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Gender Roles in Groundnut Value Chain (GVC) among Households under USAID Groundnut Up-Scaling Project (GUP) in Sokoto State, Nigeria

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Abstract

This study investigates gender roles in the Groundnut Up-scaling Project (GUP) intervention in Sokoto State, Nigeria, focusing on three rural communities out of five participating local government areas (PLGAs). The main objective is to analyze gender participation in the Groundnut Value Chain (GVC) among households under the USAID-GUP. A multi-stage sampling procedure selected 100 (56 male and 44 female) GVC participants, and 100 (84 male and 16 female) non-participants using the snowball sampling method in the non-participating LGAs (NPLGAs). The objectives were achieved with a descriptive and inferential Chi-square. The findings show that female participants dominate processing activities (72.7%) in the PLGAs, while males dominate production (92.9%). In the NPLGAs, 90.5% of males and 75.0% of females are involved in production. Informal sources are the main credit providers for both PLGAs and NPLGAs. Male participants in both PLGAs and NPLGAs cultivate more of an improved groundnut variety (Samnut – 22), with 64.3% and 70.5% of males and females in PLGAs and 59.5% and 56.3% of males and females in NPLGAs sourcing their land through inheritance. The average mean household income is higher for males (₦892,410.71 and ₦1,008,907.14) compared to females (₦531,386.36 and ₦495,000.00) in both PLGAs and NPLGAs, respectively. Significant differences between male and female categorical variables are observed at different nodes of the GVC in both PLGAs and NPLGAs, including input supply, groundnut production, harvesting, post-harvest handling, marketing, processing, and household chores. In conclusion, the study finds that the USAID-GUP activities, which aimed to promote gender equality, have not fully bridged gender inequalities in all GVC nodes. Gender equity amongst GUP participants has not been fully achieved. The study recommends addressing social and cultural rigidities to enhance gender equity participation in GVC nodes and effectively implement programs.

Keywords: Gender role; Groundnut production; Processing and marketing; Groundnut value chain

1 Introduction

Nigeria stands out among African nations due to its functional commodity exchange, which is a key factor in its involvement in the Groundnut Up-Scaling Project (GUP) by the United States Agency for International Development (USAID). The country has adopted a value chain approach to address various components of the agricultural value chain, encompassing crops, livestock (including poultry), and fisheries. The direction is set by the federal government through its ministries, departments, and agencies (MDAs), while execution is carried out by the organized private sector and local governments at the state level. The primary objective of the USAID-GUP intervention in Nigeria is to significantly enhance groundnut productivity for smallholder farmers, thereby improving their incomes, nutrition, and overall health. This initiative aligns with USAID's Feed the Future twin goals of reducing poverty and malnutrition in rural areas.

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In several rural interventions, gender mainstreaming has been employed, which involves reserving a certain percentage of participation for a specific gender. Additionally, apart from the goal of improving beneficiaries' livelihoods and rural productivity through agricultural interventions, the beneficiaries' decision to participate is influenced by their perception of the program's benefits. The value chain concept refers to a strategic network comprising independent individuals or organizations that collaborate as actors to exploit and generate economic returns by addressing resource scarcity, sharing associated risks and benefits, and investing time, energy, and resources to ensure the success of the relationship [1]. It serves as a fundamental framework for understanding how a product moves from the producer to the customer. A value chain is considered to exist when all actors within the chain operate in a manner that maximizes the creation of value along the entire chain [2]. Many of these value chains focus on food crop commodities, such as organic groundnuts, fresh fruits and vegetables, tomatoes, onions, maize, cotton, and sunflower [3]. Most value chain interventions aim to facilitate the connection of smallholder farmers to the market, thereby increasing profits and reducing poverty [4].

Consequently, the Federal Government of Nigeria (FGN), through the Federal Ministry of Agriculture and Rural Development (FMARD), embraced the value chain approach as the operational strategy for implementing the agricultural transformation agenda (ATA) [5]. This approach is employed to address the various components of the agricultural value chain, including crops, livestock (including poultry and fisheries). The FMARD launched the ATA under the auspices of the Federal Government (FG), with a vision to achieve a hunger-free Nigeria by developing an agricultural sector that drives income growth, accelerates the achievement of food and nutritional security, generates employment, and positions Nigeria as a major player in global food markets, thereby creating wealth for millions of farmers. The Growth Enhancement Support (GES) investment, targeting 20 million farmers, served as a platform to engage key stakeholders in Nigerian agriculture and shift the focus toward building a self-sustaining agribusiness-focused economy [6].

Gender is a concept widely used in the social sciences to delineate the roles and behaviors assigned to men and women within a given society. These roles are primarily shaped by cultural traditions and beliefs. Gender can be defined as the set of "rules, norms, customs, and practices by which biological differences between males and females are translated into socially constructed differences between men and women, boys and girls" [7]. Different societies uphold varying expectations and responsibilities for men and women, and these roles can evolve and shift over time [8]. Gender roles have implications for various aspects of society, including agricultural production. In fact, their influence often surpasses factors such as social status or ethnicity. Over time, gender roles become deeply ingrained and appear as natural as biologically determined distinctions. Consequently, discussions surrounding gender often center on the pursuit of gender equality, as societies have consciously or unconsciously placed women in subordinate positions compared to men, particularly in terms of ownership and control over productive resources [7].

The analysis of gender roles within the Groundnut Value Chain (GVC) among households in Sokoto State holds significant importance due to the prominence of groundnut cultivation, processing, and marketing in the region. Both men and women actively engage in these activities, making it a crucial aspect to understand and assess. By examining the involvement of men and women in the GVC in Sokoto State, it becomes possible to analyze the challenges they face and identify opportunities for improvement. Groundnut is a widely cultivated root crop in the semi-arid tropics and has played a significant role in Nigeria's economic development. It serves as both a food and cash crop, with substantial market value for millions of small-scale farmers. Furthermore, it generates employment opportunities in the farming, transportation, marketing, and processing sectors [9]. The present study aims to evaluate the USAID-GUP intervention to determine whether it has effectively addressed gender inequalities in the roles played by men and women at different stages of the GVC, utilizing the Non-Participating Local Government Areas (NPLGAs) as a control group.

Although several studies have explored gender roles within various aspects and nodes of the value chain, there remains a research gap in understanding the specific roles played by men and women in different nodes of the chain. While some analyses have focused on improvements within specific value chains, few delve into a detailed examination of gender participation in the GVC. This research aims to contribute to the existing literature by employing a gendered approach to value chain development analysis, specifically analyzing gender participation in the GVC of the USAID-GUP among households categorized as Participating Local Government Areas (PLGAs) and NPLGAs in Sokoto State.

Accordingly, the research questions are: What are the socio-economic characteristics of the respondents in GVC of both PLGAs and NPLGAs households in the study area? What are the different roles men and women play at the different nodes of the GVC among PLGAs and NPLGAs households in the study area?

The objectives of the study are to; describe the socio-economic characteristics of the respondents in GVC of both PLGAs and NPLGAs households; identify the different roles men and women play at different nodes of the GVC among PLGAs and NPLGAs households.

2 Material and methods

The study took place in Sokoto State, located in the North-Western part of Nigeria, situated between longitude 4°25' to 6°46' E and latitude 11°35' to 13°55' N. The state shares a border with Niger Republic to the north, Zamfara State to the east, and Kebbi State to the southeast. It covers a total land area of 25,973 km^2 and comprises twenty-three (23) local government areas [10]. The primary ethnic groups in Sokoto State are the Hausa and Fulani. The state has an estimated population of 6,391,000 with an annual growth rate of 3.5% [11]. Agriculture is a significant occupation for over 80% of the population, with people engaged in crop cultivation and animal husbandry activities [12]. The Sokoto Rima River system, with its fertile alluvial soil, serves as the region's vital resource for crop production [12].

For the study, a multi-stage sampling technique was employed to select households involved in the Groundnut Value Chain (GVC). In the first stage, three local government areas (LGAs) were randomly chosen from the five participating LGAs where the USAID-GUP project is being implemented in Sokoto State. The selected PLGAs were Shagari, Tambuwal, and Dange-Shuni. In the second stage, five associations participating in the project were randomly selected from each of the chosen PLGAs. A comprehensive list of these groups was obtained from the Sokoto Agricultural Development Project (SADP) under the extension department's monitoring and evaluation unit. This list was used to establish the sample frame and determine the sample size for the study. In the final stage, a random sample of 35% of the registered members from the selected associations was taken, resulting in a total sample size of 100 members out of the 294 members in the sample frame. These selected association members were considered the study's unit of analysis.

The second phase of the study involved the purposive selection of three non-participating LGAs (NPLGAs) out of the seven in Sokoto State. The selected NPLGAs were Yabo, Wurno, and Kebbe. Additionally, five non-participating communities were purposively chosen from each selected NPLGA. Finally, the snowball sampling technique (SST) was used to select 100 non-participating households since there was no population list available for the non-participants. These households served as the unit of analysis for the study. Descriptive and inferential statistics, such as frequency counts, percentages, means, and chi-square tests, were employed to analyze the data, fulfilling the study's objectives and hypotheses. To achieve the objectives of the study Chi-square statistic model was used. The formula for the chi-square statistics is given as:

$$x_c^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(\mathrm{Oij} - \mathrm{Eij})^2}{\mathrm{Eij}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:
x_c^2 is the chi-square calculated
$\sum\sum$ is the summation corresponding to the ith row and jth column
O_{ij} is the observed value corresponding to the ith row and jth column
E_{ij} is the expected frequency corresponding to the ith row and jth column
df = (r-1) (c-1) where "r" is number of rows and "c" number of columns.

After generating the chi-square value which is x_c^2

P-value will then be used in interpreting the hypothesis already stated (the null and the alternate hypothesis). Accepting the null hypothesis if P-value is greater than the alpha level but if otherwise (less than or equal to alpha) you reject the null hypothesis that there is an association which is P-value ≤ α: and it concluded that there is a statistically significant association between the variables. The P-value is the probability of the chi-square test and it measures the significance of the chi-square test.

The independent variables used include;

X_1Age (years)
X_2Marital status (single =1, married=2, widow =3, divorced =4)
X_3Major occupation (farming = 1, processing = 2, civil servant = 3)
X_4Household size (summing of total number of families)

X_5Level of education (qur'anic=0, primary=1, secondary =2, tertiary=3, none=4)
X_6 Household farm size (ha)
X_7Household income (₦)
X_8Method of land acquisition (inherited=1, purchase=2, rent=3 communal=4 gift=5fam.land=6)
X_9Improved groundnut variety cultivated (samnut-21=1, samnut-22=2, samnut-23=3, samnut-24=4, samnut-25=5 and samnut-26= 6)
X_{10}Source of credit (informal sources=1, private commercial banks=2, agricultural banks=3, government loan scheme= 4, non-governmental organizations= 5)
X_{11}Number of extension contact (no)

3 Results and discussion

Table 1 Socio-economic characteristics of respondents in GVC of PLGAs and NPLGAs households

	PLGAs					**NPLGAs**				
	Male		**Female**		**Total Freq.**	**Male**		**Female**		**Total Freq.**
	Freq.	**%**	**Freq.**	**%**		**Freq**	**%**	**Freq.**	**%**	
Age < 41	3	5.4	12	27.3	15	18	21.4	4	25	22
41 – 60	44	78.6	30	68.2	74	52	61.9	12	75	64
61 and above	9	16.1	2	4.5	11	14	16.7	-	-	14
Mean	53		47			50		48		
Marital status										
Single	-	-	1	2.3	1	1	1.2	1	6.3	2
Married	56	100	30	68.2	86	83	98.8	6	37.5	89
Widowed	-	-	11	25.0	11	-	-	6	37.5	6
Divorced	-	-	2	4.5	2	-	-	3	18.8	3
Major occupation										
Farming	52	92.9	11	25.0	63	76	90.5	12	75	88
Processing	4	7.1	32	72.7	36	6	7.1	4	25.0	10
Civil servant	-	-	1	2.3	1	2	2.4	-	-	2
Household size										
1 – 5	19	33.9	17	38.6	36	27	32.1	5	31.3	32
6 – 10	29	51.8	26	59.1	55	33	39.3	10	62.5	43
11 – 15	7	12.5	1	2.3	8	19	22.6	1	6.3	20
16 and above	1	1.8	-	-	1	5	6	-	-	5
Mean	7.39		6.05			8.49		6.44		
Level of education										
Quranic	15	26.8	28	63.6	43	31	36.9	13	81.3	44
Primary	12	21.4	13	29.5	25	20	23.8	2	12.5	22
Secondary	21	37.5	3	6.8	24	17	20.2	-	-	17
Tertiary	8	14.3	-	-	8	16	19	1	6.3	17
Household farm size										
≤ 2	8	14.3	18	40.9	26	10	11.9	13	81.3	23
3 – 4	22	39.3	23	52.3	45	33	39.3	3	18.8	36

5 and above	26	46.4	3	6.8	29	41	48.8	-	-	41
Mean	4.73		3.55			5.07		1.91		
Household income										
≤ 500000	27	48.2	19	43.2	46	31	36.9	10	62.5	41
500001 – 1000000	18	32.1	24	54.5	42	29	34.5	5	31.3	34
1000001 – 1500000	2	3.6	1	2.3	3	7	8.3	-	-	7
1500001 and above	9	16.1	-	-	9	17	20.2	1	6.3	18
Mean	892410.71		531386.36			1008907.14		495000.00		
Method of land acquisition										
Inherited	36	64.3	31	70.5	67	50	59.5	9	56.3	59
Purchased	12	21.4	9	20.5	21	26	31	1	6.3	27
Rented	4	7.1	1	2.3	5	4	4.8	-	-	4
Communal	-	-	-	-	-	-	-	1	6.3	1
Gift	-	-	-	-		-	-	-	-	-
Family land	4	7.1	3	6.8	7	4	4.8	5	31.3	9
Improved G/nut variety										
Samnut – 21	10	17.9	14	31.8	24	20	23.8	3	18.8	23
Samnut – 22	12	21.4	6	13.6	18	33	39.3	2	12.5	35
Samnut – 23	9	16.1	8	18.2	17	14	16.7	5	31.3	19
Samnut – 24	8	14.3	9	20.5	17	8	9.5	1	6.3	9
Samnut – 25	11	19.6	6	13.6	17	2	2.4	2	12.5	4
Samnut – 26	6	10.7	1	2.3	7	7	8.3	3	18.8	10
Source of credit										
Informal sources	17	30.4	13	29.5	30	43	51.2	7	43.8	50
Private Commercial Banks	6	10.7	6	13.6	12	8	9.5	2	12.5	10
Agricultural banks	12	21.4	7	15.9	19	13	15.5	4	25.0	17
Government Loan scheme	9	16.1	14	31.8	23	10	11.9	2	12.5	12
Non-Governmental organizations	12	21.4	4	9.1	16	10	11.9	1	6.3	11
Number of extensions contact										
0	0	0.0	1	2.3	1	38	0.0	7	31.3	45
1- 5	25	44.6	18	40.9	43	23	53.6	5	43.8	28
6 – 10	23	41.1	20	45.5	43	12	33.3	3	18.8	15
11 and above	8	14.3	5	11.4	13	11	13.1	1	6.3	12
Mean	6.20		6.11			3.40		2.44		

Source: Field Survey Data, 2021.

3.1 Socio-economic characteristics of respondents in GVC of both PLGAs and NPLGAs households

3.1.1 Age

Age plays a significant role in shaping individuals' thoughts, behaviors, and needs [9]. The data presented in the table indicates that both male and female participants from PLGAs and NPLGAs fall within the age range of 41-60 years, accounting for 78.6% (male) and 68.2% (female) for PLGAs and 61.9% (male) and 75.0% (female) for NPLGAs. The average age of male participants in PLGAs was 53 years, while for females it was 47 years. In NPLGAs, the average age was 50 years for males and 48 years for females. These findings suggest that the actors involved in the GVC are predominantly in their middle age, indicating that they possess the strength necessary to carry out the various tasks involved in production and processing [9].

3.1.2 Marital status

Marital status refers to an individual's current status, distinguishing between married and unmarried individuals [9]. The table reveals that the majority of participants in PLGAs, both male (100%) and female (68.2%), were married. In NPLGAs, 98.8% of males and 37.5% of females were married. These findings demonstrate that the program has succeeded in increasing the involvement of married females in the GVC, aligning with the success reported by Yelwa regarding the project beneficiaries and their marital status [13].

3.1.3 Major occupation

This refers to the primary business or activity in which an individual engages for their livelihood. According to Table 1, 92.9% of male participants and 25.0% of female participants in PLGAs were engaged in farming activities. In NPLGAs, 90.5% of males and 75.0% of females were also engaged in farming. As for processing, 7.1% of males and 72.7% of females in PLGAs were involved in processing activities, while in NPLGAs, it was 7.1% of males and 25.0% of females. These results indicate that female participants in PLGAs are more involved in processing activities, whereas their male counterparts are predominantly engaged in farming. In contrast, in NPLGAs, both men and women are highly involved in farming. The program seems to have encouraged women to shift their focus from farming to processing within the GVC. The higher number of female participants in processing activities can be attributed to program support, which enhances access to small-scale processing technologies [6]. These findings align with Umeukeje's report, which states that over 92% of women involved in groundnut processing can process up to 20 plates of groundnut daily, yielding approximately 50kg of groundnut [9]. Umeukeje attributes this increases in processing capacity to the adoption of improved groundnut processing technologies.

3.1.4 Household size

Household size is a crucial socio-economic factor that impacts agricultural production and processing as it determines the number of available individuals within a household to engage in farming activities [9]. According to the table, the majority of male participants in PLGAs (51.8%) and their female counterparts (59.1%) had household sizes ranging from 6 to 10 persons. Similarly, in NPLGAs, most male participants (39.3%) and female participants (62.5%) had household sizes within the same range of 6 to 10 persons. The average household size for male participants in PLGAs was 7 persons, while for females it was 6 persons. In NPLGAs, the average household size for males was 8 persons, and for females, it was 6 persons. These findings indicate that with smaller household sizes, participants may need to hire additional labor to supplement family labor in production, processing, and marketing. This underscores the significance of larger household sizes in agricultural production within rural communities in Nigeria. Studies conducted by Effiong [14] and Idiong [15] have reported that larger household sizes contribute to the availability of farm labor, while Nwaru [16] has noted that larger household sizes are advantageous for farm production, as rural households rely more on their own members for labor than on hired workers.

3.1.5 Level of education

This refers to the number of years individuals have spent in formal and non-formal education. The table reveals that the majority of females in both PLGAs (63.6%) and NPLGAs (81.3%) received Quranic education, while males in PLGAs (37.5%) and NPLGAs (20.2%) had more exposure to Western education. These results demonstrate that females in both PLGAs and NPLGAs are more educated in Quranic education, while males are more likely to have received Western education. The program appears to have discouraged women from enrolling in Western education, as they are more involved in Quranic education. These findings suggest that females in both PLGAs and NPLGAs have higher levels of non-formal education compared to their male counterparts, whereas the male participants in PLGAs are more likely to have Western education. This contradicts Isa et al.'s findings, which reported that the majority of men had primary education, indicating that the female participants were more educated [17]. The findings regarding the education of females in PLGAs and NPLAs highlight the fact that women have higher qualifications in

3.1.6 Quranic education

This implies that the literacy level among the participants is generally low, which can hinder full participation. Previous studies have shown that the lack of formal education negatively affects women's knowledge in cooperative societies [9]. The World Bank (1995) has also observed that access to basic education can reduce social exclusion by equipping participants with skills that facilitate their engagement in the economy and society. Onugu et al., have noted that better education enhances participants' ability to adopt program interventions as it helps them understand the principles and concepts conveyed during program implementation [18[. These findings align with Nwaru's research [16], which emphasizes the importance of education and training in enhancing farmers' capacity to understand and adopt technological innovations in economic activities, ultimately leading to increased and sustainable agricultural production.

3.1.7 Household farm size

Household farm size refers to the size of the plots or total cultivated area within a household. According to the table, 46.4% of male participants in PLGAs and 48.8% of male participants in NPLGAs cultivate 5 hectares and above of farmland. On the other hand, 40.9% of female participants in PLGAs and 81.3% of female participants in NPLGAs cultivate less than 2 hectares of land. The average farm size for male participants in PLGAs was 4.73 hectares, while for females it was 3.55 hectares. In NPLGAs, the average farm size was 5.07 hectares for males and 1.91 hectares for females. These findings indicate that men generally have larger farm sizes than women in both PLGAs and NPLGAs. The larger farm sizes cultivated by men suggest the possibility of groundnut commercialization. These results differ from the findings of Ahmed et al., who noted that the average production area of 1.94 hectares indicated small-scale production in their study on the adoption of improved groundnut varieties [19]. Sule and Yusuf also observed that farm size is a determinant of agricultural productivity, as increasing farm size allows for mechanization [20].

3.1.8 Household income

Household income refers to the income derived from GVC activities, as well as other on-farm and off-farm livelihood activities. The table indicates that both male participants in PLGAs and NPLGAs had household incomes below 500,000 Naira per annum, accounting for 48.2% and 36.9% respectively. For female participants in PLGAs and NPLGAs, the majority had household incomes ranging from 500,001 to 1,000,000 Naira per annum, with percentages of 54.5% and 31.3% respectively. The average income for male participants in PLGAs was 892,410.71 Naira, while for females it was 531,386.36 Naira. In NPLGAs, the average income for males was 1,008,907.14 Naira, and for females, it was 495,000.00 Naira. These findings indicate that males in both PLGAs and NPLGAs have higher income levels compared to females. This aligns with the work of Olakojo [21], which found that men had higher farm outputs and higher sales from harvests.

3.1.9 Method of land acquisition

Method of land acquisition refers to how respondents obtained their land, including inheritance, purchase, rent, communal land, gift, and family land. According to the table, both male and female participants in PLGAs and NPLGAs primarily acquired land through inheritance. In PLGAs, 64.3% of males and 70.5% of females acquired land through inheritance, while in NPLGAs, 59.5% of males and 56.3% of females acquired land through inheritance. This finding suggests that respondents in the study area rely heavily on family land for their groundnut cultivation. This aligns with the findings of Isa et al., who reported that land acquisition through inheritance was the predominant ownership structure among male farmers [17], while female farmers tended to purchase land for agricultural production. However, Onya et al. found that land acquisition through inheritance was the most common ownership structure among both male and female farmers [22].

3.1.10 Improved groundnut variety cultivated

Improved groundnut variety cultivated refers to the specific improved groundnut varieties grown, such as Samnut-21, Samnut-22, Samnut-23, Samnut-24, Samnut-25, and Samnut-26. The table indicates that there was no difference in the distribution and adoption of the varieties between male and female participants in both PLGAs and NPLGAs. However, there was a variation in the adoption of Samnut-24 and Samnut-25, with more farmers in PLGAs involved in their cultivation. This can be attributed to the fact that these varieties are recently released early maturing varieties resistant to various biotic stresses, contributing to reduced annual yield losses caused by Groundnut Rosette Disease (GRD) and making a noticeable difference in the lives of groundnut farmers in Nigeria. Scaling up the dissemination of these improved varieties would enable the program to reach more farmers and have significant impacts in a shorter timeframe. Scholars like Ajeigbe et al. reported that only about 13% of the area under groundnut cultivation in Nigeria is planted with improved varieties [23]. These findings are consistent with the work of Ahmed et al. [19], who observed a high level of awareness and increased adoption of improved groundnut varieties due to breeding and promotion

efforts by organizations like IAR and ICRISAT, supported by projects like the Tropical Legume Project and the USAID Groundnut Upscaling Project.

3.1.11 Source of credit

Finance is a crucial socio-economic resource that enables participants to have control over other productive assets [24]. The main sources of credit for respondents in both PLGAs and NPLGAs, regardless of gender, were informal sources and government loan schemes. In PLGAs, 30.4% of males and 29.5% of females mentioned informal sources as their credit source for their farming activities. In NPLGAs, 51.2% of males and 43.8% of females relied on informal sources for credit. This indicates that respondents in the study obtained credit predominantly from friends and relatives, which is a common practice in many developing countries [25]. Additionally, the absence of rural credit schemes for women in PLGAs has compelled them to borrow from government loan schemes [5]. This implies that the respondents' access to credit is encouraging and can be beneficial for their participation in the GVC. However, uncertainties in income may affect their confidence in repaying the credit, potentially putting them at risk of civil imprisonment [26-27].

3.1.12 Number of extension contacts

The number of extension contacts refers to the frequency of interactions between actors and agricultural extension workers within a year. The table indicates that male and female participants in PLGAs had an average of 6.20 and 6.11 contacts per farming session, respectively, while in NPLGAs, males had an average of 3.40 contacts, and females had an average of 2.44 contacts. This shows that participants in PLGAs had more frequent extension contacts compared to those in NPLGAs. Furthermore, in PLGAs, there was no significant difference in contact frequency between males and females, whereas in NPLGAs, the difference between males and females was more pronounced. These findings suggest that the program has not only increased the overall number of extension contacts but also improved gender equality in contact frequency. These findings differ from the findings of Olabanji [28], who recommended the encouragement and recruitment of more females for extension work. Similarly, Issa et al. found that farmers generally have poor participation in agricultural extension intervention programs [17].

3.2 Gender roles at different nodes of the GVC among PLGAs and NPLGAs households

The study conducted by Dubey *et al*. emphasized the significance of the value chain, which represents a strategic network of businesses encompassing all the activities within an organization to deliver valuable products or services to consumers [29]. To investigate the gender roles associated with different tasks in the various nodes of the Groundnut Value Chain (GVC), data was collected from households while adopting the Gender Action Learning System (GALS) methodology. GALS tool applied to the present study is the family tree, which aims to achieve gender transformative results by empowering both men and women to live a better and happier life. Its purpose is to address gender and social injustice in economic development through an inclusive and participatory process. Furthermore, Enfield defined the roles within the value chain as the labour contributions of each gender based on their biological factors [30].

Tables 2 and 3 present the outcomes of the gender roles played at different nodes of the GVC, ranging from PLGAs (Participating Local Government Areas) to NPLGAs (Non-Participating Local Government Areas), with multiple responses employed. The information from the field reads thus:

Input supply: The activities within this category include seed supply, agrochemical supply, fertilizer supply, farm machinery supply, and credit supply. According to the data presented in Table 2, men made the decision to undertake all activities related to input supply in both PLGAs and NPLGAs. In PLGAs, 96.4% were engaged in seed supply, agrochemical supply, and fertilizer supply, while 83.9% were involved in farm machinery supply, and 80.4% in credit supply. In NPLGAs, the percentages were 72.6% for seed supply, 70.2% for agrochemical supply, and 69.0% for fertilizer supply. These findings support the report by Mohammed and Abdulquadri, which suggests that although both men and women participate in agriculture [31], the tasks may be gender-specific, yet complementary and reciprocal. The report further mentions that men are often assumed to be the primary actors in agricultural input supply, making them the main participants and recipients of program-related support. Similarly, Olonade *et al.* emphasize the importance of both males and females recognizing their roles as essential without superiority when fulfilling their duties for the progress of humanity [32].

Table 2 Result on gender role comparison at different nodes of the GVC among PLGAs and NPLGAs households

		PLGAs						NPLGAs					
		Male			Female			Male			Female		
Value chain	**Item**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**
Input supply	Seed supply	96.4	1.8	0.0	52.3	18.2	15.9	72.6	0.0	7.1	31.3	37.5	12.5
	Agrochemical supply	96.4	1.8	0.0	54.5	11.4	9.1	70.2	0.0	1.2	50.0	18.8	6.3
	Fertilizer supply	96.4	0.0	0.0	56.8	13.6	15.9	69.0	0.0	0.0	43.8	25.0	6.3
	Farm machinery supply	83.9	1.8	0.0	34.1	6.8	4.5	34.5	0.0	1.2	12.5	12.5	0.0
	Credit supply	80.4	1.8	3.6	11.4	22.7	6.8	36.9	0.0	0.0	6.3	25.0	0.0
	Chi-square value	1.20			2.54**			0.82			2.68**		
Groundnut production													
	Decision to grow a g/nut variety	94.6	1.8	1.8	18.2	25.0	40.9	57.1	1.2	11.9	12.5	50.0	31.3
	Land preparation	96.4	1.8	0.0	81.8	2.3	2.3	97.6	0.0	2.4	31.3	25.0	25.0
	Planting	91.1	1.8	5.4	31.8	2.3	52.3	67.9	0.0	31.0	6.3	18.8	56.3
	Seed selection	94.6	1.8	1.8	68.2	11.4	6.8	86.9	0.0	13.1	18.8	37.5	25.0
	Fertilizer/manure application	91.1	1.8	5.4	29.5	4.5	52.3	97.6	0.0	2.4	31.3	18.8	31.3
	Weeding	96.4	1.8	0.0	84.1	2.3	0.0	97.6	0.0	0.0	50.0	6.3	18.8
	Mulching	57.1	0.0	0.0	31.8	0.0	0.0	33.3	0.0	0.0	12.5	6.3	0.0
	Irrigation	53.6	0.0	0.0	22.7	0.0	0.0	34.5	0.0	0.0	12.5	6.3	0.0
	Pest control/chemical application	94.6	1.8	0.0	75.0	2.3	2.3	81.0	0.0	1.2	68.8	0.0	6.3
	Equipment maintenance	82.1	1.8	12.5	31.8	2.3	54.5	63.1	0.0	0.0	43.8	6.3	18.8
	Chi-square value	2.76**			12.98**			4.80**			4.55**		

Harvesting													
	Manual harvesting	94.6	1.8	0.0	65.9	2.3	15.9	88.1	0.0	3.6	25.0	6.3	50.0
	Mechanical harvesting	80.4	1.8	0.0	22.7	2.3	11.4	31.0	0.0	1.2	12.5	6.3	6.3
	Hauling produce/transportation	94.6	1.8	0.0	65.9	6.8	11.4	71.4	1.2	7.1	43.8	6.3	31.3
	Chi-square value	2.64**			0.83			0.60			2.14**		

Table 3 Result on gender role comparison at different nodes of the GVC among PLGAs and NPLGAs households cont'd

		PLGAs						**NPLGAs**					
		Male			**Female**			**Male**			**Female**		
Value chain	**Item**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**	**Male (%)**	**Female (%)**	**Both (%)**
Post-harvest handling													
	Separation	80.4	3.6	14.3	31.8	11.4	43.2	45.2	22.6	19.0	12.5	68.8	18.8
	Drying	78.6	1.8	17.9	27.3	11.4	47.7	51.2	8.3	38.1	12.5	50.0	37.5
	Grading/clearing/sorting	80.4	1.8	16.1	25.0	18.2	40.9	34.5	2.4	38.1	12.5	43.8	43.8
	Storage	89.3	1.8	7.1	61.4	22.7	4.5	61.9	1.2	34.5	6.3	56.3	37.5
	Haulms utilization/sale	94.6	1.8	1.8	56.8	22.7	6.8	72.6	1.2	3.6	31.3	43.8	12.5
	Chi-square value	1.30			6.58**			6.45**			3.87**		
Marketing													
	Decision to sell groundnut	89.3	1.8	7.1	15.9	22.7	47.7	63.1	0.0	15.5	12.5	50.0	37.5
	Decision on quantity of G/nut to sell	87.5	1.8	8.9	13.6	25.0	47.7	67.9	0.0	23.8	25.0	50.0	25.0
	Assembling of groundnut	87.5	0.0	0.0	61.4	18.2	11.4	65.5	0.0	0.0	31.3	25.0	37.5
	Wholesaling of groundnut	96.4	1.8	0.0	52.3	29.5	4.5	71.4	0.0	14.3	25.0	31.3	31.3
	Retailing of groundnut	78.6	1.8	1.8	13.6	27.3	6.8	40.5	2.4	23.8	12.5	37.5	43.8

	Chi-square value	1.35			3.94**			2.80**			2.04**	
Processing												
	Manual shelling	23.2	7.1	67.9	27.3	38.6	31.8	0.0	3.6	59.5	0.0	37.5	56.3
	Mechanical shelling	32.1	5.4	46.4	11.4	22.7	18.2	6.0	2.4	23.8	0.0	12.5	18.8
	Manual/local oil pressing	0.0	71.4	16.1	4.5	93.2	2.3	0.0	58.3	0.0	12.5	87.5	0.0
	Mechanical oil pressing	7.1	17.9	58.9	13.6	40.9	4.5	0.0	20.2	9.5	0.0	37.5	0.0
	Snack/kuli-kuli production	0.0	76.8	8.9	2.3	95.5	0.0	2.4	58.3	0.0	12.5	87.5	0.0
	Chi-square value	18.35**			9.01**			14.16**			12.75**	
Household chores												
	Fuel wood collection	75.0	7.1	17.9	45.5	13.6	38.6	25.0	2.4	38.1	18.8	43.8	12.5
	Fetching water	58.9	8.9	32.1	43.2	20.5	36.4	36.9	13.1	41.7	12.5	56.3	25.0
	Cooking	3.6	94.6	0.0	11.4	88.6	0.0	3.6	95.2	0.0	0.0	100.0	0.0
	Chi-square value	25.46**			15.85**			20.94**			6.96**	

Source: Field Survey Data, 2021. (**) Significant @ 5% Note: multiple responses were recorded

Groundnut production: Table 2 presents the results for farm operations related to groundnut production. In both PLGAs and NPLGAs, men made the decisions regarding all farming activities. In PLGAs, the majority of men (94.6%) were involved in the decision to grow a groundnut variety, 96.4% in land preparation, and 81.8% in planting. In NPLGAs, the percentages were 97.6%, 91.1%, and 67.9% for land preparation, planting, and seed selection, respectively. For fertilizer/manure application, the percentages were 91.1% in PLGAs and 97.6% in NPLGAs, while for weeding, the percentages were 96.4% in PLGAs and 97.6% in NPLGAs. Regarding pest control/chemical application, the percentages were 94.6% and 75.0% in PLGAs, and 81.0% in NPLGAs. Additionally, 82.1% of men in PLGAs were responsible for equipment maintenance. These results align with the findings of Forsythe *et al.*, who suggested that men usually have greater authority in cropping decisions [33], particularly for higher-income-generating crops, even though both men and women work on the same farm plots. However, these findings contradict the assertions made by Ironkwe [8], who claimed that the majority of female farmers perform nearly all production activities compared to their male counterparts. Kubayo also noted that most agricultural production is a joint task [34].

Harvesting: In order to examine the gender roles in groundnut harvesting within the value chain, the study analyzed the data and found both male and female respondents participating in groundnut harvesting. However, the results in Table 2 indicate a greater male dominance in harvesting activities compared to females in both PLGAs and NPLGAs. The main activities carried out by men included manual harvesting (94.6%), mechanical harvesting (80.4%), and hauling produce/transportation (94.6%). In NPLGAs, the percentages were 88.1% for manual harvesting and 71.4% for hauling produce/transportation. This suggests that groundnut harvesting was predominantly performed by men. Nautiyal and Mejia stated that harvesting, which involves the removal of mature plants or economic parts, is a labor-intensive and costly task mainly carried out by men [35]. They further explained that manual harvesting includes activities such as digging, lifting, windrowing, stocking, and threshing. These findings differ from those of Nnaji *et al*., who found that a majority of women were involved in harvesting [36]. This contrasting result is interesting as it confirms the diversity of gender roles within the context of different studies.

Post-harvest handling: The results presented in Table 3 demonstrate the participation of both male and female respondents in all post-harvest operations within the GVC in the study area. However, male respondents (PLGAs) dominated these activities to a greater extent. The activities included separation (80.4%), drying (78.6%), grading/clearing/sorting (80.4%), storage (89.3%), and haulms utilization/sale (94.6%). This implies that men were predominantly involved in these post-harvest activities in the study area. This finding aligns with the assertion made by Adam *et al.* that post-harvest management activities are primarily assigned to men [37], as they are more extensively engaged in all the mentioned activities within this stage. Nevertheless, the results from NPLGAs indicate that both men and women interchangeably handle post-harvest roles, contradicting the previous assertion. This implies that post-harvest handling is executed by both genders in the study area, as noted by Idumah *et al*. [38].

Marketing: Marketing represents the most competitive stage of the value chain, where key players engage in price competition and timing of purchases from farmers. The findings presented in Table 3 regarding the marketing node indicate that men dominated this activity in both PLGAs and NPLGAs. The percentages for the decision to sell were 89.3% in PLGAs and 63.1% in NPLGAs, for the quantity of groundnut to sell it was 87.5% in PLGAs and 67.9% in NPLGAs, for assembling it was 87.5% in PLGAs and 65.5% in NPLGAs, and for wholesaling it was 96.4% in PLGAs and 71.4% in NPLGAs. These results are contrary to the expected notion that men would have less involvement in the marketing node of the GVC. This finding is consistent with the study by Siri *et al.* [39], which found that both genders were involved in all farming operations from production to marketing, although the degree of participation differed.

Processing: The processing activities of groundnut include manual shelling, mechanical shelling, manual/local oil pressing, mechanical oil pressing, and snack/kuli-kuli production. These activities are carried out by different gender categories within participating and non-participating households. The data presented in Table 3 indicates that females dominate the activities of manual/local oil pressing and snack/kuli-kuli production in both PLGAs and NPLGAs. In PLGAs, the percentages were 71.4% and 93.2% for females in manual/local oil pressing, and 76.8% and 95.5% for females in snack/kuli-kuli production. In NPLGAs, the percentages were 58.3% and 87.5% for females in manual/local oil pressing, and 58.3% and 87.5% for females in snack/kuli-kuli production. These findings indicate that women are more involved in groundnut processing compared to men. This aligns with the research conducted by Umeukeje *et al.* [40], which found that women play a dominant role in groundnut processing and spend a significant amount of time and days on groundnut oil production. Similarly, Manyungwa-Pasani *et al.* [41] and Ironkwe [8] have observed that women have a greater presence in the processing enterprise.

Household chores: Household chores encompass activities such as fuelwood collection, fetching water, and cooking, which are carried out by both gender categories within participating and non-participating households. The table reveals that both men and women dominate these activities in both PLGAs and NPLGAs. In fuelwood collection and

fetching water, men in PLGAs have a higher level of involvement at 75.0% and 58.9% respectively. On the other hand, cooking is predominantly performed by women, as reported by both male and female categorical variables in PLGAs (94.6% and 88.6%) and NPLGAs (95.2% and 100%).

These findings align with the notion that women traditionally take on domestic activities such as cooking and raising children, as accepted by Ogato [42]. Schaeffer also acknowledges that women tend to do more cooking and grocery shopping than men [43], implying that women possess a better knowledge of meal preparation. Additionally, Ferrant *et al.* argue that women are often confined to traditional roles associated with femininity and motherhood [44], which primarily involve reproductive and domestic chores. Agada and Ejembi found that in farm operations and household tasks, men contribute more to heavy tasks, while women are more engaged in lighter tasks [45]. Therefore, the study reveals a gender gap in GVC activities.

3.3 Gender role comparison at the different nodes of GVC among PLGAs and NPLGAs households

Based on the descriptive analysis conducted above, the hypothesis testing was performed to examine gender differentials in the roles played by males and females in different nodes of the GVC among PLGAs and NPLGAs households. The results, as shown in Tables 2 and 3, indicate significant gender differences in various nodes. In PLGAs, the following significant gender differences were observed: input supply under the female category, groundnut production for both male and female categories, harvesting for the male category, post-harvesting for the female category, marketing for the female category, processing for both male and female categories, and household chores for both male and female categories. These findings suggest that there are notable variations in the roles performed by males and females within these nodes, indicating the need for gender mainstreaming and balancing of duties. It emphasizes the importance of implementing action plans by gender experts to address gender disparities and achieve a better and more equitable distribution of workload between men and women.

Similarly, in NPLGAs, significant gender differences were observed in input supply, groundnut production, harvesting, post-harvest handling, marketing, processing, and household chores. The significant differences between the categorical variables of males and females in these nodes highlight the existence of gender differentials across both PLGAs and NPLGAs households. These results demonstrate that gender disparities exist in the roles played by men and women in various nodes of the GVC, calling for gender-sensitive interventions and initiatives to promote equality and balance in workload between genders. It indicates that the current program lacks full integration of gender mainstreaming perspectives at all stages of the PLGAs nodes, emphasizing the necessity of gender experts' action plans to address these disparities and promote a happier and more equal family dynamic.

The gender differential and imbalance observed in all nodes of the GVC among PLGAs households indicate that the USAID-GUP intervention, despite its focus on gender equality, has not successfully addressed gender inequality within the GVC. This suggests that the efforts made by the USAID-GUP intervention have not been effective in achieving gender equality among participants in the GVC. One possible explanation for this is the presence of gender-specific and cultural differences in agricultural activities among farm households in northern Nigeria. These differences stem from social norms, cultural beliefs, customary laws, and gender roles deeply ingrained in society. Furthermore, the patriarchal system prevailing in the social setting historically deprives and disempowers women socially, legally, politically, and technologically, exacerbating their marginalized position. Achieving gender equality in development programs will remain elusive until these obstacles are addressed and eliminated.

Recent scholarly works corroborate these findings, identifying these factors as constraints to gender equality in similar development interventions. More scholars have highlighted how social norms pose constraints to gender mainstreaming and contribute to gender inequality in Nigeria [46-47]. Additionally, Obianefo *et al.* argue that cultural factors have increased women's limited access to land, agricultural inputs, and credit [48]. However, Olonade *et al*. present a contrasting viewpoint [32], suggesting that gender inequality was not present before colonialism. They argue that both men and women had distinct responsibilities that complemented each other's roles for the progress and well-being of the community. They conclude that traditional African societies assigned different roles to maintain the smooth functioning of society and that gender inequality and other forms of inequality were virtually non-existent before colonialism, contradicting the earlier assertion.

4 Conclusion

The study concludes that gender differentials exist in the roles played by men and women across the various nodes of the GVC. The USAID-GUP intervention, although aiming for gender equality, has not effectively addressed these disparities. Cultural and social factors deeply rooted in the community, along with the patriarchal system, continue to

marginalize and disempower women. These findings emphasize the need for comprehensive gender mainstreaming and transformative interventions to achieve true gender equality within the GVC.

From the foregoing, the following recommendations were made:

- Enhance women's access to resources: To address the systemic barriers faced by women, initiatives should focus on improving their access to resources such as land, credit, inputs, and technology. This can be achieved through targeted programs, policy reforms, and financial inclusion strategies specifically designed for women.
- Encourage women's participation in decision-making: Efforts should be made to increase women's participation in decision-making processes within the GVC. This can be facilitated through the inclusion of women in leadership roles, creating platforms for their voices to be heard, and promoting their representation in relevant committees and organizations.
- Strengthen extension services: Extension services should be strengthened to provide equal and accessible support to both men and women. This includes increasing the number of extension workers, improving the frequency and quality of interactions, and ensuring that extension services address the specific needs and challenges faced by women in agriculture.
- Promote gender-responsive data collection: It is essential to collect sex-disaggregated data and conduct gender analyses regularly to monitor progress, identify gaps, and inform evidence-based decision-making. This will help in evaluating the effectiveness of interventions and ensuring that gender considerations are integrated into all aspects of the GVC.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have declared no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study. Grant from International Journal of Science and Technology Research Archive the right to publish and distribute the manuscript in both print and electronic formats. This includes the right to reproduce, transmit, and make the manuscript available to readers, subscribers, and databases.

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