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Effect Of Global Alliance for Improved Nutrition (Gain) Technology Transfer on Nutritional Status of Sweet Potatoes Farmers in Oyo State Nigeria

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Abstract

The integration of new technologies by GAIN (Global Alliance for Improved Nutrition) on sweet potatoes in Nigeria is cardinal to boost the bioavailability of micronutrients, increase crop yields, promote sustainable agriculture practices, ultimately improving the nutritional status and livelihoods of farmers and their families. This study evaluates the effect of the GAIN technology transfer initiatives on the nutritional status of sweet potato farmers in Oyo State, Nigeria. A multi-stage sampling technique was used to select 234 farmers from the catchment areas of Ido, Iseyin, and Oyo West Local Government Areas. Data were collected through structured interviews and analyzed using descriptive statistics and Pearson's Product Moment Correlation. Results indicated that 71.8% of farmers were male, with a mean age of 41.5 years. Most respondents (87.2%) were married, 53.8% had at least seven years of formal education, and sweet potato farm sizes averaged 1.7 hectares. Access to extension services was high (92.3%), with frequent interactions (85.9%). Pearson's correlation revealed significant relationships between household size ($r = 0.727^*$, $p = 0.000$), frequency of contact with extension agents ($r = 0.727^*$, $p = 0.000$), and nutritional status of respondents. The study concluded that while GAIN interventions have improved production and nutrition, challenges such as high input costs and market constraints persist. The study recommended that additional agronomic practices addressing pest infestations on potato tubers should be promoted to improve post-harvest management and storage facilities.

Keywords: *Technology transfer, Orange-Fleshed Sweet Potato, food security, Biofortification, smallholder farmers, GAIN, Oyo State.*

Introduction

Agricultural development plays a fundamental role in ensuring food security, improving livelihoods, and enhancing economic stability, particularly in sub-Saharan Africa. The integration of new technologies by GAIN (Global Alliance for Improved Nutrition) on sweet potatoes in Nigeria is cardinal to boost the bioavailability of micronutrients, increase crop yields, promote sustainable agriculture practices, ultimately improving the nutritional status and livelihoods of farmers and their families. Despite Nigeria's position as one of the largest producers of sweet potatoes in Africa, smallholder farmers in Oyo State face persistent challenges that hinder productivity, market access, and income generation (Food and Agricultural Organization FAO, 2021). These challenges are compounded by limited access to improved sweet potato varieties, inadequate farming technologies, and weak value chain integration, all of which contribute to low yields and economic vulnerability (Ekanem and Nwosu, 2020).

Beyond productivity concerns, malnutrition remains a critical public health issue in Nigeria, with vitamin A deficiency (VAD) affecting approximately 30% of children under the age of five (United Nations Children's Fund UNICEF, 2022). This micronutrient deficiency leads to weakened immunity, impaired vision, and increased child mortality rates. To address this issue, the Global Alliance for Improved Nutrition (GAIN) has facilitated the introduction of the Orange-Fleshed Sweet Potato (OFSP), a biofortified crop with high levels of vitamin A, as part of broader nutrition and agricultural interventions (Bouis *et al.*, 2021). While OFSP presents a viable solution to combat both malnutrition and food insecurity, its adoption among farmers in Oyo State remains limited due to insufficient awareness, inadequate extension services, and lack of financial and infrastructural support (Agbede *et al*., 2023).

Although GAIN's technology transfer initiatives aim to improve agricultural outcomes through the provision of improved OFSP vines, training on best agronomic practices, and strengthening market linkages, there is limited empirical evidence assessing the actual impact of these interventions on farming communities in Oyo State (Global Alliance for Improved Nutrition, GAIN, 2022). The extent to which these efforts have led to increased crop yields, improved household incomes, and enhanced dietary intake of vitamin A-rich foods remains inadequately documented. Moreover, existing studies indicated that market challenges, high production costs, and a lack of policy incentives continue to undermine farmers' ability to benefit fully from biofortified crop adoption (Eze *et al*., 2020 and HarvestPlus, 2022).

Furthermore, structural barriers such as poor transportation networks, post-harvest losses, and consumer preferences for traditional sweet potato varieties have constrained the market demand for OFSP, raising concerns about the long-term sustainability of the initiative (Adepoju *et al*., 2024). Without addressing these constraints, the expected benefits of GAIN's agricultural technology transfer may not be fully realized, thereby limiting its contribution to agricultural development, rural livelihoods, and public health improvements in Nigeria.

This study, therefore, assessed the effect of the Global Alliance for Improved Nutrition (GAIN) technology transfer initiatives on the nutritional status of sweet potato farmers in Oyo State, Nigeria. Specifically, the study described the socioeconomic characteristics of the respondents. identified the technology transferred to the sweet potato farmers ,determine the effect of GAIN technology transfer on nutritional status, identified the reasons for the use of technology transferred to the respondents and investigated the constraints encountered in the use of technologies transferred to the respondents.

Methodology

The study was carried out in Oyo state Nigeria. It is bounded by the states of Kwara on the north, Osun on the east, and Ogun on the south and by the Republic of Benin on the west. Oyo state is traversed by the Yoruba Hills in the north. The state has some tropical rain forest in the south around Ibadan, the state capital, but is covered mostly by a "derived" savanna that is largely the result of clearing and burning the former forest cover to provide land for cultivation. It is inhabited mainly by the Yoruba people. The study focused on sweet potato farmers in Oyo state.The sampling procedure adopted a multi-stage approach. In the first stage, purposive sampling was used to select the three participating local government areas in Oyo State: Ido, Iseyin, and Oyo West. In the second stage, all sweet potato farmers involved in the GAIN project for potato production were purposively selected. A total of 234 sweet potato farmers participated in the study. Data collection was carried out using a well-structured interview schedule designed in alignment with the research objectives. The study measured both dependent and independent variables. The dependent variable, was the effect of GAIN technology transfer on nutritional status of sweet potato farmers. Statements related to effects generated were scored using a four-point rating scale: high effect (3), moderate effect (2), low effect (1), and no effect (0).The independent variables included the respondents' age, years spent in school and so on. Descriptive statistics, including frequency counts, percentages, mean, and weighted mean scores, were used to summarize and interpret the data. To test the research hypothesis and determine the relationship between variables, Pearson Product Moment Correlation was applied as the inferential statistical tool.

Results And Discussion

In Table 1, a majority (71.8%) of the respondents were male, while 28.2% were female, indicating significant male involvement in sweet potato production on GAIN project. This aligns with findings from Aboajah and Ekeledo (2024), who reported that 70.8% of males participated in land preparation activities for sweet potato farming in Anambra State. The predominance of male participation may be attributed to the labor-intensive nature of certain farming activities

Regarding age distribution, nearly 60.0% of respondents were between 31 and 50 years old, with a mean age of 41.5 years, suggesting that the farmers were in their economically active years. This is consistent with Egwuonwu and Ozor (2020), who found an average age of 35.5 years among sweet potato farmers in Imo State, indicating that sweet potato farming is predominantly undertaken by individuals in their productive age bracket. Marital status analysis revealed that 87.2% of the respondents were married, implying a high level of social responsibility among the farmers. This finding is in line with Egwuonwu and Ozor (2020), who reported that 65.0% of sweet potato farmers in Imo State were married, suggesting that marital status may influence farmers' commitment to agricultural activities.

In terms of education, more than half (53.8%) of the respondents had between 7 and 12 years of schooling, while 33.3% had more than 12 years of formal education. This suggests a relatively high literacy level among the farmers, which can facilitate the adoption of improved agricultural technologies. Egwuonwu and Ozor (2020) found that 51.6% of sweet potato farmers in Imo State were literate, highlighting the role of education in enhancing farmers' ability to adopt new technologies.

The average household size among respondents was six members, with 60.3% having between 5 and 8 members. Larger household sizes may provide additional labor for farming activities, potentially influencing the scale of sweet potato cultivation. This observation is supported by Aboajah and Ekeledo (2024), who noted that household size significantly affects gender participation in sweet potato farming activities.

Farm size analysis indicated that 46.2% and 41.0% of respondents cultivated 1 and 2 hectares, respectively, with a mean farm size of 1.7 hectares. This suggests a moderate scale of sweet potato production among the farmers. Egwuonwu and Ozor (2020) reported an average farm size of 1.1 hectares among sweet potato farmers in Imo State, indicating that small to medium-scale farming is common in sweet potato production. Regarding farming experience, 75.6% of respondents had more than two years of experience in sweet potato production, with a mean of 3.2 years. This level of experience may be beneficial in adopting and implementing improved farming practices. Kolawole et al. (2017) emphasized that farming experience is a significant determinant of adopting improved sweet potato technologies in Kwara State.

Table1: Distribution of respondents according to socio-economic characteristics of the respondents n=234

Socioeconomic characteristics	Frequency	Percentage	Mean	
Sex				
Male	168	71.8		
Female	66	28.2		
Age (Years)				
≤ 30	48	20.5		41.6
31-50	135	57.7		
Above 50	51	21.8		
Marital status				
Single	21	9.0		
Married	204	87.2		
Divorce	3	1.3		
Separated	6	2.6		
Religion				
Christianity	144	61.5		
Islam	78	33.3		
Traditional	12	5.1		
Years spent in school				
No formal education	9	3.8		
≤ 6	21	8.9		12.0
7-12	126	53.8		
Above 12	78	33.3		
Household size				
≤4	54	23.1	6	
5-8	141	60.3		
Above 8	39	16.6		
Farm size (hectares)				
1	108	46.2	1.7	
2	96	41.0		
3	30	12.8		
Years of experience in farming				
≤2	57	24.4	3.2	
Above 2	177	75.6		
Contact with GAIN extension agent				
Yes	216	92.3		
No	18	7.7		
Frequency of contact with GAIN extension agent				
Weekly	6	2.6		
Fortnightly	201	85.9		
Monthly	3	1.3		
Yearly	24	10.3		

Source: Field survey, 2024

Access to extension services was reported by 92.3% of respondents, highlighting the importance of extension agents in disseminating agricultural innovations. Egwuonwu and Ozor (2020) found that 61.7% of sweet potato farmers in Imo State had contact with extension officers, underscoring the role of extension services in facilitating technology adoption. The frequency of contact with extension agents varied, with 85.9% of respondents reporting fortnightly interactions. Regular engagement with extension services can enhance farmers' knowledge and adoption of improved practices. Aboajah and Ekeledo (2024) recommended that research and extension should focus on both male and female sweet potato farmers with appropriate techniques to improve participation and enhance income and standard of living.

Effect of GAIN Technologies Transferred to Sweet Potato Farmers

Table 2 presents the effects of GAIN technologies on the nutritional status of sweet potato farmers. The results indicated that the increased consumption of nutrient-rich "Solo Gold" potatoes and the perceived improvement in overall health due to the consumption of nutritious "King J" potatoes were ranked highest, both with a WMS of 2.7. This finding aligns with Low *et al*. (2017), who reported that biofortified sweet potato varieties significantly enhance household nutrition and vitamin A intake, particularly in rural farming communities.

A notable increase in income from "Solo Gold" production, which enabled farmers to purchase a wider variety of nutritious foods, and the production of vitamin- and mineral-rich potatoes were ranked third, each with a WMS of 2.6. This is consistent with the findings of Thiele *et al*. (2020), who highlighted that improved sweet potato varieties contribute to higher yields and better market opportunities, thereby increasing farm incomes.

Training provided by GAIN improved farmers' knowledge of the nutritional value of the "Mother's Delight" variety, with a positive impact on household nutrition. This, along with farmers' willingness to recommend the variety to others, was ranked fifth (WMS = 2.5). Studies by Andrade et al. (2016) suggest that farmer training programs on biofortified crops enhance knowledge adoption, leading to better agronomic practices and higher acceptance of new varieties. Additionally, the production of high-yield, nutrient-dense potatoes was ranked seventh (WMS = 2.2), supporting evidence from Mwanga *et al.* (2017) that improved sweet potato varieties have superior agronomic and nutritional benefits.

Farmers acknowledged that the technology transfer improved their ability to cultivate a diverse range of potatoes and enhanced their understanding of essential micronutrients, both ranking eighth with a WMS of 2.0. However, post-harvest loss reduction ranked the lowest (WMS = 1.8), suggesting that this aspect of production still requires improvement. This finding aligns with Tumwegamire *et al.* (2018), who noted that post-harvest losses remain a major challenge for sweet potato farmers despite the adoption of improved varieties.

Reasons for the usage of GAIN Technologies on sweet potatoes

Table 3 presents the factors influencing the adoption of GAIN technology among sweet potato farmers. The findings indicate that all respondents (100%) identified high tuber yield, early maturity, tuber color, high vine yield, ease of access to the introduced technology, and access to extension agents as key determinants of adoption. These results suggest that the perceived agronomic and economic benefits of GAIN technology play a crucial role in its uptake. This aligns with Rogers' (2003) Diffusion of Innovation Theory, which posits that the relative advantage of a technology significantly influences its adoption.

Moreover, 84.6% of respondents highlighted the provision of market access as a critical factor, reinforcing the argument by Omonona *et al.* (2019) that reliable market opportunities enhance farmers' willingness to adopt improved agricultural technologies. Additionally, 66.7% and 60.3% of respondents identified good culinary quality and pest and disease resistance, respectively, as motivations for adoption. This is consistent with Abdoulaye *et al.* (2014), who emphasized that consumer preferences and resistance to biotic stress are key determinants of technology uptake in smallholder farming systems. Furthermore, 41.0% of farmers indicated that drought resistance was an important factor, while 26.9% considered high dry matter content significant. These findings are in agreement with Simtowe et al. (2021), who established that the environmental adaptability and nutritional attributes of improved crop varieties influence farmers' usage decisions.

GAIN Agricultural Technologies Transferred to Sweet Potato Farmers

Table 4 presents the GAIN agricultural technologies transferred to sweet potato farmers in the study area. The findings indicated that all respondents (100%) reported receiving improved sweet potato varieties, including Mother Delights (yellow), Solo Gold (pink), and King J (pink), alongside recommended agronomic practices such as correct spacing (30 cm × 30 cm) and the use of 2–3 node cuttings. These results suggest that GAIN extension services prioritize both varietal improvement and best agronomic practices, aligning with findings by Low et al. (2017), which highlight the role of improved crop varieties in enhancing smallholder productivity.

Furthermore, 84.6% and 73.1% of respondents indicated receiving training on the application of liquid fertilizer and the use of vines from vine multipliers, respectively, reflecting the importance of soil fertility management and quality planting materials in sweet potato production. This aligns with Abidin et al. (2015), who emphasized that the availability of certified planting materials significantly enhances yield and disease resistance.

In addition, 39.7% of farmers reported adopting the 75 cm × 75 cm ridge planting method, and 37.2% utilized insecticides, fungicides, and tractors for cultivation. The relatively lower adoption rates for mechanized farming and chemical pest control may indicate financial or infrastructural constraints, consistent with studies by Gurmu et al. (2020), which found that resource limitations often hinder smallholder farmers from fully integrating modern agricultural technologies.

Table 2: Distribution of respondents according to effect of GAIN technologies transferred to the sweet potato farmers

*Effect of the GAIN technologies transferred on sweet potato farmers nutritional status	WMS	Rank
There is increase in consumption of nutrient-rich "solo gold" potatoes since adopting the GAIN technology	2.7	1st
GAIN technology transfer has helped me to produce a more diverse range of potatoes, improving my family's access to essential micronutrients	2.0	8th
My family noticed an improvement in my overall health and wellbeing, which attributed to the increased consumption of nutritious "king J" potatoes	2.7	1st
The training received from GAIN enabled me to make informed decisions about the nutritional value of "mothers delight" sweet potato variety	2.5	5th
Through GAIN technologies, there is considerable production of potatoes with higher yields and better nutritional content, which has improved my family's nutrition status	2.2	7th
The technology transfer project has helped to reduce post-harvest losses, resulting in more potatoes available for consumption and improved nutrition for the family	1.8	10th
There is significant increase in income since adopting the production of "Solo gold", which has enabled me to purchase a more diverse range of nutritious foods for the family	2.6	3rd
The technology transfer project has empowered me to take control of my nutrition and make informed decisions about the food I grow and consume	2.0	8th
There is production of the new potatoes that are rich in essential vitamins and minerals, improving family's overall nutrition status	2.6	3rd
Production of "mothers delight" has had a positive impact on family's nutrition status, and I would recommend it to other farmers	2.5	5th

Source: Field survey, 2024**WMS:** Weighted Mean Score

Table 3: Distribution of respondents according to reasons for the use of GAIN agricultural technology transferred

* Reasons for the use of GAIN technology transferred	Frequency	Percentage
High tuber yield of varieties	234	100.0
Good culinary test	156	66.7
Early maturity of varieties given	234	100.0
High dry matter of tuber	63	26.9
Colour of tuber	234	100.0
Drought resistant varieties	96	41.0
Disease and pest tolerant	141	60.3
High vine yield	234	100.0
Ease of access to technology introduced	234	100.0
Provision of market for sweet potato cultivated by GAIN	198	84.6
Access to extension agents from GAIN	234	100.0

Source: Field survey, 2024
*: Multiple responses

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Table 4 Distribution of respondents according to technologies transferred to respondents in the study area

*Technologies Transferred	Frequency	Percentage
Mother delights variety (Yellow in colour)	234	100.0
Solo gold variety (Pink in colour)	234	100.0
King J variety (Pink in colour)	234	100.0
Correct spacing (30-30cm apart)	234	100.0
Application of liquid fertilizer	198	84.6
2-3 node cuttings inserted into the soil	234	100.0
Use of vines from vine multiplier	171	73.1
Use of insecticide/fungicide	87	37.2
Use of tractors for cultivation	87	37.2
75cm x 75cm on ridges	93	39.7

Source: Field survey, 2024
***:** Multiple responses

Severity of constraints encountered in the use of GAIN agricultural technology transferred to sweet potato farmers

Table 5 presents the severity of constraints affecting the adoption of GAIN agricultural technologies among sweet potato farmers in the study area. The results indicate that poor storage facilities and millipede and centipede infestations were the most significant challenges, each with a weighted mean score (WMS) of 3.0. This suggests that post-harvest loss management remains a critical issue despite the introduction of GAIN technologies. Tuber rot disease ranked third, with a WMS of 2.7, while the high cost of recommended liquid fertilizer and excessive water content in potato tubers followed, both with a WMS of 2.6. These findings highlight financial constraints as a major impediment to the full implementation of GAIN technologies. Furthermore, inadequate market access (WMS = 2.3) and low income from sweet potato cultivation (WMS = 2.1) were identified as additional constraints. Poor extension education on sweet potato production ranked the lowest, with a WMS of 1.1, indicating a potential gap in knowledge dissemination.

Table 5. Distribution of respondents according to severity of constraints encountered in the use of GAIN agricultural technology transferred in the study area

Severity of constraints encountered in the use of GAIN technology transferred	WMS	Rank
High cost of recommended liquid fertilizer	2.6	4th
Tuber rot disease	2.7	3rd
Inadequate access to market	2.3	6th
Millipede and Centipede infestation (pest)	3.0	1st
Poor income from sweet potato cultivation	2.1	7th
Poor extension education on sweet potato production	1.1	8th
High water content in the potato tuber	2.6	4th
Poor storage facilities	3.0	1st

Source: Field survey, 2024
F: Frequency
%: Percentage
WMS: Weighted Mean Score

The result in table 5 revealed that that household size (r = -0.727*, p = 0.000) and frequency of contact with extension agents (r = 0.727*, p = 0.000) were significantly related to the effect of GAIN technologies. These findings suggested that larger household sizes attracted lower nutritional status of farmers. Additionally, frequent interactions with GAIN extension agents enhance farmers' ability to utilize the technologies effectively, leading to improved production and nutritional status.

Table 5: PPMC showing significant relationship between the selected socioeconomic characteristics of respondents and effect of GAIN technology transferred on sweet potato farmer's nutritional status

Socioeconomic characteristics	Correlation Coefficient	P-value	Remark
Age	0.039	0.735	Not Significant
Years spent in school	0.094	0.413	Not Significant
Household size	0.764*	0.000	Significant
Frequency of contact with GAIN extension agents	0.348*	0.000	Significant
Years of farming experience	0.004	0.974	Not Significant

Source: Computed data, (2024)

Conclusion And Recommendations

This study concluded that GAIN technologies transferred on sweet potatoes have significantly benefited sweet potato farmers by enhancing their nutritional status. The usage of GAIN technologies was influenced by reasons such as high tuber yield, early maturity, and ease of access to improved varieties. Key technologies received and utilized included the Mother Delights, Solo Gold, and King J sweet potato varieties, along with recommended agronomic practices. However, farmers faced challenges such as poor storage facilities and pest infestations. The study recommended that additional agronomic practices addressing pest infestations on potato tubers should be promoted to improve post-harvest management and storage facilities.

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