only affect the crops but also human life at stake. This is in alignment with findings by Kinyera (2014) who reported crop raids, especially by elephants in Nwoya parishes which directly and indirectly affected the food security status of the communities affected. On the other hand, even though participants were not aware of aphids, the pest has been documented as a transmitter of the three agents that cause groundnut rosette disease (GRD) (Okello et al., 2014) which was reported to wipe farmers` gardens, especially those who grew the red beauty variety. The spread of GRD was also encouraged by the dry spell which was faced by the farmers in both regions at the beginning of 2021 thus reducing the yield and quality of the peanut at harvest. Mukoye et al. (2019) also attributed the higher incidence of GRD to the higher vector pressure during the short rains as compared to the long rains when the aphid pressure is low since they are washed off the plant. However, research by Okello et al. (2014) reported that farmers who had acquired improved varieties registered low GRD severity levels compared to regions that grew the local varieties (red beauty) in Uganda.

Storage

Based on the storage conditions which were displayed in the photos by the participants, the quality and safety of peanuts are highly compromised in the communities. Waliyar et al. (2015) reported that significant deterioration of grains caused by moulds mainly occurred during storage because of the prevailing ambient conditions. In addition, Baluka et al. (2017) also reported that high aflatoxin contamination was attributed to poor practices during harvesting, processing and storage with business people who also buy in bulk during bumper harvest and store them in poorly ventilated and highly humid premises. Farmers majorly at risk are the ones that store their products in their own homes and not in group-owned stores. This was in line with findings from Tibagonzeka et al. (2018) who observed that farmers mainly stored their produce within their residential homes including bedrooms, kitchens and living rooms. Produce stored in homes was mainly stored on the ground which probably encouraged the pick-up of moisture from the surrounding environment thus encouraging mould growth (MAAIF, 2019). However, based on the photo presented by a female participant from Nwoya, there is hope for farmers to adopt better storage conditions, especially those organized in farmer groups. Furthermore, from the photos presented in this study, it can be noted that farmers have devised local means of using pallets to avoid placing their produce on the floor even if they are storing them in their own homes. Participants discouraged the storage of peanuts in jerrycans because they had registered losses due to the moulding of the produce. Peanuts stored in jerrycans are mainly shelled, a practice that is not recommended. Okello et al. (2013) noted that when peanuts were stored in kernel form, they deteriorated very fast because they picked up moisture and were easily invaded by moulds, insects and rodents which was not the case with unshelled peanuts. This is because the shells offered protection to the kernels against spoilage agents. Shelled peanuts are fragile and exposed to various agents that can cause physical, chemical and biological deterioration thus rapidly losing their seed viability when stored under such conditions (Ntare et al., 2008).

Processing

Participants were able to use photovoice to identify factors affecting peanut quality and safety during primary and secondary processing in their communities. In this study, participants revealed that peanuts intended for seed were predominantly shelled using hands which was time-consuming and labour-intensive but could produce better quality peanuts intended for sowing. Participants stressed that shellers caused a lot of breakage of kernels which is undesirable for peanuts intended for seed. Lavkor & Var (2017) reported that cracks and breaks in the kernels during shelling make the kernels more susceptible to attack by moulds compared to intact peanuts in any environmental conditions.

Once the produce was harvested from the garden, the study revealed that farmers either dried it on bare ground, ground smeared with cow dung, cemented floor or tarpaulin among others. These drying techniques raise quality and safety issues which compromise the integrity of the produce. Peanuts dried on bare ground and grounds smeared with cow dung are prone to aflatoxin contamination yet these are the predominant techniques practised in the communities. Tibagonzeka et al. (2018) and Lukwago et al. (2019) stressed that drying on the bare ground contributed to the prevalence of aflatoxins in agricultural produce in Ugandan communities. In addition, cow dung was not only smeared on drying grounds but also winnowing baskets because communities believed that the use of cow dung was safe. However, the presence of cow dung on food surfaces is a hazard and encourages the growth of E.coli which is natively associated with manure (Çekiç et al., 2017) in food. Okonya et al. (2013) stated that it was important to note the local perceptions which cannot be estimated by models thus documenting how their lives are affected by recent changes is very crucial. Therefore, through photovoice, such perspectives are aired, corrected and improved techniques such as the use of tarpaulin, cemented floors, animal skins and mats among others are advertised and recommended to farmers to reduce aflatoxin prevalence in food as recommended by Okello et al. (2013).

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

In the current study, windrow drying was embraced in the Nwoya district because it made plucking easy and was discouraged in Tororo because it caused fermentation and spoilage of peanuts in the garden. MAAIF (2019) settled the debate and discouraged farmers from drying the product in the field by emphasizing that the longer the produce stayed in the garden, the higher the chances of mould infection and pests' infestation that can pre-dispose peanuts to mould contamination. Additionally, there is a possibility of re-wetting if it rains and finds the produce in the field leading to rotting and sprouting. In a study about aflatoxin contamination by Aspergillus species in Ethiopia, Guchi (2015) noted that peanut pods in Africa were often heaped in the field after uprooting for partial sun-drying before home drying; a traditional technique that exposed peanut pods to rapid fungal invasion and aflatoxin production. Therefore, windrows should not be practised by farmers to reduce the occurrence of aflatoxins in agricultural produce. Even though such practices were already stated by MAAIF (2019), photovoice displayed that enforcement of recommended practices by extension agents was still low and needed a boost especially in rural communities. Therefore, extension agents can utilize this photovoice technique in their trainings and monitoring to check whether communities are adhering to the recommended postharvest technologies or not.

Communities in both districts involved in the current study preferred grinding their peanut using either a grinding stone or mortar and pestle at home rather than using machines. This argument aligns with Mwaka et al. (2021) who reported that participants in Acholi society thought that grinding using grinding stones was a healthy habit practised by women because the stones were natural and even if they wore out into food, there would be no harmful consequences. Study participants expressed their fear of consuming metallic fragments in machine-processed peanuts thus rendering such products unsafe for human consumption. This food safety concern was also raised by Linderhof et al. (2019) about peanut sauce which was suspected to contain iron parts but the product was not inspected for potential contaminants. In a study to determine the mycotoxin and metallic element concentrations of peanut products in Uganda markets, Baluka et al. (2017) reported that metallic element concentrations were higher in market-processed peanuts than in traditional home-made peanut products although the concentrations were below the FDA standard limit. Nkansah et al. (2021) also stated that the presence of metallic elements such as iron in peanut products was attributed to the ageing milling machines used by processors. Furthermore, preference for traditional grinding methods also stemmed from participants who reported that processors were fond of adulterating peanut powder with other flours thus refraining from the consumption of the product.

Marketing

According to Osuret et al. (2016), 40% of samples of peanuts and peanut paste produced in Kampala markets, Uganda, exceeded the permissible levels of aflatoxin (20 µg kg-1) adopted in most countries, with peanut paste testing 100% aflatoxin concentrations. This raises food quality and safety concerns that cannot go unaddressed. Most of the peanut products which were packaged in tins and plastic jars had price tags but lacked expiry dates. This was also reported by Nyamweha (2016) who stressed the importance of expiry dates on locally processed peanut products so that consumers know how long the powder or paste had remained packed in containers without deterioration. Under the same initiative, farmers who sold their seeds at the local seed business community fair included "best before" dates of the seeds after laboratory analysis so that consumers are guided well on their choices. However, some peanut products were criticized by consumers because they claimed they were adulterated before packaging which could affect their health. This observation was also noted by Choudhary et al. (2020) who stated that adulteration not only had a very serious impact on farmers, processors, consumers and the government but also caused serious diseases like cancer, diarrhoea, asthma and ulcers.

On the other hand, red beauty was sold more expensively than serenut because its products were considered to be of better quality and its colour attracted consumers. This assertion was in line with findings by Mugisha et al. (2014) and Semalulu et al. (2014). Furthermore, the preference for red beauty did not stop at the marketplace, rather it extended to the production node. Farmers preferred growing red beauty because of its price outcome and the fewer days it takes in the garden. All these factors compounded together to give a stretch of why red beauty even though it does not give much yield to farmers is the most commonly grown peanut variety in rural communities. However, Okello et al. (2013) urged that the perfect variety possessing all the necessary traits for diverse environments doesn't exist, therefore, it makes good sense to plant a couple of different varieties to reduce the production risk.

Conclusion

Based on the findings from the study, photovoice was able to depict the quality and safety state of peanuts along the value chain in Uganda. Through the visuals, it can be stated that the peanut quality and safety burden in Uganda is still great and needs urgent and appropriate interventions. Deterioration in peanut quality mainly occurred post-harvest and was accelerated by the poor handling practices carried out by value chain actors in the communities. As a participatory research technique, photovoice has contributed to the efforts toward addressing the quality

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

and safety of peanuts in Uganda since it has been able to portray the risk factors which exposed peanuts to adverse contamination levels. These can also be determined using laboratory techniques reported by Wacoo et al. (2014). These risks presented by youth in their communities could be prevented and controlled before adverse effects emerge. Therefore, the photovoice technique can be used as a training tool for pre- and postharvest handling in rural communities. Due to its effectiveness, the photovoice technique can also be adopted by youth farmer groups and extension workers as a dissemination technique of agricultural knowledge in rural and urban communities.

Acknowledgement

Sincere gratitude goes to the youth participants and their coordinators from Nwoya and Tororo districts in Uganda for their contribution towards this research.

Funding source: This study was made possible by the generous support of the American people through the United States Agency for International Development (USAID) through Cooperative Agreement No. 7200AA 18CA00003 to the University of Georgia as the management entity for U.S. Feed the Future Innovation Lab for Peanut (2018–2023).

References

Adekeye O, Kimbrough J, Obafemi B, Strack RW (2014). Health literacy from the perspective of African immigrant youth and elderly: A photovoice project. J Health Care Poor Underserved. 25: 1730-1747.

Andersson E & Isgren E (2021). Gambling in the garden: Pesticide use and risk exposure in Ugandan smallholder farming. J Rural Stud. 82: 76–86.

Baluka SA, Schrunk D, Imerman P, Kateregga JN, Camana E, et al (2017). Mycotoxin and metallic element concentrations in peanut products sold in Ugandan markets. Cogent Food Agric. 3: 1313925.Bashore L, Alexander GK, Jackson DL, Mauch P (2017). Improving health in at-risk youth through photovoice. J Child Health Care. 21: 463-475.

Capewell C, Ralph S, Symonds M (2020). Listening to women's voices: Using an adapted photovoice methodology to access their emotional responses to diagnosis and treatment of breast cancer. J Patient Exp. 7: 1316-1323.

Çekiç SK, De J, Jubair M, Schneider KR (2017). Persistence of indigenous Escherichia coli in raw bovine manure-amended soil. J Food Prot. 80: 1562–1573.

Choudhary A, Gupta N, Hameed F, Choton S (2020). An overview of food adulteration: Concept, sources, impact, challenges and detection. Int J Chem Stud. 8: 2564-2573.

Falade AA & Labaeka A (2016). Enhancing food security in Nigeria through integrated weed management. Int J Adv Acad Res. 2: 2488-9849.

FAO (2016). A scheme and training manual on good agricultural practices (gap) for fruits and vegetables.

FAO (2017). Analysis of existing approaches for rural youth employment in Uganda.

FAO (2018). National gender profile of agriculture and rural livelihoods - Uganda.

FAO (2019). Rural youth employment and agri-food systems in Uganda: A rapid context analysis.

Fountain JC, Scully BT, Chen ZY, Gold SE, Glenn AE, et al (2015). Effects of hydrogen peroxide on different toxigenic and atoxigenic isolates of Aspergillus flavus. Toxins. 7: 2985-2999.

Gianessi L & Williams A (2011). Overloking the obvious: The opportunity for herbicides in Africa. Outlooks Pest Manag. 22: 211-215.

Guchi E (2015). Aflatoxin contamination in groundnut (*Arachis hypogaea* L.) caused by *Aspergillus* species in Ethiopia. J Appl Environ Microbiol. 3: 11-19.

Han CS & Oliffe JL (2016). Photovoice in mental illness research: A review and recommendations. Health (United Kingdom), 20(2), 110-126.

Hunter O, Leeburg E, Harnar M (2020). Using photovoice as an evaluation method. J Multidiscip Eval. 16: 14-20.

Jelliffe JL, Bravo-Ureta BE, Deom CM, Okello DK (2018). Adoption of high-yielding groundnut varieties: The sustainability of a farmer-led multiplication-dissemination program in Eastern Uganda. Sustainability (Switzerland). 10: 1597.

Kinyera A (2014). Elephant crop raids in selected parishes in Nwoya district and its impact on household livehood, food security, and wildlife conservation.

Kombiok JM, Buah SSJ, Dzomeku IK, Abdulai H (2012). Sources of pod yield losses in groundnut in the northern savanna zone of Ghana. West Afr J Appl Ecol. 20: 53-63.

Lal S, Jarus T, Suto MJ (2012). A scoping review of the Photovoice method: Implications for occupational therapy research. Can J Occup Ther. 79: 181-190.

Lavkor I & Var I (2017). The control of aflatoxin contamination at harvest, drying, pre - storage and storage periods in peanut : The new approach. Aflatoxin-control Analysis Detection Health Risks. 46-65.

Linderhof V, Dijkxhoorn Y, Fongar A, Onyango J, Nalweyiso M (2019). Food system mapping in kanyanya (kampala)" workshop report.

Lukwago FB, Mukisa IM, Atukwase A, Kaaya AN, Tumwebaze S (2019). Mycotoxins contamination in foods consumed in Uganda: A 12-year review (2006–18). Sci Afr. 3: e00054.

MAAIF (2019). Aflatoxin management in Uganda: A Handbook for extension workers (Issue August).

Mirembe RM, Kaaya AN, Male D, Kansabe S, Lwasa S, et al (2023). Feasibility of using photovoice for assessment of peanut quality and safety along the value chain: Perspectives of youth in rural Uganda. Afr J Food Sci. 14: 01-013.

Mugisha J, Lwasa S, Kai M (2014). Value chain analysis and mapping for groundnuts in Uganda.

Mukembo SC, Edwards M, Robinson JS (2020). Comparative analysis of students' perceived agripreneurship competencies and likelihood to become agripreneurs depending on learning approach: A report from Uganda. J Agric Educ. 61: 93-114.

Mukoye B, Ndonga MFO, Were HK (2019). Incidence of groundnut rosette disease (grd) and genetic diversity of groundnut rosette assistor virus (GRAV) in Western Kenya. Int J Genet Genom. 7: 98-102.

Musoke D, Ekirapa-Kiracho E, Ndejjo R, George A (2015). Using photovoice to examine community level barriers affecting maternal health in rural wakiso district, Uganda. Reprod Health Matters. 23: 136-147.

Musoke D, Ssemugabo C, Ndejjo R, Ekirapa-Kiracho E, George AS (2018). Reflecting strategic and conforming gendered experiences of community health workers using photovoice in rural Wakiso district, Uganda. Hum Resour Health. 16: 1-9.

Mwaka AD, Achan J, Adoch W, Wabinga H (2021). From their own perspectives: A qualitative study exploring the perceptions of traditional health practitioners in northern Uganda regarding cancers, their causes and treatments. BMC Fam Prac. 22: 1-14.

Mwesigwa D & Mubangizi BC (2019). Agricultural practices in mid-western Uganda: Challenges and prospects for food security in rural areas. Gender Behavior. 17: 13820-13837.

Nkansah MA, Adrewie D, Darko G, Dodd M (2021). Potential elemental exposure and health risk associated with the consumption of groundnut paste processed with local milling machines within the Kumasi metropolis. Sci Afr. 13: 21.

NPA (2020). Third national development plan (NDPIII) 2020/21-2024/25. In National Planning Authority.

Indexed at, Google Scholar, Cross Ref

Ntare BR, Diallo AT, Ndejeunga J, Waliyar F (2008). Groundnut seed production manual.

Nukakora CB (2014). Combating gender-based violence and enhancing economic empowerment of women in Northern Uganda through cash transfers.

Nyamweha BR (2016). Analysis of food hazards in groundnut chains. Analysis of food safety of groundnut products at retail level in Rwenzori region and identifying suitable package materials for them.

Nykiforuk CIJ, Vallianatos H, Nieuwendyk LM (2011). Photovoice as a method for revealing community perceptions of the built and social environment. Int J Qual Methods. 10: 103-124.

Ojelade OB, Lagoke ST, Adigun JA, Babalola OA, Daramola OS, et al (2018). Intra-row spacing and weed control influence growth and yield of groundnut (*Arachis hypogea* L.). Adv Agric Sci. 6: 1-11.

Okello DK, Akello LB, Tukamuhabwa P, Odong TL, Ochwo-Ssemakula M, et al (2014). Groundnut rosette disease symptoms types distribution and management of the disease in Uganda. Afr J Plant Sci. 8: 153-163.

Okello DK, Monyo E, Ininda J, Oloka HK (2013). Groundnut production guide for Uganda : Recommended practices for farmers. NARO.

Okello DK, Deom CM, Puppala N, Monyo E, Bravo-Ureta B (2018). Registration of 'serenut 6T' groundnut. J Plant Regist. 12: 43-47.

Okello DK, Monyo E, Deom CM, Ininda J, Michael DC, et al (2013). Groundnut production guide for Uganda: Recommended practices for farmers. NARO.

Okonya JS, Syndikus K, Kroschel J (2013). Farmers' perception of and coping strategies to climate change: Evidence from six agro-ecological zones of Uganda. J Agri Sci. 5: 252.

Omara T, Nassazi W, Omute T, Awath A, Laker F, et al (2020). Aflatoxins in Uganda: An encyclopedic review of the etiology, epidemiology, detection, quantification, exposure assessment, reduction, and control. Int J Micro. 2020. 18.

Osuret J, Musinguzi G, Mukama T, Halage AA, Natigo AK, et al (2016). Aflatoxin contamination of selected staple foods sold for human consumption in kampala markets, Uganda. J Bio Sci. 16: 44-48.

Ottmann G & Crosbie J (2013). Mixed method approaches in open-ended, qualitative, exploratory research involving people with intellectual disabilities: A comparative methods study. J Int Dis. 17: 182-197.

Ronzi S, Pope D, Orton L, Bruce N (2016). Using photovoice methods to explore older people's perceptions of respect and social inclusion in cities: Opportunities, challenges and solutions. SSM - Popul Health. 2: 732-745.

Sarfo JO, Debrah TP, Gbordzoe NI, Afful WT, Obeng P (2021). Qualitative research designs, sample size and saturation: Is enough always enough?. J Advocacy Res Educ. 8: 1-7.

Seitz CM & Strack RW (2016). Conducting public health photovoice projects with those who are homeless: A review of the literature. J Soc Distress Homeless. 26: 33-40.

Semalulu O, Mugonola B, Bonabana-Wabbi J, Kayanga ST, Mogaka H (2014). Optimizing use of integrated soil fertility management options for profitable groundnut production in Uganda. Agri Soil Sci. 1: 061-069.

Sharma S, Choudhary B, Yadav S, Mishra A, Mishra VK, et al (2021). Metabolite profiling identified pipecolic acid as an important component of peanut seed resistance against *Aspergillus flavus* infection. J Hazard Mater. 404: 124155.

Ssemugabo C, Nalinya S, Lubega GB, Ndejjo R, Musoke D (2021). Health risks in our environment: Urban slum youth' perspectives using photovoice in Kampala, Uganda. Sustainability (Switzerland). 13: 1-16.

Tibagonzeka JE, Akumu G, Kiyimba F, Atukwase A, Wambete J, et al (2018). Post-harvest handling practices and losses for legumes and starchy staples in Uganda. Agri Sci. 09: 141-156.

Torres AM, Barros GG, Palacios SA, Chulze SN, Battilani P (2014). Review on pre-and post-harvest management of peanuts to minimize aflatoxin contamination. Food Res Int. 62: 11-19.

UBOS (2017a). National population and housing census 2014 - Area specific profiles, Nwoya District.

UBOS (2017b). National population and housing census 2014 - Area specific profiles series.

UBOS (2019). The international labor day May 01, 2019 - Agago district.

UBOS (2020). 2020 Statistical abstract. In uganda bureau of statistics. 1.

UNBS (2018). UNBS new price list for laboratory testing services 2017-2018.

UNICEF (2013). Uganda poverty maps 2012/2013.

USAID (2016). Youth engagement in agricultural value chains across feed the future: A synthesis report. 46.

Veettil PC, Raghu P, Mohapatra B, Mohanty S (2021). Gender differences in rice value chain participation and career preferences of rural youth in India. Dev Prac. 31: 93-111.

Wacoo AP, Wendiro D, Vuzi PC, Hawumba JF (2014). Methods for detection of aflatoxins in agricultural food crops. J Appl Chem. 1-15.

Citation: Mirembe, Kaaya, Male, et al (2023). Using photovoice to analyse factors that influence peanut product quality and safety along the value chain in Uganda. AJFST: 047.

Waliyar F, Osiru M, Ntare BR, Vijay Krishna Kumar K, Sudini H, et al (2015). Post-harvest management of aflatoxin contamination in groundnut. World Mycotoxin J. 8: 245-252.

Wang C (2006). Youth participation in photovoice as a strategy for community change. J Community Pract. 14: 147- 161.

WHO (2018). Aflatoxins. Dep Food Saf Zoonoses. 6

Woodgate RL, Zurba M, Tennent P (2017). Worth a thousand words? Advantages, challenges and opportunities in working with photovoice as a qualitative research method with youth and their families. Qualitative Socisl Research. 18: 1-23.

Yang Y, Lim AC, Wallace RE, Marhefka-Day S, Liller KD (2020). Photovoice and youth on violence and related topics: A systematic review. Florida Ppublic Health Rev. 17: 44-59.