

CHARACTERIZATION OF FARM MANAGEMENT PRACTICES AND IMPROVED CROP VARIETIES IN NORTHERN NIGERIA: APPLICATION OF "TRANSECT WALKS" METHOD

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ABSTRACT

The need to increase yields and farm income, stimulate agricultural growth, alleviate poverty and promote food security in rural communities necessitated the introduction of improved farm management practices and crops varieties in northern Nigeria. Like every well-intended innovation, the benefits of the improved systems could only be realized if farmers adopted and practiced them. This paper assesses the use status of the improved cropping patterns and farm management systems in the drier savanna area of northern Nigeria. It used data collected through line intersects sampling survey, an aspect of transect-walks methodology, involving farm fields in ten communities in the area. The results revealed that 82.6% of the surveyed fields were arable non-fadama fields as against 6.8% fallow and 4.7% settlement fields. Less than one percent of surveyed fields were arable fadama and community reserved fields while 1.7% was woodland. The modern farm management practices introduced into the area have not been fully adopted by farmers. "Gicci", a traditional cropping pattern, was very common having been observed in 38.7% of the 1001 farm fields surveyed. Sole cropping (30.9%) and relay (14.9%) were second and third commonly practiced farm management practices. Of improved crops' varieties, maize was the most widely adopted, appearing in 11.9% of the fields as first crop, and in 26.1% as the first four crops. Improved cowpea and soybean varieties were observed as the first four crops in 8.5% and 4.5% of the surveyed fields respectively. In general, the study found that the proportion of the communities that devoted up to 50% of the observed maize fields to the improved maize was 30% while the proportion that devoted up to 50% to improved cowpea and soybean was only 20%. The study identified the need for intensified extension services, training and enlightenment programmes as ways for promoting the use of improved farming technologies to realize their full benefits.

Key words: line transects, farm management practices, improved varieties, gicci, drier savanna, Nigeria

INTRODUCTION

The need to stimulate agricultural growth, alleviate poverty and promote household food security in rural communities necessitated the introduction of improved farming techniques and innovations in many areas of the sub-Saharan Africa. In Nigeria, the International Institute of Tropical Agriculture, Ibadan, working in collaboration with

the national research systems and universities, has contributed immensely towards the development and spread of improved technologies. It was anticipated that intensive use and eventual adoption of the improved practices will by increasing farmers' incomes, promote their welfare and livelihoods. Some positive results have been reported. In the case of maize for example, IITA (1992) reported that the maize expansion programme in northern Nigeria resulted to the transformation of maize farmers who adopted improved varieties found that they could produce enough grain to meet household needs on a smaller area, freeing additional land for cash crops—either more maize or the additional alternatives, groundnut and cotton (IITA 1992). As part of the efforts at evaluating the success of the initiatives, there was need to investigate the extent of use of the improved practices alongside other techniques indigenous to the farmers and widely used by them before the new methods were introduced. This study therefore sought to describe the different land usage patterns and farm management practices of rural communities in the drier savanna zone of northern Nigeria, as well as farmers' use of improved maize, cowpea, soybean and other crops' varieties introduced into the area at various times. The characterization of improved production and farm management technologies forms part of a broader evaluation of impact of research and extension services' activities in northern Nigeria.

MATERIALS AND METHODS

The study area

Kaduna and Kano States were purposively selected because previous characterization works have been documented in them (Manyong et al. 1999; Okike et al. 2001). Kaduna lies between latitudes $9^{\circ}04'$ to $11^{\circ}50'$ N and longitude $6^{\circ}09'$ to $10^{\circ}41'$ E with the guinea savanna ecology and annual rainfall range of 600-1200 mm. Kano on the other hand lies between latitudes $10^{\circ}33'$ to $12^{\circ}37'$ N and longitude $7^{\circ}34'$ to $9^{\circ}25'$ E with the sudan savanna ecology and annual rainfall range of 300-600 mm. Rainfall is unimodally distributed in both ecologies. The length of growing period (LGP) is 150-200 days in guinea savanna and 90-150 days in the sudan savanna. Five villages were randomly selected from each of the states to give the ten villages covered in the study. The GPS location read at the centre of each of the selected villages from Kaduna State are Gidan Hayaki (Lat. 11.089° N, Long. 7.587° E, Alt. 714m), Gwaraji Tsoho (Lat. 10.567° N, Long. 7.333° E, Alt. 632m), Kaya (Lat. 11.096° N, Long. 7.590° E, Alt. 718m), Mahangi (Lat. 11.238° N, Long. 8.246° E, Alt. 664m), and Ungwan Dan Mallam (Lat. 10.791° N, Long. 8.252° E, Alt. 712m). The selected villages from Kano State and their locations are Barnawa (Lat. 11.355° N, Long. 8.282° E, Alt. 498m), Bichi (Lat. 12.233° N, Long. 8.144° E, Alt. 541m), Gargai (Lat. 11.328° N, Long. 8.232° E, Alt. 530m), Mariri (Lat. 11.943° N, Long. 8.613° E, Alt. 524m) and Ungwan Dawa (Lat. 11.404° N, Long. 7.789° E, Alt. 667m).

Transect Walks Methodology

A transect walk is a mobile interview method in which the research team walks from the centre of the village to the outer limit of the territory accompanied by local informant(s) who is/are expected to be matured and knowledgeable about natural resource issues (FAO 1997; FAO 2005). The technique of the line transect is an aspect

of the transect walk methodology (van der Meer et al. 2001), which ensures that an observer walks quietly along a straight line at a self-controlled pace, stopping intermittently at predetermined distance intervals to take records of observations (Quang and Becker 1997). A sample surveying data collection sheet was used to record observations. The distance sampling method uses statistical calculations to account for differences in detectability of individuals at varying distances from the transect line. Because of this, if the observer strays from the line and detects an object that would have not otherwise been detected, those detections should not be recorded (Centre for Alpine Studies, 2005). Among the merits of the transects is that it is helpful in focusing on such issues relating to where available resources are located in a community, how they are used, how much pressure exists on various resources, what are the rules of access and whether there are conflicts.

During the growing season of 2002 a four-week Geographic Positioning System (GPS) line transect survey was carried out through each of the ten selected villages to provide quantitative data on the relative areas grown by farmers, describe the general land use status, identify crop management systems, and access the levels of use of the improved maize, cowpea and soybean varieties introduced into the area as directly observed in the farmers' plots. Eight possible cardinal directions -- east, west, north and south, and northeast, northwest, southeast and southwest -- would have been walked in each village. This was not however possible due to time and cost constraints. The initial plan then to randomly select any five of the eight directions for a five-dimensional two-kilometre line transects in each village was also realized to be unrealistic and unattainable, due to the same constraints of time and cost, coupled with the pressure to complete the survey before the short-duration crops, like early cowpea, started flowering. This necessitated further reduction in the number of the transect distances to be conveniently covered. Three directions, which would comprise of one three-kilometre, and two one-and-half-kilometre line transects, were consequently settled for in each village. Random selection of three out of the eight options resulted in selection of the north, southeast, and southwest directions for the transect walk in each village. The research team had to randomly select any of the three directions for the three-kilometre walk and the other two would be for the one-and-half kilometre walk. Standing at the centre of each village the co-ordinates of the end point of each radial would be pre-loaded into the GPS equipment to avoid directional bias during the transect walk (van der Meer et al. 2001). Then, the research team walked along the selected north, southeast, and southwest directions at separate intervals after randomly selecting a direction for the three-kilometre walk. During the survey, the team recorded the position of each field boundary with the GPS equipment. Also recorded were observations made of the crops, crop geometry, cropping pattern, plant spacing within the fields, and general farm management systems. The transect walk survey took the research team of three enumerators an average of two-and-half days in each village. The total distance covered in the studied ten villages was 60 km.

This paper presents only the report on the aspect of the survey on the common cropping patterns and the improved varieties observed on the farmers' fields crossed in the study area. The result from the characterization study would enable formation of

opinion on the commonly grown varieties in the area, which would serve as basis for possible adoption studies. Descriptive statistics were used for the data analysis.

RESULTS AND DISCUSSION

Community land use patterns

The various uses to which lands were put in the communities are presented in Table 1. On the average over 80% of fields crossed was devoted to arable farming. The proportion ranges from 64.06% in Gwaraji Tsoho to 89.02% in Ungwan Dawa. Arable fadama were observed in 3% of farm lands in Gwaraji Tsoho and 1% each in Kaya and Ungwan Dan Mallam. Community reserved lands and dams were observed in Gwaraji Tsoho and Ungwan Dan Mallam as 1.56% and 1% respectively. The Table shows that the community members settled on the average of 5% of the crossed fields, ranging from 1.80% in Mahangi to 10.87% in Bichi.

Table 1: Percentage of fields devoted to various land usage patterns

Land Use	BAR	BCH	GAG	GHY	GWT	KAY	MAH	MAR	UGD	UDW
Arable	78.72	79.35	84.78	86.67	64.06	80.18	88.62	83.46	77.00	89.02
Arable Fadama	-	-	-	-	3.13	0.90	-	-	1.00	-
Community Reserved	-	-	-	-	1.56	-	-	-	-	-
Fallow fields	11.35	6.52	7.97	2.86	10.94	4.50	5.99	6.02	12.00	3.05
Road	-	-	0.72	-	-	-	-	-	-	1.22
Settlement	5.67	10.87	2.90	1.90	4.69	8.11	1.80	7.52	3.00	3.05
Wasteland	2.84	3.26	2.90	6.67	-	3.60	2.40	2.26	-	3.66
Water/dam	-	-	-	-	-	-	-	-	1.00	-
Wetland	0.71	-	0.72	-	6.25	0.90	-	-	-	-
Woodland	0.71	-	-	1.90	9.38	1.80	1.20	0.75	6.00	-

BAR=Barnawa, BCH=Bichi, GAG=Gargai, GHY=Gidan Hayaki, GWT=Gwaraji Tsoho, KAY=Kaya, MAH=Mahangi, UGD=Ungwan Dan Mallam, UDW=Ungwan Dawa.

The patterns of land use confirm that agriculture still remains the mainstay of the rural economy of the area. Arable farming constituted the primary occupation of the citizens. Included in the identified food and cash crops are maize, yam, millet, cowpea, rice, sorghum, and cocoyam. Others are soybean, groundnut, tomato, onion, pepper, and sugarcane.

The results also reveal that the communities still practice bush-fallow culture as a way of promoting agricultural productivity. Bush-fallow is land management system where a piece of land is left uncultivated or conserved for say 3-4 years, during which attention is shifted to other fields. Chidumayo (1988) observed that the purpose of natural fallow in bush-fallow cultivation systems is to improve soil fertility following a phase of cultivation and to provide useful forest products, including livestock feed. However, when the natural fallow system fails to serve these purposes, it can be supplemented or replaced by planted trees. Fallow land was observed in all

the communities. The proportion of crossed fields met fallow ranged from 3% in Gargai and Ungwan Dawa to 11% in Barnawa and Gwaraji Tsoho. On the average, fallow fields consisted of 7% of all crossed fields. Also, wastelands were observed in eight villages while woodlands were observed in seven.

Cropping patterns identified in the savannas

The survey identified six main cropping patterns in the area (Table 2). Sole cropping, which is a system of growing single crop specie on a piece of land during a farming season, was observed in 31% of farm fields crossed in the ten villages. Specifically, the method was spotted in 50% of fields in Ungwan Dan Mallam, 44% in Gwaraji Tsoho, 40.28% in Ungwan Dawa, and 38% in Kaya. It was also observed in 35% of fields in Barnawa, 31% in Gargai, 27% in Mahangi, 22% in Gidan Hayaki, and 10% in Bichi.

Table 2: Fields devoted to the various cropping patterns in communities

Village	Fields (number)	Gicci (%)	Mixed (%)	Relay (%)	Row (Ridge) (%)	Sole (%)	Strip (%)
Barnawa	110	49.09	4.55	10.91	-	35.45	-
Bichi	70	51.43	21.43	12.86	-	10.00	4.29
Gargai	114	41.23	14.04	12.28	-	30.70	1.75
Gidan Hayaki	87	43.68	26.44	2.30	-	21.84	5.75
Gwaraji Tsoho	43	11.63	23.26	9.30	-	44.19	11.63
Kaya	90	31.11	8.89	7.78	1.11	37.78	13.33
Mahangi	146	40.41	25.34	3.42	-	27.40	3.42
Mariri	109	45.87	4.59	7.34	-	12.84	29.36
Ungwan Dan Mallam	88	23.86	14.77	3.41	1.14	50.00	6.82
Ungwan Dawa	144	34.03	12.50	4.86	-	40.28	8.33
Mean	100.10	38.70	15.00	7.10	1.00	30.90	9.11
(Std. Deviation)	(31.61)	(9.64)	(3.84)	(0.42)	(0.00)	(15.71)	(9.28)

Source: Analysis of Field Survey Data

The traditional *gicci* cropping pattern dominated in majority of the villages. *Gicci* is a cropping pattern, which involves an introduction of a minor crop into the main single-crop field in a manner that the minor crop runs across the ridges of the major crop in a systematic pattern. It is common practice for farmers in the study area to use a cereal crop, like sorghum or maize, as a *gicci* crop in fields where legumes, such as soybean or cowpea, are grown. Sorghum is the popular crop used by farmers for *gicci* because of its vegetative nature and relatively late maturity time. There is no fixed interval or standard distance apart as this is determined subjectively by the farmer. *Gicci* cropping pattern was observed in 51.43% of fields in Bichi, 40.09% in Barnawa, 45.87% in Mariri, 43.68% in Gidan Hayaki and above 40% each in Gargai and Mahangi. In the remaining villages *gicci* was spotted in over 20% of the observed fields. Another identified cropping pattern is mixed-cropping. Also known as poly-culture or poly-cropping' this is a system of combining or sowing together two or

more crop species on the same piece of land in the same season. Usually, one will be the main crop and the others the subsidiaries, examples include tomato/maize, yam/cocoyam/melon. Mixed cropping spotted in 26% of the fields in Gidan Hayaki, 25% in Mahangi, 23% in Gwaraji Tsoho, 21% in Bichi, and 15% in Ungwan Dan Mallam. The average of the fields devoted to mixed farming in all ten villages is 15%.

Relay cropping, which is a form of intercropping that involves overlapping of two crops in the same field for a short period within the same season, was also identified. Among the benefits of relay cropping pattern is that it can be a means of minimizing yield loss by reducing the time that crops overlap. It can also help to minimize competition between component crops for key resources (Parsons et al., 2007). Relay was observed in 7% of the farm fields, ranging from 2% in Gidan Hayaki to 13% in Bichi. Row cropping was only observed in two villages: Kaya and Ungwan Dan Mallam each of which devoted only 1% of farm fields to the method. Row cropping is the practice of planting crops along rows, which may be in a form of parallel ridges. The benefits of row cropping include that: it allows for the treatment of crop row and inter-row space separately, banding of nitrogen anytime, inter-row cultivation or spraying, and on-row treatments of farms. For riparian areas, row cropping ensures that such areas are cleared to increase drainage, reduce competition with crops for moisture and sunlight, reduce sources of weeds, allow easy operation of agricultural machinery, and remove habitat for wildlife that may damage crops. The results reveal that this method is not widely used by farmers in the area being only identified in 20% of studied villages. Also in the list of identified cropping patterns is strip cropping. It is the practice of growing field crops in narrow strips either at right angles to the direction of the prevailing wind, or following the natural contours of the terrain to prevent wind and water erosion of the soil. The system was spotted in 9% of all fields in ten villages. Analyses according to villages reveal that 29% of fields crossed in Mariri were devoted to the system against 13% in Kaya, 11% in Gwaraji Tsoho, 8% in Ungwan Dawa and 6% in Gidan Hayaki.

Use status of improved crop varieties

Maize (Zea Mays)

Table 3 presents the share of fields devoted to all maize varieties, including the local and improved varieties on the one hand, and the fields devoted to the improved maize on the other in the total arable fields of farmers. It shows that maize was planted in 34.47% of fields crossed in all ten villages. The proportions ranged between 2.75% in Mariri and 65.52% in Gidan Hayaki. Maize occupied 60.00% of all fields crossed in Kaya, 47.73% in Ungwan Dan Mallam and 47.14% in Bichi.

Table 3 shows further that the improved maize varieties consists of 41.15% of all observed maize fields and 14.19% of all arable fields crossed in all villages. The improved maize varieties were highly adopted in Ungwan Dan Mallam, Kaya and Bichi, where they consisted respectively of 92.86%, 72.22% and 57.58% of all observed maize fields. Of all the improved crops varieties grown by farmers improved maize was spotted as most predominant crop in 11.9% of the fields and as the first four predominant crops in 26.1% of the fields.

Table 3: All maize varieties and improved maize as percentage of arable fields

Village	All maize as percentage of arable fields	Improved as percentage of all maize fields	Improved as percentage of all arable fields
Barnawa	12.73	35.71	4.55
Bichi	47.14	57.58	27.14
Gargai	23.68	11.11	2.63
Gidan Hayaki	65.52	17.54	11.49
Gwaraji Tsoho	37.21	25.00	9.30
Kaya	60.00	72.22	43.33
Mahangi	28.77	2.38	0.68
Mariri	2.75	0.00	0.00
Ungwan Dan			
Mallam	47.73	92.86	44.32
Ungwan Dawa	39.58	38.60	15.28
Aggregate	34.47	41.16	14.19

Source: Analysis of Field Survey Data

The spotted improved maize varieties were 9021-18 (popularly called Oba Super1), 8644-27 (called Oba Super2) and TZESR-White. Of these the 9021-18 variety was most predominant, having been found in all the villages except in Gargai and Mariri. As shown in Figure 1, the improved 9021-18 maize was the most predominant having been observed in 34 fields in Kaya, 30 fields in Ungwan Dan Mallam and 21 fields in Ungwan Dawa, 19 fields in Bichi and 10 fields in Gidan Hayaki.

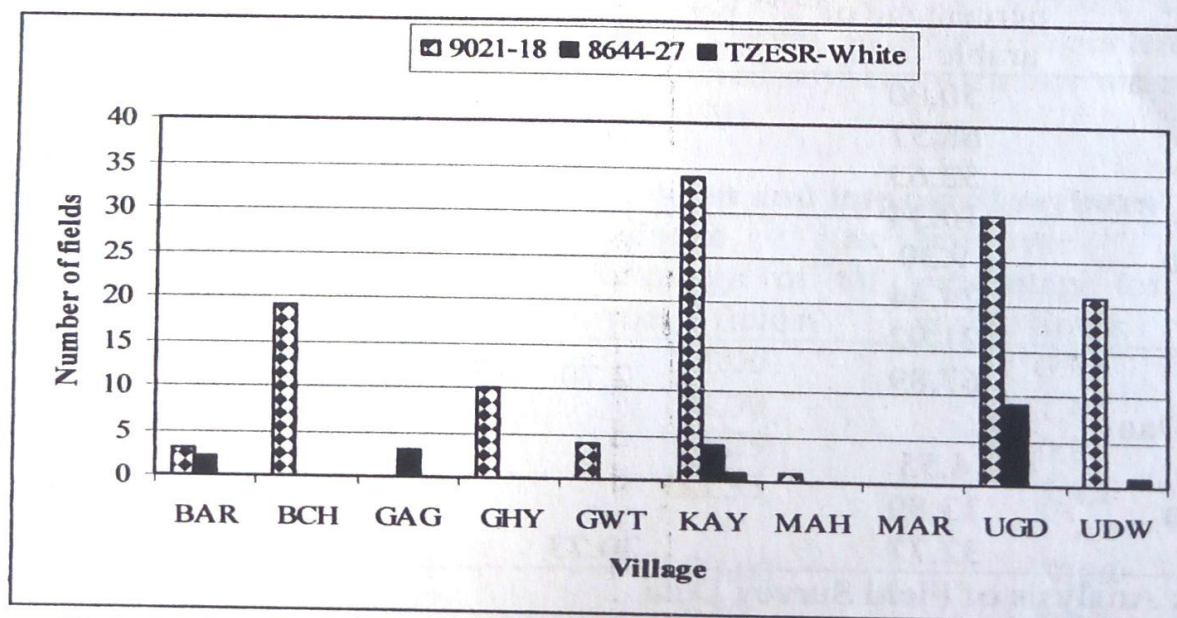


Figure 1: Fields devoted to improved maize varieties in villages

The second most predominant maize variety adopted was the improved 8644-27, but it was only observed in four villages. The least in terms of predominance was

the TZESR-White varieties, which was observed in one field each in only a few villages. In all, 9012-18 variety was observed in 86% of all crossed villages compared to 8644-27 and TZESR-White observed in 13% and 1% of villages respectively (Figure 2).

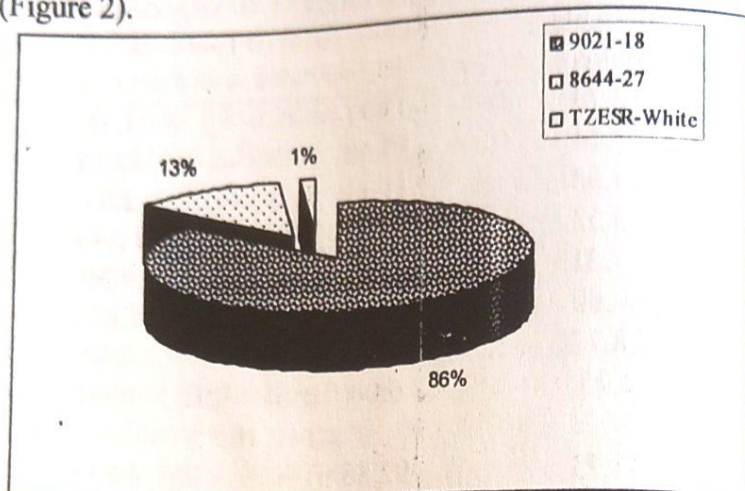


Figure 2: Fields devoted specific maize varieties

Cowpea (*Vigna unguiculata*)

Results of the share of cowpea in the arable fields of farmers are presented in Table 4. Column 2 shows the percentage share of all cowpea varieties (local and improved) in the observed arable fields in each of the studied villages. On the aggregate 32.77% of observed arable fields were planted with cowpea. Improved cowpeas were observed as first four crops in 8.5% of the surveyed fields.

Table 4: Cowpea and improved cowpea as percentage of arable fields

Village	All cowpea as percentage of arable fields	Improved as percentage of all cowpea fields	Improved as percentage of all arable fields
Barnawa	50.00	5.45	2.73
Bichi	68.57	75.00	51.43
Gargai	52.63	35.00	18.42
Gidan Hayaki	10.34	33.33	3.45
Gwaraji Tsoho	9.30	75.00	6.98
Kaya	24.44	-	-
Mahangi	21.92	-	-
Mariri	67.89	2.70	1.83
Ungwan Dan	4.55	-	-
Mallam	13.89	-	-
Ungwan Dawa	32.77	20.73	6.79
Aggregate			

Source: Analysis of Field Survey Data

The ratios ranged from lowest 4.55% in Ungwan Dan Mallam to highest 68.57% in Bichi. Others villages include Gargai (52.63%), Barnawa (50.00%), Kaya (24.44%), Mahangi (21.92%) and Ungwan dawa (13.89%). The improved cowpea as a percentage of all observed cowpea fields was 20.73%, which ranged from zero percent

in four villages to 75.00% in two villages. Thus, the improved cowpea was highly adopted in Bichi and Gwaraji Tsoho but not in Kaya, Mahangi, Ungwan dan mallam and Ungwan Dawa with zero percent. As percentage of all arable fields, the improved cowpea consists of 51.43% in Bichi, 18.42% in Gargai and 6.93% in Gwaraji Tsoho.

Figure 3 shows that four improved cowpea varieties were identified: IT93K452-1, IT93K452-2, IT90K277-2 and IT97K499-35. Of these, the IT93K452-1 variety was the most adopted having being found in six of the ten surveyed villages. The Table shows that whereas this variety was observed in more fields in Gargai the improved IT90K277-2 variety was more adopted in Bichi.

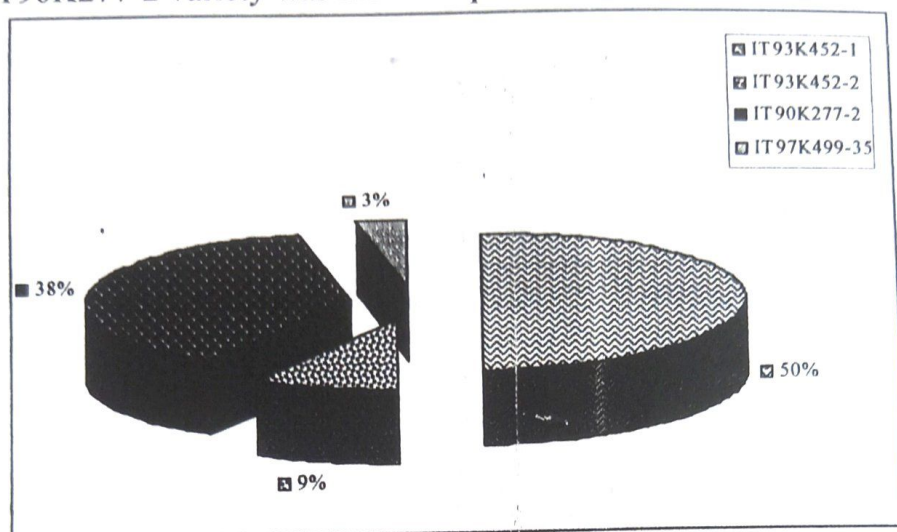


Figure 3: Fields devoted to specific improved cowpea varieties

Soybean (Glycine max)

The proportions of fields devoted to soybean in the surveyed villages are presented in Table 5. All categories of soybean as a percentage of all arable fields cultivated by farmers was 7.49%. The highest proportion of 17.78% was observed in Kaya as against 12.50% in Ungwan Dan Mallam, 10.34% in Giadan Hayaki, 10.27% in Mahangi, 6.94% in Ungwan Dawa and 6.14% in Gargai. In other villages less than 5% of arable fields were devoted to soybean. Improved soybean varieties were observed as the first four crops in 4.5% of the surveyed fields.

Table 5: Percentage of fields devoted to soybean and improved soybean

Village	All soybean as percentage arable fields	Improved as percentage of all soybean fields	Improved as percentage of all arable fields
Barnawa	3.64	25.00	0.91
Bichi	2.86	50.00	1.43
Gargai	6.14	14.29	0.88
Gidan Hayaki	10.34	33.33	3.45
Gwaraji Tsoho	-	-	-
Kaya	17.78	100.00	17.78
Mahangi	10.27	6.67	0.68
Mariri	0.92	0.00	0.00

Ungwan	Dan		
Mallam	12.50	36.36	4.55
Ungwan Dawa	6.94	10.00	0.69
Aggregate	7.49	37.33	2.80

Source: Analysis of Field Survey Data

Column 3 of Table 5 shows that all soybean fields observed in Kaya (90%) were planted with the improved varieties. In Bichi the improved germplasm constituted 50.0% of observed soybean fields as against 36.36% in Ungwan Dan Mallam, 33.33% in Gidan Hayaki, 25.00% in Barnawa and less than 15% in all other villages. On the aggregate the 37.33% of soybean fields were planted with the improved varieties. Four improved soybean varieties – TGx1019-2EN, TGx1019-2EB, TGx1448-2E and TGx1485-1D – were spotted during the survey (Figure 4). The TGx1019-2EN was observed in 46% of fields as against TGx1448-2E in 32% and TGx1485 and TGx1019-2EB in 11% each.

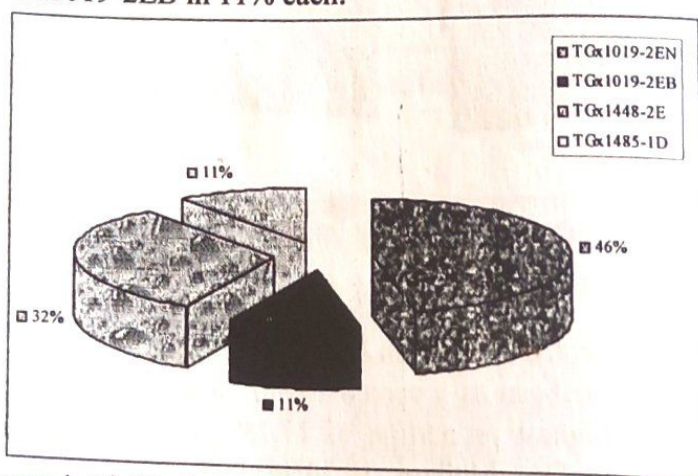


Figure 4: Fields devoted specific improved soybean varieties

CONCLUSION AND RECOMMENDATIONS

This study has used the methodology of line transect to investigate the use status of the old and modern farm management practices and crops' varieties introduced into the drier savanna area of northern Nigeria. It has thus shown the usefulness of the transect walks methodology in characterization studies. Among other things the study conducted in ten villages has revealed that arable farming constitutes the primary occupation of the people of the area. Farming is basically rain fed, although few fadama farms were spotted in some villages. Communities practice traditional bush-fallow means of enhancing soil fertility and crops' yields. The modern farm management practices introduced into the area are not variously practiced by farmers since the traditional *gicci* system is still widely used. Also, the improved crop varieties were spotted only in few communities. The level of use was low at average of less than 45% for maize, cowpea and soybean. The proportion of the communities that devoted up to 50% of the observed maize fields to the improved maize was only 30% while the proportion that devoted up to 50% to improved cowpea and soybean was 20%. The study recommended that intensified extension services

training and enlightenment programs should be used as ways of promoting awareness to foster the use of improved farming technologies to realize their full benefits.

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