

Women Groundnut Farmers' Participation in Aflatoxin Management Interventions in Chemba District, Tanzania

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Abstract:

This study examined the nature of women groundnut farmers' participation in aflatoxin management interventions in Chemba District in Tanzania. The study employed a cross-sectional mixed-methods research design involving quantitative and qualitative methodologies. Data were collected using a survey of 137 women groundnut farmers. Also, qualitative data were collected through focus group discussions and key informant interviews. Data were analysed using descriptive statistics and content analysis. Specifically, 66.5% of women respondents were involved in the aflatoxin management interventions currently being implemented in the study area, while 33.5% reported no participation in such interventions. Also, the findings show that the recent TANIPAC project interventions were perceived positively to bring anticipated positive economic changes and lessen aflatoxin contamination in the food system. Overall, women's participation in interventions is crucial for effectively managing aflatoxin and reducing contamination within the food system.

Keywords: Women participation, Groundnuts, Management, Interventions, Aflatoxin, Food systems

Introduction:

Aflatoxins pose a significant global health risk due to their immediate and long-term effects on public health and their substantial economic implications (Jallow *et al.*, 2021; Meneely *et al.*, 2023). These naturally occurring toxins, produced by certain strains of *Aspergillus* fungi, pose a severe threat, particularly in the context of food safety. Among the various crops susceptible to aflatoxin contamination, groundnuts and groundnut products are especially vulnerable, making them a major food safety concern in many developing countries (Meneely *et al.*, 2023; Ortega-Beltran and Bandyopadhyay 2019). The situation is particularly alarming in rural areas of Tanzania, where aflatoxin contamination is

prevalent throughout the maize and groundnut value chains (Kimanya *et al.*, 2016; Boni *et al.*, 2021; Seetha *et al.*, 2017). The widespread presence of aflatoxins in these staple crops necessitates the implementation of robust intervention strategies to mitigate their impact.

In response to this pressing issue, various interventions have been initiated to combat aflatoxin contamination, particularly within the postharvest value chain of groundnuts (Ahmad *et al.*, 2023; Meneely *et al.*, 2023; Seetha *et al.*, 2017). These efforts are crucial as the postharvest stage is critical for preventing the development and spread of aflatoxins. Additionally, these interventions often involve women, who play a pivotal role in groundnut postharvest activities.

Recognising the importance of women's participation, several programs have been designed to include them in aflatoxin management efforts, acknowledging their unique contributions to the process (Cervini *et al.*, 2023; Christie *et al.*, 2015; Xu *et al.*, 2017). These interventions aim to reduce aflatoxin contamination and empower women by providing them with the necessary knowledge and tools to effectively manage the postharvest handling of groundnuts, thereby enhancing food safety and security in affected regions.

It is widely agreed that aflatoxin management interventions have effectively contributed to reducing aflatoxin contamination (Meijer *et al.*, 2018; Xu *et al.*, 2017; Seetha *et al.*, 2019; Christie *et al.*, 2015; Matumba *et al.*, 2018). Besides, the literature show the significant participation of women groundnut farmers in aflatoxin management (Cervini *et al.*, 2023; Seetha *et al.*, 2019; Seetha *et al.*, 2017; Christie *et al.*, 2015; Xu *et al.*, 2017). However, generally, there is limited knowledge regarding women participation in aflatoxin management and their perceived role of the interventions being implemented especially in Tanzania.

Thus, this paper analyses the nature of women's participation in aflatoxin management with reference to the TANIPAC project interventions. The rest of the paper is organised as follows: First, the background of the study is presented. This is followed by a description of the conceptual framework guiding this study, after which the research methodology is outlined. Next, the results of the study are presented and discussed, and the conclusion is drawn towards the end of the article.

Background:

Acknowledging the critical need to address aflatoxin contaminations, the Tanzanian government, in partnership with the Global Agricultural and Food Security Program (GAFSP) and the African Development Bank (AfDB), launched the Tanzania Aflatoxin Prevention and Control (TANIPAC) project. Other ongoing interventions are implemented by other organisations, including Inades Formation, FARM Africa, The Centre for Counselling, Nutrition, and Health Care (COUNSENUH), as well as Dorkas Pamoja. TANIPAC, which is the focus of this study, is a nationwide project. It has been implemented across ten regions in Tanzania

mainland and Zanzibar since 2018 and is expected to conclude by 2025. Chemba District, where the study was conducted, is also part of the TANIPAC project interventions.

TANIPAC aims to reduce aflatoxins in the food system by providing capacity building and aflatoxin-related inputs and technologies in maize and groundnut value chains, targeting, among others, extension officers, traders, and farmers (AfDB, 2018). It also aims to enhance food safety, security, community health, agricultural productivity, and trade, ultimately improving community health and nutrition (AfDB, 2018). Its comprehensive interventions encompass both pre-harvest and post-harvest stages in the maize and groundnut value chain, specifically targeting the vulnerability of these crops to high aflatoxin contamination levels. Specifically TANIPAC interventions include conducting training on Good Post-Harvest Management Practices and Good Agricultural Practices (GAP) to prevent and control aflatoxin contamination, raising awareness through the distribution of posters and leaflets, improving infrastructure by building and equipping modern warehouses and laboratories, facilitating farmers in managing demonstration plots, and providing postharvest technologies, such as hermetic storage solutions (silos and bags), to farmers.

Conceptual framework:

This study adapted the framework of Cohen and Uphoff (1980), which has been widely used to analyse competitiveness determinants in developmental intervention programs (Doloh *et al.*, 2023; Robrujen *et al.*, 2023; Sutiyo and Maharjan 2017; Zahirinia and Nikkhah 2012), thus making it suitable for studying women groundnut farmers' participation in aflatoxin management interventions. It describes the nature of participation as involving the following dimensions: decision-making, implementation, benefits, and evaluation. Furthermore, Cohen and Uphoff (1980) defined participation in rural development as people's involvement in decision-making, implementation, sharing benefits, and evaluation. Each of these four dimensions of participation is outlined as follows: Decision-making: Specifically, this kind of participation centres on the generation of ideas, the formulation and assessment of options, and making choices about them, as well as the formulation of plans for putting selected options into effect. For this

reason, three types of decisions are distinguished as follows: (1) initial decisions, (2) ongoing decisions, and (3) operational decisions. Implementation: Rural people can participate in the implementation of a project in three principal ways: (1) resource contributions, (2) administration and coordination efforts, and (3) project enlistment activities. Benefits: Enlistment in a project can lead to at least three kinds of possible benefits: (1) material, (2) social, and (3) personal. While we would agree that participation in benefits sharing is one of the more passive kinds of participation, it has such a long tradition in the economic literature that it should not be overlooked (Cooke & Kothari, 2001). Evaluation: Gregory (2000) emphasised that participation in evaluation is a crucial issue and noted that it has been a persistent challenge, particularly in the use of participatory approaches. To address this, Cohen and Uphoff (1980) proposed a framework for measuring evaluation by examining whether participation was direct or indirect, who participated, the consistency of their involvement, the decision-making power they held, and whether they were involved in evaluation through farmer groups or project-centred methods.

Also, according to Cohen and Uphoff (1980), this framework defines the contexts of participation in projects encompassing three project characteristics: effects, benefit, and design effects.

These characteristics affect the patterns of participation dimension of any rural development intervention. However, participation can extend beyond the project's primary goal and manifest in various ways (Doloh *et al.*, 2023; Robrujen *et al.*, 2023; Daluwatte *et al.*, 2020). Thus, conceptual framework in Figure 1 shows the nature of women groundnut farmer participation in the context of this study encompassing, firstly, "decision making" by checking whether women participate in initial, ongoing, and operational decision-making; "implementation"—whether they are involved in resource contribution like labour, cash, material goods, information giving, group activities and aflatoxin management training interventions. In terms of "benefits," the study examined whether women realised personal benefits such as self-esteem and a sense of efficacy in managing aflatoxin contamination. Further, with respect to "evaluation," the study involved finding out who participated, how consistently, what decision-making power they had, and whether they were involved in evaluation through farmer groups or project-centred surveys.

Moreover, the project contexts, including entry, benefits, and design effects, help analyse the perceived role of the TANIPAC interventions. This means project contexts influence the project's implementation and performance.

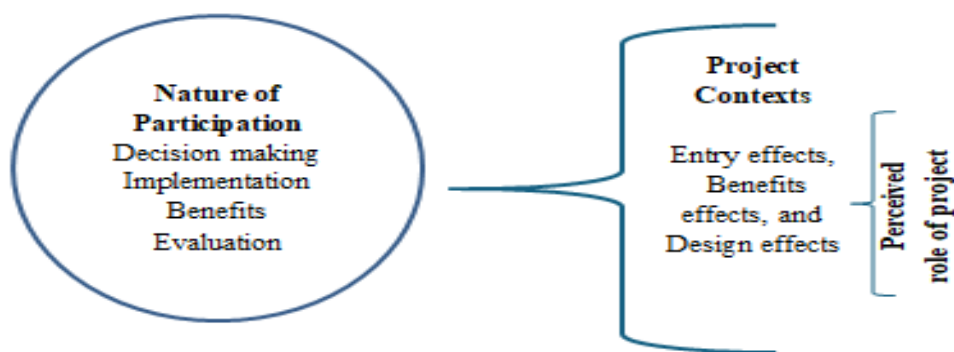


Figure 1: The conceptual framework

Materials and Methods:

Description of the Study Area:

The study was conducted in Chemba District (Figure 2), which is situated 140 kilometres to the north of the regional headquarters of Dodoma City at the coordinate's 05°14' 34" S latitude and 35°53' 24" E longitude, respectively. Its current population is 339,333, of whom 170,837 are males and 168,496 are females (NBS, 2022). The

study area was chosen because of the high occurrence of aflatoxin contamination in maize and groundnuts, which resulted in an outbreak of aflatoxicosis, a health disease caused by the consumption of food sources contaminated with aflatoxins, the fungal toxins that are produced by *Aspergillus* spp. that affected clusters of families (Kamala *et al.*, 2018) as well as the presence of the TANIPAC project, whose implementation is on-going.

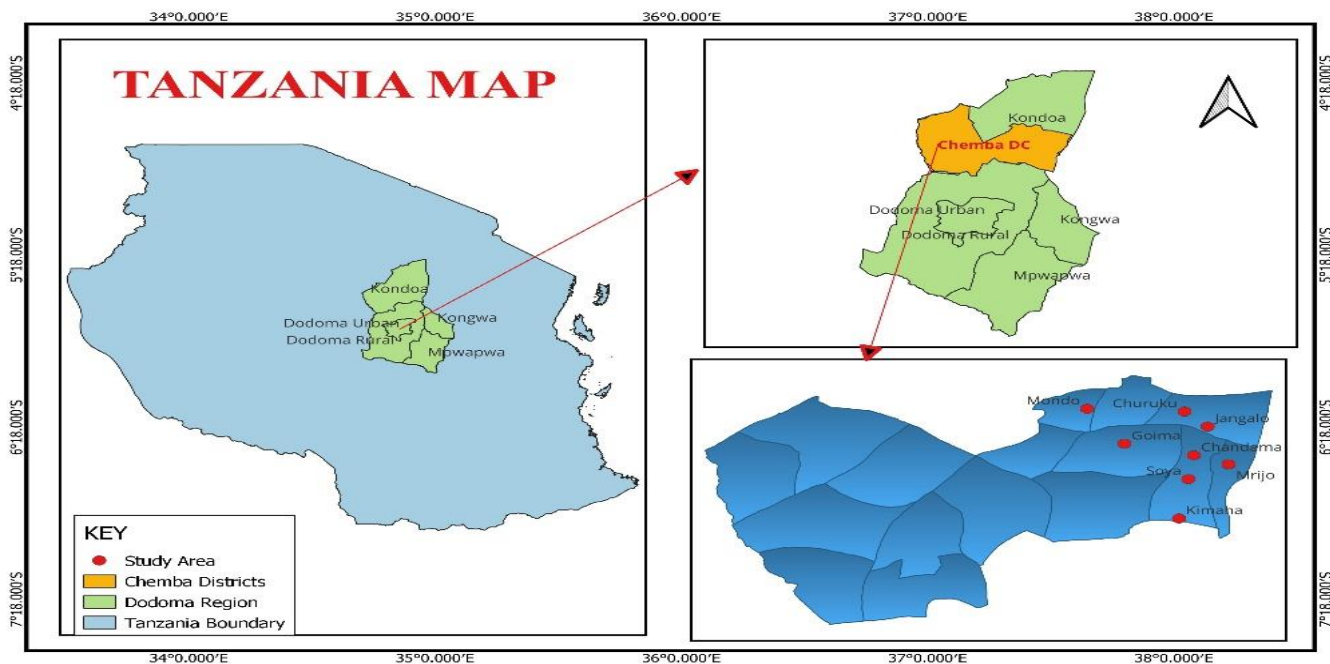


Figure 2: Study area map

Research Design:

The study adopted a cross-sectional mixed research design, incorporating household interviews, FGDs, key informant interviews, and participant observation. The study population consisted of women groundnut farmers distributed in 12130 agricultural households in villages with reported incidences of aflatoxicosis in Chemba District.

Sampling Procedure and Sample Size:

The sample size of the study was obtained from the purposefully selected eight (08) wards, which are Goima, Chandama, Soya, Kimaha, Mrijo, Mondo, Jangalo, and Churuku. Furthermore, 12 villages were purposefully selected from these wards, which are Igunga, Mapango, Soya, Mwailanje, Mwaikisabe, Isusumya, Mondo, Daki,

Mlongia, Itolwa, Churuku, and Kinkima. Thereafter, simple random sampling was used to obtain 137 respondents from these villages. The sample size was calculated using Kothari's (2004) formula:

$$n = \frac{Z^2 \cdot p \cdot q \cdot N}{e^2 (N-1) + Z^2 \cdot p \cdot q}$$

Where: n is the sample size; N is the sampling frame/population size; Z is the standard value at a given confidence level, i.e., 1.96 (confidence interval at 95%); p is a sample proportion (0.1); q equals 1-p, and e is sampling acceptable error, i.e., 0.05. Proportional sample size for each village was calculated by using a formula as proposed by Kothari (2004) $n = \frac{n}{N} \times S$ as shown in the Table 1 below.

Table 1: Proportionate Sampling Matrix (Source: Chemba District 2022)

Wards	Village	Total Households	Agricultural Households	Sample Size
Goima	Igunga	1424	1210	14
Chandama	Mapango	806	685	8
Soya	Soya	1688	1435	16
Kimaha	Mwailanje	2414	2052	23
	Mwaikisabe	1798	1528	17
Mrijo	Isusumya	460	391	4
Mondo	Mondo	986	838	9
	Daki	214	182	2
Jangalo	Mlongia	2238	1902	21
	Itolwa	891	757	9
Churuku	Churuku	694	590	7
	Kinkima	657	558	6
		14270	12130	137

Source: Survey data, 2023

Data collection:

The primary data were collected through 137 random scheduled household interviews, four (4) key informant interviews, and five (5) focus group discussions (FGDs). The key informants for this study were chosen from among women groundnut farmers' group leaders, village chairpersons, extension agents, and project representatives. They were all selected based on their participation in previous and current aflatoxin interventions. The key informants were asked about the nature of women groundnut farmers' participation in aflatoxin interventions. The focus groups, which lasted for an average of one hour each, were conducted, including 5 and 8 women groundnut farmers. In FGDs, participants were asked about the nature of women groundnut farmers' participation in different stages of aflatoxin interventions and their perceptions about the role of the TANIPAC project in aflatoxin management interventions.

Data analysis:

Data analysis involved descriptive statistics (means, standard deviations, frequencies, and percentages) using the IBM SPSS Statistics v20 software to assess the nature of participation in aflatoxin management interventions. Additionally, the nature of participation and perceptions about the role of TANIPAC project interventions were analysed using content analysis techniques. During content analysis, the recorded data from household interviews, key informants, and focus group discussions were transcribed through constant reading and rereading to ensure a thorough understanding of the content. Once familiarised with the material, sentences and phrases were systematically coded to identify significant patterns and recurring concepts. These coded segments were then grouped into broader themes, allowing data to be organised into coherent categories. This thematic analysis facilitated the interpretation of the data, revealing insights and trends that were critical for addressing the research objectives. By adopting this rigorous approach, the analysis ensured a comprehensive and refined understanding of the perceptions and experiences shared by the participants.

Results:

Nature of women's participation in aflatoxin project interventions

Table 2 presents the results on the nature of

participation of women in aflatoxin interventions by TANIPAC and other projects. The results show that women's level of participation was higher in the TANIPAC project than in other projects, namely Inades Formation, FARM Africa, The Centre for Counselling, Nutrition, and Health Care (COUNSENUH) as well as Dorkas Pamoja. Generally, the level of participation in aflatoxin management interventions was found to be high (66.5%). Specifically, high level of participation was recorded in decision-making (54.3%), training (53.5%), and group activities (57.7%), but a lower level of participation was recorded in evaluation (44.4%) and resource contribution (9.6%). Further details regarding the nature of participation in its various dimensions in aflatoxin interventions are presented below.

Decision-making:

The findings indicate that 36.4% of the respondents participated in decision-making in TANIPAC project interventions, 17.9% participated in decision-making in other projects' interventions, and 12.2% did not participate in decision-making at all. This suggests that the level of women participation in decision making was generally low although more of them participated in decision making in the TANIPAC project interventions than in other interventions.

Implementation

Regarding participation in the implementation of project interventions, the study found that the respondents were involved in training, group activities, and resource contributions. The majority participated in training (37.4%) and group activities (35.4%) organized by TANIPAC and (16.1%) in training and (22.3%) group activities in other project interventions. This is supported by remarks given by a key informant when he said,

“...farmers are happy because training and demonstration plots helped them better understand issues about aflatoxin. However, they expect to benefit more in the near future because of the warehouse and laboratory built in our district, both economically and in managing aflatoxin contamination...”
(Farmers' group leader in Mondo Ward, April 15, 2023)

However, resource contribution was found to be low where by 3% (3.1%) contributed resources in interventions implemented by TANIPAC, while about 6.5% contributed resources to interventions

of other projects.

Sharing benefits

The findings show that 39.2% of the respondents benefited from the TANIPAC project interventions and 15.9% from other project interventions, while only 11.4% of the respondents did not benefit from the interventions. Moreover, findings of key informant interviews suggest that the interventions had a positive impact on the farmers, as remarked by one of the key informants:

“...participating in TANIPAC interventions has truly made a significant impact on me. I

have gained awareness and consciousness regarding aflatoxin management in groundnuts, thus enabling me to safeguard my family against aflatoxicosis...” (Farmers’ group leader in Mrijo Ward, April 8, 2023)

Evaluation

The findings show that 33.2% of the respondents participated in evaluation activities related to the TANIPAC interventions, while 11.20% participated in the evaluation of interventions promoted by other projects. In contrast, 22.1% of the respondents did not participate in evaluation activities at all.

Table 2: Nature of women's participation in aflatoxin project interventions (n=137)

			TANIPAC Project	Other Projects	None
Nature of participation	Activities		%	%	%
Decision making	Did you participate in decision-making?	No	0	12.2	33.5
		Yes	36.4	17.9	0
Implementation	Did you contribute any resources to project activities?	No	27.4	29.5	33.5
		Yes	3.1	6.5	0
	Have you recently attended training on aflatoxin?	No	0	13	33.5
		Yes	37.4	16.1	0
	Did you participate in group activities?	No	0	8.8	33.5
		Yes	35.4	22.3	0
Benefits	Did you acquire any benefit from project activities?	No	0	11.4	33.5
		Yes	39.2	15.9	0
Evaluation	Did you participate in the evaluation?	No	0	22.1	33.5
		Yes	33.2	11.2	0

Source: Survey data, 2023

Perceived role of TANIPAC project interventions in aflatoxin management

Table 3 presents results on five aspects (awareness, availability of quality food, health, marketing and production) regarding the respondents’ perceived role of the TANIPAC project in aflatoxin management interventions.

Awareness

During FGDs, participants expressed that the TANIPAC project played a crucial role in raising awareness about aflatoxins through its comprehensive capacity-building programs. They emphasised that the TANIPAC capacity-building programs provided them with valuable knowledge on managing and preventing aflatoxin contamination. Many noted that increased awareness among them led to greater responsibility and self-initiative in managing aflatoxin risks. They described how they became

more proactive in implementing preventive measures, such as discarding low-grade nuts after sorting, drying produce on tarpaulins, and storing groundnuts in Purdue Improved Crop Storage (PICS) bags on raised platforms. One participant (farmers’ group leader) remarked:

“...before the interventions, farmers normally employed practices that are susceptible to aflatoxin contamination such as consuming grade out, drying and storing on the bare ground...” (April 15, 2023, Mondo Ward)

Availability of quality food

Participants in FGD expressed that the TANIPAC project has played a pivotal role in improving the availability of food quality through reduced aflatoxin contamination and accessibility. They anticipate that groundnut quality will increase due to the project’s interventions, which introduced aflatoxin management practices throughout the

groundnut value chain. Additionally, one respondent during the household survey felt confident that the quality of groundnuts would improve by adhering to the improved aflatoxin management practices. Also, during FGD, one participant gave the following remarks:

“.....adopting better post-harvest handling practices, such as properly drying groundnuts on tarpaulins and storing them in PICs on raised platforms, has significantly reduced contamination. As a result, the groundnuts they consume no longer have a bitter taste.....” (FGD in Kimaha Ward, April 6, 2023,)

The participant in FGD appreciated the project's post-harvest handling practices, believing that they will ultimately contribute to reduced levels of aflatoxin contamination by Tanzania Bureau of Standard's maximum acceptable limit for groundnuts, which is $10 \mu\text{g kg}^{-1}$ for total aflatoxins and $5 \mu\text{g kg}^{-1}$ for aflatoxin B1 (PACA, 2020).

Health

When asked about their perception of TANIPAC's role during the household survey, women groundnut farmers said that TANIPAC would contribute to reduced incidences of aflatoxicosis. This will be achieved through testing harvested crops for aflatoxin contamination in the newly established laboratory observed during the field visit. According to their perceptions, the proactive approach of interventions to food safety would enhance overall public health by alleviating the burden of aflatoxicosis. This was also confirmed by FGD participants, as they agreed and anticipated that;

“.....the newly established laboratory at Mrijo Ward will offer farmers access to reliable aflatoxin testing, enabling them to assess the safety of their produce and take necessary actions if contamination is found.....” (FGD in Mrijo Ward, April 8, 2023)

Furthermore, the women farmers felt that the TANIPAC project's interventions would lead to sustainable improvements in public health safety.

Marketing

Women groundnut farmers who participated in FGDs perceived the TANIPAC project interventions as crucial for ensuring their groundnuts meet market standards, which in turn

enhances their marketing opportunities. They expressed that the market has been difficult and unreliable for them, but with the project's efforts of building a new warehouse, they will be able to reach the market and secure better prices. This connection is expected to open new avenues for expanding market (locally and internationally) reach and increasing profitability for women groundnut farmers. Additionally, it was observed during the field visit that the warehouse building was ready for use. Also, participants agreed that:

“...the role of the newly built warehouse will ensure farmers with safe storage facility across the District and will attract markets for their produces...” (FGD in Goima Ward, April 14, 2023)

On the other hand, the women noted that the project's interventions will likely attract more men into commercial groundnut cultivation, driven by the promise of a better market environment.

Production

During the household survey, respondents expressed their views that TANIPAC interventions have helped them learn about managing aflatoxin and good agricultural practices (GAP) necessary for improving production. They appreciated how the project introduced innovative techniques and technologies that helped minimise losses during both pre-harvest stages, which in turn increased production. Furthermore, a key informant expressed that,

“...the TANIPAC interventions have capacitated farmers on good pre and post-harvest management practices which will help them increase their production, manage aflatoxin contamination and reduce their post-harvest losses.....” (Extension agent in Chandama Ward, April 10, 2023)

More specifically, women groundnut farmers noted that adhering to good agricultural practices, including the use of Aflasafe, the right planting time, the use of pesticides, and the right harvesting time, significantly increased groundnut production while reducing aflatoxin contamination.

Generally, TANIPAC interventions were perceived positively and groundnut farmers had much expectation that it would impact them positively as agreed in FGD that:

“...the TANIPAC project interventions play a significant role in ensuring awareness of

aflatoxin in groundnut production, promoting food safety and security with aflatoxin-free groundnuts, eliminating aflatoxicosis

incidences, and empowering farmers economically through assured markets....” (FGD in Mrijo Ward, April 8, 2023)

Table 3: Perceived role of TANIPAC project interventions

Category	Perceived role of TANIPAC project interventions
Awareness	Increased awareness by the acquisition of useful knowledge
	Improved self-initiative to prevent aflatoxin contamination
Food quality availability	Ensure quality groundnuts to consumers.
	Availability of groundnuts
Health risk	Reduced incidence of aflatoxicosis incidences
	Assured aflatoxin testing facilities
	Improved public health
Marketing	Assured groundnuts met market standards
	Provide linkage with local and international markets.
	Increased number of men growing groundnuts commercially
	Improved economic growth
Production	Reduced postharvest losses
	Increased scale of groundnut production

Source: Survey data, 2023

Discussion:

This study sought to analyse the nature of women's participation in aflatoxin management interventions and examine their perception regarding the role played by the TANIPAC interventions in managing aflatoxin. Specifically, the study analysed how women groundnut farmers are involved in aflatoxin management interventions, covering key dimensions drawn from the framework by Cohen and Uphoff (1980), including participation in decision-making, implementation, benefits, and evaluation. This study found the level of participation to be generally higher in the TANIPAC project due to its wide-scale execution than in other project interventions. Specifically, findings show a high level of participation recorded in decision-making, training, group activities, and benefit sharing, which could be due to the noble introduction of the projects and mobilisation of project implementation. Similarly, a study in Uganda by Christie *et al.* (2015), indicates women groundnut farmers participated highly throughout the intervention's decision-making, training, group activities, and benefit sharing. On the other hand, low level of participation was found in the evaluation and resource contribution. These

findings are consistent with those of a study in Indonesia by Sutiyo and Maharjan (2017), who found that the community was involved more in the project execution but less in planning and evaluation.

Findings further show that the majority of respondents were involved in decision-making, particularly during the implementation activities (initial, ongoing, and operational decision-making). Despite women groundnut farmers' involvement in decision-making within the intervention, their participation is influenced by household responsibilities and the need for permission from their spouses. Studies reveal that aflatoxin management interventions are influenced at the household level, where women's participation in decision-making and adoption of control technologies remains limited (Karki *et al.*, 2023; Komba *et al.*, 2024). These inequalities at the household level (Cervini *et al.*, 2023) have undermined aflatoxin management interventions by rendering the knowledge and skills women received ineffective. This reflects an inadequate focus on women's economic empowerment and the persistent cultural stereotypes and other challenges they face (Bako and Syed, 2018).

Aflatoxin management interventions must address these issues to be truly effective.

Additionally, the study found that the majority of respondents participated in training for pre- and post-harvest management of aflatoxin contamination, indicating that the training programs were accessible and engaging for a majority of the targeted women groundnut farmers. Similarly, various studies (Cervini *et al.*, 2023; Christie *et al.*, 2015; Seetha *et al.*, 2017, 2019; Xu *et al.*, 2017) revealed a substantial number of interviewed women had previously attended aflatoxin management training. This high level of participation reflects respondents' ability to explain issues related to aflatoxin management. On the other hand during implementation of aflatoxin management interventions, a small percentage (9.6%) of respondents contributed resources during implementation, indicating a reliance on external support and a lack of capacity among women groundnut farmers to contribute their own resources (Okiror *et al.* 2021). This could hinder the long-term success of interventions, as sustained engagement and ownership are often linked to participants' ability to contribute resources (Meijer *et al.*, 2021; Okiror *et al.*, 2021; Bashir *et al.*, 2021).

Furthermore, the majority of respondents were involved in group activities, indicating that collective approaches to aflatoxin management are well-received and potentially effective in the community. Group-based interventions could be a key strategy for successful implementation, as they foster collaboration, knowledge sharing, and mutual support among farmers. Similarly, previous studies (Christie *et al.*, 2015; Seetha *et al.*, 2017), indicates the importance of a participatory approach (group activities) to aflatoxin management interventions. Women groundnut farmers are generally actively involved in the group activities but often lack the ability to contribute resources. Similarly a study in Indonesia by Sutiyo and Maharjan (2017), who studied a rural development project, found that the majority of participants are poor farmers who are actively engaged but unable to contribute resources.

With regard to shared benefits, the findings show that majority of respondents benefited from the interventions. Similarly, other studies (Seetha *et al.*, 2019; Xu *et al.*, 2017) found that aflatoxin management interventions benefited women

groundnut farmers. Moreover, besides capacity-building activities (training and demonstration), participants received support from tarpaulins, Aflasafe, hermetic storage technologies, pesticides, and fertilisers. However, it was evident that the received support was deemed unsustainable because majority of the respondents were not sure of continued support as the project was nearing its end.

The perceived role of TANIPAC project interventions was expressed by women groundnut farmers based on the following categories: awareness, food quality availability, health risk, marketing, and production as follows:

On awareness, women groundnut farmers perceived the TANIPAC project interventions significantly contributed to raising awareness about managing aflatoxin in groundnut farmers since the outbreak of aflatoxicosis. The project has created awareness and sensitised women on managing aflatoxin in pre- and post-harvest activities. This is in line with studies by Seetha *et al.* (2019) in Malawi and Christie *et al.* (2015) in Uganda, both of whom found a significant increase in knowledge about the management of aflatoxin before and after training. This is crucial for long-term improvements in public health and agricultural practices. Also, women groundnut farmers perceived the TANIPAC as a contributor to improving the availability and accessibility of quality food by reducing aflatoxin contamination, thus addressing key challenges in the groundnut value chain. In general, women had a positive perception of the role played by TANIPAC in improving groundnut quality and accessibility, which was attributed to the capacity-building training they received on both the pre-and post-harvest groundnut value chain. Similarly, Posey *et al.* (2024) in Ghana reported capacity-building training for farmers to ensure the availability of quality groundnuts for the premium groundnut processor.

Women groundnut farmers perceived TANIPAC interventions would significantly contribute to improved public health by reducing aflatoxicosis incidences. They expressed that this perception is attributed to the project establishment of a modern laboratory for testing aflatoxin contamination levels in the district, safeguarding the health of individuals and alleviating the broader public health burden. They further narrated that this improvement in health outcomes likely enhances

the quality of life for women groundnut farmers and their families. Similarly, Umar, *et al.* (2023) noted that in Pakistan, communities face significant aflatoxin contamination in crops, partly due to the limited availability of testing laboratories. They recommended that setting up laboratory facilities in developing countries for aflatoxin testing could assist in early detection, prevention, and mitigation of aflatoxin-related risks, thereby safeguarding public health.

Additionally, in terms of marketing, women groundnut farmers perceive TANIPAC project interventions as crucial for ensuring their groundnuts meet market standards and enhance their marketing opportunities. Respondents believe that the construction of a warehouse and modern laboratory as part of the project activities will significantly enhance the area's appeal to potential markets. This perception is grounded in the anticipated improvements in operational efficiency and logistical capabilities that these state-of-the-art facilities offer. As reported elsewhere (Ortega-Beltran and Bandyopadhyay, 2021), the warehouse is expected to streamline inventory management and distribution processes, while the modern laboratory will provide cutting-edge research and testing services. These advancements are likely to attract businesses seeking robust infrastructure and technological innovation, thereby boosting economic activity and investment in the study area.

Conclusion:

Generally, enhancing women's engagement in aflatoxin management practices is essential for improving agricultural outcomes and health in the region. The study revealed a high level of women's participation in aflatoxin management interventions, particularly in decision-making, training, group activities, and benefit sharing. However, lower levels of involvement were noted in evaluation and resource contribution. Notably, women's participation in the TANIPAC project was significantly higher than in other initiatives, highlighting the potential for their active involvement to lead to more effective implementation of aflatoxin control measures, improved crop quality, and reduced health risks. Furthermore, women groundnut farmers expressed a positive perception of the TANIPAC project, particularly regarding awareness, food quality, health risks, marketing, and production. Their promising participation in aflatoxin management

interventions indicates potential for even greater involvement in future initiatives.

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