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GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D
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AGRICULTURE & VETERINARY

VOLUME 20 ISSUE 5 (VER. 1.0)

OPEN ASSOCIATION OF RESEARCH SOCIETY

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Frontier Research. 2020.

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GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D
AGRICULTURE AND VETERINARY
Volume 20 Issue 5 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Assessment and Documentation of Indigenous and Introduced Soil and Water Conservation Practices in the Case of Silte and Gurage Zone, SNNPR, Ethiopia

By Bagegnehu Bekele, Yenealem Gemi, Temesgen Habtemariam
& Dagnaw Ademe

South Agricultural Research Institute

Abstract- Soil erosion is the most limiting environmental factor for crop production in Ethiopia, particularly Southern Regional State. To reverse the land degradation problem, many indigenous and introduced soil and water conservation interventions were implemented in different parts of Ethiopia. However, this practice is not well documented and known in South-central zones. The current study has been initiated to assess the indigenous and introduced soil and water conservation practices in the Gurage and Silte zone. As a method; Key informant interview, Focused group discussion, observation through transect walk was used as a source of data. Key informant interviews has been conducted at zonal and woreda level to group two representative woredas per zone and three representative kebeles per woreda. Based on the key informant interviews, Sankura and Alichu-wuriro woreda from the Silte zone, whereas Meskan and Gummer woreda from the Gurage zone was selected based on their adoption potential of both indigenous and introduced soil and water conservation practices.

Keywords: FGD, indigenous SWC, introduced SWC, soil and water conservation, soil erosion.

GJSFR-D Classification: FOR Code: 070199



ASSESSMENT AND DOCUMENTATION OF INDIGENOUS AND INTRODUCED SOIL AND WATER CONSERVATION PRACTICES IN THE CASE OF SILTE AND GURAGE ZONES SNNPR ETHIOPIA

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Assessment and Documentation of Indigenous and Introduced Soil and Water Conservation Practices in the Case of Silte and Gurage Zone, SNNPR, Ethiopia

Bagegnehu Bekele ^α, Yenealem Gemi ^σ, Temesgen Habtemariam ^ρ & Dagnaw Ademe ^ω

Abstract- Soil erosion is the most limiting environmental factor for crop production in Ethiopia, particularly Southern Regional State. To reverse the land degradation problem, many indigenous and introduced soil and water conservation interventions were implemented in different parts of Ethiopia. However, this practice is not well documented and known in South-central zones. The current study has been initiated to assess the indigenous and introduced soil and water conservation practices in the Gurage and Silte zone. As a method; Key informant interview, Focused group discussion, observation through transect walk was used as a source of data. Key informant interviews has been conducted at zonal and woreda level to group two representative woredas per zone and three representative kebeles per woreda. Based on the key informant interviews, Sankura and Alichu-wuriro woreda from the Silte zone, whereas Meskan and Gummer woreda from the Gurage zone was selected based on their adoption potential of both indigenous and introduced soil and water conservation practices. From each selected woreda, three representative kebeles from highland, middle land, and low land were selected. Focus group discussion has been conducted with the involvement of women, Youth and Elders who have long experience in the area about soil and water conservation practices at selected kebeles. Several introduced and indigenous soil and water conservation practices has been identified. However, lack of ignorance by farmers to periodically maintain the structures aggravating soil erosion in their field. Unlike indigenous conservation structures, construction and design of each introduced conservation structures has not been based on technical standards of the Ethiopian Ministry of Agriculture (MoA). It has been recommended that the identified indigenous and introduced conservation measures which have a better role in reducing soil erosion in cropland should be scaled. The implemented conservation measures in different parts are different in their dimensions during field measurement, and their variation should be scientifically proven. Finally, in most parts, the constructed engineering measures should be periodically maintained and integrated with biological conservation measures.

Keywords: FGD, indigenous SWC, introduced SWC, soil and water conservation, soil erosion.

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I. BACKGROUND AND JUSTIFICATION

Soil erosion is a serious global environmental problem and constrains food production for the increasing world population (Lieskovský, 2014). Erosion is a major Environmental problem to the national economy of Ethiopia due to cultivation on steep slopes, clearing of vegetation, and overgrazing (Tamene, 2005). Many studies reported the extent of soil erosion based on erosion modeling. Soil Conservation Research Project (SCRCP) estimated that about 1.5 billion tons of soil (Hurni, 1984; Kruger, 1995), whereas FAO (1984) and Hurni (1993) reported annual soil loss from Ethiopian highlands to be 200-300 tons ha⁻¹yr⁻¹. The impact of erosion is particularly severe in the highlands of the country (areas that lie above 1500 m), which constitute less than half of the country (≈ 43 percent of the country) (FAO, 1986). In the mid of 1980s, 50% of the highlands are significantly eroded, 25% seriously eroded, while 4% had reached a point of no economic return (FAO, 1986). The report of Bagegnehu et al. (2019) in the Southern Region reported the soil loss as 42,413.7 ton per year soil with an average annual soil loss rate of 4.27ton/ha/yr. The impact of soil erosion both on-site nutrient loss and off-site sedimentation of water resources ((Emrah et al. (2007)). The root causes of soil erosion in Ethiopia are due to deforestation, intense rainfall cultivation of steep slope to fulfill the demand of a growing population (Bewket, 2007; Adimassu, 2012).

In Ethiopia, soil and water conservation practices has been started after famine in 1973 and 1985 as food-for-work program to mitigate soil erosion problems (Hoben, 1996). After this program, various physical and biological soil and water conservation measures has been implemented by extensions, research institutions, and other development practioners through collective action community collective action, and farmer's personal trial (Wagayehu and Lars, 2003).

Indigenous soil and water conservation practices by farmers play a major role in facilitating the optimum level of production from a given area of land while keeping soil loss below a critical value. According

to IFAD (1992), conservation measures are broad classified as agronomic measures, physical /structural/ measures, and biological/vegetative/ measures. According to Genene M. and Abiy G. (2014), most of the farmers in south western Ethiopia practices introduced and indigenous soil and water conservation activities like; contour farming, furrow making, residue leaving, agronomic practices, putting trash lines on contour, etc. However, the soil and water conservation practices are site specific and, particularly the contribution of indigenous conservation measures has been ignored by Extensions, farmers and research organizations. Therefore, the current study has been initiated to identify indigenously and introduced SWC practices, to measure and describe identified indigenous and introduced soil and water conservation practices, and to know socio-economic aspects of identified indigenous and introduced SWC Practices

II. MATERIALS AND METHODS

a) Study area description

This study has been conducted in Silte and Gurage zone, Southern Nation Nationalities and Peoples Region (SNNPRs). Silte zone is bordered on the south by Halaba zone, on the west by Hadiya, on the north by Gurage zone, and on the east by East shewa. Geographically it lies between $38^{\circ}3'25.812''E$ $7^{\circ}45'10.864''N$. Whereas, Gurage zone is bordered on the south by Silte zone, on the west by Jimma, on the north by Southwest shewa, and on the east by East shewa. Geographically it lies between $37^{\circ}48'12.533''E$ $8^{\circ}4'3.093''N$. The major crops grown in both zones are maize, wheat, barley, teff, sorghum, beans, pea, potato, Enset(CSA, 2010)

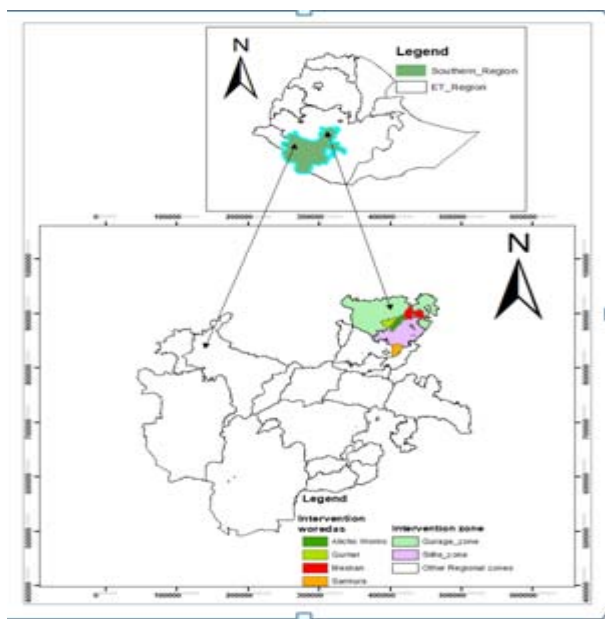


Figure 1: Location of the study area

b) Methods of data collection

As a data collection, key informant interview, Focus group discussion, field observation through transect walk has been used to generate the required data.

i. Focus group discussion

A discussion with Key informant has been conducted at zone and woreda level. Teams like a natural resource, irrigation, animal science, and plant science experts were participated to have information's about all woredas of the zone so that, the grouping of woredas was done based on its agro-ecologies and expectation to have indigenous and introduced soil and water conservation practices. Focus Group Discussion (FGD) with different social groups at the kebele level has been undertaken. The composition of social groups includes Youths, Women, and Elders know about SWC practices in the area (figure 1). A quick checklist has been prepared to collect the required information. The farmer's response has been validated with the information collected through a transect walk.



Figure 2: Focus group discussion

ii. Field survey and Observation

From the baseline information at zonal, woreda and kebele level, field observation on existing ISWC practices has been done with appropriate transect walk. The response of FGD has been validated through field surveys. The different SWC practices has been observed and measured to characterize identified indigenous and introduce SWC practices.

iii. Key informant interview

Key informant interviews were done at zone and woreda. This method of data collection in our current research is the primary step to identify the potential woredas and kebeles who have the best experience on indigenous and introduced soil and water conservation practices. During the interview, administrators, experts, and older farmers participated. At the kebele level, farmers who have long experience on indigenous and introduced soil and water conservation practices has been selected, and the required data has been collected.

c) Data Analysis and Presentation

Simple descriptive statistics like tables and figures were used as a means of data analysis. The analysis focused on a zonal basis to summarize the

identified indigenous and introduced soil and water conservation practices.

The following two tables describe the respondent demographic characteristics in each zone.

III. RESULTS AND DISCUSSIONS

a) Demographic characteristics of respondents

Focus group discussion has been conducted at each zone by selecting 44 respondents from each zone.

Table 1: Demographic characteristics of respondents in Silte zone

Variables	Descriptive	Frequency	Percentage
Sex	Male	41	93.2
	Female	3	6.8
Age	18-30	4	9.1
	31-50	30	68.2
	51-70	8	18.2
Education	>71 years	2	4.5
	Read only	9	20.5
	Read and write	29	65.9
	1-8th	1	2.3
	9-10th	0	0
Marital status	Non educated	5	11.4
	Single	2	4.5
	Married	42	95.5
	Divorced	0	0
Religion	Widowed	0	0
	Orthodox	2	4.5
	Muslim	42	95.5
	Protestant	0	0
	Catholic	0	0

Table 2: Demographic characteristics of respondents in Gurage zone

Variables	Descriptive	Frequency	Percentage
Sex	Male	36	81.8
	Female	8	18.2
Age	18-30	8	18.2
	31-50	30	68.2
	51-70	6	13.6
Education	>71 years	0	0.0
	Read only	8	18.2
	Read and write	24	54.5
	1-8th	4	9.1
	9-10th	2	4.5
Marital status	Non educated	4	9.1
	Single	2	4.5
	Married	40	90.9
	Divorced	1	2.3
Religion	Widowed	3	6.8
	Orthodox	12	27.3
	Muslim	29	65.9
	Protestant	3	6.8
	Catholic	0	0.0

b) Existing soil and water conservation(SWC) practices
 i. Indigenous soil and water conservation(ISWC) practices

Land degradation is a serious problem in central Ethiopia. To curb those threats, farmers apply

a. Gurage and Silte zone

Table 3: List of Indigenous Soil and water conservation practices in Gurage and Silte zone

SWC practices	Locations	Average dimension		
		L(m)	W(m)	D(m)
Ditcher	SZ	As interest	0.6	1.2
Contour farming	SGZ	-	0.2	0.15
Furrow making	SGZ	-	0.25	0.17
Planting pit	SZ	-	0.7	0.6
Planting cabbage across the slope	SZ	-	0.2	0.15
Planting Enset across the slope	SZ	-	2	*
Mulching for vegetables	SZ	-	*	*
Intercropping	SGZ	-	*	*
Strip cropping	SGZ	*	*	*
Trash line	GZ	10	0.4	*
Desho grass strip planted on soil bund	GZ	25	0.5	0.5

NB: SZ= Silte Zone; GZ=Gurage Zone, SGZ=Silte and Gurage Zone

• Description of Indigenous Soil and water conservation practices

Ditcher: is the traditional practices constructed around farmland with a dimension of 60cm top width and 1.2m height. Its length depends on the size of the farmland. Farmers use this structure for fence and prevent farmland from run-off.



Figure 3: Dicher at Silte zone

Planting pit: It is a form of water harvesting prepared with manure and constructed around homestead area majorly for soil fertility improvement for chat practiced by Alichu wuriro woreda farmers. During rainstorms, the pits catch runoff and concentrate it around the growing plant. Manure has been placed in the pits before planting a chat to improve soil fertility. Chat is planted thereby benefit from the increased moisture availability in the pits. The dimensions of are 70cm diameter, 60cm depth, and spaced 50cm. As compared to the standard 10-30 cm diameter, and 5-15cm depth by FAO (2003), the current measured dimensions are by far higher. According to Itabari and Wamuongo (2003), organic

various indigenous soil and water conservation practices. The structure varies from farmers to farmers across both locations. The identified measures has been discussed below

manure preferable from cattle and other forms is added and mixed with the soil to improve fertility, structure, and conserve moisture in the pit.



Figure 4: Planting pit at Silte zone

Contour farming: It is the activities of plowing and planting along the contour, and farmers majorly adopt this to prevent surface runoff and infiltration of water into the soil. Structures and plants has been established along the contour lines following the configuration on the ground. They were planting cabbage and Enset across the slope, which is the identified practice in silte zone.

Mulching is a management practice that combats the problem of water scarcity. Farmers around the silte zone use wheat stalk as a mulching material for vegetables, particularly for carrot seedling performance at nursery level as shown in (figure 5). The role of mulching was to improve soil moisture by reducing soil evaporation and gully side stabilization.



Figure 5: Mulching for Carrot

- *Living crop residue*

The practice of leaving crop residue after crop harvest for soil fertility and soil moisture improvement were well known in the selected areas of the central zone. The experience of barley and wheat straw in the field is another indigenous conservation practices identified from silte area (figure 6). The straw on their farmland has been used to improve soil fertility, conserve soil moisture, and reduce raindrop erosion.



Figure 6: Crop residue after harvest

Intercropping: Intercropping annual with perennial crops is one of the practices known in the Silte and Gurage zone. It is the practices of growing more than one crop in a piece of land. To increase the land productivity, farmers at silte zone intercrop Chat with potato, Enset with cabbage as a practice majorly to increase land productivity by improving soil fertility. Chat and cabbage is the most important cash crop in the area. Chat planted at 1m space, and potato has been planted in rows of chat at 50cm spacing (figure 7)



Figure 7: A combination of intercropping

Strip cropping: Practicing a strip of cereal with root crops is another conservation practice identified. Farmers practice strip majorly to efficiently utilize their land use. The component of strip cropping practiced in the area is (*wheat*)-potato-chat-Enset plantation.

• *Furrow making*

Farmers have experience in making furrow by creating 17cm soil depth and 25cm width along the contour for cereals and horticultural crop (cabbages) majorly to improve soil moisture and prevent soil erosion. The length of the furrow depends on the size of the farm (figure 8)



Figure 8: Furrow making experiences from Silte zone

- ii. *Introduced soil and water conservation (ISWCP) practices*
 - a. *Gurage and Silte zone*

Table 4: List of Introduced Soil and water conservation practices in Gurage and Silte zone

SWC practices	Locations	Average dimension		
		L(m)	Width(m)	D(m)
Graded cutoff drain	SGZ	As interest	.3	.2
Fanya juu	SZ	As interest	2	.3
Soil bund	GZ	100	.5	.5
Cutoff drain	SGZ	15	.6	.4
Trench	SGZ	5	.5	.5
Planting sisal on graded soil bund	GZ	20	.4	.5
Wood Check dam	SGZ	15	1	.4
Stone bund	GZ	15	.3	.4
Soil bund	SZ	20	.5	.5
Fanya juu	GZ	8	.4	.4
Stone faced soil bund	GZ	80	1	.8
Farm fond	SZ	8	4	.5

NB: SZ= Silte Zone; GZ=Gurage Zone, SGZ=Silte and Gurage Zone

• *Description of introduced soil and water conservation measures*

Soil bund: Soil bunds are ridges and ditches made of soil, dug across the slope, or along the contour with a water retention basin at its upper part. Farmers construct soil bund in their farmland to reduce or stop the velocity of overland flow and consequently, soil erosion. The design of this structure varies from zone to zone. The sample of soil bund has been measured at the slope below 15%. Farmers in the Gurage construct soil bund with the an average length of 100m, 0.3 m the average bottom width, and the average depth of 0.5m and 20cm an embankment height (figure 8). However, farmers around the Silte zone design soil bund with an average length of 20m, 0.5m an average bottom width, 0.5 m depth and an embankment height of .35m. According to MOA (2016), embankment height of 50-75cm high and a bottom width of 100-150cm are

appropriate dimensions for level soil bund. The design of each parameter across locations is by far below the standard. The variability of slope length in both locations has been related to the farm size.



Farmers construct soil bund in steeper and moderately steeper slope in their farm land. The practice is made from the soil and designed following the contour line and formed by digging the soil and thrown the soil down ward to form the embankment. Farmers construct it primarily for reducing the runoff generated from farm land which interns to increase crop productivity.

Figure 9: Soil bund at Gurage zone

Fanya juu terraces

Fanya juu is an embankment along the contour, made of soil, with a water retention basin at its lower part. Farmers construct soil bund in their farm land to retard the runoff or stop the velocity of overland flow by collecting it in the ditch. Farmers in Gurage zone construct *fanya juu* with an average length of 8m, 0.4m average bottom width, and average depth of 0.4m and 15cm embankment height. However, farmers around Silte zone design *fanya juu* of slope length based on their interest, 2m average bottom width, 0.3m depth and embankment height of 0.15. According to MOA (2016), embankment height of 50-75cm, a bottom width of 100-150cm and the ditch is about 0.5m deep is appropriate dimensions for level *fanya juu*. The design of each parameter across locations is by far below the standard. The variability of slope length in both locations has been related with the farm size. Farmers who have large farm size use large size.

Trench- is a short ditch dug along the contour to trap runoff water in dry and moist areas to plant trees out of farmlands. This structure is the well-known practice in both Silte and Gurage zones. Farmers construct the structures primarily to plant trees in the center of the trench to rehabilitate the degraded land. Farmers design them with an average length of 5m, 0.5m width and 0.5m depth (figure 10). As compared to the technical

standard given by MOA (2016), a trench is normally 2-3m long and 0.3-0.5 m deep; depending on soil depth, the current dimension, particularly its length is long, and the depth is within the range of MOA technical guideline. In the center of the trench, no tree has been planted across the locations.



Figure 10: Overview of trench at Gurage zone

Planting sisal on graded soil bund

Graded soil bund is similar with level bund, with the only difference being slightly graded sideways, with a gradient of up to 1%, towards a waterway or rivers. Farmers in the Gurage zone integrate Sisal as biological conservation measures with graded soil bund majorly to control dispersed runoff by retarding its velocity on farmlands and gullies, which ultimately mitigate land degradation (figure 11)



Figure 11: Overview of Sisal planted on graded soil bund at Gurage zone

Stone bund- farmers have the experience in preventing soil erosion from their farmland by constructing Engineering soil and water conservation measures. Due to the availability of a stone in the area, farmers align stone along the contour to build stone bund. During design, certain depths has been constructed, and stone is aligned straight to form the embankment height of 0.50cm (figure 12)



Figure 12: Overview of stone bund in Gurage zone

The Farm pond is a rectangular structure constructed with the dimension of side length 3.5m and width of 8m with the primary focus of rainwater harvesting for sustainable crop production to reduce the risk of crop failure during the dry spell. The plastic-lined is used to prevent seepage loss (figure 13)



Figure 13: Farm pond at Silte zone

IV. CONCLUSION AND RECOMMENDATION

Several introduced and indigenous soil and water conservation practices were identified. Although lack of ignorance by farmers to periodically maintain the structures aggravating soil erosion in their field. The technical measurements, construction, and design of both conservation structures were not based on technical standards of the Ethiopian Ministry of Agriculture (MoA). Recognizing the severity of soil erosion, farmers adopted various conservation strategies in their farmland. Despite high labor, cost, and time requirement of introduced soil conservation measures, farmers enforced to apply their indigenous knowledge to control soil erosion from their farmlands.

In most of the area, engineering/mechanical conservation measures were not integrated with biological conservation measures, which contributed to soil erosion in the farmland. The current study shows, various introduced and indigenous soil and water conservation practices identified and documented for further uses.

From the assessment result, it is recommended that, identified indigenous and introduced conservation measures which have a better role in reducing soil erosion in the farmland should be scaled up, during field measurements the implemented conservation measures in the study areas are different in their dimensions. The variation should be proven in the research, and finally, in most parts, the constructed engineering/mechanical measures should be periodically maintained and supported with biological conservation measures.

ACKNOWLEDGEMENT

Special gratitude goes to South Agricultural Research Institute (SARI) for the financial support. The authors also thank both silte and Gurage zone farm and natural Resource Department and farmers for their willingness to provide the required information. The appreciation also goes to worabe Agricultural Research Center Natural Resource Research process technical Assistancess for their efforts to collect the required information.

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Consumer Behavior in Yogurt Purchase and Consumption

By Irum Raza, M. Asif Masood, Muhammad Haroon Shaukat,
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Abstract- In recent years, yogurt has become prevalent in diary fermented food in the market. The trend of yogurt consumption is gradually increasing with customer consciousness on a diet. In the present study, we investigate the yogurt purchase and consumption pattern of people who buy yogurt from PARC Agrotech Company Limited (PATCO) shop in the Nation Agriculture Research Center (NARC). A Chi-square test was applied to assess the yogurt buying and consumption patterns of NARC employees against the outsiders. Besides, the finding showed that out of 27 respondents 17 of them purchased yogurt for others, including friends and relatives. Above findings depicts the importance of yogurt to consumers. Mostly, yogurt was consumed by whole family members comprising of 12 NARC employees and nine outsiders. Yogurt was used throughout the year however; increase consumption of yogurt is observed in summer (67%) as compared to winters and at other times of the year almost (33%). The overall acceptance level of yogurt is high (72.73%) for consumers from outside in contrast with NARC employees (19%). Likewise, in terms of taste, flavor, appearance, price and packing size, most of the buyers outside NARC were highly satisfied with 54.5%, 54.5%, 72.73%, 72.73%, and 54.5% respectively. It is recommended to ensure an adequate supply of yogurt and an improvement in the packing be made.

Keywords: yogurt, consumption, preference, purchase.

GJSFR-D Classification: FOR Code: 860299



Strictly as per the compliance and regulations of:



Consumer Behavior in Yogurt Purchase and Consumption

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Abstract- In recent years, yogurt has become prevalent in dairy fermented food in the market. The trend of yogurt consumption is gradually increasing with customer consciousness on a diet. In the present study, we investigate the yogurt purchase and consumption pattern of people who buy yogurt from PARC Agrotech Company Limited (PATCO) shop in the Nation Agriculture Research Center (NARC). A Chi-square test was applied to assess the yogurt buying and consumption patterns of NARC employees against the outsiders. Besides, the finding showed that out of 27 respondents 17 of them purchased yogurt for others, including friends and relatives. Above findings depicts the importance of yogurt to consumers. Mostly, yogurt was consumed by whole family members comprising of 12 NARC employees and nine outsiders. Yogurt was used throughout the year however; increase consumption of yogurt is observed in summer (67%) as compared to winters and at other times of the year almost (33%). The overall acceptance level of yogurt is high (72.73%) for consumers from outside in contrast with NARC employees (19%). Likewise, in terms of taste, flavor, appearance, price and packing size, most of the buyers outside NARC were highly satisfied with 54.5%, 54.5%, 72.73%, 72.73%, and 54.5% respectively. It is recommended to ensure an adequate supply of yogurt and an improvement in the packing be made.

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I. INTRODUCTION

Yogurt is considered to be the most well-known milk product in the world (Pomsanam *et al.*, 2014). The advantage of yogurt as one of the functional food is scientifically recognized as having physiological benefits beyond those of elementary nutrition to human health, and this is also giving a reason why it tends to become popular today (Weerathilake *et al.*, 2014; McKinley, 2005; Murphy *et al.*, 2015; ohijanheimo and Sandell, 2009).

Furthermore, scientific research indicated that the consumption of the recommended level of milk and dairy products as a part of a healthy diet could contribute and reduce the risk of many diseases (sandholomSarrela 2003). According to Andreson and Gilliland (1999), fermented dairy products and probiotic bacteria decrease the absorption of cholesterol. There

are many types of yogurts, but now, the frozen yogurt is most popular in the market (Chandan *et al.*, 2006). Many studies have been conducted about the customer's perception in the various field (Gurnert *et al.* 2000 and 1996).

The purchasing characteristics of a customer can help in explaining how consumers get satisfaction and become loyal to the product. Therefore, the information about consumer features and satisfaction of yogurt is needed to make accurate decision in the marketing of yogurt. In this regard, various studies have been conducted internationally, however, little attention has been given here in Pakistan. (Wantasenet, *al.*, (2007)) have studied consumer satisfaction of yogurt in Manado. (Hlédik and Lógó, (2017)) had discussed product experiences and consumer preferences related to the selection of yogurt's brand. Similarly, (Koščiarová *et al.*, (2017); Tait *et al.*, (2018)) had worked on the consumer behaviors in the purchase of yogurt. Besides, (Hossain *et al.* (2012)) was studied the quality comparison and acceptability of yogurt with fruit juices.

(Kusumastuti, 2012) studied the perceptions and buying choice of customers towards yogurt in Malang City, East Java Province, Indonesia. The quantitative data is collected by questionnaires are distributed to 400 respondents. These respondents belong to the rural and urban area of Malang City. It is observed from the Chi-square test that factors such as age, education, occupation, and income level are greatly influencing urban consumers' perception of yogurt in urban areas. Whereas, gender and income level are affecting on consumers' perception of yogurt in suburban areas.

In the NARC, yogurt is prepared at Animal Sciences Institute (ASI) and is also sold at the PATCO shop in NARC. Unfortunately, no study has been undertaken with regard to consumer perception about yogurt at the Social Science Research Institute (SSRI) of NARC. Based on this background, the present study is designed in collaboration with PATCO, NARC, with the following objectives: To assess yogurt buying and consumption preferences of respondents and also to determine the satisfaction level of respondents who purchase yogurt from PATCO, NARC.

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II. MATERIAL AND METHODS

Data for this study is collected through questionnaires, including information such as Socio-economic characteristics of the respondents. Such that the yogurt purchase and preferences, satisfaction level, factors affecting purchase decisions by consumers, and suggestions are required for further improvement. The questionnaires were filled by the customers who visited the PATCO shop at NARC. Only, twenty-seven customers have filled in the questionnaires. Additionally, the Chi-square test was performed to assess the perception of consumers about yogurt. Minitab software was used for analysis.

III. RESULTS AND DISCUSSION

Socio-economic characteristics of respondents are summarized in Table 1. Majority of the respondents are less than 40 years of age. The percentage of male members is a higher than as compared to female members. Mostly, the respondents had higher degree than bachelor's. Almost 82% of the respondents were married. With regards to different professionals, the majority of yogurt buyers were scientists and also belonged to other professions or employment are depicted in Figure 1.

Table 1: Socio-economic attributes of the respondents

Age	No	Percent
<40	17	62.96
41-60	4	14.81
>60	6	22.22
Total	27	100
Gender		
Male	18	66.67
Female	9	33.33
Education		
Metric	3	13.64
Inter	2	9.09
Bachelor	3	13.64
Above	14	63.64
Total	22	100
Marital Status		
Married	22	81.48
Unmarried	5	18.52
Total	27	100
Profession		
Engineer	2	7.41
Lawyer	1	3.70
Scientist	11	40.74
Shopkeeper	1	3.70
Other	12	44.44
Total	27	100
NARC		
Employee	11	40.74
No	16	59.26
Yes	27	
Total		

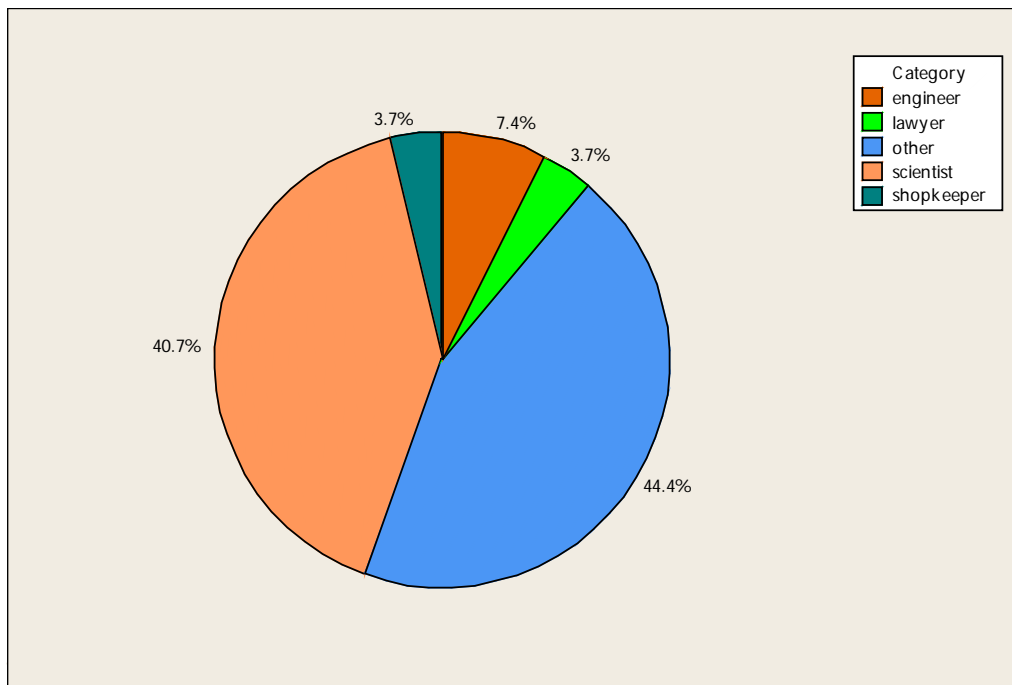


Figure 1: Pie chart showing percentage of different professions

The respondents' purchase preference for yogurt is depicted in Table 2. The total number of respondents was 27, and out of them, 16 were NARC employees. Among these 27 NARC employees, four purchased yogurt daily, three weekly, and nine of them bought yogurt on some other days. On the other hand, the total number of outsiders was 11, and four of them purchased yogurt daily. Moreover, the same number of NARC employees and outsiders purchased yogurt daily. Two outsiders purchased yogurt weekly, and five of them bought some other time. With regards to the query about the reason for buying yogurt from PATCO, NARC, 7 out of a total of 16 NARC employees responded that they buy it from the PATCO shop because of its taste. On the flip side, nine members answered that they purchase yogurt for its quality and quantity. The majority of NARC employees 15 purchased yogurt for themselves, whereas nine respondents outside NARC reported that they bought it for their own use. In terms of quantity, both NARC employees and outsiders purchased two boxes of yogurt (400 grams per box), whereas; few of the outsiders also bought three boxes. The results of Chi-square indicated no difference in buying behavior of NARC employees and outsiders, because the p-values of the Chi-square test are greater than the 5% level of significance.

Likewise, the preference for yogurt purchase was inquired with regards to having children or not. It was observed that of 18 respondents having children, seven claimed that they purchased yogurt daily, three weekly, and 8 of them purchased it some other time. There was a total of 9 respondents with no children, and only one of them reported daily purchase of yogurt.

Whereas most of them, six respondents bought it on other occasions. Additionally, 18 respondents having children, eight respondents purchased yogurt for its taste, and ten bought for quality. There was almost equal proportion of respondents without children in terms of taste and price preference of yogurt. It was observed that the 11 respondents having children purchased one box at a time.

The Chi-square test values corresponding to the daily and weekly purchases of yogurt as well as for taste and quality preferences are insignificant. Because the p-values of the Chi-square test greater than 5% level of significance. Therefore, we have sufficient evidence to conclude that yogurt buying preferences remain the same as respondents with or without children. Furthermore, the yogurt buying preference concerning having children varies because the Chi-square test value is large and having a p-value of less than 0.01 level of significance.

Table 2: Yogurt Purchase and Preferences

NARC Employee	Daily	Weekly	Others	Taste	Quality	Self	Others	Quantity (No)		
								1	2	3
Yes	4 (14.81)	3 (11.11)	9 (33.33)	7	9	15	1	1	4	0
No	4 (14.81)	2 (7.41)	5 (18.52)	6	5	9	2	3	6	2
Total	8 (29.63)	5 (18.52)	14 (51.85)	13	14	24	3	1	10	2
Chi-square value	0.698 ^{ns}			0.304 ^{ns}			0.940 ^{ns}			
Have children	Daily	Weekly	Others	Taste	Quality	Self	Others	Quantity (No)		
								1	2	3
Yes	7 (38.89)	3 (16.67)	8 (44.44)	8 44.44	10 55.56	18 (100)	0	11	6	1
No	1 (11.11)	2 (22.2)	6 (66.67)	5 (55.56)	4 (44.44)	6 (66.7)	3 33.33	4	4	1
Total	8 (29.63)	5 (18.52)	14 (51.85)	13 (48.5)	14 (51.85)	24 (88.89)	3 (11.11)	15	10	2
Chi-square value	2.234 ^{ns}			0.297 ^{ns}			7.380 **			

The preference of yogurt purchase with regards to the level of education is described in Table 3. It is described as 18 respondents are having an education of 14 years. Out of 18 respondents, five purchase yogurt daily, three weekly and ten on some other days. Similarly, the eight respondents buy it for its taste and 10

for quality. Interestingly, 17 respondents purchase yogurt for others, including friends and relatives. If we talk about the quantity of yogurt, we can see that most of the respondents (10) purchase one box of yogurt, whereas six respondents buy two boxes and 2 buy three boxes per visit.

Table 3: Education-wise preference for yogurt purchase

Education	Daily	Weekly	Others	Taste	Quality	Self	Others	Quantity		
								1kg	2kg	3kg
Matric	1	1	1	3	0	2	1	1	2	0
Intermediate	1	0	1	0	2	1	1	1	1	0
Bachelors	1	1	2	2	2	0	4	3	1	0
Above	5	3	10	8	10	1	17	10	6	2
Total	8	5	14	13	14	4	23	15	10	2

The consumption pattern of yogurt is summarized in Table 4. Mostly, yogurt was consumed by the whole family of NARC employees is 12. Likewise, the majority of outsiders consume yogurt but less than NARC employees (4). It is also apparent from the table that 7 of NARC employees eat yogurt once a day, whereas 4 use it 3 to 6 times a week. On the other hand, the majority (6) of the respondents from outside NARC consume yogurt more than once a day. Also, yogurt is mostly consumed at dinner time by the NARC employees. In contrast, most of the outsiders use it with breakfast or lunch.

Table 4: Yogurt consumption preferences

NARC Employees	Yogurt Consumption Pattern									
	Male	Female	Whole family	1to 2 times a week	3to 6 times a week	Once a day	More than once a day	With Breakfast	Lunch	Dinner
Yes	1 6.25	3 18.75	12 75	1 6.25	4 25	7 43.75	4 25	5 31.25	4 25	7 43.75
No	2 18.18	0	9 81.82	0	3 27.27	2 18.18	6 54.55	5 45.45	5 45.45	1 9.09
Total	3 11.11	3 11.11	21 77.78	1 3.70	7 25.93	9 33.33	10 37.04	10 37.04	9 33.33	8 29.63

The consumption pattern of yogurt in summer as compared to the whole year is depicted in Figure 2. It is observed that the consumption of yogurt in summer is

high as compared to the whole year, which is obvious in Figure 2.

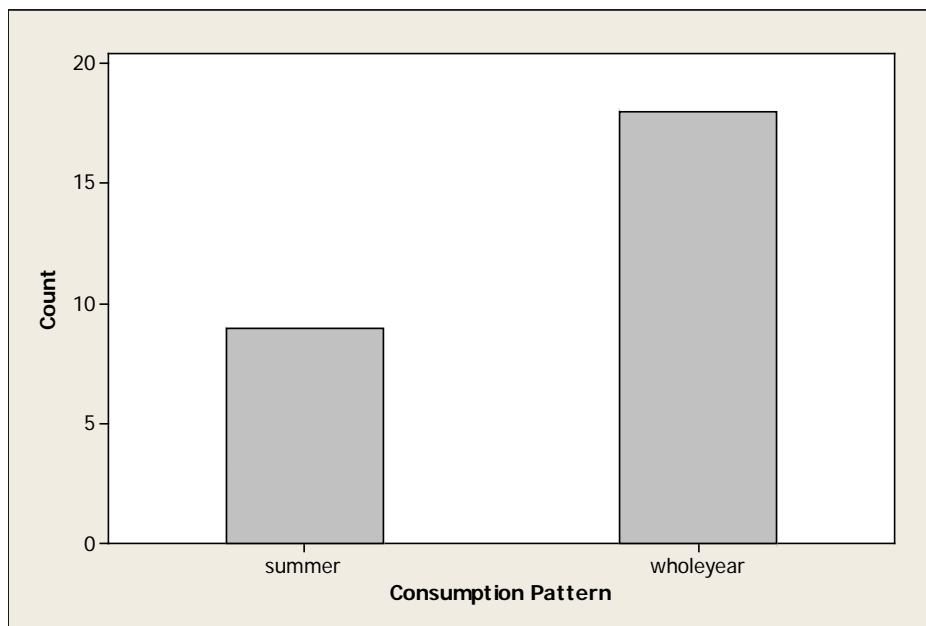


Figure 2: Consumption pattern of yogurt

The consumption of yogurt in summer as compared to routine is depicted in Figure 3. It is observed that the consumption of yogurt in summer (66.7%) is higher as compared to as per routine (33.3%).

It is concluded that mostly respondents use yogurt in the summer.

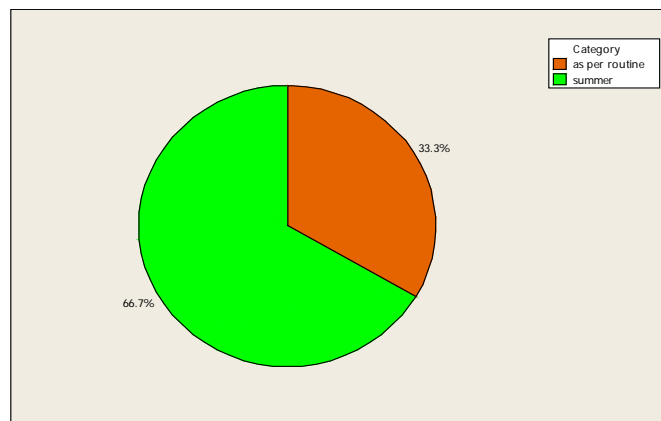


Figure 3: Increase consumption of yogurt



The satisfaction level of respondents about yogurt consumption is illustrated in Table 5. It is apparent from the table that overall acceptance level of yogurt was the most for yogurt buyers from outside NARC (72.27%) highly satisfied. In contrast, yogurt consumers of NARC showed a slightly less satisfaction (68.75%). Similarly, with regards to taste preferences, most of the respondents from NARC (62.50%) were satisfied. However, the low percentage of 54.55% was observed in the high satisfaction levels from outsiders. Additionally, the interest of yogurt buyers in terms of

flavor shows that the high percentage of NARC employees is 62.50 %, while 54.55% of outsiders were highly satisfied with the flavor. The perception of respondents about price depicted high satisfaction level (72.73%) of yogurt buyers from outside NARC as compared to NARC employees with (62.50%) satisfaction level. Likewise, the opinion of respondents regarding the packing size of yogurt implied a greater percentage (62.50 %) of NARC employees as compared to the outsiders with (54.55%) satisfaction level.

Table 5: Satisfaction level of yogurt consumers

NARC Employees	Overall Acceptability		
	Highly Satisfied	Satisfied	Neutral
Yes	3 18.75	11 68.75	2 12.50
No	8 72.73	2 18.18	1 9.09
Total	11 40.74	13 48.15	3 11.11
NARC Employee	Taste		
	Highly Satisfied	Satisfied	Neutral
Yes	5 31.25	10 62.50	1 6.25
No	6 54.55	4 36.36	1 9.09
Total	11 40.74	14 51.85	2 7.41
NARC Employee	Flavor		
	Highly Satisfied	Satisfied	Neutral
Yes	5 31.25	10 62.50	1 6.25
No	6 54.55	3 27.27	2 18.18
Total	11 40.74	13 48.15	3 11.11
NARC Employee	Appearance		
	Highly Satisfied	Satisfied	Neutral
Yes	5 31.25	11 68.5	0
No	8 72.73	2 18.18	1 9.09
Total	13 48.15	13 48.15	1 3.70
NARC Employees	Price		
	Highly Satisfied	Satisfied	Neutral
Yes	2 12.50	10 62.50	4 25
No	8 72.73	2 18.18	1 9.09
Total	10 37.04	12 44.44	5 18.52
NARC Employees	Packing size		
	Highly Satisfied	Satisfied	Neutral
Yes	2 12.50	10 62.50	4 25
No	6 54.55	3 27.27	2 18.18
Total	8 29.63	13 48.15	6 22.22

IV. CONCLUSION AND RECOMMENDATIONS

The results of this study indicated that most of the 44.4% yogurt buyers belonged to other professions, and 40% were scientists. Chi-square test of significance was employed to test the association between the yogurt buying preferences of NARC employees against the outsiders. The results showed that the buying preferences of NARC employees and outsiders were similar because the Chi-square test value was small, with a P-value greater than 5% level of significance.

Likewise, daily and weekly purchases of yogurt and interest in terms of taste and quality remained the same with or without having children due to low Chi-square test value, and the P-value is greater than 5% level of significance which implied association between the opinions of respondents with regards to buying preference of yogurt. However, the opinions of respondents about whether they purchase yogurt for themselves or others vary because the Chi-square test value is large with a P-value is less than 1% level of significance.

This study shows another interesting finding that most of the respondents had more than 14 years of education. Moreover, the maximum quantity of yogurt was purchased by respondents having above bachelor's degree education. The consumption pattern of yogurt was almost the same for NARC employees and outsiders though the timings of using yogurt varied. NARC employees ate yogurt at dinner time where as outsiders used it in breakfast.

The majority of the respondents were satisfied with regards to the qualitative characteristics of yogurt, for instance, overall acceptance, taste, flavor, price, and packing size. However, few suggestions were made regarding improvement in yogurt quality that it should be maintained, proper packing with good quality packing material, nutritional information should be mentioned, and lastly that PATCO should ensure an adequate supply of yogurt.

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GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D
AGRICULTURE AND VETERINARY
Volume 20 Issue 5 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Design, Construction and Testing of Hydraulic Oil Press for Groundnut Oil Extraction

By Benjamin Ternenge Abur, Bawa M. A, Abubakar Hamadu & Goni Usman

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Keywords: *hydraulic oil press, oil yield, extraction efficiency, improve capacity and efficiency.*

GJSFR-D Classification: FOR Code: 070199



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Design, Construction and Testing of Hydraulic Oil Press for Groundnut Oil Extraction

Benjamin Ternenge Abur ^α, Bawa M. A ^σ, Abubakar Hamadu ^ρ & Goni Usman ^ω

Abstract- This paper presents the design, construction and testing of a hand operated hydraulic oil press for groundnut oil extraction. The device consists of a pressure cylinder, pressure plates, hand operated hydraulic press and oil collector. The maximum design pressure of the device is put at 16.2N/mm² with groundnut holding capacity of approximately 1kg per batch. Materials for the construction of the device were selected to meet the design, safety, cost and service requirements of the device. Stainless steel was used for pressure cylinder, pressure plates and collector to avoid contamination of the oil while mild steel was used for constructing the frame. Other tools like steel rule/measuring tape and hacksaw for taking measurements and cutting of materials while vanier caliper for measurement of internal and external diameters of the pressure cylinder, plates and collector. The drilling and lathe machines were employed for drilling finishing, boring, and turning operations. The joining of parts was achieved using electric welding. Roasted groundnut seed is place between the layers of the pressure plates and the driven hydraulic press is used to compress the groundnut in the pressure cylinder to extract the oil which is then collected through the collector. The pressure cylinder consists of holes in which the extracted oil flows out of the cylinder. The press is released and the cylinder is taken away from the collector and the residual is removed with a press rod when the oil stops coming out. Test result show that an average weight of 0.2049kg oil is obtained from appropriately 1kg weight of roasted groundnut seeds which gives 21.8% of oil yield efficiency and extraction efficiency of 48.3% with an extraction loss of 0.33%. Considering the oil content of groundnut as 45%, it indicates that the simple hydraulic press could be effective in the oil extraction process with minimum extraction loss. It is recommended that it could be produce in relatively large number for usage in rural and semi-urban areas with no electricity to replace the traditional method while an electrically operated hydraulic press could facilitates small to medium scale businesses with improve capacity and efficiency.

Keywords: hydraulic oil press, oil yield, extraction efficiency, improve capacity and efficiency.

I. INTRODUCTION

Oil extraction is the process of recovering oil from oil-bearing products through manual process, mechanical or chemical method. The agricultural products are classified into oil seeds (cotton, castor, sunflower etc), nuts (coconut, groundnut, sheanut etc) and mesocarps or fruit (oil palm). Many type of oil are

obtained from these products with only a few of them being very significant in terms of world production and traded as major commodities (Robbelen *et a.*, 1989). These oil as well as their by-products are also very useful as food and non-food material for the production of snacks, cake, margarine, biscuits, cosmetics, detergent, plastic etc (). Oil production is important not only among small to medium scale industries but also to rural populace, employing quite a substantial workforce and also served as a source of income to many communities which engage in their productivity acativities (Abalu, 1978; UNIFEM, 1987).

Extraction of oil from oil-bearing products is mainly carry out in two major ways; the traditional method (primitive) and modern methods. The traditional method has been practiced for ages and is usually a manual process which involves preliminary processing and hand processing. This method is labour intensive, time consuming, unhygienic and has poor oil extraction leading to waste of oil. It is mainly practice in rural areas by farmers which have no access to electricity and income to afford modern machineries and equipment including the technical-know how for the extraction process. Traditionally, oil is extracted from groundnut by roasting and crushing to as fine as possible, afterward, the crushed mass is mixed with water and the oil is obtained by cooking the mixture causing the oil to float. The oil is finally skimmed off and directly heating (Hans, 1989. Ajao *et al*, 2010). The improve method of oil extraction can either be of chemical extraction or mechanical extraction method. The chemical extraction method requires the use of organic solvent to recover the oil from the product. Mechanical method employs the use of device like screw and hydraulic presses as a means of applying the pressure to the seeds for oil extraction (Gunstone and Norris, 1983). Other mechanical device includes oil expeller and improved Ghanis which are used for seed and nut because of the high pressure required to extract the oil (UNIFEM 1993). As reported by Norris (1964), Ward (1976) and Khan and Hanna (1983), the oil yield and quality depend on the content adjustment, heating time, pressure applied, operating temperature among others. The mechanical method involving the screw press is more reliable than the hydraulic press but is slower and produces less pressure, thus relatively low oil yield (Aseidu, 1984). Generally, the mechanical methods have relatively higher operating cost than the traditional method.

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However, they have higher efficiencies and are usually more adaptable for small to medium scale producers (Abubakar and Yiljeb, 1996).

Groundnut oil extraction in most developing nation such as those of the south Asia and Africa is usually done manually by hand and like all other manual operations, it is drudgery and time consuming. The groundnut *Arachis hypogea* also known as the peanut or earthnut is botanically a member of papilionaceae largest and most important member of leguminous (Hans and Frans 1989; Shankarappa *et al.*, 2003). It is very important oil seed and crop around the globe for its nutritional and trade value (Shankarappa *et al.*, 2003; Olaomi, 2008). Mainly native to warmer climate, groundnut frequently provides food for human or livestock and in the absence of meat, form a valuable dietary protein component (Hamos, 1994).

In Nigeria, groundnut is almost exclusively processed in combination with the utilization of the residue for human consumption and animal feed. In fact, often the by-product a kind of snack called by the Hausas in Nigeria as kulikuli. Groundnuts give edible and pleasant tasting oil for human consumption and are used as salad oil for cooking. The oil extracted from groundnut is called groundnut oil. The oil content of groundnut contains up to 50% oil (although the usual range is 25% - 30% protein (Hans and Frans 1989; Hamos, 1994).

Various attempts have been made to develop devices adaptable to the local farmers in Nigeria. The Institute for Agricultural Research, IAR at Ahmadu Bello University, Zaria developed a traditional model for groundnut oil extraction in 1995. The model was operated manually with the mortar installed and centred to ground for sterility and the pestle was clamped on the mortar such that it could be ported on the casing as it kneaded the ground pestle in the mortar (Eke, 1995) while at the National Agricultural Extension and Research Liaison Services, NAERLS Ahmadu Bello University, Zaria attempt was made to replace the traditional mortar and pestle with manually operated drum chamber and a stirring shaft and finger mechanism as reported by Abubakar (1996).

With the design and construction of a portable hydraulic press at afford cost will eliminate the manual labour involved in groundnut oil extraction, increase oil extraction output per unit time, make high yield groundnut oil affordable to the populace most especially the rural dwellers and also generate income to the local farmers.

II. MATERIALS AND METHODS

a) Materials and Tools

Materials for the construction of the device were selected to meet the design, safety, cost and service requirements. Stainless steel was used for the pressure

cylinder, pressure plates and the collector to avoid contamination of the oil while mild steel was used for constructing the frame.

Steel rule/measuring tape used for measuring length, hacksaw for cutting the frame material to the required dimension while vernier caliper for measuring internal and external diameter of the cylinder, plates and collector. The drilling machine was used for drilling holes on the plates and the cylinder, lathe machine employed for finishing, boring, drilling, and turning operations. The joining of parts was achieved using electric welding.

b) Methods

i. Design of the Machine Components

The various components of the machine were designed based on established theories and principle for each member as follows:

ii. Design of the Pressure Cylinder

a. Pressure Required for the Extractor

The pressure required is given as stated in equation 1 by Khurmi and Gupta (2005).

$$P = \frac{2 \times t \times \delta_a}{d} \quad \dots (1)$$

Where; P is the pressure, N/m²; t is the cylinder thickness, m; δ_a is the allowable stress of the cylinder material; d is the internal diameter of the cylinder, m

Compressive allowable stress for the cylinder material (Stainless steel) grade A403 (WP316) is 15300 Psi \approx 105.5 N/mm² (Robert –James sale, Inc, 2018).

iii. Area of the Cylinder

The area of the cylinder is given as stated in equation 2 (Khurmi and Gupta, 2005).

$$\frac{\pi}{4} [(D)^2 - d^2] \quad \dots (2)$$

Where; D is the external diameter of the cylinder, m; d is the interior diameter of the cylinder, m

iv. Capacity of the Cylinder

The maximum capacity of the cylinder is given by the total volume (V) of the cylinder as stated in equation 3 (Khurmi and Gupta, 2005).

$$V = \frac{\pi}{4} d^2 h \quad \dots (3)$$

Where; h is the height of the cylinder, m
The mass (M) of the groundnut is found by the relation

$$M = \rho \times v \quad \dots (4)$$

Where; ρ is the density of groundnut, kg/m³; V is the volume of the cylinder, m³

v. *Thickness of the Cylinder Wall*

The cylinder when subjected to an internal pressure experiences tensile stress acting tangential to the circumference. This tends to burst the cylinder along a longitudinal seam while the tensile stress acting in the direction of the cylinder axis causes failure across a transverse section of the cylinder (Bahl and Goel, 2010).

The total force, F acting on half of the cylinder and tending to rupture it along the cutting plane is given as

$$F = P \times L \times d \quad \dots(6)$$

Where; L is the length of the cylinder, m; P is the pressure, N/m²

The total resisting force in the cylinder walls is

$$F = 2 \times t \times L \times \delta_h \quad \dots(7)$$

Where; δ_h is the hoop stress,

Equating Equation 6 and 7 gives t

$$t = \frac{P \times d}{2\delta_h} \quad \dots(8)$$

Where; t is the cylinder thickness, m

The total force, F tending to rupture the cylinder along the transverse section is

$$F = \frac{\pi}{4} \times d^2 \times P \quad \dots(9)$$

Force resisting rupture is

$$F = \pi \times t \times d \times \delta_l \quad \dots(10)$$

Equating equation 9 and 10

$$t = \frac{Pd}{4\delta_l} \times d^2 \times P$$

Where; δ_l is the longitudinal stress.

Evidently, hoop stress is double in magnitude as compared to longitudinal stress. Thus the design of the cylinder is based on hoop stress. The hoop stress for a cylinder material in N/mm² its value may be taken as 35 Mpa to 100 Mpa depending upon the size and material of the cylinder (Khurmi and Gupta, 2005).

vi. *Design of Circular Flat Pressure Plate*

The thickness, t of a circular flat plate with uniformly distributed pressure over the area is given as stated in equation 12 (Khurmi and Gupta, 2005).

$$t = k_1 d \sqrt{\frac{P}{\delta_a}} \quad \dots (12)$$

Where; k_1 is the load factor; σ_a is the allowable design stress

vii. *Design of Frame*

The frame is design in such a way that the pressing operation can be carried out conveniently.

viii. *Design of the Rectangular Frame Base*

For a rectangular flat plate with concentrated load, the thickness is given as stated in equation 13 (Khurmi and Gupta, 2005).

$$t = k_3 \sqrt{\frac{a \times b \times F}{\delta_a (a^2 + b^2)}} \quad \dots(13)$$

Where; k_3 is the load factor; a is the length of the plate; b is the breadth of the plate.

The coefficient k_1, k_2 and k_3 depend on the plate material and the holding method at the edges.

Table 1: Table of coefficients

Material of the plate	Type of connection	Circular plate (k_1)	Rectangular plate (k_3)
Cast iron	Freely supported	0.54	4.3
	Fixed	0.44	4.0
Mild steel	Freely supported	0.42	3.45
	Fixed	0.35	3.0

ix. *Design of axially loaded column*

The jig or frame meant for carrying the pressing is a structure that contains columns and beams. Using the Euler formula as stated in equation 14.

$$F_{cr} = \frac{\pi^2 \times E \times I}{L^2} \quad \dots(14)$$

Where; F_{cr} is the crippling load; I is the moment of inertia; E is the Young's modulus; L is the length of member.

x. *Design of beam*

Beams are structural members that carry transverse loads which produce bending moments and shear with bending resistance. They could be horizontal, slopping or vertical and could be simple (having no end moments) or having moment at the each end of the span (continuous or fixed end). For this design, only simple beams existed and were designed appropriately.

Table 2: Summary of Design Calculations

Input	Calculation	Value
D = 122 mm d=104 mm	$\frac{\pi}{4} [(D)^2 - d^2]$	1357.17 mm ²
d=104 mm h = 183 mm $\rho = 580\text{kg/m}^3$ V =1554560.57mm ³	$V = \frac{\pi}{4} d^2 h$ $M = \rho \times v$	1554560.57mm ³ 1kg
$\sigma_a = 105.5 \text{ N/mm}^2$ t =8mm d=104mm	$P = \frac{2 \times t \times \delta_a}{d}$	16.2N/mm ²
P = 16.2N/mm ² d=104 mm $\sigma_h = 100\text{N/mm}^2$	$t = \frac{P \times d}{2\delta_h}$	8.42mm
$\sigma_a = 900\text{Mpa}$ $K_1 = 0.54$ d=104mm P = 16.2N/mm ²	$t = k_1 d \sqrt{\frac{P}{\delta_a}}$	7.5mm
$k_3 = 0.35$ $\delta_a = 900\text{Mpa}$ F = 21986.15N a = 170mm b =160mm	$t = k_3 \sqrt{\frac{a \times b \times F}{\delta_a (a^2 + b^2)}}$	122 mm

III. DEVICE MODE OF OPERATION AND COST

The machine consists of a pressure cylinder with layers of pressure plate. Roasted groundnut seeds are placed between the layers of the pressure plate. The essence of roasting the groundnut seeds is to increase the yield of oil extraction. The hand driven hydraulic press is used to compress the groundnut in the cylinder thereby extracting the oil. The cylinder

consists of holes in which the extracted oil flow out of the cylinder and is collected through the collector. When there is no more oil from the groundnuts, the press is release and the cylinder taken away from the collector and then the chaff is removed with a press rod. The unit cost of production of the groundnut oil extractor is put at #26,900 as at December, 2018 as shown in table 3.

Table 3: Specification and Cost Analysis

S/N	Item Description	Specification	Quantity	Rate (₦)	Cost (₦)
1	Stainless Steel Pressure Cylinder	Internal diameter 104mm, External diameter 122mm, Thickness 9mm	1	1000	1000
2	Stainless Steel Pressure Plate	Diameter 102mm, Thickness 7.5mm	3	450	1350
3	Stainless Steel Top Plate	Diameter 102mm, Thickness 15mm	1	800	800
4	Stainless Steel Collector	Internal diameter 130mm, External diameter 136mm, Depth 30mm	1	350	350
5	Rubber Cup		1	100	100
6	Drill Bit	Diameter 7mm and 6mm	2	200	400
7	Mild Steel Rectangular Base	Length 350mm, Breadth 165mm, Width 85mm	1	1500	1500
8	Mild Steel L-shape Bar	Height 305mm, Breadth 45mm, Width 55mm	4	250	1000

9	Mild Steel Rectangular Bar	Length 350mm, Breadth 55mm, Width 50mm	2	300	300
10	Hydraulic Press System	Potable size	1	15000	15000
11	Hacksaw Blade	Small size	1	200	200
12	Cutting Disc	250mm X 20mm	1	650	650
13	Welding Electrode	Gauge 12 mild steel	20 pieces	350	350
14	Paint	Green oil paint	Half Tin	600	600
15	Miscellaneous			3000	3000
TOTAL					26,900



Plate 1: Hydraulic Oil Press for Groundnut Oil Extraction

IV. RESULT AND DISCUSSION

a) Results

The test was carried out using three (3) varieties of groundnut seeds purchased at Yelwa Tundu market of Bauchi state. Each variety has a mass of 0.9432kg

and press operated 220 revolutions. At the end of each extraction process, mass of the extracted oil and residual were recorded as shown in the table below.

Table 4: Values of Test Result

Groundnut variety	1	2	3	Average
Weight of sample (kg)	0.9432	0.9432	0.9432	0.9432
Weight of residual (kg)	0.7386	0.7371	0.7298	0.7352
Weight of oil yield (kg)	0.2013	0.2029	0.2104	0.2049

Calculations

Average Weight of sample, $W_s=0.9432\text{kg}$

i. Average weight of residual, $W_R = \frac{0.7386 + 0.7371 + 0.7298}{3} = 0.7352\text{kg}$

ii. Average weight of oil yield, $W_{OE} = \frac{0.2013 + 0.2029 + 0.2104}{3} = 0.2049\text{kg}$

iii. Percentage of oil yield, $O_Y = \frac{100 \times W_{OE}}{W_{OE} + W_R} = \frac{100 \times 0.2049}{0.2049 + 0.7352} = 21.80\%$

iv. Extraction efficiency, O_{Ee}
 We know that the oil content of the seed is 45%

$$O_{Ee} = \frac{100 \times W_{OE}}{0.45 + W_s} = \frac{100 \times 0.2049}{0.45 \times 0.9432} = 48.30\%$$

v. Extraction loss (E_L)

$$E_L = \frac{100[W_s - (W_{OE} + W_R)]}{W_s} \% = \frac{100[0.9432 - (0.2049 + 0.7352)]}{0.9432} = 0.33\%$$

b) Discussion of Results

Table 4.2: Summary of Result

Average weight of sample (W_s)	0.9432 kg
Average weight of residual (W_R)	0.7352 kg
Average weight of oil yield (W_{OE})	0.2049 kg
Percentage of oil yield (O_Y)	21.8%
Extraction efficiency (O_{Ee})	48.3%
Extraction loss (E_L)	0.33%

The test result show that an average weight of 0.2049kg oil is obtained from appropriately 1kg weight of roasted groundnut seeds which gives 21.8% of oil yield and extraction efficiency of 48.3% with an extraction loss of 0.33%. Considering the oil content of groundnut as 45%, it clears shows that the simple hydraulic press could be effective in the oil extraction process with minimum extraction loss. Thus, it is recommended that it should be produce in relatively large number for usage in rural and semi-urban areas with no electricity to replace the traditional method currently in use for groundnut oil production while for medium scale businesses, the manual operated hydraulic press could be replace with electrically operated as this will increase the capacity and efficiency of the device.

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GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D
AGRICULTURE AND VETERINARY
Volume 20 Issue 5 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Institutional Factors and Crop Farmer's Participation in Agricultural Insurance Scheme: Evidence from South Western Nigeria

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Abstract- The paper investigated the effect of institutional factors on crop farmer's participation in agricultural insurance scheme in South Western, Nigeria. Specifically, the study described the socio-economic characteristics of crop farmers in the study area, examined the level of awareness of the crop farmers, analyzed the factors influencing the participation of crop farmers and intensity of use of the agricultural insurance policy and compare the income between the participating and non-participating crop farmers in the study area. Multistage sampling techniques was used to select 240 respondents in the study area. Primary data were used for the study which were sourced from cross-sectional survey of crop farmers in the study area with the aid of well-structured questionnaire. The data were analysed using descriptive, Cragg's (double-hurdle) model and t-test.

Keywords: agricultural insurance, participation, crop farmers, double- hurdle, south western.

GJSFR-D Classification: FOR Code: 079999



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Institutional Factors and Crop Farmer's Participation in Agricultural Insurance Scheme: Evidence from South Western Nigeria

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Abstract- The paper investigated the effect of institutional factors on crop farmer's participation in agricultural insurance scheme in South Western, Nigeria. Specifically, the study described the socio-economic characteristics of crop farmers in the study area, examined the level of awareness of the crop farmers, analyzed the factors influencing the participation of crop farmers and intensity of use of the agricultural insurance policy and compare the income between the participating and non-participating crop farmers in the study area. Multistage sampling techniques was used to select 240 respondents in the study area. Primary data were used for the study which were sourced from cross-sectional survey of crop farmers in the study area with the aid of well-structured questionnaire. The data were analysed using descriptive, Cragg's (double-hurdle) model and t-test. The result of the descriptive analysis showed that the mean age of participant and non-participant was 49.47 (± 16.36) and 48.19 (± 15.41) respectively, where the mean years of formal education for participants and non-participant were 10.23 (± 5.46) and 10.54 (± 5.72) respectively. The result of the Cragg's model in the first hurdle (Probit model) showed that variables such as education, access to credit, farm size, membership of association and awareness significant influence the decision of crop farmers to participate in agricultural insurance. In the second hurdle (truncated regression), access to credit, income, risk assessment and contact with extension was significant to intensity (continuous) use of agricultural insurance policy in the study area. The result of the t-test showed that there is a significant difference in the income of participants and those that does not participate in agricultural insurances scheme in the study area. Despite the fact that considerable proportion of respondents sampled were aware of agricultural insurance, there is still a need to increase awareness among the farmers so that more farmers can participate in the scheme in order to stabilize their income.

Keywords: *agricultural insurance, participation, crop farmers, double-hurdle, south western.*

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I. INTRODUCTION

Prior to the discovery of petroleum in Nigeria, Agricultural was the mainstay of the country's economy. Agriculture alone contributes about 57% to the GDP during this period (Oluyole and Sanusi, 2009). Crops like cocoa, groundnut, cotton, oil palm and livestock including cattle and goats were the major crops and livestock being produce during this period. However, Nigeria agriculture has witnessed many phases of policies till date even though those policies is yet to revive the stumbling situation of the agricultural sector in present day Nigeria. In Nigeria today, Agriculture provides employment for nothing less than 70% of the total work force (Obatolu, Fashina and Olaiya, 2003). Although majority of them being produce on a small scale. The agricultural sector is an important sector to Nigeria economy as it contributes substantially to the economy after the oil sector.

However, agriculture in Nigeria faces myriads of problem including pest and disease infestation, drought, flooding etc. (Obatolu, Fashina and Olaiya, 2003; Oluyole and Sanusi, 2009; Villalobos, 1989; Wood, 1985; Wright, 1993). Agriculture as an enterprise is faced with risk and uncertainties which has affected the productivity of farmers over time (Oluyole and Sanusi, 2009). Although, farmers have developed different strategies to cope with this unforeseen circumstances and events that might affect their production and output from their respective farms. One of the important strategy to cope with risk and uncertainties experienced on farm is agricultural insurance.

Agricultural insurance, in its widest sense may be defined as the stabilization of income, employment, price and supplies of agricultural products by means of regular and deliberate savings and accumulation of funds in small installments by many in favourable time periods to defend some or few of the participants in bad time periods (Arene, 2005). The term "insurance" is simply "a risk management strategy". The primary motive of any agricultural insurance policy is to serve as a security for losses resulting from natural disasters. Agricultural insurance is therefore the most important available device for minimizing the adverse effects of natural hazards. Nigerian farmers suffered various

losses on their investment and had no means of going back to production. The frustration made them to move into cities in droves in search of easy means of livelihood. This situation led to depletion of farming populace, which was a serious threat to food security. The Federal Government was disturbed by the ugly trend, hence the establishment of Nigerian Agricultural Insurance Corporation (NAIC) to address the need of farmers. The need for a specialized Agricultural Insurance Company to provide insurance cover to farmers was informed by Government's concern over the vacuum created due to the unwillingness of conventional Insurers to accept Agricultural risks, which they considered too risky. This led to the establishment of the Nigerian Agricultural Insurance Scheme on 15th of November, 1987. The implementation of the Scheme was initially vested on the Nigerian Agricultural Insurance Company Limited, which was later incorporated in June, 1988 but later turned into a Corporation in 1993 by the enabling Act 37 of 1993. Nigerian Agricultural Insurance Corporation is therefore a wholly-owned Federal Government of Nigeria insurance company set up specifically to provide Agricultural risks insurance cover to Nigerian farmers, the name which later changed to Nigerian Agricultural Insurance Scheme (NAIS). The Nigerian Agricultural Insurance Scheme (NAIS) is to protect the Nigerian farmer from the effects of natural hazards by introducing measures which shall ensure a prompt payment of appropriate indemnity (compensation) sufficient to keep the farmer in business after suffering a loss

Many studies (Akinola, 2014; Falola *et al.*, 2013; Ajiboye *et al.*, 2018; Oluwatusin *et al.*, 2018 and Akintunde, 2015) have been conducted to assess the situation of agricultural insurance policy use, acceptance and adoption by farmers in Nigeria. According to Akinola (2014), farmers' adoption of agricultural insurance will increase if there is increase in formal and extension education, higher level of awareness of insurance policy, more perception and concern for past experience with risk and less indifference resulting from too much confidence in their years of experience and alternative risk management strategies. According to Ajiboye *et al.* (2018), most of the farmers were influenced by the financial institutions (Bank of Agriculture (BoA)) compelling them to acquire insurance policy as a precondition for obtaining loans or as a practical response to some risks which they were faced with in the immediate preceding season. Akintunde (2015) ascertained that Stock size, rearing system, access to extension services and poultry rearing experience were significant variables that influenced the participation of the poultry farmers in livestock insurance policy.

However, majority of these studies used logit regression model to analyzed the determinants of the use and adoption of agricultural insurance policy among

the farmers in Nigeria. None of the studies on adoption of insurance policy in Nigeria had address the situation at hand using durable- hurdle regression (Cragg's model) in other to further ascertain the intensity of the use of insurance policy among the participating farmers in Nigeria taking into consideration the effect of institutional factors. In this study, the institutional factors considered includes, access to credit, contact with extension agent and membership of association. Specifically, the study described the socio-economic characteristics of crop farmers in the study area, examined the level of awareness of the crop farmers, analyzed the factors influencing the participation of crop farmers and intensity of use of the agricultural insurance policy and compare the income between the participating and non-participating crop farmers in the study area.

II. METHODOLOGY

a) Area of Study

The study was carried out in South-Western region of Nigeria. The South-Western region represents a geographical area covering between latitude 6° North and 4° South. It comprises six states which include: Ekiti, Oyo, Osun, Ondo, Ogun and Lagos State. The region is bounded in the north by Kogi and Kwara States, in the South by Atlantic Ocean, in the West by Republic of Benin and in the East by Edo and Delta State. The tropical climate of the region is broadly of two seasons: rainy season (April-October) and dry season (November-March). Temperature throughout the year ranges between 21°C to 29°C and humidity is relatively high. The annual rainfall varies from 2,000mm in the southern areas to 1,150mm in the northern areas. Agriculture is the mainstay of the region and 65% of the region labour force is in agricultural sub-sector (Folayan, Oguntade and Ogundare, 2007). The South western region of Nigeria can boast of different varieties of arable and tree crops as the climatic conditions support the production of various arable and tree crops including cassava, maize, groundnut, cotton etc. Farmers in this region are often faced with myriads of climatic problem with posed threat to agricultural production in this region. Agricultural insurance policy had been identified as an important strategy to combat risk and uncertainties to agriculture in this region, hence the choice of the study area for the study.

b) Sampling procedures and sample size

Multistage sampling procedures were employed for the study. The first stage involved purposive selection of three States including Ogun, Osun and Oyo States due to their high participation in agricultural insurance based on reconnaissance survey conducted during the 2017 agricultural season. The second stage involved the random selection of two Local Government Areas from each State. The third stage involved random selection of 20 participating and 20 non-participating

crop farmers in each of the selected Local Government based on a list of farmers obtained from ADP and NAIC offices in each State. Thus, a total of 240 respondents were used for the study. Primary data were sourced from cross-sectional survey of crop farmers in the study area with the aid of well-structured questionnaire to cover information about the socio-economic characteristics of respondents, awareness and level of use of agricultural insurance policy, output and income of the farmers and reasons for participation in agricultural insurance. Data were collected during the period of March, 2018-August, 2018.

c) *Analytical techniques*

The data were analysed using descriptive, Cragg's (double-hurdle) model and t-test

d) *Descriptive statistics*

Descriptive statistics were used to described the socio-economic characteristics, awareness and level of use of agricultural insurance policy in the study area.

e) *The Cragg's model two-step estimation procedure*

The Cragg's model was chosen for this study because it relaxes the restrictive assumption of the Tobit

model that the factors influencing the discrete decision (adoption decision) and the continuous decision (intensity of use) as well as their effects are the same. Hence, in the Cragg's model, the coefficients of the dependent variables of the first and second hurdle are different.

The first step analyses the factors influencing the decision of the crop farmers to use agricultural insurance policy, while the second step deals with the intensity of use of the agricultural insurance policy.

Step 1: Probit model for the discrete use decision

For the probit model, we assume that the decision of the 'i'th farmer to use agricultural insurance policy or not depends on an unobservable utility index Y_i^* , that is determined by the explanatory variables, and that the higher the value of this utility index the higher the probability that the farmer will use agricultural insurance policy. The decision probability (dependent variable) Y_i is limited between the values of 1 and 0.

$$Y_i = \begin{cases} Y_i^* & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* \leq 0 \end{cases}$$

The probit model is expressed as:

$$\text{Prob}(Y^* > 0) = F(X' \beta) = \Phi(X' \beta) = \int_{-\infty}^{X' \beta} \phi(Z) dZ$$

Where; $F(X' \beta)$ = cumulative degree of freedom of the standard normal distribution.

$$Y_i^* = X' \beta + e_i$$

$$X' \beta = \beta_0 + \beta_1 \text{AGE} + \beta_2 \text{GENDER} + \beta_3 \text{EXPER} + \beta_4 \text{EDUYRS} + \beta_5 \text{ACCRDT} + \beta_6 \text{FINCOME} + \beta_7 \text{FARMSIZE} + \beta_8 \text{LNDWNSHP} + \beta_9 \text{ASSN} + \beta_{10} \text{PERCEPTN} + \beta_{11} \text{RISK} + \beta_{12} \text{AWARE} + \beta_{13} \text{ACCMKT} + \beta_{14} \text{EXTN}$$

Where; Y = decision to Use (1= Use, 0= not use)

AGE is Age (years)

GENDER is Gender (1=male; 0=female)

EXPER is Experience (years)

EDUYRS is Years of Education (years)

ACCRDT is Access to credit (1=yes fertile; 0=no)

FINCOME is Income (#)

FARMSIZE is Farm size (ha)

LNDWNSHP is Land ownership (3=purchased; 2=leased; 1=borrowed; 0=inherited)

ASSN is Association membership (1=member; 0=non-member)

PERCEPTN is Perception (1=positive; 0=negative)

RISK is Risk affinity (#)

AWARE is Awareness (1=aware; 0=not aware)

ACCMKT is Access to market (1=yes; 0=no)

EXTN is Extension contacts (#)

Step 2: Model for the continuous decision (intensity of use using uncensored observations)

The second hurdle model uses the truncated regression model to determine intensity of use of agricultural insurance policy.

$$E(Y|Y^* > 0) = X'\gamma + \sigma\lambda\left(\frac{X'\gamma}{\sigma}\right)$$

Here the Cragg's model makes use of uncensored observations i.e. the observations with zero adoption level were not cut out of the observation, thus giving a better representation of the population.

$$X'\gamma = \gamma_0 + \gamma_1\text{AGE} + \gamma_2\text{GENDER} + \gamma_3\text{EXP} + \gamma_4\text{EDUYRS} + \gamma_5\text{ACCRDT} + \gamma_6\text{FINCOME} + \gamma_7\text{FARMSIZE} + \gamma_8\text{LNDWNSHP} + \gamma_9\text{ASSN} + \gamma_{10}\text{PERCEPTN} + \gamma_{11}\text{RISK} + \gamma_{12}\text{AWARE} + \gamma_{13}\text{ACCMKT} + \gamma_{14}\text{EXTN}$$

Where; Y = Intensity of use

AGE is Age (years)

GENDER is Gender (1=male; 0=female)

EXP is Experience (years)

EDUYRS is Years of Education (years)

ACCRDT is Access to credit (1=yes fertile; 0=no)

FINCOME is Income (₦)

FARMSIZE is Farm size (ha)

LNDWNSHP is Land ownership (3=purchased; 2=leased; 1=borrowed; 0=inherited)

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RISK is Risk affinity (#)

AWARE is Awareness (1=aware; 0=not aware)

ACCMKT is Access to market (1=yes; 0=no)

EXTN is Extension contacts (#)

T-test

This was used to achieve the impact of participation in agricultural insurance on farmers' income. It was specified as

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

X_1 = Mean income of participating farmers

X_2 = Mean income of non-participating farmers

S_1 = Standard deviation of participating farmers

S_2 = Standard deviation of non-participating farmers

n_1 = Sample size of participating farmers

n_2 = Sample size of non-participating farmers

III. RESULTS AND DISCUSSION

a) Socio-economic characteristics of respondents

The result of the socio-economic characteristics of the respondents were presented on Table 1. The mean age of participant and non-participant was 49.47 (± 16.36) and 48.19 (± 15.41) respectively. This shows that there is no major difference in the ages of both the participant and non-participant as the two categories were in their active and productive age. This result agreed with Falola *et al.*, 2013 who established that farmers in Nigeria were in mid and active age. As regarding gender, 53% of participants were male while 62% of the non-participant were male. This suggest that both male and female participant and non-participants

respectively were actively involved in crop production in the study area. This result agrees with Oluwatusin *et al.*, 2018. The mean years of formal education for participants and non-participant were 10.23 (± 5.46) and 10.54 (± 5.72) respectively. This suggest that crop farmers in the study area were literate as they possess considerable years of formal education. This result agreed with Ajiboye *et al.* (2018). The mean years of farming experience for participants and non-participants was 19.14 (± 11.19) and 19.32 (± 11.73) respectively. This implies that crop farmers in the study area had been into the business for many years and thus have the necessary experience to increase their production. From Table 1, 73% and 53% of the participants and non-participants respectively belong to one association or the other. This shows that the participant was more involved in society association than the non-participant. This might have influence the participant to take up agricultural insurance policy as they might have been influenced by group dynamism. This agree with Oluwatusin *et al.* (2018). About 86% of the participants had access to credit while 43% of the none participant had access to credit. This implies that the participant had more access to credit than the non-participant which might be largely due to their involvement in agricultural insurance. Furthermore, 76% of the participants had contact with extension agents while 51% of the non-participant had contact with extension agents. This implies that users of agricultural insurance in the study area had more contact than the non-users hence might have influence their decision to adopt agricultural insurance policy in the study area. The mean annual farm income of the participant and non-participant was 623543 (± 395839) and

482624(±294538) respectively. This result shows that there is a difference in their annual income. This difference might have been influence by the indemnity

received by the participant at the end of production season.

Table 1: Socio-economic characteristics of respondents by gender

Variables	Participant	Non-participant	Pooled
Age	49.47 (±16.36)	48.19(±15.41)	48.79(±145.25)
Male (%)	53	62	64
Years of formal education	10.23(±5.46)	10.54(±5.72)	10.38(±5.41)
Years of farming experience	19.14(±11.19)	19.32(±11.73)	19.12(±11.31)
Association membership (%)	73	52	68
Access to credit (%)	86	43	76
Extension contact (%)	76	51	61
Farm income	623543(±395839)	482624(±294538)	549302(±293746)

Figures in parenthesis are standard deviation

Source: Data Analysis, 2018

b) Respondents level of Awareness of Agricultural insurance policy

The level of awareness of the crop farmers as regarding agricultural insurance policy were presented on Table 2. The result shows that 73.3% of the crop farmers were aware while 26.7% were not aware. This

implies that majority of the farmers sampled have knowledge of the agricultural insurance in the study area although some of the crop farmers despite their knowledge of agricultural insurance policy, they still do not make use of the opportunity.

Table 2: Distribution of respondents by awareness

Awareness	Frequency (%)	Percentage
Yes	176	73.3
No	64	26.7
Total	240	100.00

Source: Data Analysis, 2018

c) Reasons for participating in agricultural insurance

The various reasons why crop farmers participated in agricultural insurance in the study area were presented in Table 3. 15.9% of the participants take up agricultural insurance policy due to uncertainty of climatic conditions. Crop farmers have been faced with problem of climate change in recent years and this had affected their farm output in recent times. So, in other to brace up with the inputs invested in their respective crop production, they take up agricultural insurance policy as a cover up against risk and uncertainties of weather condition in the study area. About 13.7% of the participants partook in agricultural insurance due to availability of optional policies. Thus, NAIC have different insurance policy cover for crop farmers and the crop farmers in the study area have the opportunity to choose and decide which policy best suit their needs. About 18.2% of the respondents used agricultural insurance because of government subsidization on premium since the government including federal and state government in which the enterprise is established is responsible for 50% of premium payable by the crop farmers. Also, 20.7% of the respondents utilized agricultural insurance because of easy access to credit facilities. Most of the financial lending institutions in Nigeria requires

agricultural insurance policy for granting loans and farmers have thus sees agricultural insurance policy as an easy gateway for obtaining credit facilities. This agrees with Ajiboye *et al.* (2018) who ascertained that most of the farmers were influenced by the financial institutions (Bank of Agriculture (BoA)) compelling them to acquire insurance policy as a precondition for obtaining loans. About 14.7% of the respondents participated in agricultural insurance policy due to prompt and early settlement of claims by NAIC. In time past majority of the farmers normally find it difficult to claim their indemnity. However, with the reform in NAIC in recent years, farmers have been experiencing early and prompt payment of indemnity and have thus encourage them in taking up agricultural insurance policy in the study area. Furthermore, about 16.8% of the respondents participated in agricultural insurance because of provision of effective technical assistance to farmers. NAIC had over the years granted expertise assistance to farmers who took up agricultural insurance with them educating the farmers on best agricultural practices to be adopted. This has helped improved farmers productivity over the years and also, the capital that the farmers would have literarily paid for expertise consultation were been saved in the process.

Table 3: Reasons for participating in Agricultural insurance

Reasons	Frequency	Percentage (%)
Uncertain climatic condition	91	15.9
Availability of optional policies	78	13.7
Government subsidization on premium	104	18.2
Easy access to credit	118	20.7
Prompt and early settlement of claims by NAIC	84	14.7
Provision of effective technical assistance to farmers by NAIC	96	16.8
Total	571	100.00

Source: Data Analysis, 2018

**Multiple response

d) Effect of Institutional Factors on Decision to Participate and Intensity of Participation in Agricultural Insurance

The result of the first hurdle (Probit model) was presented on Table 4. The study revealed that the generalized likelihood function was -83.583. The likelihood function implies that there is adequacy in the choice of explanatory variable set. The Prob > chi² statistic of 0.0893 (p < 0.10) obtained shows that the model gave a good fit for the analysis. From Table 4, variables such as education, access to credit, farm size, membership of association and awareness significant influence the decision of crop farmers to participate in agricultural insurance. Education was positive and significant at 1%. This implies that the higher the level of education attained by the crop farmers, the tendency to participate and use in agricultural insurance policy. This is possible because farmers tend to get enlightened based on their educational exposure. This result agreed with Olubiyo *et al.* (2009); Masoumi *et al.* (2013) and Farayola *et al.* (2013). Access to credit was positive and significant at 1%. Farmers access to credit facilities can encourage them to participate in agricultural insurance

as they tend to ensure that they insure the risk they might experience so that should they experience issues on their farm, they will be able to repay the loan through indemnity received from the insurance company. Farm size was positive and significant at 1% level of probability. It is logical that as farm size increases, the farmers tend to ensure that they practice a risk management strategy and their participation and use of agricultural insurance policy might be possible. This result is consistent with that of Fallah *et al.* (2012). Membership of association was positive and significant at 5% probability level. This implies that group dynamic can influence the decision of crop farmers to use agricultural insurance policy in the study area. Farmers tend to be briefed about the necessity of agricultural insurance through their regular involvement in cooperative societies. Furthermore, Awareness was positive and significant at 10% level of probability. This shows that increased awareness on the importance of agricultural insurance to farmers might increase the chances of crop farmers participating in agricultural insurance in the study area. This agreed with Ajiboye *et al.* (2018).

Table 4: First hurdle (decision to use)

Variables	Coefficients	Std. Error	T-value
CONSTANT	0.110***	0.007	15.74
AGE	0.020	0.020	1.01
GENDER	0.001	0.005	0.28
EXPERIENCE	0.197	0.139	1.42
EDUCATION	0.042***	0.007	5.63
ACCESS TO CREDIT	0.174***	0.049	3.56
INCOME	189.135	273.029	0.69
FARM SIZE	5618.24***	1183.819	4.75
LAND OWNERSHIP	-0.045	0.029	-1.52
ASSOCIATION	0.610**	0.273	2.24
PERCEPTION	0.013	0.021	0.63
RISK ASSESSMENT	0.197	0.139	1.42
AWARENESS	12.686*	7.054	1.80
ACCESS TO MARKET	6.158	112.629	0.05
EXTN. CONTACT	0.044	0.054	0.82
LRchi ²	14.74		
Log likelihood	-83.583		
Prob > chi ²	0.08930		

*, **, *** Significant at 10, 5 and 1% respectively

Source: Data Analysis, 2018

From Table 5, the second hurdle shows that access to credit, income, risk assessment and contact with extension was significant to intensity (continuous) use of agricultural insurance policy in the study area. Access to credit was positive and significant at 5% probability level. This implies that farmers continue to use and participate in agricultural insurance as long as they continue to access credit facilities in the study area. This is true because lending institution will continue to ask for agricultural insurance policy of the farmers before new credit facilities were given to them. Income was positive and significant at 1% level of probability. When farmers take up agricultural insurance policy, their income is expected to be stabilized and their income

increases they tend to continue the use of agricultural insurance policy. Risk assessment was positive and significant at 5% probability level. As crop farmers assessed the risk they encountered before and after their involvement in agricultural insurance, they tends to continue the use of agricultural insurance and they likely found out that the risk they encountered after their involvement in agricultural insurance weigh less than before. Contact with extension agent was positive and significant at 10% level of probability. This implies that as long as the farmers continue to have contact with extension agents, they tend to be encourage continuously to participate in agricultural insurance in the study area.

Table 5: Second hurdle (intensity of use)

Variables	Coefficients	Std. Error	T-value
CONSTANT	0.400	0.375	1.06
AGE	4.353	4.518	0.96
GENDER	1.822	6.050	0.30
EXPERIENCE	1.061	4.488	0.23
EDUCATION	0.005	0.021	0.23
ACCESS TO CREDIT	0.318**	0.141	2.25
INCOME	2.260***	0.744	3.03
FARM SIZE	0.947	0.903	1.04
LAND OWNERSHIP	0.005	0.335	0.01
ASSOCIATION	1.219	1.711	0.71
PERCEPTION	0.004	0.157	0.02
RISK ASSESSMENT	0.445**	0.066	6.74
AWARENESS	0.027	0.052	0.51
ACCESS TO MARKET	0.033	0.026	1.50
EXTN. CONTACT	0.021*	0.012	1.75
LRchi ²	19.47		
Log likelihood	-95.628		
Prob > chi ²	0.09247		

*, **, *** Significant at 10, 5 and 1% respectively Source: Data Analysis, 2018.

e) T-test result showing the differences between the net income of the crop farmers participating and those not participating in agricultural insurance

T-test (Table 6) result shows that there is significant difference between the net income of the crop farmers participating and those not participating in

agricultural insurance. This confirmed that the users of agricultural insurance policy had more net income than the non-participant at the end of the production season. This might be possible due to indemnity received by the participant after assessing their loss by the insurance company at the end of the production season.

Table 6: T-test result showing the differences between the net income of the crop farmers participating and those not participating in agricultural insurance

Variable	Mean difference	Standard error difference	T-test
Net income	34739.467***	148296.531	4.729

Source: Data Analysis, 2018.

***significant at 1 percent

IV. CONCLUSION AND RECOMMENDATIONS

The study concluded that crop farmers in the study area were in their active age, literate and had the necessary experience in carry out their farming activities. In addition, the study concluded that farmers who

participated in agricultural insurance had access to credit and had more contact with extension agents. Considerable proportion of crop farmers were aware of agricultural insurance in the study area. Furthermore, in the first hurdle (Probit model), variables such as education, access to credit, farm size, membership of

association and awareness significant influence the decision of crop farmers to participate in agricultural insurance. In the second hurdle (truncated regression), access to credit, income, risk assessment and contact with extension was significant to intensity (continuous) use of agricultural insurance policy in the study area. The result of the t-test showed that there is a significant difference in the income of participants and those that does not participate in agricultural insurances scheme in the study area.

Therefore, based on the findings of the study, the following recommendation were made in other to encourage farmers to participate in agricultural insurance;

- i. Farmers should be encouraged to get more education inform of training which will increase their chances of participating in agricultural insurance in other for their income to be stabilized.
- ii. Credit facilities should be made available to the farmers so as to increase their level of production which will instigate them to participate in agricultural insurance.
- iii. Farmers should be encouraged to join more association which will benefit them in many ways such as assessing loans which eventually instigate them to participate in agricultural insurance.
- iv. Despite the fact that considerable proportion of respondents sampled were aware of agricultural insurance, there is still a need to increase awareness among the farmers so that more farmers can participate in the scheme in other to stabilize their income.

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GLOBAL JOURNAL OF SCIENCE FRONTIER RESEARCH: D
AGRICULTURE AND VETERINARY
Volume 20 Issue 5 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Diversity, Distribution and Domestication of Leguminous Plants in Zamfara State Nigeria

By Sani Hamza & Dr. Lawal Mohammad Anka

Abstract- The ecosystems of savannas and grasslands, provide habitat of important species, regulate an important part of the Earth's nutrient cycles, and serve many purposes for people. Features of these ecosystems, includes the unique coexistence of tree and grass life forms in savannas. The study therefore described the Diversity, distribution and domestication of leguminous plants in Zamfara state northwest Nigeria. The study tends to expose the variety, division and domestication of leguminous plants such as; crops, trees, grass and shrubs. Multistage random sampling technique was employed for the study four local government areas were selected where 25 farmers in two districts in each LGA were also randomly selected. The result of the study indicated that 49.5% of the respondents said leguminous crops were found to be distributed and domesticated, while 5.9% of the respondents and 5.0% indicated that leguminous shrubs and leguminous grass are also found in the study area. 28.7% of the respondents revealed that all types of savanna leguminous plants are found in Zamfara states which are economically important to human life. However, the study suggested requires that government should, Research bodies should explore further the potentials of wild and other leguminous plants for the benefit of our farmers and their livestock.

Keywords: crops, distribution, diversity, domestication grass, leguminous, plants and shrubs..

GJSFR-D Classification: FOR Code: 060799



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Diversity, Distribution and Domestication of Leguminous Plants in Zamfara State Nigeria

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Abstract- The ecosystems of savannas and grasslands, provide habitat of important species, regulate an important part of the Earth's nutrient cycles, and serve many purposes for people. Features of these ecosystems, includes the unique coexistence of tree and grass life forms in savannas. The study therefore described the Diversity, distribution and domestication of leguminous plants in Zamfara state northwest Nigeria. The study tends to expose the variety, division and domestication of leguminous plants such as; crops, trees, grass and shrubs. Multistage random sampling technique was employed for the study four local government areas were selected where 25 farmers in two districts in each LGA were also randomly selected. The result of the study indicated that 49.5% of the respondents said leguminous crops were found to be distributed and domesticated, while 5.9% of the respondents and 5.0% indicated that leguminous shrubs and leguminous grass are also found in the study area. 28.7% of the respondents revealed that all types of savanna leguminous plants are found in Zamfara states which are economically important to human life. However, the study suggested requires that government should, Research bodies should explore further the potentials of wild and other leguminous plants for the benefit of our farmers and their livestock.

Keywords: crops, distribution, diversity, domestication grass, leguminous, plants and shrubs.

Foreword- Zamfara State is one of state out of 36 that makes Nigeria is located between latitude 10°40' N – 13°40' N and longitude 4°30' E – 7°06' E within Savannah ecology, which can be divided into Sahel, Sudan and Northern Guinea Savannah. Having been located in this kind geographical location the state is bestowed with abundant growing grass, trees, shrubs and other natural surviving micro organisms. In existence are leguminous plants that include both herbaceous and woody types available for people. About 62% these people are agrarian living within rural areas and depending on agriculture and agriculture related activities for Livelihood Given the role Agriculture plays in stimulating the process of economic growth and development through increased production processing marketing and development of small scale Agro-business its development is crucial in the generation of broach based economic growth necessary for rural development.

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The peoples' utmost dependence on Agriculture that provides food and income for growth of the state the and Government of Zamfara that's what contributed to cultivation and domestication of numerous leguminous crops plants, trees, shrubs and perennial or annual which bring about increasing the food and nutritional security of poor people and enhancing the environment through the better management of natural resources in the agro ecosystem. The leguminous crops identified for cultivation in the state are such for food and oil; cowpea, Groundnut, soybean Bambara nut while Leguminous tree species are important rural health care through provision of drugs for treatment to rural communities providing food, medicine, firewood, charcoal, fodder, green-manure and timber. Yet there a lot of these abundance plants useful in different ways that are not explored and domesticated beneficial to people. The research conducted by Dr Sani Hamza is original and significant in terms of health livelihood, policy implication for future agriculture and rural development programmes in Zamfara state and the country in general. The author being a scholar his dedication, perseverance and team work can be judged from the quality of data and interpretation of inferences that are incorporated in his work. The analysis presented in this book should enable agricultural scientist, policy makers and all stake holders to gain a deep insight into the working of agricultural sector in Zamfara state and to highlight its predicament.

I confirm that the work is exceptional and has indeed contributed to advancement of knowledge. I recommend this book to all agricultural professionals, under graduate and postgraduate students and all those who intend to conduct advance research on the subject matter will find this book a useful reference maternal.

Preface

Several Agricultural components have been very beneficial to man; plants, livestock, fishery etc. ranging from food, medicine, shelter, power, income, enhance environment etc. savannas and grasslands, provide habitat of important species, regulate an important part of the Earth's nutrient cycles, and serve many purposes for people. Distribution and Domestication of leguminous in Zamfara have remarkably uplift the growth income of teeming farmers and state

CHAPTER ONE

I. INTRODUCTION

government, most of the cultivated leguminous crop were main for national consumption and export at proving its great importance to the welfare and economy of farmers.

The book was written to study Diversity, distribution and domestication of leguminous plants in Zamfara state Nigeria, which is composed of five chapters. Methodology in the process demonstrated an illustrative analysis of farmer's socio economic status (standard) that indicated farmers' income, yield level, use of resources in leguminous farming business. Potentials of these leguminous plants were also disclosed, so it exposed several among others: benefit for food, livestock feeds, medicine, shelter and climate mitigation etc, Nutritional values, the type and amount of tannins of acacia tree foliage (*Acacia karroo*, *Acacia nilotica*, *Acacia tortilis*, *Acacia galpinii*, *Acacia sieberiana*, *Acacia hebeclada* and *Acacia rhemniana*) were also revealed. The wide distribution of both leguminous trees, crops, shrubs and grasses cultivated and domesticated for their importance and wild ones provided mankind with both products and environmental services and its vital role was disclosed.

Furthermore, many trees were grown in association with the main crops as their seed were preserved by farmer who use them. The study also recommends the need for essential use of these leguminous plants in modern medicinal process to increase the income of the people and government should intensify effort to reveal and explore the potentials of wild and other leguminous plants for the benefit of our farmers and their livestock. The audience of this book should be of interest to higher level decision makers of private and public organization. It should also be useful to farmers, students, extension agents and researchers.

List of Acronyms

ADP-agricultural development project
CP- crude protein
DM – Dry matter
FMARD-Federal ministry of Agriculture and Rural Development
FAO- Food and Agricultural Organisation
ICRAF- International Center for Research in Agro forestry
IFAD- International Fund for Agricultural Development
LGAs- Local Government Areas
ZACAREP-Zamfara comprehensive
ZADP- Zamfara Agricultural Development Project
ZASIDEP-Zamfara State Integrated Development Programme
ZMSG- Zamfara State Government

Legumes (Fabaceae) are most important crop plants that provide 33% of the dietary protein consumed by humans, while pasture and forage legumes provide vital part of animal feed. Legumes are divided into the following three subfamilies: Caesalpinioideae, Mimosoideae, and Papilionoideae, all together with 800 genera and 20,000 species. The latter subfamily contains most of the major cultivated food and feed crops. (Taylor and Francis 2015).

Legumes (grain and forage) constitute the second largest group (1,041,345 accessions, 15% of all [FAO, 2010]) after cereals. Similarly the Zamfara state annual average yield of major crops from 2011-2016 indicated that leguminous crops such as groundnut (140,600mt), cowpea (170,965mt) and soybean (9,860mt) are second largest crop produced after cereals like sorghum with (780,100mt),millet (550,150mt), and rice (41,970 mt). (ZADP, 2016)

Taylor and Francis, (2015) the importance of legumes is evidenced by their high representation in ex situ germ plasm collections, with more than 1,000,000 accessions worldwide. Among the grain legumes are some of mankind's earliest crop plants, whose domestication paralleled that of cereals: Soybean in China; faba bean, lentil, chickpea and pea in the Fertile Crescent of the Near East; cowpeas and bambara groundnut in Africa; soybean and mungbeans in East Asia; pigeon pea and the grams in South Asia; and common bean, lima bean, in Central and South America.

The most common among them produced in Nigeria are Soybean, bambara nut, groundnut, mungbeans and different domesticated ones like common centro (*centrosema pubescens*), lablab, hyacinth bean (lablab, hyacinth bean), siratro (*macroptilium atropurpureum*), schofield stylo (schofield), cook stylo (*s.guinensis* cv. Cook) verono stylo (*s.hamoto* cv. Verano), Townsville stylo (*s.humilis*) axillaris (*macrotylomo axillare*), horsegram bean (*M. uniflorum*), leucaena (*leuceana leucocephala*) (FMARD,2012).

The domestication of wild species annual and perennial plants such as spontaneous plants describes as plants growing naturally and freely in wild state are surrounded in our environment, other sub spontaneous are wild but indirectly encourages their growth and spread. These plants are plentiful near compounds, by the road side and in orchards, although they are not planted there deliberately. An example of Foetid cassia is a bushy legume cultivated for its leafy shoots. It is usually growing wild in savanna or as a weed in fields. However, in some places, it is domesticated on the edges of fields or in compounds. (Dupriez and philippe,

1989) in west Africa, many trees such as African locust bean, tamarind, shea butter, baobab and the silk cotton tree grow in association with the main crops. From time immemorial, the wild seedlings of these plants have been respected by farmers who wish to preserve them. In fact, these plants are sub-spontaneous species which man has gone to the trouble of conserving, although they are largely sown in nurseries with a view to permanent planting. Their multiplication in this way, however, is quite feasible and would be profitable for the farming community.

a) *Aims and objectives*

The main purpose of the study carried out based on distribution and diversity of leguminous plant (fabaceae) in Zamfara state with all focuses to find the different species of trees, shrub, and perennial or annual herbaceous plant.

i. *Objectives*

1. To identify the socioeconomic status of farmers involve in leguminous plants production
2. To identify and document the leguminous taxa present in Zamfara.
3. To classify the various leguminous taxa according to their growth pattern and economic use
4. To provide botanical illustrations with colour photographs of all the species found.

ii. *Scope*

The study is focus on the diversity and distribution legumous plan (fabacaea) in zamfara state north western Nigeria.

iii. *Problem Statement*

Legumes have Several uses varying from traditional food and forage uses, medicine, soil cover increasing soil fertility, legumes are used in industries prepared as milled food etc. this are in line with Garcia *et al.*, (1998) legumes can be milled into flour, used to make bread, doughnuts, tortillas, chips, spreads, and extruded snacks used in liquid form to produce milks, yogurt, and infant formula. Gathumbi *et al.* (2002) Legume tree fodder with high levels of crude protein and minerals, and in some cases, good digestibility is readily accepted by livestock. Fertilization with rock phosphate is often needed to improve the N benefits from tree fallows. Legumes have been used industrially to prepare biodegradable plastics, oils, gums, dyes, and inks, Galactomannan gums derived from *Cyamopsis* spp. and *Sesbania* spp. are used in sizing textiles and paper, as a thickener, and in pill formulation. (Paetau *et al.*, 1994, and Morris, 1997). In Nigeria many leguminous crop have long ago been domesticated like common centro (*centrosema pubescens*), lablab, hyacinth bean (lablab, hyacinth bean), siratro (*macroptilium atropurpureum*), schofield stylo (schofield), cook stylo (*s.guineensis* cv. Cook) verono stylo (*s.hamoto* cv.

Verano), Townsville stylo (*s.humilis*) axillaris (*macrotylomo axillore*), horsegram bean (*M. uniflorum*), leucaena (*leuceana leucocephala*) (FMARD, 2012) Domestication in Zamfara were mostly common food crops like cowpea, soy bean, bambara nut and groundnut etc. As report Hamza, (2017) Technology disseminated to farmers' includes by ZACAREP (Zamfara comprehensive agricultural revolution programme) improved crop production processing, group/association formation and management, marketing The crops among others include maize, rice, sorghum, millet, groundnut, cowpea, sesame, soya bean, and cotton for wet season and wheat, vegetables, cowpea and green maize for dry season. There are Different taxa, e.g., fruits or tubers and other cover grass) but these shows little or no clue of the distribution or the diversity of numerous leguminous plants in the north western part of Nigeria in (Zamfara state) that what become most imperative or leads to view about the understanding of the distribution and diversity of these legumes plants.

CHAPTER TWO

II. LITERATURE REVIEW

a) *Socio-economic Characteristics of the Farmers involved in the leguminous plants Production*

Food legume cultivation as an economical and sustainable means of drastic reduction over-dependence on external inputs such as inorganic fertilizers and widely used for food, fodder, shade, fuel, and timber, as cover crops and for green manure. The socio-economic characteristics Farmers involved in the leguminous plants Production. Relationship exists between age, farming experience, household size, education and farm size.

Ani *et al.*; (2005) revealed that as one advances in age, the number of legume crops planted also increases. This is likely due to the fact that as one gets older, there is the tendency for one to be more knowledgeable about the crops that improve soil fertility while at the same time provide foods and cash income. Also the positive relationship between farmers' household size and number of legume crop planted is likely due to the fact that the higher the household size, the higher the availability of family labour a farmer has to diversify into the cultivation of more legume crops. The positive relationship between farming experience and the number of legume crops a farmer plants is in line with the expectation that the more experienced a farmer is in farming, the more potentials he has to differentiate crops that give highest income, best as food, increases soil fertility and high yield and therefore the tendency to plant them based on his needs.

i. *Important of leguminous plants*

Leguminous plants are of great attention in agriculture; these plants represent the primary source of

food for all animals, addition of materials to the young body, used in parallel with food crops to enrich the soil with natural fertilizers (ammonium). Plants also play important roles in Man welfare and his economy to a degree not popularly (Muhammad and. Amusa, 2005).

Nieuwenhuis and Nieuwelink (2002) Legumes take up nitrogen from the air and pass it on to the soil, thereby improving soil fertility. Furthered by saying some beans are a good source of oil (groundnuts and soya beans), others are good for cooking, either as whole beans or pulses or as split beans or peas. Some beans are ground into flour which is used to prepare a number of foods. After the beans have been harvested the crop remains make a good source of animal feed.

Leguminous plants are capable of manufacturing organic matter using the solar energy of the sun, green plants thus supply food to all animals and Proteins are the foods that enable the body to replace Not only do or repair wounded parts, and which ensure growth by addition of materials to the young body several plants including humans but a large number of plant species are very rich in protein, and these include beans, Other legumes, the seeds of various plants groundnuts, cowpea and green grain.

Legumes may have long-term benefits on some soils that again are difficult to convert into monetary value. Usually legume rotations, compared to continuous grain cropping result in enhanced soil organic matter content and mineralizable N. Thus, the overall advantages of any legume technology according to is to increase yield, improved resource use efficiency, crop diversification and reduction of environmental pollution (Ani *et al.* 2014).

Muhammad and. Amusa (2005) Legume and nut: Leguminous tree species are important rural health care through provision of drugs for treatment to rural communities throughout the tropics for providing food, medicine, firewood, charcoal, fodder, green-manure and timber. *Pakia biglobosa* has been described as a Savannah tree with a crooked and short bole of about 20-30 metres tall.

The natural habitat of some legumes like *Pakia biglobosa* in savanna which may also be found in the moist forest area of West Africa, its uses is well documented. In Nigeria it is eaten both the sweet-tasting pulp and the embedded black seeds. Purse glove, F.A.O. (1990).and Okafor (1993)reported that the seeds are fermented and used as a condiment throughout West Africa. They documented that.

- Seeds are used as soup condiment;
- The yellow pulpy coating around the seeds keeps well and can be eaten with cereals, as porridge or as cake;
- The leaves enrich compost with nitrogen and potash;

- Drinks are made from both seeds and leaves;
- Whole pods are fed to livestock (in northern Nigeria);
- dyeing pots and for glazing pottery;
- Young flower buds are used for prevention of leprosy;
- A husk combination is taken for diarrhea; and the whole tree is grown as avenue tree in drier regions.

b) *Types of legumes*

Legumes: These belong to three different families (Mimosoideae, Caesalpinoideae and Papilionaceae) depending on the nature and shape of their flowers. They have broad leaves with net venation pattern. They are herbaceous plants with flowers occurring mainly at the terminal buds. However, it is also possible to have flowers in other parts of the plant such as auxiliary branches. These flowers produce seeds in pods. Examples include *Centrosema pascourum*, *Alysicarpus vaginalis* and *Mucuna pruriens*. (Hassan, 2013).

i. *Potentials of Fodder Trees and Shrubs*

Plants, especially the leguminous trees and shrubs are often higher in crude protein and other nutrients and play a vital role as dietary supplements.



Source; ZADP, 2018 *Parkia biglobosa* (doruwa) available tree crop in zamfara

Mokoboki *et al.*, (2005) reported that the nutritional values, attached to acacia tree foliage (*Acacia karroo*, *Acacia nilotica*, *Acacia tortilis*, *Acacia galpinii*, *Acacia sieberiana*, *Acacia hebeclada* and *Acacia rhemniana*). These species had crude protein levels above 100 g/kg dry matter (DM), ranging from 103 g/kg DM for *A. rhemniana* to 183 g/kg DM for *A. sieberiana*. He further concluded that all the species except *A. galpinii*, *A. karroo* and *A. tortilis* are of good nutritive value. Smith *et al.* (2005) pointed that improved performance of goats resulting from supplementation with *D. cinerea* fruits. In addition, Basha *et al.*, (2009) reported *D. cinerea* to have 123.2 g/kg CP, and low tannin content (57.9 g/kg).

Fodder trees and shrubs from some type of leguminous family, these plants (shoots or sprouts, especially tender twigs and stems of woody plants with their leaves, flowers, fruits or pods) are used as animal feed, processed and managed to feed livestock. Fodder plants are plants which are grown in order to provide the nutritional needs of animals. Babayemi and Bamikole, (2006) opined that fodder and shrubs are important components of ruminant diet and they have been found to play an important role in the nutritional requirement of grazing animals (Van *et al.*, 2005). Osemeobo (1996) also observed that fodder is consumed in the livestock industry and the savannah areas account for about 10-15% fodder as livestock food in the dry seasons. Fodder

trees and shrubs were noted to support livestock such as-cattle, sheep, goats, donkey and camel - in the dry season.

Elevitch and Wilkinson (2000) supported that fodder trees and shrubs have several applications and uses, Wind shelter, Living fence, Improved fallow, Improved pasture, Mulch, Bee forage, Human food, Fuel wood, Timber, Fiber, Resins, Dyes, Tannins, Medicine, Food, Fertility enhancement, Soil stabilization, Beauty, Oxygen, Wildlife habitat, Bird habitat, Increased self-sufficiency, Nutrient cycling, Farm diversity.

ii. *Leguminous Crop production*

Food supply to man by plants falls into several categories, which include carbohydrates, proteins, and oils, vitamins and salt, and beverages. One may also add the spices to this category; Soya is a legume with many good qualities, and it can be used to improve farming systems. It can also be processed into products which contribute to the daily diet and to family income. (Nieuwenhuis and Nieuwelink, 2002.)

There are 450,000 farming families in Zamfara State, most of whom are small-scale farmers having less than 5 hectares of land. Majority of the farming families practiced mixed farming. The rain fed crops grown are millet, sorghum, rice, maize, cowpea, cotton and groundnut. During the dry season farmers in the State produce mainly vegetable crops such as tomato,

lettuce, carrot, onion, pepper and spinach (ZMSG, 2001; Saddiq, 2012).

Supported with ZACAREP (Zamfara comprehensive agricultural revolution programme) Technology to farmers on improved crop production processing, group/association formation and management, marketing etc. The major crops among others include maize, rice, sorghum, millet, groundnut, cowpea, sesame, soybean, and cotton for wet season and wheat, vegetables, cowpea and green maize for dry season. (ZASIDEP, 2004).

Leguminoceae:

There are three (3) important families. They are

1. Papilionaceae
2. Caesalphiaceae
3. Mimosaceae

1. *Papilionaceae – Trees, Shrubs & Herbs.*

Trees-

- *Andirainermis* (Gwaska) NT, A, N, P, So, Z, N.
- *LonchocarpusLoxiflarus* (Shuninbiri) NT, A, Ba, Bo, Kn, P, So.
- *OstryoderrisStuhlmanii* (Durbi) NT, I, N, So, Z, W.
- *Ormacarpumbibracteatum* (Faskaragiwa) Nt, Ba, N, P, So
- *AfrormosiaLaxiflora* (Makarfo) NT, Ba, Be, I, Kb, Ka, So, W, Z, E, W, M
- *Pteracarpuserinaceus* (Madobia) NT, I, Kn, N, So, Z

2. *Caesalphiaceae*

- *Afzella Africana* (kawo) NT, Ba, Be, I, Kb, N, P, Z
- *Cassia arereh* (malga, gamafada) NT, Kb, Kn, Br, P, So, Z
- *Cassia Sieberiana* (gamafada, malga) NT, Kb, Kr, So, often planted
- *Cassia Singueana* (Runtu) NT, Kr, Kt, P, Z, So
- *DanielliaOliveri* (maje) NT, Ben, I, Kb, N, P, A, Z
- *TermarindusIndica* (Tsamiya) NT, A, Ba, Bo, Kt, P, So, Z
- *Isoberialiadoka* (Doka) NT-Ba, Bo, P, So, Z, N
- *Isoberialiatomentosa* (farardoka) NT, A, I, N, P, So, Z
- *Detariummacrocarpum* (Taura) NT, I, W, Kb, So, N, A
- *Bauhinia rufescens* (Jirga) NT, I, N, P, So, Z, A, Be
- *Piliostigmareticulatum* (kalgo) NT, Ba, Bo, Kt, So, W

3. *Mimosaceae*

- *Acacia macrathysra* (Gwanno) NT, A, Bo, Kt, P, So
- *AlbiziaChevalieri* (Katsari) NT, Ba, Bo, Kn, Kt, So, Z
- *AlbeziaCoriaria* (Doruwarmahalbi) NT, Z, E, W
- *EntadaAbyssinica* (Tawatsa) NT, Bo, I, Kb, N, P, So
- *Prosopis Africana* (Kirya) NT, Kt, N, A, So, Z, E, W

- *Burkea Africana* (Bakinmakarfo) NT, BE, KN, KT, A, Z, E, W
- *Parkiabioglobosa* (Doruwa) NT, BE, I, KN, KT, S, Z, N
- *Acacia forbia* (former albida) (Gawo) NT, BA, BO, KN, SO, Z
- *Acacia hebecladoides* (Bakar Kaya) NT, A, BO, I, KB
- *Acacia hockii* (bakar kaya) NT, A, BO, I, Kb
- *Acacia nilotica* (Bagaruwa)NT, A, BA, BO, KT, KN, SO, Z
- *Acacia Senegal* (Dakwara) NT, BA, BO, KN, KT, SO
- *Acacia Sieberiana* (Farar kaya) NT, BA, BO, I, KT, KN, N, SO, Z
- *Dichrostachyscineria* (Dundu) NT, BA, BO, I, KN, K(Plant Sahel,2008)

iii. *Food Crops and Medicinal Plants*

Soybean is an important leguminous crop, which serves as a source of food, prevents malnutrition and a cash crop. Soybean crop has replaced cotton and groundnuts as a cash crop production. This crop is produce in Zamfara state the main reasons first serve as soil improvement for its nitrogen fixation Secondly, attract market more other leguminous crops as international prices which have affected cotton production in particular. Third factor, it can be processed for many purposes and finally the crop also does not need much fertilizer (Bushand Noura, 2012).

Dugje *et al.* (2006) and Mustapha *et al.* (2012) reported the agronomic practices which are recommended for soybean production in Nigeria to include; site selection, land preparation, planting time, spacing and seed rate, fertilizer application, weed control, pest and disease control, harvest and storage. According to Ironkwe *et al.*, (2008) in production the technology has seven component practices as follows; (i) land preparation, (ii) use of mini sett dust or insecticide, (iii) time of planting (when the rains become steady) (iv) seed rate, Sett size (for yam 25g setts), (v) seed bed preparation (vi)spacing and (vii) fertilizer.

According to Adekunle, *et al.* (2012) Soybean is an important crop in Nigeria. It has high nutritional qualities. Soybean contains protein content of 40% by weight, 32% carbohydrate, 20% fat, 5% minerals and 3% fibre, and other trace substances. It is used as sources of protein in human food, animal feed and in industries. It is processed in industries as oil and the by-product of the oil extraction is the soybean cake for animal feed. Based on the importance of this crop to human nutrition and industrial growth, there is the need to produce it in commercial quantity.

Zamfara is a Mixed Crops Zone the Cotton, Groundnut and Mixed Cereals Zone is located east of the main rice-producing area in the state (which lies along the Sokoto-Rima River Basin complex). The Zamfara Mixed Crops Zone belongs to the Sudan-

Savannah Agro Ecological belt. Rain-fed agriculture is carried out during the single rainy season which runs from April/May to October. In the Sudan-Savannah Agro-Ecological belt, millet, sorghum, and maize are the principal crops grown for food. Cowpeas, groundnuts, cotton and increasingly soybeans are grown mainly for sale. (Bush and Noura, 2012)

c) *Diversity and Distribution of Legumes Plants in the Savanna*

The natural growing plant found and widely distributed on the earth surface could be grass, trees, shrubs but their diversity and distribution are mostly adhering to difference in ecology, domestication, breeding and agricultural system.

Roger Blench, (2007) proved that trees and plants identify useful to people and have extensive knowledge about these trees and plants in their region, and distribution. In order to work effectively with communities, it is necessary to discuss individual plant species. The Hausa language, apart from being the first language of many people in Nigeria and Niger, is an important second language to many communities in surrounding areas. Ethno botanical information is essential to the work of scientists and others concerned more practically with the environment.

Harlan, (1992). (Leguminous plants include both herbaceous and woody types. both shrubs and tree'. Many of them shrubs and some have been used as ornament and; many others hew the potential, in appearance and adaptation to complement existing plantings. Most leguminous plants are capable of growth on soils lacking nitrogen by forming symbiotic associations with bacteria that inject the plant root, forming specialized structures known as nexuses.

d) *Leguminous plants Domestication*

Human existed as species they were first hunters and gatherers whilst the "agricultural nepotistic revolution" took place ten thousand years ago, then the process of plant domestication was accepted for human advancement (Harlan, 1992).

Domestication has been defined as "human-induced change in the genetics of a plant to conform to human desires and agro ecosystems, culminating in the plant's loss of its ability to survive in natural ecosystems" (Harlan, 1975). More recently, the concept has been broadened to embrace "the regeneration and sustainable management of a species" (Leakey and Newton, 1994) and "the management and adoption of genetic resources by farmers" (Leakey and Simons, 1998; Leakey *et al* 1999).

The extension of the concept of domestication from farm / domestic animals and staple crops to trees only emerged in the 1970-80s (Libby, 1973; Leakey *et al.*, 1982), with the start of clone approaches to forest tree improvement. Since then it has been the topic of several international conferences (e.g. Leakey and

Newton, 1994; Leakey *et al.*, 1996) and is growing in importance as a means of balancing food security with sustainable natural resource utilization (Sanchez and Leakey, 1997). Tree domestication has been hailed as the start of a "Woody Plant Revolution" to follow the Green Revolution (Leakey and Newton, 1994; Leakey *et al* 1999).

Domestication is the upshot of a selection process that leads to increased adaptation of plant and animals to cultivation or rearing and utilization by humans. Agriculture has so far been able to keep pace with human population growth and provides sufficient food and other needs so that humans can tend to other activities (Cohen 1995; Smil 2001). This close relationship between humans and their domesticated plants and animals is precisely one of the aspects that make the study of domestication such a fascinating area of study. Domesticated (and, in some cases, undomesticated) plants and animals have had a significant effect on human history (Crosby 1986; Viola and Margolis 1991; Hob house 1999. Gepts, 2004).

Foetid cassia is a bushy legume cultivated for its leafy shoots. It usually grows wild in savanna or as a weed in fields. However, in some places, it is domesticated on the edges of fields or in compounds. (Dupriez and philippe, 1989) in west Africa, many trees such as African locust bean, tamarind, shea butter, baobab and the silk cotton tree grow in association with the main crops. From time immemorial, the wild seedlings of these plants have been respected by farmers who wish to preserve them. In fact, these plants are sub-spontaneous species which man has gone to the trouble of conserving, although they are largely sown in nurseries with a view to permanent planting. Their multiplication in this way, however, is quite feasible and would be profitable for the farming community.

i. *Purpose of Tree Domestication*

Trees in the wild have traditionally provided mankind with both products and environmental services, although the importance of the latter has really only been appreciated in second half of the Twentieth Century. With increasing environmental pressures on the land arising from increasing human and domestic animal populations, and with the parallel consequences of overpopulation on natural resources, agro forestry is seen ICRAF, (1997) as a means of simultaneously:

- Increasing farmer income;
- Increasing the food and nutritional security of poor people; and
- Enhancing the environment through the better management of natural resources in the agro ecosystem.

The domestication of the tree components of agro forestry is aimed at further increasing these three benefits.

Numerous non-timber forest products, especially wild fruits and nuts, are used by local people as a source of food on a daily basis (Lamien *et al.*, 1996), especially in periods of drought and famine. Many of these products are rich in minerals, vitamins, essential amino-acids, etc. (Leakey, 1999), and have the potential to become food crops through domestication. Several parts of the baobab are nutritionally valuable: the average vitamin C content of the fruits is ten times that of oranges (Booth and Wickens, 1988); the seed kernels contain 12-15 % edible oils, more protein than groundnuts and are rich in lysine, thiamine, calcium and iron and the leaves are rich in vitamin A. A deficiency of this vitamin is severe in many African countries where baobab occurs.

ii. Domestication process

During domestication, mutations affecting specific traits of the domestication syndrome are selected until they achieve near or full fixation, few studies in plants that have investigated mutation rates and the magnitudes (positive or negative) of mutations (Drake *et al.* 1998). As pointed out by Hill and Mbaga (1998) and Gepts (2004), mutations were not thought to play a significant role in breeding programs because of the short time span and the limited response observed in some experiments. Both empirical and theoretical analyses, however, have shown that mutations can cause a significant and continued response even in small populations.

The process of tree domestication includes the conservation of tree germ plasm, in some circumstances, the process should also include the conservation of the associated microsymbionts (mycorrhizal fungi and rhizobium), and then the selection and use of the most appropriate isolates. Systematic range-wide germ plasm collections have also been made by other organizations for *Faidherbia albida* (Fagg, 1992); *Acacia karroo*, *A. nilotica*, Senegal, and *tortilis* (OFI, 1999). Less complete collections have been made of a number of other species, (e.g. *Azadirachta indica* (Gupta *et al.*, 1996), *Prosopis cineraria* (Solanki, 1996)), leading to genetic improvement studies via provenance/progeny trials.

iii. Time Frame of Domestication

The process of domestication is but one aspect of the transition from hunting-gathering to agriculture. It is generally thought that this transition has taken several millennia (Smith 1995; Gepts (2004). One of the milestones of this transition was the domestication of crops and animals.

The Domestication Syndrome; Darwin (1859) and Gepts (2004)., the most intensively domesticated plants have lost their ability to survive on their own in the wild. In selecting plants to fulfill their needs for food, feed, and fiber, humans have-perhaps inadvertently-selected crops that, while they do extremely well in

cultivated fields, are unable to grow and reproduce successfully for more than a few seasons in natural environments, away from the care of humans who provide adequate seed beds and reducing competition from weeds.

e) Cultivation Requirements for Legumes

Nieuwenhuis and Nieuwelink (2002) to grow legumes successfully farmers need to know about the following:

- Climate requirements
- Soil type and soil fertility requirements
- When to sow
- Suitable varieties
- How to combine legume crops with other activities on the farm Practical examples show how legumes can be integrated into local farming systems and under which conditions legumes grow well in different areas of the world.

The maturity date of Soybean is 3–4 months after planting and some varieties requires timely harvesting to prevent yield losses. It is recommended that soybean be harvested when about 85% of the pods have turned brown for a non-shattering variety but 80% for shattering varieties (Dugje *et al.* 2009; Hamza 2017).

i. Suitable areas

The variety of conditions under which legumes do well; Upland river terraces and hills, Lowland along rivers and coastal areas, but legumes not suitable for coastal areas where mangroves used to grow are often as they are too acid. Other soils in these areas which are not subjected to salt water are less acid and more suitable for agriculture. legumes can be grown in highland areas, at altitudes above 1000 metres. these areas are characterized by low temperatures, dryness and a relatively short growing season. Nieuwenhuis and Nieuwelink, 2002. In humid tropical climates Soya (*Glycine max*) and pigeon peas (*Cajanus cajan*) are suitable in these climates. Cowpea (*Vigna unguiculata*), green gram (*Vigna aureus*), black gram (*Vigna mungo*) and groundnut (*Arachis hypogaea*) can tolerate extreme dryness and high temperatures of hot arid climates.

ii. Varieties and cultivars

Local varieties of most sorts of legumes have developed and many agricultural institutes all over the world have bred cultivars with desirable characteristics such as resistance to disease and pests, higher yields and shorter ripening time. FAO, (2010). Common Names and Scientific Names; Cowpea, asparagus bean, black eyed pea, black eyed bean, crowder pea, field pea, southern pea, frijole, paayap (*Vigna unguiculata*, syn. *Vigna sinensis*), Adzuki bean, azuki bean, Adanka bean (*Vigna angularis*, syn. *Phaseolus angularis*), Soybean, soya, soyabean (*Glycine max*), Common bean, common field bean, kidney bean, habichuela, snap bean (*Phaseolus vulgaris*).

CHAPTER THREE

III. METHODOLOGY

a) *The Study Area*

The study was conducted in four of the fourteen Local Government Areas (LGAs) in Zamfara State. The selected LGAs were: Bungudu, Talata mafara, Maru and Zurmi. Zamfara State is located between latitude 100401N – 130401N and longitude 40301E – 70061E. The state has an estimated area of about 38,000km², about 50% of which is cultivated. It shares boundary with Sokoto state and the republic of Niger to the north, Kebbi and Niger States to the west, Katsina State to the east, and Kaduna State to the South (ZMSG, 2001; ZSMG 2016).

Zamfara State comprises of 14 Local Government Areas located within Savannah ecology, which can be divided into Sahel, Sudan and Northern Guinea Savannah. The Sahel vegetation is found in northern-most fringes near the border with Republic of Niger. The climate is specially alternated by dry and wet seasons. The rains usually commence in May/June and end in September/October. The effective rainy season in the study area is restricted to July to mid-September (Yakubu, 2005). The mean annual rainfall ranges between 969 mm and 1,086 mm. Relative humidity varies between 24% in January and rises to 85% in September. The mean annual temperature also varies between 290c and 370c (ZSMG, 2010).The Sudan Savannah covers most of the northern and central parts of the State and is the predominant ecology of Zamfara State. The average annual precipitation in the Sudan region is between 550 and 900mm, while the growing period ranges between 90 to 165 days (ZMSG, 2001). The southern end of the state is typically Northern Guinea Savannah ecology, characterized by annual precipitation of more than 900mm and growing period of 150 days or more (ZMSG, 2001; Saddiq, 2012).

The study area is blessed with a number of rivers and lakes. Among these rivers are Sokoto, Ka, which flows through Maru, Bukkuyum local Government Areas. Bunsuru, flows through Zurmi and Shinkafi Local Government Areas. Gagare flows through Tsafe, Kaura Namoda and Shinkafi Local Government Areas and Zamfara rivers flows through Gusau, Bungudu, Maru, Maradun and Bakura. Famous lakes include Kalale in Maru, Natu in Bakura, Saru in Gummi, and Jema in Zurmi LGAs. Along the flood plains of most of these rivers, farmers can be seen cultivating small plots of land under irrigation (ZMSG, 2001; Saddiq, 2012).

The choice of a proper variety is the most important factor in crop production. Several of these varieties have been released in Nigeria and are being promoted by the State Agricultural Development Projects (ADPs), farmers' groups, and seed companies.

Ajeigbe, *et al.* (2010) selected brown seeded cowpea varieties released in Nigeria; Ife Brown, IAR-48 Medium maturing, IT84S-2246-4 Early maturing (70 days), IT90K-82-2 Early maturing (70 days) & IT89KD-391.

Selected white seeded cowpea varieties released in Nigeria; TVX 3236 Medium maturing (80 days), IT86D-719 Medium maturing (80–85 days), IT90K-277-2, Medium maturing (75–80 days), IT93K-452-1 Extra-early maturing (60 days), IT97K-499-35 Medium maturing (75–80 days) & IT89KD-28

iii. *Soil*

Legumes grow in different soils, and can do on very acid soils (up to pH 3.8). Groundnuts and Bambara groundnuts (*Vigna subterranea*) grow in poor sandy soils and loamy soils, but also in clay soils such as vertisols, although harvesting the pods from under the ground is difficult. While groundnuts grow well in chalky soils, Bambara groundnuts do not. (Nieuwenhuis and Nieuwelink 2002)

The butterbean (*Lablab purpureus*) has deep roots, which enable it to grow better on badly draining soils than most legumes. The butterbean however does not do well in saline (salty) soils. Generally speaking, legumes do not do well on salty soils, although there are a few exceptions: pigeon pea (*Cajanus cajan*) and pea. However, many of the characteristics of most other leguminous crops are similar with a few exceptions; most leguminous crops are sensitive to day length: they are either short-day or long-day plants.

iv. *Labour requirements*

Sowing soya by hand is very labour intensive. The sowing density must be very high to ensure a good yield. The only way to keep weeds down is by letting the soya plants cover the whole of the ground. Most other leguminous crops have a wider branching pattern, which means that the sowing density is lower. Other legumes therefore take less time to sow (Nieuwenhuis and Nieuwelink 2002)

v. *Weed control*

Weed control is very important the most critical period is between the 15th and the 35th day after sowing. If you only start weeding after the 35th day, the yields will be lower. It is best to keep the crop weed-free from the moment it is sown until the harvest The best way to fight weeds is by encouraging the growth and development of the crop as much as possible so that it does better than the weeds. (Nieuwenhuis and Nieuwelink, 2002).

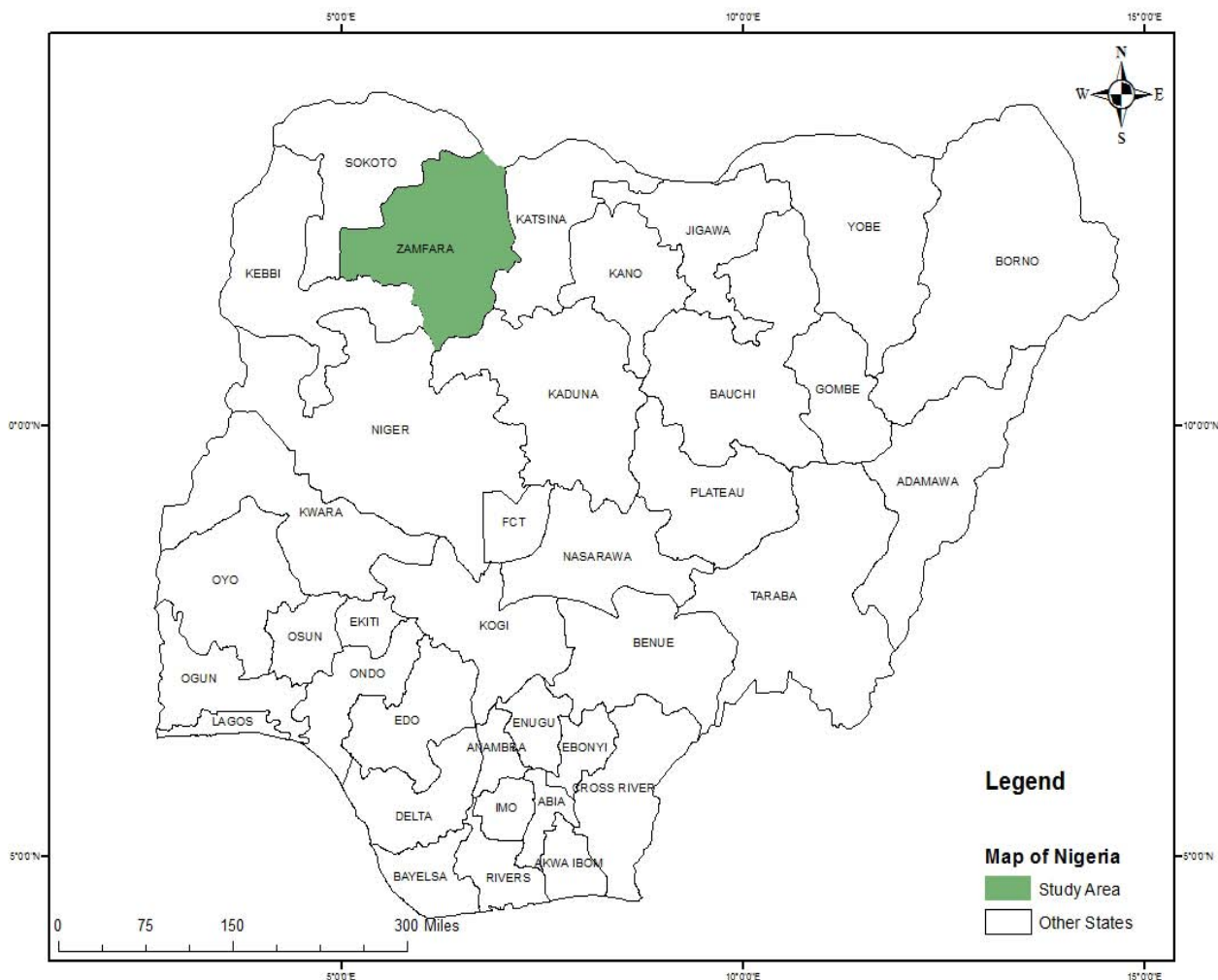


Fig. 1: Map of Nigeria Showing Zamfara State

Source: ZSMG (2016).

b) Study Population Sampling Procedure

Multistage random sampling technique was employed for the study Bungudu, Talata mafara, Maru and Zurmi were selected where 25 farmers in two district were also randomly selected. These districts included: Bingi south, and Nahuche in Bungudu LGA, Jangebe and Matusgi in Talata Mafara LGA, Dangulbi and Kanoma in Maru LGA, Mashema and Birnin Tsaba in Zurmi LGA. Total of 100 farmers proportionately selected from the local governments, 2 districts selected from each of the four local government areas, but with equal number of target farmers.



Fig. 2: Map of Zamfara State showing sampled LGAs of leguminous plants distribution

c) Data Collection

Data was collected by four trained enumerators. The enumerators were staff of ZACAREP/ADP that has considerable practical experience in agricultural extension work. The questionnaires were designed to collect information relating to socio-economic characteristics of respondents. These include age, household size, farm size (in hectare), educational level, extension contacts and details including sources of knowledge and source of leguminous plant, their cultivation, data on available types of leguminous crops, trees grass and shrubs, the importance, uses, domestication and Constraints/Problems of Legume Production in Zamfara of these plants. Additional information was collected from officials of Agricultural Development Programme (ADP), GUSAU, Zamfara agricultural revolution programme (ZACAREP).

d) Analytical Techniques

The analytical tools used in this study were descriptive statistics, mean differences were used to analyse the data.

i. Descriptive statistics

Descriptive statistics was used to answer objectives, as follows; describe the socio economic characteristics of the leguminous plants farmers. Identify

the socioeconomic status of farmers involve in leguminous plants production. These involve such measures as frequencies, percentage minimum, and maximum, standard deviation to describe and present the result of the analysis Mustapha *et.al.* (2012) in his study employed descriptive statistics to summarize data percentages and frequencies.

CHAPTER FOUR

IV. RESULTS AND DISCUSSION

a) *Socio Economic Characteristics of the Respondents*

This chapter highlights the findings of the study carried out in Zamfara state. The study aimed at identifying the Diversity and distribution of leguminous

crops/plants in Zamfara state northwest Nigeria. Both qualitative and quantitative statistics on demographic, socio-economic, production and socio-cultural were used to obtain the findings. The study findings were multi-variate where one farmer could respond to practicing more than one method of leguminous cultivation at the same time.

Table 1: Distribution of the respondents by their socio economic characteristics

Variables	Category	Frequency	Percentage
Age	26-30	16.4	48
	41-50	51.2	113
	51and above	29.2	74
Gender	Male	72	71.3
	Female	29	28.7
Occupation	Farming	33	32.7
	Civil Servant	18	17.8
	Farming and Civil Servant	21	20.8
	Farming and Trading	19	18.8
	Trading	10	9.9

i. *Socio-Economic Characteristics of Respondents Cont'd*

The socio-economic characteristics of the respondents were examined with respect to their gender, age, and occupation as presented in Table 1. The study shows that majority (71.3%) were male, while female constitutes only 28.7% of the respondents. This implies that gender was a significant factor in agriculture, because of its vital role in determining farming activities in the study area. Majority 39.6% of the respondents were found to fall into 41-50 years category; 26 – 30 years indicated 38.6 % followed by 41 – 50 years category.

Table 1 also shows that 32.7% of the respondents were farmers, 20% were indicated to be farmers as well as civil servants also 18.8 % were farmers as well traders while 17.8%, and 9.9% are traders and civil servants its implies that majority of the respondents in the study area are engaged in agricultural activities and agrarian people. This agrees with the report, Hamza, (2017) that the Zamfara state whose slogan is “farming is our pride” figure of 3, 278, 87 (NPC, 2006). About 82% of the population live in the rural areas and depend on agriculture to varying degrees for their live hood.

b) *Distributions of Leguminous Plants*

The fabaceae or leguminous includes crops plants, trees, shrubs and perennial or annual

herbaceous plants characterized by their fruits, stipulated leaves as in fig 1&2. Below.



Source; field survey, 2018 Soybean (*Glycine max*) leguminous crop in Zamfara state



Source: Field Survey 2018, groundnut (*arachis hypogea*), available food crop in Zamfara state

Table 2: Distribution of Leguminous Plants

Variables	Frequency	Percentage
Leguminous crops	50	49.5
Leguminous trees	11	10.9
Leguminous grass	6	5.9
Leguminous shrubs	5	12.9
All	29	28.7

Source: Field data survey, 2018.

Table 4.2 shows that 49.5% of the respondent's leguminous crops such as cowpea, groundnut and soybean were found to be cultivated in the study. This report is agreement with Nuora and Bush (2012), that the zone is primarily agricultural, supporting a wide variety of dry land crops including millet, sorghum, maize, cowpeas and groundnuts, as well as rice and (increasingly) soybeans. 10.9% of the respondents indicted Leguminous tree like parkia biglobosa (dorawa) tamarind us indica (tsamiya)piliostigma thonningi (kalgo)detrarium senegalensis (taura) dichrostachy ssp, acacia linitica (bagaruwa),. etc, of the leguminous plants found in the study area while 5.9% of the respondents and 5.0% indicated that Leguminous shrubs and Leguminous grass are also found in the study area. 28.7% of the respondents revealed that all types of savanna leguminous plants are found in Zamfara state which are economically important to human life, that agrees with the report Muhammad and. Amusa, (2005) Legume and nut: Leguminous tree species are important rural health care through provision of drugs for treatment to rural communities throughout

the tropics for providing food, medicine, firewood, charcoal, fodder, green-manure and timber. Parkia biglobosa has been described as a Savannah tree with a crooked and short bole of about 20- 30 meters tall.

Table 3: Types of leguminous crops in the study area

Variables	Frequency	Percentage
Cowpea	28	27.7
Peanut	24	23.8
Bambara nut	9	8.9
Soybean	13	12.9
Others	27	26.7
Total	100	100

Source: Field data survey, 2018.

i. Types of leguminous crops

From table 3 shows that 27.7% of the respondents indicated cowpea crops is being cultivated in the study area and 23.8% also revealed that Peanut or groundnut are cultivated. While 12.9% and 8.9% of the respondents indicated Bambara nut and soybean were among the leguminous plant grown in the study area. The cultivation of these leguminous crops implies that the plants represent the primary source of food and income to humans likewise their animals as supported by the report, Muhammad and. Amusa, (2005) Food supply to man by plants falls into several broad categories, which include carbohydrates, proteins, fats and oils, vitamins and salt, and beverages. From this table, however 26.7% of the respondents were pointed that other leguminous crop was found in the study area.



Source; field survey, 2018 cowpea (*vigna engluta*), available food crop in Zamfara state

ii. *Distribution of leguminous trees*

The table below revealed that 21.8% of the respondents noted tamarindus Indus exist in the study area, 23.8% pointed out that Pakia biglobosa trees are found in the study area. 18.8,9.9%, 7.9%, 6.9%, 5.9%, and 5.0% were for Piliostigma thonningi, Detrarium sengalensnse, Dichrostachy spp, Others, Belonix regia and Erythrinia sengalensnsis respectively. From the study it implies that these trees were domesticated for their importance, as opined by Trees in the wild have traditionally provided mankind with both products and environmental services, although the importance of the latter has really only been appreciated in second half of the Twentieth Century. With increasing environmental pressures on the land arising from increasing human and domestic animal populations, and with the parallel consequences of overpopulation on natural resources, agro forestry is seen (ICRAF, 1997) as a means of simultaneously:

- Increasing farmer income;
- Increasing the food and nutritional security of poor people; and
- Enhancing the environment through the better

management of natural resources in the agro ecosystem.

Table 4: Distribution of leguminous trees in the study area

Variables	Frequency	Percentage
Tamarindus induca	22	21.8
Pakia biglobosa	24	23.8
Belonix regia	6	5.9
Piliostigma thonningi	19	18.8
Detrarium sengalensnse	10	9.9
Erythrinia sengalensnsis	5	5.0
Dichrostachy spp	8	7.9
Others	7	6.9
Total	100	100

Source: Field Survey, 2018



Source; ZADP, 2018 albezia coriaria (Doruwa Mahalbi) available fodder tree in Zamfara

iii. *Distribution of leguminous grass*

The table below indicated that 66.3% of the respondent accounted for abrus precatorius leguminous grass is distributed in the study area and 14.9% of the respondent also accounted for vigna vexillata leguminous grass, while 18.8% indicted for Other leguminous grass distribution in the study area. From

the finding of the study it may imply that the two varieties of grass in the table are most common savanna leguminous grass.

Table 5: Leguminous Grass found in the study area

Variables	Frequency	Percentage
abrus precatorius	67	66.3
vigna vexillata	15	14.9
others	19	18.8

Source: Field data survey, 2018

c) Uses of Leguminous Plants in the Study Area

From the table below its indicated that 60.4% of the respondent prove the use of leguminous plants for food, 10.9% are used for medicine and 13.9% generate cash income while 14.9% of the respondents prove leguminous plants were used as raw materials. From the findings of the study it implies that plants ply important role in human life this in agreement with the report Noura and Bush, (2012) Soybean plays important role in the life of resource poor farmers, as a source of food (with high protein content) to prevent malnutrition and a cash crop. Leguminous plants are notable for their high levels

Fig. 3: Some important Drug Plants in Northwestern Nigeria

Plants	Claims and Parts Used
Senna caccidentalis	Malaria, typhoid (leaves a roots)
Acacia nilotica (Bagaruwa)	iodine and tanning
Acacia forbia (former albida) (Gawo)	Bacterial, fungal and viral diseases.
Entada Abyssinica (Tawatsa)	Skin infection- leaves
Parkiabiglobosa (Doruwa)	Bacterial diseases in the mouth gastrointestinal diseases
TermarindusIndica (Tsamiya)	Chest, stomach, sore throats, preserves food – pod, bark
Afzella Africana (kawo)	Malaria, analgestic- stem, bark

Source: Field Survey, 2018.

d) Domestication of leguminous plants

The table below described that 59.4% of the respondents revealed that leguminous plants are domesticated while 40.6% indicated not meaning that some trees usually grows wild in savanna as reported in west Africa, many trees such as African locust bean, tamarind, shea butter, baobab and the silk cotton tree grow in association with the main crops. From time immemorial, the wild seedlings of these plants have been respected by farmers who wish to preserve them. (Dupriez and philippe, 1989)

Table 7: Domesticate leguminous plant in the study?

Variables	Frequency	Percentage
Yes	60	59.4
No	41	40.6
Total	100	100

Source: Field Data Survey, 2018.

e) Source of Illustration

From Table 9 it was found that 52.5% of the respondents' indicted illustrations were from ADP, 27.7% IFAD, 11.9% from the Library and 7.9% from ZACAREP

of bioactive compounds, which can influence glucose metabolism by the following:(1) carbohydrate digestion inhibition and the suppression of glucose absorption in the intestine,(2) stimulation of insulin secretion from pancreatic cell liver glucose release modulation,(3) insulin receptor activation (Hanhineva, *et al.*,2010).

Table 6: Uses of Leguminous Plants in the Study Area

Variables	Frequency	Percentage
Food	61	60.4
medicine	11	10.9
cash income	14	13.9
raw material	15	14.9
Total	100	100

Source: Field data survey, 2018.

Table 8: Source of Illustration

Variables	Frequency	Percentage
ADP	53	52.5
ZACAREP	8	7.9
IFAD	28	27.7
Library	12	11.9
Total	100	100

Source: Field Data Survey, 2018.

CHAPTER FIVE

V. CONCLUSION AND RECOMMENDATIONS

From the findings of the study it was concluded that the diversity and distribution of leguminous plants includes the variety of leguminous plants within the Leguminoceae family such as Papilionaceae, Caesalpinhiaceae and Mimosaceae. Potentials of these leguminous plants were also disclosed. Plants, especially the leguminous trees and shrubs are often higher in crude protein and other nutrients and play a vital role as dietary supplements of low quality grasses in dry seasons.

Almost all species had crude protein levels above 100 g/kg dry matter (DM), Leguminous Crop Supply Food to man into several categories, which include carbohydrates, proteins, and oils, vitamins and salt, and beverages. One may also add the spices to this category; Soya is a legume with many good qualities, and it can be used to improve farming systems.

The study also revealed bushy legume grows wild in savanna or as a weed in field however, in some places, it is domesticated on the edges of fields or in compounds African locust bean, tamarind, shear butter, baobab and the silk cotton tree grow in association with the main crops. From time immemorial, the wild seedlings of these plants have been respected by farmers who wish to preserve them. These trees the wild have traditionally provided mankind with both products and environmental services, increasing farmer income; increasing the food and nutritional security of poor people; and enhancing the environment through the better management of natural resources in the agro ecosystem.

Recommendations

Some recommendations were made: government should intensify effort to reveal and explore the potentials of wild and other leguminous plants for the benefit of our farmers and their livestock.

Research bodies should collaborate with ministries of agriculture and ADP's to demonstrate the cultivation and domestication of these leguminous plants as an adoption process.

The study also recommends the need for essential use of these leguminous plants in modern medicinal process to increase the income of the people in the study area.

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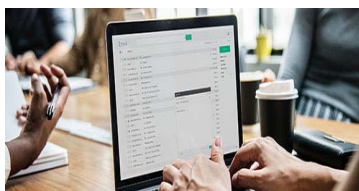
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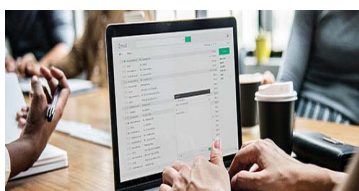
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20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

THE ADMINISTRATION RULES

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BY GLOBAL JOURNALS

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Topics	Grades		
	A-B	C-D	E-F
<i>Abstract</i>	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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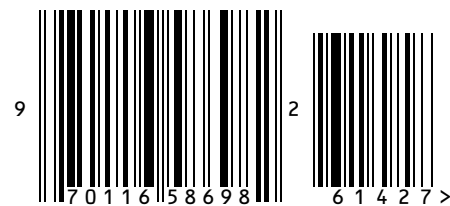
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