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RESEARCH ARTICLE

TYOLOGY OF GROUNDNUT PODS AND HAULMS PRODUCERS IN THE SUDANESE ZONE OF NORTHERN BENIN.

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Abstract

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Producers' typology is a key factor to identify the diversity of existing farms in order to establish development actions. This study aimed to characterize existing groundnut production systems in Northern Benin. Therefore, 126 groundnut farmers were enrolled and interviewed in Borgou and Alibori Departments where by three types of production were identified. In the type 1 (about 42.06% of the study population), most of farmers are not educated and practice mainly agro-breeding and crop production. They do not use much herbicide and practice narrow ploughed ridges using daba (hoe). The production of groundnut haulms is least developed in this system. Majority of farmers found under the type 2 are basically non-educated or in some extents a few had primary or secondary education. This type includes livestock keepers, agro-breeders, agriculturists and traders. They represent 30.26% of the investigated population and almost half of the muse herbicides. For this case, fields are ploughed using farm carts and groundnut haulms production is a well-developed activity. Then comes the type 3 in which most of farmers have at least primary and secondary education. Such farmers are few (27.78%) in the investigated population and are mostly agro-breeders and traders. Cultivation is carried out with carts but also with tractors. Flat ploughed fields are common and herbicides are highly used in this type of production. Most of farmers in this system produce groundnut haulms. The characterization of the three types of producers is used to propose integrated development actions.

Introduction:-

Groundnut (*Arachis hypogaea L.*) is the 13th most important food crop in the world. It represents the 4th source of cooking oil and the 3rd source of plant derived proteins (Waliyar et al., 2007). Groundnut is one of the most important oleaginous plants because of its high oil content of about 22 to 30% and 44 to 56% with respect to its dried seed and belongs to the family of Fabaceae (Reddy et al., 2003, Priyas et al., 2013). Groundnut is generally cultivated either for its seeds, its oil or the haulms (Idinoba et al., 2008). It is cultivated in about 100 countries in the world of which China, India, Nigeria, United States, Indonesia and Sudan are the largest producers. Developing countries represent 96% of the world's groundnut fields and 92% of the global production. (Taru et al., 2010).

Africa provides about 25% of the world's groundnut production (Kouadio, 2007). Reports from FAO in 2013 revealed that groundnut is cultivated on approximately 25.5 million hectares across the world with a production of 45.654 million metric tons, and an average yield of 1.796 metric ton per hectare (FAO, 2015). Moreover, groundnut is produced in nearly all West African countries where it occupies a predominant place in people's diet as a veritable source of proteins and oil (Adomou et al., 2005).

In Benin, the groundnut production is essentially reserved for local consumption through products such as; direct pods consumption, groundnut dough and cooking oil, utilization in soap factories and to the manufacturing of other derived products. Groundnut oil is a basic foodstuff for human populations in Benin (Goudjo et al., 2002). The average groundnut yield in Benin in 2013 was 872.97 kg/ha, which is lower than the ones of West Africa (1006.5 kg/ha), Africa (938.15 kg/ha), Asia (2553.51 kg/ha) and the world (1795.15 kg/ha) (FAO, 2015). Groundnut production is of great interest to Benin farmers because it fits well in crops' rotation and easily cultivated without fertilizers. Despite the importance of this crop in Benin, groundnut is hardly the subject of particular attention from decision makers, public authorities and researchers. This lack of interest leads to the absence of research towards the characterization of different varieties that exist in the country, their productivity, existing cultivation techniques employed and the organization of the sector.

Apart from its nutritional contribution in human consumption, groundnut is useful in animal production through the use of groundnut haulms in the feeds of small ruminants. Arbouche et al., (2008) reported that dried groundnut haulms are more nutritive than straws especially when they are treated with urea and constitute an interesting feed to ruminants in fleshing systems. Groundnut haulms are therefore regarded as harvest residues that can be valuably used in animal consumption.

In Benin, the livestock subsector is one of the main boosters of the country's economic development. Therefore, several programs have been implemented to improve the performances of this subsector. Among all species, small ruminants' rearing occupies a paramount place. In the improvement of the productivity of these animals, the valorization of groundnut haulms in their feed is a major possibility.

The main objective of the present study was to determine the characteristics of groundnut production systems in the Soudan zone of Northern Benin. Specifically, it aimed to determine the socioeconomic profile of groundnut farmers, to characterize the agronomic practices used in the groundnut production, and to propose improvement strategies for betterment of groundnut production.

Materials and Method:-**Study area:-**

The typology of groundnut farmers was carried out in Parakou, Tchaurou and N'Dali Municipals in the Department of Borgou and Kandi, Banikoara and Gogounou Municipals in the Department of Alibori (Figure 1). The Department of Borgou covers a total surface of 25 856 km² and is situated in the Nord-East Benin between the latitudes 8°55' and 10°53'N, and the longitudes 2° and 3°50'E. It is characterized by a Soudan type of climate with one dry season (November to May) and one rainy season (June to October). The annual rainfall is 1,200 mm (Zakari et al., 2012). The Department of Alibori, is located in the extreme North of Benin between 10° 49' and 11.86° 0' of North latitude and 2° 25' and 3°41' of longitude. Its surface is of 26242 km² and the climate is of Soudano-sahelian type. The rainy season lasts from May to September and the dry season from November to April. The average annual rainfall varies between 700 and 1,000 mm (DDPD/B-A, 2007). These two Departments are situated in Northern Benin. Benin is bordered in the North by Niger River that separates it from the Republic of Niger, in the

North-West by Burkina-Faso, the west by Togo, the East by Nigeria and the South by Atlantic Ocean, with a total surface of 114.763 km².

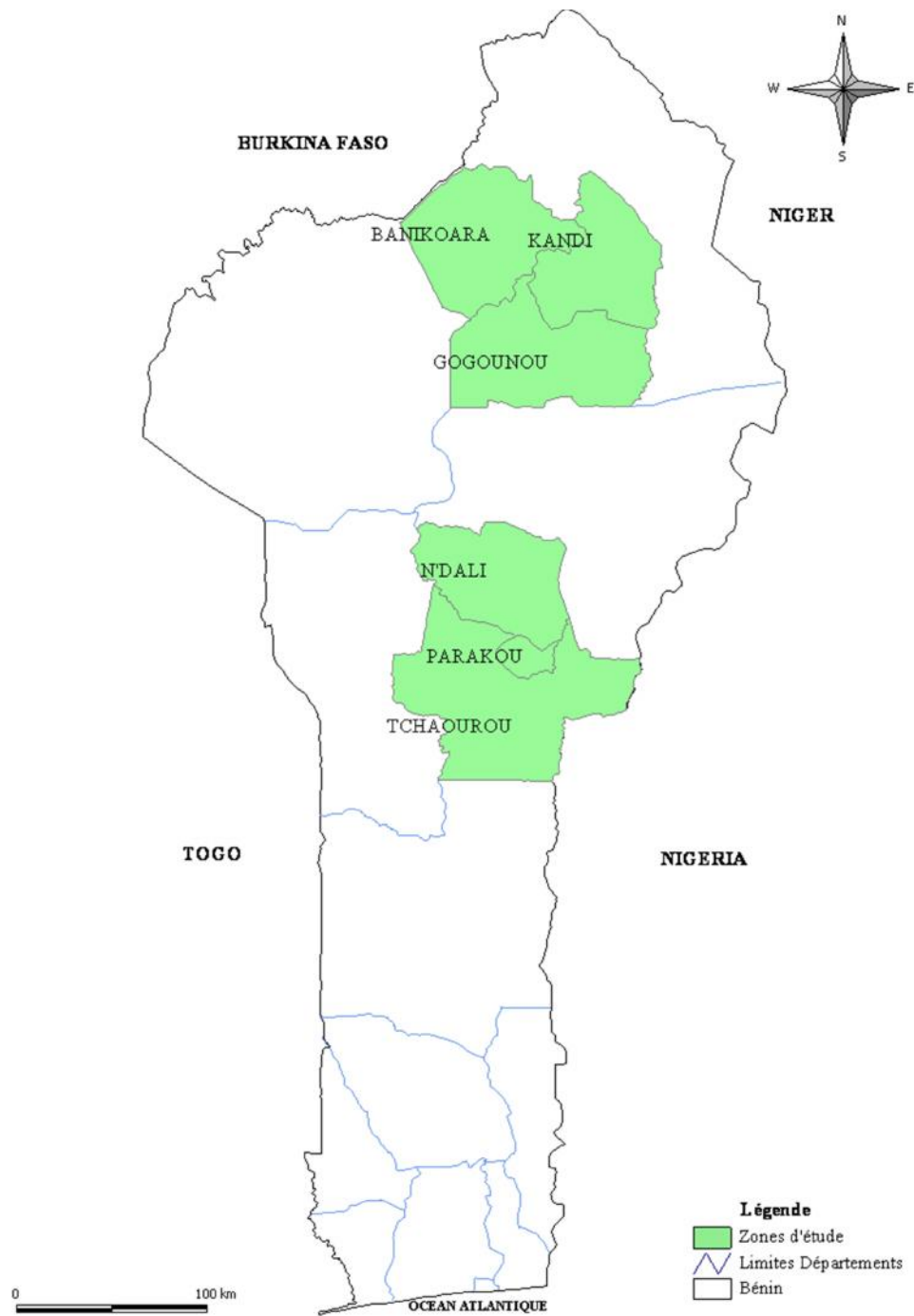


Figure 1: Study area

Methodology:-

Data collection was carried out through questionnaires administered to groundnut farmers of the study area. The collected data were mainly the identification of farmers, the cultivation practices and the methods of production, preservation and use of groundnut haulms. This was a retrospective study in which farmers were interviewed. A preliminary survey was conducted to select all farmers cultivating groundnut as part of the sampling frame. During the actual investigation, the enrolled farmers were chosen based on two extra criteria which are the accessibility of the farmers and their availability to provide the needed information. A total of 126 groundnut farmers were therefore enrolled in this study. The collected data were reviewed, encoded and recorded in a data base created in Excel software.

Statistical analyses:-

Data were analysed using SAS (2006) software. The procedure *Proc corresp* was used to perform the factorial analysis of the correspondences (AFC). The used variables are: aim of the production, ploughing type, replacement of missing plants, use of herbicides and the production of groundnut haulms. A hierarchical ascending classification based on producers' characteristics on the most significant components of the AFC was carried out. Groups of farmers were identified and each group corresponded to a particular type of production. The procedure *Proc means* was used for the descriptive statistics. For quantitative variables (age, number of dependent, length of groundnut production, length of drying and preservation and use of groundnut haulms), an analysis of variance with one factor was used and the type of production was the only source of variation. The procedure *Proc GLM* was used for the analysis of variance and the test of F was employed to determine the importance of the effect types of production on the variables. The means were calculated and compared two by two using Student t test. Proportions were calculated by the procedure *Proc freq* of SAS and compared with Chi-Square test and by the bilateral Z test. For every relative percentage, a confidence interval (CI) at 95% was calculated using the formula below:

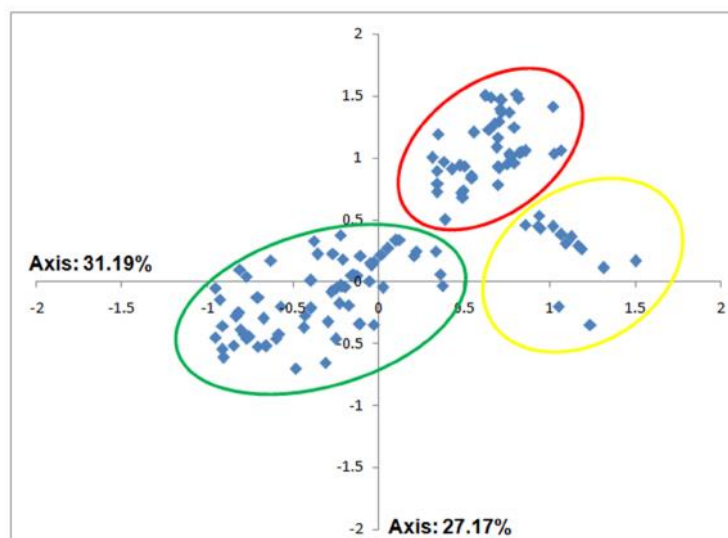
$$ICP = 1,96 \sqrt{\frac{[P(1-P)]}{N}}$$

P is the relative proportion and N the sample size.

Results:-

Description of the 3 types of groundnut farmers:-

Three axes were chosen for the interpretation of the results of the factorial analysis of correspondences ($\chi^2=3775.71$). Each axis corresponds to a group of groundnut farmers and each group corresponds to a particular type of production. The group 1 corresponds to type 1 farmers, group 2 to type 2 farmers and the type 3 farmers are found in group 3. Results of the factorial analysis of correspondences is given per group of groundnut farmers displayed in Figure 2



Legend: Red: Group 1; Green: Group 2; Yellow: Group 3

Figure 2: Distribution of groundnut farmers on the factorial axes 1 and 2.

Majority of farmers clustered as type 1 did not have school education and practice mainly agro-breeding and agriculture. They represent 42.06% of the study population and exist in both concerned Departments. They hardly use herbicides and use narrow ridges using daba (Hoe). The production of groundnut haulms is least developed in this type of production and the duration of groundnut haulms drying is very low (5.92 ± 1.79 days). Most of farmers found under the type 2 are basically non-educated or in some extents a few had primary or secondary education. This type includes livestock keepers, agro-breeders, agriculturists and traders. They represent 30.26% of the investigated population and about half of them use herbicides. They are commonly found in the Department of Alibori. For this case, fields are ploughed using farm carts and groundnut haulms production is a well-developed activity. About two third of the interviewed farmers do replace missing groundnut plants after the normal germination period. Approximately twenty days are required to dry groundnut haulms of this type of production. In the type 3, most of farmers have at least primary or secondary education. Such farmers are few (27.78%) in the investigated population and are mostly agro-breeders and traders. The cultivation is carried out with carts but also with tractors. Flat ploughed fields are common and herbicides are highly used in this type of production. The replacement of missing is a common practice in this system in which most of farmers produce groundnut haulms and the drying process uses about 12 days.

Comparison of the characteristics of farmers in the three types of groundnut production:-

Most of investigated farmers belong to Batonou ethnic group irrespective of their production type. They are mainly found in group 2 (47.37%) followed by group 3 (37.14%) and a few of them in group 1(30.19%). Group 1 is characterized by the predominance of Ottamari ethnic groups (24.53%) while the group 3 is made of farmers of Gando (20%) and Mokolé tribes (22.86%). Farmers of the three groups are essentially men with 71.05% in group 2, 52.83% in group 1 and 62.86% in group 3. Most of the farmers are married and represent 92.11%, 85.71% and 84.91% of groups 2, 3 and 1 respectively. However, no significant variation was observed between their proportions in the three groups. Group 2 is characterized by the absence of divorced and widowed farmers. Furthermore, bachelors are few in all the three groups and vary between 6 and 8%. With respect to religion, 68.57% of farmers of type 3 are Muslims. This proportion is greater than those recorded in the types 2 (42.11%) and 1 (41.50%) ($P < 0.05$) However, no significant difference was observed between the proportion of Christians and Animists of the three groups. The group 2 harboured many Christians (42.11%) while group 1 is characterized by a high population of Animists (26.42%). Moreover, most of farmers were non-educated representing 89.02%, 54.21% and 36.47% of groups 1, 2 and 3 respectively. The mean age of groundnut farmers did not vary according to the type of production. The highest age was recorded in type 3 (42 years) while the average age of type 1 and 2 farmers was 38 years. The number of dependents was on average 9 for the types 2 and 3 and 8 for the type 1.

The main activity of groundnut farmers varied. Although no significant difference was observed, agro-breeding is the most practiced activity in the three groups. It constitutes the main activity of 83.78%, 71.43% and 66.67% of farmers for the groups 2, 3 and 1 respectively. These were significantly higher than the proportions of those practising agriculture as main activity ($P < 0.001$) in the three types of production. Farmers who use agriculture as main activity represent 29.41% in group 1 and this proportion is greater ($P < 0.05$) than the one recorded in group 2 (8.11%) and group 3 (2.86%). Groundnut farmers who are traders are commonly found in group 3 (11.43%).

Table 1: Modes of production of groundnut pods and haulms in the Soudan zone of Benin.

Variables		Group1 (N=38)		Group2 (N=53)		Group3 (N=35)		Significance test
		%	CI	%	CI	%	CI	
Type of ploughing	Large ridges	19.23a	10.71	18.42a	12.33	25.71a	14.48	NS
	Narrow ridges	78.85a	11.10	71.05a	14.42	45.71b	16.50	**
	Flat fields	5.77b	6.34	10.53b	9.76	40.00a	16.23	***
Ploughing tools	Daba	66.04a	12.75	42.11b	15.70	20.00c	13.25	***
	Cart	33.96b	12.75	57.89a	15.70	68.57a	15.38	**
	Tractor	0.00b	0.00	0.00b	0.00	17.14a	12.49	***
Groundnut haulms production		32.08b	12.57	63.16a	15.34	80.00a	13.25	***
Haulms cut before the pods harvest		5.56a	7.49	0.00a	0.00	3.13a	6.03	NS
Groundnut harvest tools	Hands	42.22a	14.43	40.54a	15.82	21.21a	13.95	NS
	Daba	95.56a	6.02	94.59a	7.29	78.79b	13.95	*
	Carts	0.00b	0.00	2.70b	3.22	6.06a	3.14	*

N : Frequency ; % : Percentage ; CI: Confidence Interval ; NS : P>0.05 ; * : P<0.05 ; ** : P<0.01 ; *** : P<0.001 ; proportions of the same row followed by the same letters do not differ significantly at 5%.

The recorded modes of production of groundnut pods and haulms are presented in Table 1 and showed that the types of ploughing practiced by the farmers varied. The proportion of farmers that practise large ridges did not differ significantly between the three groups of producers. Nevertheless, this type of ploughing is mostly practiced by farmers of group 3 (25.71%). Compared to farmers of group 3, (45.71%), the narrow ridges are mostly used (P <0.01) by farmers of group 1 (78.85%) and those of group 2 (71.05%). The proportions of farmers that practice flat ploughs vary according to the groups of producers (P <0.001). Farmers of group 3 practise mainly (40%) flat ploughs followed by those of groups 2 (10.53%) and 1 (5.77%).

The three main devices used for ploughing are daba (hoe), carts and tractors. Daba is essentially used by farmers of group 1 (66.04%), followed by those of group 2 (42.11%) and group 3 (20%). Carts are the main ploughing tools used in groups 3 and 2 (68.57% and 57.89% respectively); while only 33.96% of group 1 producers use them. However, tractors are only used by farmers of group 3 (17.14%). Groundnut haulms production is practised by the three groups but with different proportions (P <0.001). It is mainly produced in group 3 (80%) followed by 63.16% in group 2 and 32.08% in group 1. Some farmers of group 1 (5.56%) and group 3 (3.13%) do cut groundnut haulms before extraction of the groundnut stems. Hands, daba and carts constitute the main tools used by farmers to harvest their products. The use of hands in groundnut harvesting is observed in the three groups with various proportions but without significant difference. Farmers who use their hands to harvest represent 42.22%, 40.54%, and 21.21%, of groups 1, 2 and 3 respectively. Many farmers use daba to harvest their groundnut and their proportions vary significantly between the groups (P <0.05). The highest proportions are 95.56% in group 1, 94.59% in group 2 and 78.79% in group 3. Carts are essentially used by farmers of group 2 (2.70%) and group 3 (6.06%).

Farmers group 3 do not use fertilizers for their groundnut production. Those who use fertilizers in group 2 are 2.63% and 1.89% in group 1. The proportion of herbicide users varied significantly according to the types of production. Herbicides are used by 27.74% of farmers in group 1, 44.82% in group 2 and 77.14% in group 3. The number of time that herbicides are applied in the fields vary in the groups (P <0.05). In the three groups, most of farmers use herbicides only once in their fields during the production cycle with proportions of 70.59%, 94.74% and 95%, for the types 2, 1 and 3 respectively. Farmers who use herbicide twice during the production cycle represent 29.41% in the type 3, 5.26% in the type 1 and 5% in type 2. The length of herbicides use before ploughing is about 7 to 8 days from all investigated farmers. However, the length of herbicides use after seedling differs significantly between the different types of farmers (p <0.05). Herbicides are used one day after seedling in the type 1, 2 days in the type 2 and 4 days for the type 3.

All the farmers of group 3 produce more than one crop while this is applicable for 97.37% of those in group 2 and 98.11% in group 1. Apart from groundnut that is produced by all investigated farmers, many other crops such as maize, cotton, sorghum, rice, soy, beans, yam, sweet potatoes, pepper and sesame, are produced as well. Maize and sorghum are the two most cultivated crops in the three groups. Cotton is mainly cultivated by 57.14% of type 3 farmers. Farmers who produce beans are in higher proportion in type 2 (39.47%) than in types 1 (30.19%) and 3 (25.71%). The same observations were recorded for soy production ($P < 0.05$). Sesame is more produced by farmers of type 1 (18.87%) than those of type 2 and 3 ($P < 0.05$).

All investigated farmers do weed their farms during the production. However, the number of weeding during the production cycle varies according to farmers types ($P < 0.01$). The most common option in all the three groups is two weeding per production cycle practised by 65.71%, 60.53% and 58.49% of farmers in the groups 3, 2 and 1 respectively. The case of a single weeding per production cycle is found mainly in group 1 (37.74%) whereas those who weed 3 times per cycle are predominant in group 3 (22.86%). The proportions of farmers that plough their fields in ridges do not differ significantly ($P > 0.05$) between farmers of type 2 (48.65%) and type 3 (52.94%); however they are higher ($P < 0.01$) than those of group 1 (22.64%).

Usually, the end use of groundnut is either the direct consumption of the pods or the production of oil or both. Most of farmers from the three groups opt for both with 67.92%, 57.14% and 51.35% in the type 1, 3 and 2 respectively. Farmers who cultivate groundnut for oil production only represent 25.71% in the type 3 and 11.32% in type 1 ($P > 0.05$). These proportions are higher than the one in type 2 (5.41%; $P < 0.05$). Those who produce only for direct pods' consumption constitute 40.54% of the type 2 which is higher than the 22.64% of type 1 and the 20% of type 3.

The length of groundnut production did not vary significantly between the three groups. It was of 3.62; 3.70 and 3.74 months, for groups 1, 3 and 2 respectively. A highly significant difference was observed in relation to haulms drying length ($P < 0.001$) in the three groups. The highest drying length (29.75 days) was recorded among farmers of group 2 and the lowest (15.63 days), from group 3. Farmers of group 1 dry their haulms for about 19.62 days. The length of haulms preservation did not vary significantly between farmers of groups 1 and 2. Groundnut haulms are stored for 68.92 days by farmers of group 2 against 71.25 days in group 1. However, a significant difference was recorded between these ones and farmers of group 3 ($P < 0.05$). The length of haulms preservation in group 3 is 52.17 days. The length of haulms use did not vary significantly between the different groups. They were 84.56, 86.25 and 86.33 days for groups 2, 1 and 3 respectively. Table 2 below displays the length of haulms production, drying, storage and use.

Table 2: Length of groundnut haulms production, drying, storage and use.

Variables	Group 1		Group 2		Group 3		Significance test
	Mean	SE	Mean	SE	Mean	SE	
Production length (months)	3.62a	0.06	3.74a	0.08	3.7a	0.08	NS
Drying length (days)	19.62b	2.65	29.75a	2.16	15.63c	2.03	***
Length of storage (days)	71.25a	3.95	68.92a	3.22	52.17b	3.22	*
Length of use (days)	86.25a	6.32	84.56a	16	86.33a	5.17	NS

SE : Standard Error ; NS : $P > 0.05$; * : $P < 0.05$; *** : $P < 0.001$; means of the same row followed by the same letters are not significantly different at 5%

Discussion:-

Description of the 3 types of groundnut production:-

Farmers of type 1 are mainly agro-breeders and agriculturists who are mostly not educated. According to Taru et al. (2010), 50% of groundnuts produced in the world are used for oil extraction, 37% for candies and 12% for direct pods consumption. Their results confirm the observations of the three types of production in the current study. The use of herbicides is not much developed in this type of production. Such results could be explained by the fact that weeding is mainly practised with hoe and farmers of this type use daba to plough narrow ridges and produce very little groundnut haulms.

Farmers of type 2 are present in the Department of Alibori. Most of them have primary or secondary education though some are non-educated. Agro-breeding, agriculture and trading are the main activities of this type of farmers.

About half of them use herbicides because of the high cost of the manpower. Hussaini and Lado (2010) reported the high labour cost due to weeding in pluvial and irrigated beans production. Lado et al. (2015), revealed that apart from the cost, the unavailability of manpower is one of the factors that encourage the use of herbicides.

In type 3, groundnut is cultivated with carts and tractors. These ploughing equipment are in correlation with the level of education of the farmers. Farmers of this category are characterized by improved cultivation practices. It is reported that the level of education and the age of farmers influence positively and significantly the use of improved agricultural practices (Oyewole and Ojeleye, 2015). In the present study, age was not a limiting factor for the adoption of modern techniques. Farmers of type 3 were not much represented among the investigated population. Agro-breeding and trading are the main professions of farmers in this group. Flat fields are commonly practiced and the main goal of the production is usually for pods' consumption and the extraction of groundnut oil. Replacement of missing groundnut plants is commonly practiced by these farmers usually 5 to 7 days after germination. The aforementioned missing is usually due to the post seeding losses commonly caused by pests such as birds and ants. Herbicides are highly used in this type of production because farmers of this group are agricultural entrepreneurs who take the activity very serious with great concerns to profitability. They are therefore ready to invest for better productivity. The type 3 is characterized by the production of groundnut haulms by most of the farmers. This haulm is used in animal feed as majority of these farmers are agro-breeders.

The management of soil nutritive elements is an important factor for the improvement of groundnut yield (Bala and Nath, 2015). According to Kipkoech et al. (2007), groundnut farmers of western Kenya can be grouped in four categories with respect to their manure use practices. Those who cultivate their groundnuts without fertilizers are in the first category. The category 2 regroups farmers who use only organic fertilizers and chemical fertilizer users are gathered in category 3. Farmers who use both organic and chemical fertilizers belong to category 4. Unlike the case of Kenya, the results of this study show an absence of manures use in most of the groups.

Comparison of the characteristics of the types of groundnut farmers:-

Groundnut production is not a specific activity for a particular ethnic group even though Batonou farmers seem to be in the highest proportion. The third of farmers of group 1 are Ottamari. Gando and Mokolé people represent the fifth of farmers in group 3. This result correlates with the demography of the study area which is naturally dominated by Batonou people. Although Peulh ethnic group represents the second group of the study population in terms of size, none of them was met in this study. This absence can be explained by the fact that Peulhs are not interested in crop production as they are exclusively pastoralists (Alkoiret et al., 2009; Youssao et al., 2013). In all the groups, groundnut production is essentially the activity of men. Similar observations were made by Simtowe et al. (2010) while studying the parameters of adoption of agricultural technologies in groundnut production in Malawi.

The sociological characteristics of investigated groundnut farmers revealed low level of education and a high proportion of married farmers. Farmers of type 1 are characterized by a high proportion of woman in their category. Reports of Hassan et al. (2012) demonstrates women's importance in agriculture especially in the transformation sector. In Niger state of Nigeria, Mohammed and Olaleye (2015) revealed the important role of woman in groundnut transformation. The two third of groundnut farmers of group 3 are Muslims and this proportion is higher than those of groups 1 and 2. The proportion of Christians and Animists did not differ significantly between the different groups. The mean age of groundnut farmers of the current study varies between 40 and 42 years and there was no significant difference between the ages of farmers of the three groups. Similar observations were made with respect to the investigated household size. The size of investigated households varied between 8 and 9 people. This number is quite higher than the one recorded in Malawi which was of 5 people per household (Simtowe et al., 2010).

The investigated groundnut farmers practise various activities among which Agro-breeding is the predominant one among the three groups. The association of livestock keeping and crop production revealed by the current study is consistent with the report of Alkoiret et al. (2009) when they were studying the typology of cattle keeping in Gogounou Municipal. Similar observations were reported by a study on the characterization of livestock keeping systems in the semi-arid zone of central African savannahs (Awa et al., 2004). Farmers who have agriculture as main activity represent about 30% of group 1. This proportion is significantly higher than those of groups 2 and 3. Groundnut producers who are traders are mostly found in the group 3. This diversity of the main activities of the groundnut farmers testifies that groundnut production is rarely the sole source of revenue in the households.

Different types of ploughings are employed in the three groups of production. The proportion of farmers who practices large ridges did not differ significantly between the three groups. However, most of farmers of groups 1 and 2 do practise narrow ridges. The flat ploughed fields are more developed in group 3. Ploughing is usually practised in crop production as a mean of unwanted herbs control (Adeyemi et al., 2008). It allows to frequently cut the young plants of unwanted herbs and to bury their seeds deeply in the soil. This practice destroys unwanted herbs that may prevent the normal growth of sowed crops and their yield (Lado et al., 2015). All groundnut farmers plough their fields before sowing. The infestation of a groundnut field by unwanted herbs can lead to a yield decrease of up to 77% (Rao, 2004). Therefore, ploughing and unwanted herbs controls are among the most important activities in groundnut production. The diversity of ploughing types in the present study is related to its importance. In fact, the type of ploughing has an important influence on groundnut production because soil disturbances must either be avoided or reduced to act on the development of the pods. The determination of the best method of ploughing helps to effectively control the proliferation of unwanted herbs and to have high yields (Lado et al., 2015).

Three main tools such as daba (hoe), carts and tractors are used for ploughing among the investigated farmers. Daba is the tool used for ploughing by two third of farmers in group 1. This proportion is significantly higher than those of group 2 and group 3. Dansi et al. (2008) reported that hoes are the tools used for the soils preparation, for plantation and weeding during their study on the production and preservation of traditional seeds of leafy vegetables in rural areas of Benin. The use of hoes can be attributed to the incapability of farmers to purchase modern tools. More than half of farmers of groups 2 and 3 use carts to plough their fields. However, only 33.96% of farmers of group 1 use carts. The use of tractors is not widespread and only present in group 3. The use of tractors is one of the new technologies developed to improve the performances of crop production (Oyewole and Ojeleye, 2015). The results of this study show a low level of adoption of this tool by groundnut farmers. In Nigeria, similar observations were reported by Ojeleye (2009), who revealed a low level of adaptation to new technologies by farmers despite the efforts devoted by the government in that sense. This situation can be explained by the level of education of the farmers. It was reported that the education level positively influence the adoption of new agricultural practices because the higher the education level of the farmers, the easier they get adapted to innovations and technologies that are essential to improve their productivity (Oyewole and Ojeleye, 2015).

Groundnut haulms are highly produced in group 3 whereas only 2/3 of the farmers of group 2 and 1/3 of those of group 1 are involved in such activity. Though haulms production is not among the main objectives of groundnut production, this study revealed its high importance in the groundnut value chain. This is certainly because agro-breeding is in most of the cases, the main activity of groundnut producers of the study area. They commonly use groundnut haulms in animal feeds. It is a usual practice that was previously reported by many other authors such as Pande et al. (2003); Bdliya (2007) and Garduno-Lugo and Olvera-Novoa (2008). Groundnut haulms are one of harvest by-products highly used in animals fleshing in the Sahelian part of West Africa (Ayantunde et al., 2007). In India, haulms constitute the most valuable and available harvest residues among other legumes (Garg et al., 2009). In the study area, a few farmers cut the haulms before the extraction of the pods. However, no farmer of group 1 practised this approach while those who employed it in groups 2 and 3 varied between 3 and 5%. It is not a common practice because haulms production is not part of the main objectives of groundnut production. Hands, daba and carts are used by farmers to harvest their groundnut but daba is the most commonly used tool. The proportion of farmers that uses daba did not vary significantly between groups 1 and 2. However, it shows a significant difference compared to the one of group 3. Groundnut is usually harvested at the end of the rainy season, period in which the soil is dried; this justifies the high use of daba. The use of hands for harvesting is present in the three groups of farmers. This practice is only possible if the soil is not too dry to ease the extraction of the groundnut plants or to use the hand as a digging tool. It is a similar practice to the one described by Kombiok et al. (2012), whereby groundnut is harvested either by uprooting the plant with hands or by digging the soil using the hoe. The use of carts for harvesting is not a common practice because it is only used by a minor proportion of farmers of groups 2 and 3.

The use of fertilizers is not common in farmers of group 1 and 2 whereas those of group 3, do not use fertilizers at all. In this study, farmers who use fertilizers represent a minority of the investigated population. The non-use of fertilizers by groundnut farmers of the study area has resulted in poor pods yield because the deficiency of nitrogen and phosphorus in the soils is one of the main constraints for a good productivity of the groundnut (Mohamed and Abdalla, 2013, Maheswar and Sathiyavani, 2012). The contribution of fertilisers is therefore necessary in order to maintain a positive nutritive balance for the plants (Buah and Mwinkaara, 2009). According to Veeramani et al. (2012), the improvement of minerals' availability is essential to optimize groundnut production. For Ntare et al.

(2008), depending on the nature of the soil, agricultural straws varying from 200 to 600kg/ha are recommended to have a better yield. Kipkoech et al. (2007) demonstrated in Kenya that the use of the organic or mineral fertilizers improves the productivity of the land.

The unwanted herbs control is one of the problems that hinder groundnut production, because groundnut cannot effectively resist unwanted herbs especially between the 3rd and 6th weeks after sowing (El Naim et al., 2010). Herbicides are used in the three groups of farmers. The proportion of groundnut producers that uses herbicides in their fields differs significantly with the types of production. These producers vary from 30 to 80% of the investigated population. This observation is different from what is reported in groundnut farmers in southern Ghana. According to Bolfrey-Arku et al. (2006), only 4% of these farmers use herbicides in their fields. However, in India, because manual weeding requires manpower and takes longer time, the use of herbicides is the most commonly used method to fight unwanted herbs because of its low cost (Kumar et al., 2013). In Asian and African countries, the use of herbicides for weeding is more developed in big farms (Prasad et al., 2009). In the current study, weeding is practised by all investigated groundnut producers. Weeding is the best technique of unwanted herbs control and the most extensively practiced in great crop production farms across tropical countries because of the prohibitive costs of herbicides, the fear of toxin residues and the lack of knowledge on their use (El Naim et al., 2010). In Asian and African countries, weeding is conducted manually or by using hoes or with tractors (Prasad et al., 2009). However, the number of weeding during the cycle of production varies according to the farmers. The option of two times weeding per cycle is mainly practiced by farmers of the three groups. Most of farmers in group 1 practise only one weeding per production cycle. Farmers who weed 3 times during a cycle are mainly found in group 3. Studies of El Naim et al. (2010), in the North Kordofan in Sudan showed that two times weeding at 2 and 4 weeks after seedling is efficient to control unwanted herbs.

The end use of peanut production in the investigated populations is either the direct consumption of the pods or the production of oil, or both. In Nigeria, apart from the direct consumption of groundnut pods, and the production of oil, groundnut is also cultivated for their haulms (Idinoba et al., 2008). In Cameroon, groundnut constitute the main ingredient for a number of kitchen preparations and presented as dough and powder in many households (Betdogo et al., 2015). These observed end uses confirm the report of Adomou et al. (2005) who concluded that in most of West African countries, groundnut is one of the leguminous plants that are important sources of proteins and oil for various diets. Groundnut is a cheap source of oil and proteins with high-quality (Ayoola and Adeyeye, 2010). Farmers whose production objective is oil extraction are in high proportion in the group 3 representing the quarter of the total size of that group. Groundnut oil is a basic food for Beninese (Goudjo et al., 2002). With about 41%, group 2 harbours the highest proportion of farmers that only produce groundnut for the direct pods consumption. The proportion of farmers of type 1 and 3 whose unique objective of production is the direct pods consumption did not show any significant difference and constitute about the fifth of their population.

Groundnut can be classified in two groups according to its physiological maturity, such as the short cycle varieties (90 days) and long cycle varieties (120 days). The length of production of groundnut does not vary significantly between farmers of the three groups. It was for 110 days in type 1, 122 days for type 2 and 121 days for type 3. The cycle of groundnut production varies between 100 to 150 days according to the varieties (Putman et al., 2013). Results of this study cannot allow to determine the type of variety that is cultivated since farmers do not use the same variety throughout the cycles. Besides, there is a difference between the obtained lengths of production and the physiological maturity of groundnut. Furthermore, it is difficult to monitor the actual maximal maturity period of pods because of the underground nature of the fructification process of groundnut and its indeterminable growth (Seutra Kaba et al., 2014). Groundnut haulms are dried to decrease their water content and to ease their preservation. The duration of drying varies significantly with the types of production. The length of drying recorded in farmers of type 2 is the longest with about 30 days. Farmers of type 1 dry their haulms for 20 days and those of type 3 use 16 days. The variation of the drying length is related to the period in which groundnut were harvested. Groundnut is commonly harvested when the leaves turn into yellow. At that moment, the pods are considered as mature (Arakama, 2009). This practice is not always followed by every farmer. Some farmers anticipate the harvest to avoid the loss of pods in soil. The delay in the harvest after physiological maturity can lead to serious pods losses in the soil due to the weakening of the plants' ankles (Azmoodeh-Mishamandani et al., 2014). For these kinds of farmers, the length of haulms drying is quite longer. Nevertheless, others harvest their products long after the physiological maturity because of the lack of manpower. The length of drying is then shorter. The length of preservation of the haulms doesn't vary significantly between the farmers of type 1 and 2; it is about 70 days. However, with 52 days, farmers of type 3, store their haulms on a short period compared to the two others. Farmers of type 3 begin to use

their groundnut haulms earlier than the others. This is due to the fact that this group includes agricultural entrepreneurs to whom profitability is important. Likewise, they begin to feed their animals so that they don't lose weight at the beginning of the dried season. The length of use of groundnut haulms doesn't vary significantly between the different groups. It is about 85 days in the three groups. The absence of difference between the three groups can be explained by the fact that the average cultivated field superficies by farmers doesn't differ, hence the amount of produced haulms cannot differ either.

Conclusion:-

The current study conducted on the typology of groundnut producers, revealed three types of producers in the Sudanese zone of Northern Benin. Producers of type 1 are characterized by a high proportion of women in their group and the use of rudimentary cultivation practices. Herbicides use is negligible in this type of production and daba is used to plough narrow ridges. From type 1 to type 3, a progressive increase of modernization of the practices was recorded, especially in the tools used and the level of education of farmers. A few farmers are aware of the importance of groundnut haulms for the economy of their households. The improvement the production performances of groundnut farmers of type 1 and 2 requires an increased education of their children which will in turn impart the family's knowledge on the importance of the use of new production technologies. The use of herbicides and fertilizers (chemicals or organics) is a promising factor in the reduction of the cost assigned for manpower and can improve the yield. Farmers of type 3 need to be sensitized on the positive impact of the contribution of manures on groundnut yield. By analogy, they need more information on the usefulness of increasing the cultivated surfaces for their production in order to better benefit from the use of machines.

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