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Gender and Innovation in Agriculture: A Case Study of Farmers' Varietal Preference of Drought Tolerant Maize in Southern Guinea Savannah Region of Nigeria

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Abstract

Maize is one of the worlds' three primary cereal crops, sustainable increasing production of this crop is important to farmers to be able to meet the ever increasing consumption of maize which is one of the major reasons for the development of Drought tolerant maize variety (DTMA). The study analyses farmers' varietal preference of drought tolerant maize in Southern Guinea Savannah region of Nigeria. It specifically determined the socioeconomic characteristics of farmers, identified their gender based preference for Drought Tolerant maize variety and elucidated the reasons for preference. Three-stage stratified sampling technique was used. Well-structured questionnaire was used to collect information from a total of 48 farmers. Descriptive, Ranking and LSD were used to analyse the data collected. The result of the analysis showed that majority of the male and female farmers have primary education and are youths. The result of varietal preference differs between genders in some locations Male farmers identified big cobs with full grains, big seed, and multiple cobs as the main reasons for their preference while female farmers identified yellow colour of seed, nutrient fortified seed and big cobs with full grains as the main reasons for their preference. It is therefore recommended that effort should be made to involve male and female farmers in the varietal selection procedure as to facilitate easy adoption of hybrid maize. The women are more concerned with the food security of their family and hence are important segment in maize innovation that improve the food security of farming households. It is therefore imperative that Programmes and policies should not exclude female farmers.

Keywords: Innovation, Gender, Drought Tolerant Maize Variety, Nigeria.

1. Introduction

Maize is one of the worlds' three primary cereal crops. It occupies an important position in world economy and trade as a food, feed and industrial grain crop. The importance of maize in Nigeria cannot be over emphasized, with the country producing 43% of maize grown on West Africa (8). Empirical evidence have shown that the use of drought tolerant (DT) maize varieties stabilize maize yields in the DT-prone ecologies and also increase land area cultivated to maize. The corollary is an enhancement in the economic status of the resource-limited farmers in the country.

Agricultural production in low income countries is generally diversified; focusing on rain fed staple crop production and raising livestock, activities that are inherently risky (12). The contribution of farming to rural development is highly dependent on the generation and delivery of new agricultural technology (9). Technological innovation refers to a process driven by an intention of imposed changes, managed, accompanied, collaboratively or individually elaborated in view of introducing, suppressing, restructuring or displacing an element or system within an established context (1).

In recent years, development practitioners have become increasingly interested in questions relating to the distributional impacts of technological change in agriculture. Scientific breakthroughs have brought about dramatic productivity gains in many of the world's leading cereal crops, but the persistence of chronic malnutrition among a significant portion of the world's population has led to the realization that millions of people still lack reliable access to sufficient quantities of food. This realization has caused increased attention to be directed at the technology adoption process (6).

Technological adoption among Male and female farmers is crucial to improving the productivity of maize under cultivation in Nigeria, therefore it is crucial to know whether gender-related differences in

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adoption patterns can be attributed to innate characteristics of improved technologies themselves or result from other, external factors. It has been recommended that information and knowledge on new technology and innovation should be made available to the both male and female farmers (4). The distinction is also crucial, because gender directly affects the technology adoption process. Despite the important role women play in agricultural production, they remain disadvantaged in numerous respects. Women have limited access to a wide range of physical assets including agricultural inputs, technological resources, land, and so forth (2). Re-enforcing maize innovation adoption and productivity can help render dynamic development in maize production for sustainable growth in this staple food. This can be done by the use of core socio-cultural fabrics like the role women play is value-added, as per food security and growth processes (7).

In order to know and meet the farmers' need, evaluation of the maize variety preference is necessary and important. Satisfying the need of farmer has been a challenge to innovation producers due to change in technology, innovations and life style. Preferences are symbolized by the perceptions, taste and attitudes that consumers hold toward food types (3). As markets emerge, consumers are faced with more choices. For successful adoption, a new crop or cultivar should offer a combination of good variety and market demand by meeting the needs of users (3). Innovation producers should know that end-users' preference will drive the evolution of the farm industry (5).

Women are a key part of the mainstream in agriculture, yet they face formidable obstacles (10). It is therefore of importance to have strategy to put men and women's concerns and experiences at the centre of research design, implementation, monitoring, and evaluation. This involves looking at the socioeconomic settings of men and women to ensure that they benefit equally – often referred to as "gender mainstreaming". Bridging the gap in access to technology between men and women, we could increase productivity (Food and Agriculture report (2010-2011). It can contribute to child survival and nutrition, as "women are key to household food security." Gender shapes patterns of power relations, asset and wealth distribution and control, labor allocations, as well as preferences and aspirations within households. Gender is moving from neutrality to awareness and finally to gender transformative program design and implementation. Gender "aware"— that is, not only generating gender disaggregated data on the stakeholders that benefit from their development work — but transformation lies in using that information to improve the products and services delivered, paying specific attention to women's preferences. Research and innovations that would reduce the drudgery of farm work for women and meeting their needs is also important. Paying attention to women's needs and voices in the selection of maize varieties will make it possible to meet their needs. It is against this background that this research seeks to describe the socio-economic characteristics of respondent farmers; identify farmer varietal preference based on different gender for Drought Tolerant Maize (DTM) and elucidate the reasons for preferences.

2. Methods

The study was carried out in southern guinea savanna (SGS) of Nigeria. The sampling technique consists of three multi- stage stratified sampling. At the first stage, two states out of the three states in the SGS were selected purposively. The states with the highest seed distribution for on - farm trials (see Appendix 1) were selected which were Kwara and Niger. The second stage involved selection of locations. In the two states there were four location of DTMA trials (Appendix 2), three of the locations with the highest varietal distribution where selected. The locations selected were Mokwa, Ilorin 1 (Unilorin) and Ilorin 2 (Alapa). The third stage involved selection of farmers. Sixteen farmers with equal number of female and male were selected in each of the locations for the survey. The total number of farmers selected was forty – eight (48) with Female Twenty –four (24) and Male Twenty –four (24).

Data Collection

The Primary data were collected with the use of structured questionnaire. The questionnaire included questions on the farmers' socio-economic characteristics and the preference of the varietal DTM planted. The procedure followed is as thus:

The intention was to collect data on trait (and variety) preferences of participating farmers on all the varieties tested. This evaluation was done when the crop was still on the field. Farmers viewed all the plots before they selected the variety/plot they like most and the variety/plot they dislike most from the entire plots. Careful discussion with female and male participants on why they liked or disliked a plot/variety based on the counts of like and dislike was documented.

Data Analysis

Data collected were analyzed using descriptive analysis (frequency, averages, mode and mean), ranking mean and Least Square Difference (LSD).

Ranking Method

The ranking method used a four-Likert scale. Most preferred Rank 1, and More preferred Rank 2, Preferred rank 3 and Least preferred rank 4. The Likert scale summative scores were then ordered.

Least Significance Difference (LSD)

The ordered scores significant differences were identified using LSD. The relative frequency with which a quality was preferred was used to establish its ordinal rank. This preference ranking was tested for statistical significance using the method reported in (11). The test statistic (at $\alpha = 0.05$) = 1.96 x (SF(n) x $(n+1)/6)^{1/2}$, where SF was the number of surveyed farmers and n was the number of ranked quality parameters. Least significance difference (LSD) was used to test the ranking for statistical significance using the method represented in pair-wise comparism at 5% level of significant.

3. Results and discussion

Socio- Economic Characteristics of the farmers by gender

The result of the analysis revealed in Table 1 that majority of the farmers (both male and female) were youths between the ages of 21-30 years. This probably gives the respondent almost the same level of exposure. More than 54% of the male farmers have more than 10 years of education while only about 37% of the female farmers also have more than 10 years of education. Only one female farmer is a household head while majority of the male farmers are their household heads. This may affect their decision taken in innovation. The average farm size of the male farmers was 3.5ha while that of the female farmer was 2.8ha. This couple with fact that 75 % of male respondents own and managed their farms unlike the female while only 25% own and managed stipulates that the female are less privileged to inputs and less involved in decision making process.

Table 1: Result of Socio- Economic Characteristic of Respondents.

Age	***Male***		***Female***	
	Frequency	Percentage	Frequency	Percentage
1-10	0	0	0	0
11-20	0	0	1	4.2
21-30	12	50.0	12	50.0
31-40	1	4.2	4	16.7
41-50	6	25.0	5	20.8
51-60	3	12.5	2	8.3
Above 60	2	8.3	0	0
Total	24	100	24	100
Mean	38.6250		35.0417	
Minimmum	21.00		20.00	
Maximmum	65.00		60.00	
Standard Deviation	15.10489		12.12428	
Literacy Year	**Male**		**Female**	
	Frequency	Percentage	Frequency	Percentage
None	2	8.3	4	16.7
1-5	3	12.5	2	8.3
6-10	6	25.0	9	37.5
11-15	9	37.5	8	33.3
16-20	4	16.7	1	4.2
Above 20	0	0	0	0
Total	24	100	24	100
Mean	9.5833		7.5833	
Minimmum	.00		.00	
Maximmum	18.00		16.00	
Standard Deviation	5.53971		5.10683	
Household Head	**Male**		**Female**	
	Frequency	Percentage	Frequency	Percentage
Myself	16	66.7	1	4.2

Age	***Male***		***Female***	
My Husband	0	0	17	70.8
My Wife	0	0	0	0
My Father	8	33.3	6	25.0
My Mother	0	0	0	0
Total	24	100	24	100
Household Size	**Male**		**Female**	
	Frequency	Percentage	Frequency	Percentage
1-5	3	12.5	4	16.7
6-10	13	54.2	16	66.7
11-15	8	33.3	2	8.3
16-20	0	0	2	8.3
Above 20	0	0	0	0
Total	24	100	24	100
Mean	8.6250		7.6667	
Minimmum	1.00		2.00	
Maximmum	15.00		20.00	
Standard Ddeviation	3.60932		4.18763	
Farm Size	**Male**		**Female**	
	Frequency	Percentage	Frequency	Percentage
0-1	5	20.8	10	41.7
1.1-2.0	8	33.3	6	25.0
2.1-3.0	1	4.2	1	4.2
3.1-4.0	3	12.5	1	4.2
4.1-5.0	2	8.3	2	8.3
Above 5	5	20.8	4	16.7
Total	24	100	24	100
Mean	3.4900		2.8421	
Minimmum	.25		.50	
Maximmum	12.00		10.00	
Standard Deviation	2.96702		2.84135	
Farm Size Ownership And Management	**Male**		**Female**	
	Frequency	Percentage	Frequency	Percentage
Myself	18	75.0	6	25.0
My Husband	0	0	12	50.0
My Wife	0	0	0	0
My Father	6	25.0	5	20.8
My Grandfather	0	0	1	4.2
Total	24	100	24	100

Source : Author' s Field Work

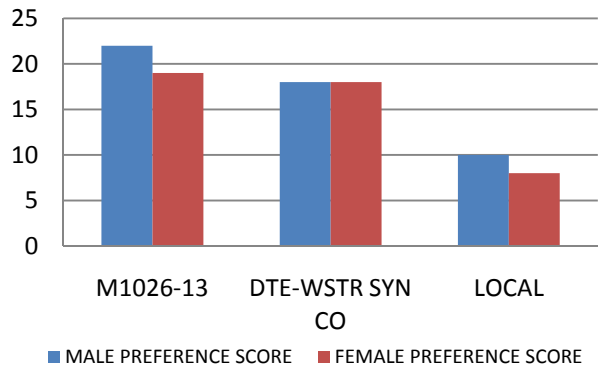

Figure 1: Farmer variety Preference Result for Mokwa On- Farm Trial 1 (Source : Author' s Field Work)

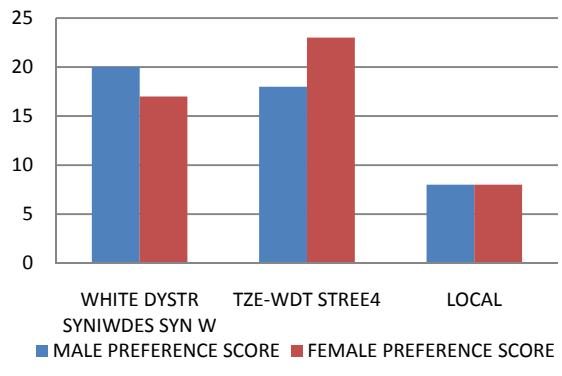

Figure 2. Farmer variety Preference Result for Mokwa On- Farm Trial 2 (Source : Author' s Field Work)

Preference Result

In Niger state, the preferences of the farmers by gender are similar. The evaluated farmers preferred DTMA hybrid (M1026-13) and white maize of striga tolerant variety (WHITE DYSTR SYNIWDES SYN W) for trial plot 1 and 2, respectively as shown in figure 1 and 2. The evaluated farmers least preferred local variety. However the most preferred and second preferred are not significantly different so the DT maize varieties are equally preferred (Table 1 & 2). This shows that male and female farmers' preferences may not all times contradict.

Table 2. Result of LSD for Farmer variety Preference Result (Mokwa On- Farm Trial 1)

	Male		*Female*	
Variety	Preference Score	Rank	Preference Score	Rank
M1026-13	22^{a}	1^{st}	19^{a}	1^{nd}
Dte-Wstr Syn Co	18^{a}	2^{nd}	18^{a}	2^{nd}
Local	10^{b}	3^{rd}	8^{b}	3^{rd}
Lsd			7.84	

Source : Author' s Field Work

TABLE 3. Result of LSD for Farmer variety Preference Result (Mokwa On- Farm Trial 2)

	Male		*Female*	
Variety	Preference Score	Rank	Preference Score	Rank
White Dystr Syniwdes Syn W	20^{a}	1^{st}	17^{a}	1^{st}
Tze-Wdt Stree4	18^{a}	2^{nd}	23^{a}	2^{nd}
Local	8^{b}	3^{rd}	8^{b}	3^{rd}
Lsd			7.84	

Source : Author' s Field Work

In Kwara State the preferences of the farmers by gender are not similar. Male farmers preferred 2004 TZE Y DT STR C4 followed by 2010 TZE-WDT STR while the female preferred 2004 TZE Y DT STR C4 followed by EVDT-1-2000-STR QPM CO (Figure 3). In varietal trial, female farmers most preferred variety was M0926-6 while the male most preferred variety was M1026-8 as shown figure 4. This reveals that the preferences might not be same among genders.

Table 4 shows the results of the LSD statistic which revealed that least preference of the local variety by both male and female farmers is significantly different. However in the varietal trial farm, unlike the female, the male farmers do not least preferred the local variety rather least preferred variety was M0826-11 (table 5).

Reasons for Preference by Gender

Table 6 highlighted the reasons for preference by gender. Male farmers identified big cobs with full grains, big seed, and multiple cobs while female farmers identified yellow colour of seed, nutrient fortified seed and big cobs with full grains as the main reasons for their preference. The female farmers are more concerned with the colour and nutrient content of the seed such as in case of quality maize (EVDT-1-2000-STR QPM CO). On further examination it was discovered that the quality protein maize has been grown by farmers and they identified that it has good taste. The female farmers preferred maize with fortified nutrient. They added that it will be good also if other nutrients like vitamins can be fortified in maize. Other reason farmers' identified include; Produce multiple cobs; High vigorous; Cobs with full grains (see figure 5); Tall stalks or good stand as in case of (DTE STR SY); Strongly matured cobs; Well tasseling; Attractive look; Greenish leaf colour.

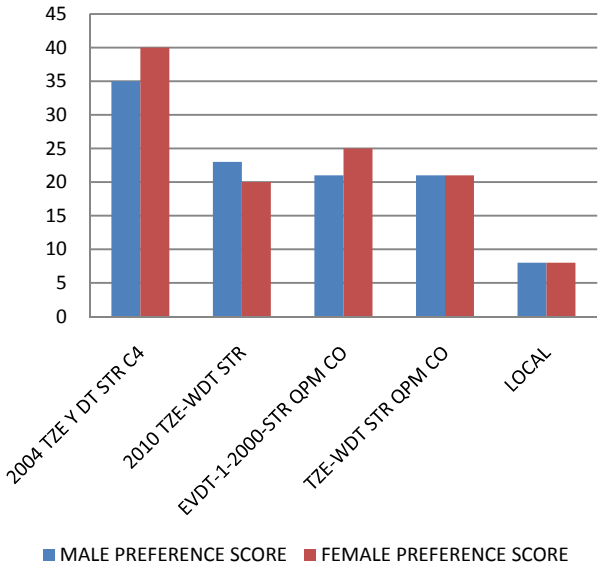

Figure 3: Farmer variety Preference Result for On- Farm Trial (Kwara state). Source : Author' s Field Work

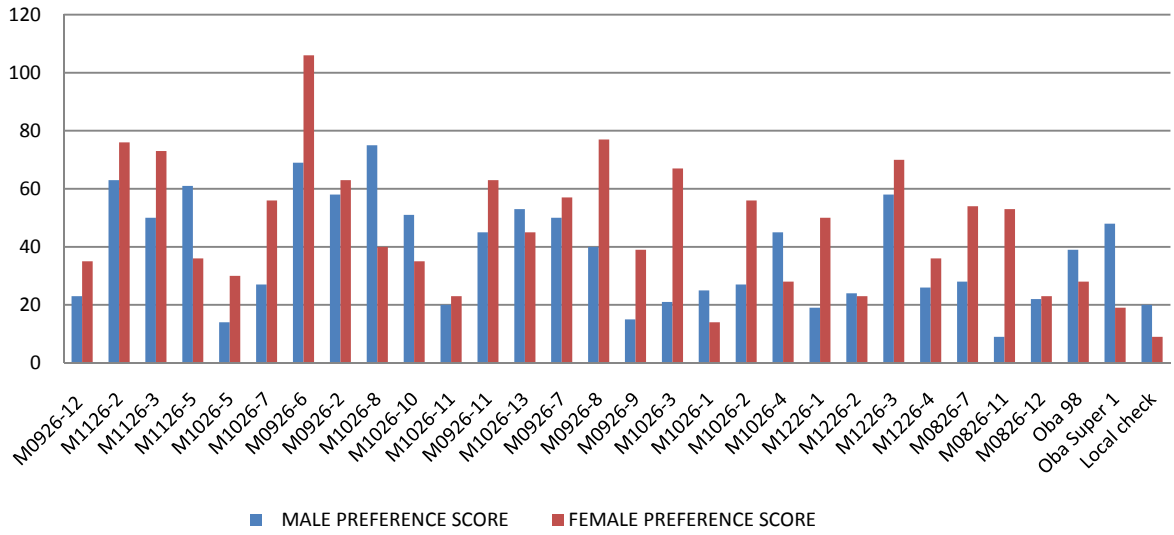

Figure 4. Farmer Variety Preference Result for Kwara varietal Farm trial. Source : Author' s Field Work

Table 4: Result of LSD for Farmer variety Preference Result (Kwara On- Farm Trial)

	Male		*Female*	
	Scores	Rank	Scores	Rank
2004 Tze Y Dt Str C4	35[a]	1st	40[a]	1st
2010 Tze-Wdt Str	23[b]	2rd	20b	4nd
Evdt-1-2000-Str Qpm Co	21[b]	3nd	25[b]	2rd
Tze-Wdt Str Qpm Co	21[b]	3rd	21[b]	3th
Local	08[c]	5th	08[c]	5th
Lsd Stastistic		12.39		

Source : Author' s Field Work

Table 5. Result of LSD for Farmer variety Preference Result (Kwara Varietal farm Trial)

	Male			Female		
Variety Name	Preference Score	Likert	Rank	Preference Score	Likert	Rank
M0926-12	23 B		22nd	35 B		20th
M1126-2	63[a]		3rd	76 A		3rd
M1126-3	50 A		9th	73 A		4th
M1126-5	61 A		4th	36 B		18th
M1026-5	14 B		29th	30 B		22nd
M1026-7	27 B		17th	56 B		10th
M0926-2	58 A		5th	63 B		7th
M0926-6	69 A		2nd	106[a]		1st
M1026-8	75 A		1st	40 B		16th
M1026-10	51 A		8th	35 B		20th
M1026-11	20 B		25th	23 B		25th
M0926-11	45 A		12th	63 A		7th
M1026-13	53 A		7th	45 B		15th
M0926-8	40 A		14th	77 A		2nd
M0926-7	50 A		9th	57 A		9th
M0926-9	15 B		28th	39 B		17th
M1026-3	21 B		24th	67 A		6th
M1026-1	25 B		20th	14 B		29th
M1026-2	27 C		17th	56 B		10th
M1026-4	45 A		12th	28 B		23rd
M1226-1	19 B		27th	50 B		14th
M1226-2	24 B		21st	23 B		25th

M1226-3	58 A	5th	70 A	5th
M1226-4	26 B	19th	36 B	18th
M0826-7	28 B	16th	54 B	12th
M0826-11	9 B	30th	53 B	13th
M0826-12	22 B	23rd	23 B	25th
Oba 98	39 A	15th	28 B	23rd
Oba Super 1	48 A	11th	19 B	28th
Local Check	20 B	26th	9 C	30th
Lsd Statics		46.38		

Source : Author' s Field Work

Table 6: Reasons Stated by Farmer Variety for their Preference

	Female			*Male*	
Reasons	Frequency	Rank	Reasons	Frequency	Rank
Big And Grain Filling Cobs	107	1st	Yellow Colour Of Seed	101	1st
Big Seeds	100	2nd	Nutrient Fortified Seed	99	2nd
Yellow Colour Of Seed	95	3rd	Big And Grain Filling Cobs	88	3rd
Big Leaves	83	4th	Big Seeds	76	4th
Multiple Cobs	83	5nd	Big Leaves	63	6th
Nutrient Fortified Seeds	69	6th	Multiple Cobs	63	6th
High Vigorous	68	7th	Well Tasseling	63	6th
Tall And Good Looking Stalks	63	8th	High Vigorous	50	8th
Strongly Matured Cobs	40	9th	Tall And Good Looking Stalks	48	9th
Well Tasseling	40 B	10th	Strongly Matured Cobs	34	10th
Attractive Look	25	11th	Greenish Leaf Colour	30	11th
Greenish Leaf Colour	17	12th	Attractive Look	26	12th

Source : Author' s Field Work

Figure 5: Comparison between the cob of variety. DTM Variety (Right) with farmers' best variety (Left) during the field day at Niger State. The cobs of the DT maize variety were well filled while that of farmer's variety was not fully covered with grains. Source: 2012 On - Farm Trial Field Day

4. Conclusion and Recommendation

It is evident that men and women farmers have different preferences sometimes and it is possible to conceive an integrated innovation in which men and women interest will be considered. The result shows that the women are incapacitated in their decision making ability but they are still having their preferences and choices. The women choices are based on the food security of their household and that explains reasons for their preference of nutrient fortified improved maize varieties. Hence women are essential segment to be involved at any stage of innovation's conception. Considering the complex nature of agricultural research demands, coordinated effort is needed among all actors in order to

ensure appropriate technology is promoted. It is therefore recommended that effort and policies should be made to involve male and female farmers in the varietal selection procedure as to facilitate easy adoption of improved maize. The collaboration

between biological scientists, extension agents, socio-economist, male and female farmers can improve the result of maize innovation.

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5. References

1. Adamczewski G: « La notion d'innovation : figures majeures et métaphores oubliées », dans L'innovation en éducation et en formation, Collection Pédagogies en développement, De Boeck Université, Belgique, 1996, 15-29.
2. Arndt C. Tarp F: **Agricultural technology, risk and gender: A CGE analysis of Mozambique** *World Development* 2000, 28(7):1307-1326
3. Ayinde, OE, Adewumi MO, Folorunsho, WO: **Consumer preference of Banana (Musa Spp.) in Kwara State, Nigeria** in *Banana and Plantain in Africa: Harnessing International Partnership to increase research impact ActaHorticultrae* 2010, 89-93
4. Ayinde OE, Muchie M, Adewumi MO, Abaniyan EO: **Risk Analysis of Gender in Innovation System: A Case Study of Production of Downy Mildew Maize Resistant Variety in Kwara State, Nigeria** *Obeche Journal* University of Ibadan 2012, 30(1):459-465.
5. Ballenger N, Blaylock J: **Consumer-driven Agriculture in Market and Trade.** Amber Waves 2003, 1:29–33.
6. Doss CR, Morris ML: **How does gender affect adoption of agricultural innovations? The case of improved maize technology in Ghana** *Agricultural Economics* 2001, 25(7): 27-39
7. Food and Agricultural Organization (FAO): Gender and Food Security. Sythesis report of Regional Documents: Africa, Asia and Pacific, Europe, Near East, Latin America. FAO, Rome 2007
8. Olarinde LO, Manyong VM, Akintola JO: **Attitudes towards risk among maize farmers in the dry savanna zone of Nigeria: some prospective policies for improving food production** *African Journal of Agricultural Research* 2007, 2 (8):399-408
9. Tripp R: **Agricultural technology policies for rural development** *Development Policy Review* 2001, 19 (4): 497-489
10. Kandiwa V: **Mainstreaming gender in maize improvement research** CIMMYT Report 2012 .http://dtma.cimmyt.org/index.php/component/content/article/110-news-articles/158-mainstreaming-gender-in-maize-improvement-research-MMK,N (accessed January 12, 2013).
11. Urquhart NS, Clyde E: **Ranking energy policy alternatives in a particular informed population.** *Proceeding of DOE Statistical Symposium*, Oak Ridge National Laboratory, Oak Ridge 1978, 53–65.
12. Yesuf M, Bluffstone R: **Risk Aversion in Low-Income Countries: Experimental Evidence from Ethiopia**, *IFPRI Discussion* 2007, Paper No. 715 (Washington, DC: International Food Policy Research Institute.

Appendix 1: Seed Distribution For 2012 DTMA On-Farm Trials.

	State			
Variety	Kwara (Kg)	Niger(Kg)	Oyo (Kg)	Purpose
	Opvs			
Tze-W Dt Str C4		10		Baby Trial
2010 Tze-W Dt Str	10			Baby Trial
Tzee-W Dt Str Qpm-W	10			Baby Trial
2009 Tze-W-Dt Str		10		Mtp
Evdt-Y 2000 Str Co	3			Baby Trial
2004 Tze-Y Dt Str C4	10			Baby Trial
Tzl Comp 1 C6/Dt Syn-1			10	Baby Trial
Tzl Comp 4 C3 Dt			20	Seed Production
White Dt Str Syn/Iwd C3 Syn-W-1		10		Baby Trial
Dt-Sr W C2			10	Baby Trial
Dte Str Syn Co	5			Baby Trial
Evdt-W 2008 Str		10		Mtp
2011 Evdt-W 99 Qpm Str	5	5		Baby Trial
Dte-Y Str Syn		8		Baby Trial
2010 Tze-Y Dt Str	10			Mtp
99 Tzee-Y Str Qpm		5		Baby Trial
2000 Syn Ee-W Qpm	10	10	5	Seed Production
	Hybrids			
Tzeei 29 X Tzeei 90			1	Baby Trial
Tzeei 82 X Tzeei 79 X Tzeei 95			1	Baby Trial
M1026-10	4	4		Baby Trial
M1026-13	4	4		Baby Trial
Tzeei 29 X Tzeei 37 X Tzeei 14			3	Baby Trial
Tzei 29 X Tzei 60			5	Baby Trial
Tzeei 83 X Tzei 60	5		5	Baby Trial
Tzeei 39 X Tzeei 90		4		Baby Trial
Tzei60 X Tzei 86	5			Baby Trial
Tzeei 21 X Tzeei 29		4		Baby Trial
Total	81	84	60	

Source: 2012 DTMA Mid-season Report

Appendix 2: DTMA Variety Trial Distribution for 2012 Growing Season.

	Location					
Trial	Ilorin	Ilorin	Mokwa	Lapai	Ballah	Kishi
Package	1	2				
M12-25	X			X		
M12-26	X		X			
M12-27		X	X			
M12-28		X	X			
M12-29		X		X		
M12-30					X	X
M12-31	X			X		
M12-32					X	X
M12-33					X	X
M12-34	X		X			
M12-35		X	X			
Total	4	4	5	3	3	3

Source: 2012 DTMA Mid-season Report