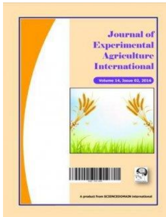

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Introduction of Sasakawa Technology on Irrigated Maize *(Zea mays* L) Production in Kurmi Mayolope, Hong. of Adamawa State Nigeria

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The study was conducted in Kurmi Mayolope, Hong Local Government Area of Adamawa State, Nigeria, Sasakawa technology was introduced on irrigated maize (*Zea mays* L) production. A hybrid maize variety OBA 98, MR (white), obtained from skill acquisition Centre and local variety retained by farmers were used. The specific objectives of the study described the socio-economic characteristics of the respondents: determines the problem encountered by farmers in maize production, demonstrated how to increase yield through the use of Sasakawa technology on irrigated maize and best agronomic practice and examined the performance of Sasakawa technology for increase yield of maize production. Data collected were analysed and presented in percentage performance over that of farmers. The result revealed that the significant Technology used in Sasakawa that increased yield was spacing, the rate of fertiliser application and single seed sowing per hill. The yield components determined were number of cobs per plant, number of seed per cob and cob weight. Sasakawa technology experimental plots were observed to have significantly outperformed the farmers plot in a number of cobs per plant, number of seeds per cob, cob weight, cob length and grain yield. It is therefore recommended that spacing of 25 cm x25 cm between plants and 75 cm x75 cm between rows, burying (sowing) of fertiliser at the recommended

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dose and other inputs such as seeds and herbicides should be made available in time and at a subsidized rate to farmers by Government and Nongovernmental organizations. Effective extension services should also be extended to farming areas to enlighten and intensify the use of Sasakawa technology to the farmers for maize production.

Keywords: Sasakawa; sowing.

1. INTRODUCTION

Maize (*Zea mays* L) belongs to the family Poaceae, originated in the South and Central America, where it spreads to Europe and the rest part of the world. It was also introduced to the West African Countries by Portuguese, it is most popular in the Benin Republic, Ghana and Nigeria.

Maize is an important traditional basic commodity contributing a significant production of food requirement for the Nigerian population, cultivated in almost all the agro-ecological zones of Nigeria. It is also a major cereals crops being cultivated and has now replaced sorghum in many areas not only on the basis of farmers engaged in its cultivation but also in economic value International Institute of Tropical Agriculture [1]. In recent years, maize production has been on the increase but not sufficient to meet the demand of growing population. Thus, the need for technological agronomic practices to make-up for the shortfall is required. By any estimate, the bulk of the food and silage production in Nigeria is from the rain-fed agriculture. This makes the crop now to start risen from commercial or cash crop, on which many agro-based industries depend on as raw material [2]. Although irrigated farming accounts for only 18% of the cultivated area in the developing world. It produces about 40% of the value of agricultural output, [1].

Irrigation, therefore, holds the key for sustainable farming practices that can meet food self-sufficiency and security needs. However, in spite of the giant stride in irrigation development in Nigeria through River Basins Developments Authorities, their performance leaves a lot to be desired. This finds expression in lack of effective harnessing of this key variable with a view to stepping down to the barest minimum. The devastating effect of drought prevalent in Northern Nigeria is also a prevailing factor as opined by [3].

In the past, the main findings to the growth recorded was domestic maize production were due to area expansion. However recent strategies through research system sought to increase production through increase productivity. This is pivoted on intensification, involving the development and dissemination of modern technology and improved maize varieties as a composite package to maize farmers.

The introduction of quality protein maize (QPM) which was introduced, solved the problem in all cereals that contain the lysine and tryptophan, as amino acids found in the grains. This quality protein maize (QPM) with enhancing values of these amino acids is of help to the dietary needs of the Nigerian consumer of both human and animals [4]. However, the maize varieties available in Nigeria are of two categories, these are the open pollinated varieties (OPV); ACR 97, TZE, COMP 3 and TZE-WI. The hybrid varieties; OBA SUPA 1, OBA 98, MR (white), MS (yellow), SGM 1 (white), SGM 2(yellow). Reports by [5]; [6], from farming skills stations (based on the trials and on stations) showed that, the adoption of technologies and improved management practices led to substantial yield increases in maize production. This invariably underscores the significant role that technology stands to play in attaining the much-needed growth in maize sub-sector.

History of Maize Types in Nigeria: Two types of maize are cultivated in Nigeria. These are the dent and flint maize. However, the cultivation of popcorn and sweet maize is on the increase mainly as cash crop. The hybrid maize OBA SUPA 1 and OBA 98 were made available only to farmers to increase food production Programme [7]. ACR 97 and TZE comp3 which are the open pollinated varieties (OPV) was introduced in Northern regions of Nigeria where its spread through the local farmers for cultivation in their farms during both rainfed and under irrigation practice during dry season. The cultivation of the hybrid and open pollinated varieties were practiced in the riverine areas of Northern Nigeria during dry season as a field crop and cash crop to evolve going as far back in sixteenth century [8]. Remarkable drier varieties of maize also exist which are specific to the unusual dry conditions that occurred in the dry season farming, the river basin and boreholes constructed for irrigation channels in the extreme North of Nigeria were used for maize cultivation. Maize can also be harvested like the rain fed maize from the field in view of its importance. Indigenous maize is one of the least-known major cereals until the recent introduction of the quality protein maize (QPM) by scientist with the use of biotechnology techniques to unlock its greats genetic potentials, [4]. The major maize grown is the dent and flint maize. The exact zone of its domestication remains uncertain, although it is certainly in the Central America. Recent studies have suggested that it may have been domesticated from the South and Central America and Europe, corresponding to *Zea mays L* races. Maize would have spread across Europe to African Countries and classical sources suggest that it was being cultivated in the Portuguese region in far back second century BC. Unlike its African relatives, maize has relatively short history in Africa. In the 13th and 14th centuries maize is reported on the West African coast. Its route of entry into Nigeria can be in two directions. Portuguese traders introduced maize from East Africa to West Africa some years back [7]. The maize history of cultivation assigned the spread to all the regions of the North Eastern States, Western and southern part of Nigeria. About a hundred years later and now the cultivation of maize has increased with the introduction of the hybrid and the open pollinated variety in the Northern Nigeria. However, the introduction of quality protein maize (QPM) assisted in reducing several deficient amino acids in maize. The maize is now cultivated in two phases as the rain fed and irrigated in the riverine and irrigation practices.

Climatic and Soil Requirements: Maize requires 75 cm to 150 cm of rainfall per annum evenly distributed during growing season. Under the irrigation system, the crop needs distribution of the surface or sub-surface water. It cannot tolerate frost or arid condition unless grown under the irrigated system. A sunshine hour is required throughout the growing period. Best performance is obtained with temperature of 21°c spread throughout the growing period, low temperature retards growth. Maize performed best between latitude 50°N to 40°S and an altitude from the sea level to about 4000 m above sea level.

Maize require a deep medium-textured, well drained, fertile soil and a well drain sandy loamy soil of p^H 5.0 – 8.0 or p^H 6 – 7 if properly managed. Soil moisture and temperature are very important at sowing and all the growing stages. Moisture stress at early growth may affect subsequent development. Also harmatan during irrigated maize affect the growth and make the plant to be dwarf with subsequent lower the yield.

Maize crop serves as an important source of carbohydrates if eaten in the immature state and provides useful quantities of vitamin A and C. It forms major part of our diet for over one third of the country's population [7]. It is one of the most valued cereals crops in West Africa.

Irrigation Maize: Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of the landscapes and re-vegetation of disturbed soils in dry areas and during the period of inadequate rainfall. The establishment of river basin development authority (RBDA) in the 1980's gave a boost to dry season farming schemes in maize irrigations. Irrigation is supplied from rivers, dams, wells, bore holes, and wash bores and other sources to supplement rainfall for full maize crop growth [3]. This system account for 17% of cultivated maize land and 10 – 12 percent of National maize supply. In part of Northern areas, irrigation is by wash bores and furrows in riverine areas and dams. It is by gravitational irrigation practices and was developed by farmers entirely. They have incorporated the use of farm residues with organic fertilizers in the farming systems more especially in the Northern Guinea Savannah, Sudan savannah and Sahel Savannah.

Uses: Maize can be eaten when boiled or roasted. The crop can also be processed into flour baked in bread. Locally, used in making porage (local palp drink), one of the Northern Nigeria dish. It can also be used as animal feeds and consumed after cooking as a staple dish. It is used for making ethanol. The crop also serves as source of income to farmers that engaged in production in large quantities. The stalk can be used as manure and the crops used as silage for animal feeds.

Statement of the problem: Over decades' maize has occupied a position as a strategic crop for food security and economic development of Nations of the world. [9] classified the crop as the most important food dependent upon by over 45% of the World population for about 75% of their food needs. Due to the growing importance of the crop and the increasing challenges of attainment of food security, it has been estimated that annual maize production needs to increase from 486 million metric tons from 2002 to meet the projected global demand of about 656 million metric tons by 2030 [9]. Recent global trends in the maize industry however, shows that there is a growing production demand for the commodity in Africa, as evidenced from pressure on world supply and steady increase in the world price of the commodity in the last years [10]. In the West African sub-region, Nigeria has witness a well-established growing demand for maize as propelled by rising per output consumption and consequently the insufficient domestic production had to be complemented with enormous technological in both quantity and value at various time [11].

The enormous production has however, been considered by various regimes. To attain maize self-sufficiency and meet future demand for maize yield, productivity has to be increased. Therefore, this study introduced the Sasakawa technology practices under irrigated farming practice so as to stabilized the maize yield in the study area.

Objective of the Study: The main objective of this study was the introduction of Sasakawa technology on irrigated maize (*Zea mays* L*)* Production in Kurmi Mayolope, Hong. The specific objectives were to:

i. determines the problems encountered by farmers in maize production and
ii. demonstrate how to increase yield through the use of Sasakawa technology on irrigated maize and examine the performance of Sasakawa technology for increase yield of the improved production through agronomic best practice.

2. MATERIALS AND METHODS

This projects were conducted in Kurmi Mayolope, Hong Local Government area (LGA) of Adamawa State. It is located within the latitude 10°23N and longitude 13°12E. It has a mean annual range of temperatures of 15°c – 17°c with the coolest months in December and January and relative humidity between 20 to 40% in January and 60 to 80% in July and August. The soil, sandy clayed and loamy soil along the riverside and fadama areas.

2.1 Experimental Materials

Maize (hybrid) OBA 98, MR (white), and (farmer's variety) obtained locally, Fertilizer (NPK 20:10:10, Urea and farmyard manure), Hoe, Shovel, Rake, Rope, Pegs, measuring tape, Water pump, Measuring scale, Basin, Trampoline, Bag and Herbicides (vinash, nicosulfuran).

2.2 Experimental Design

The study comprises of two treatments, the first treatment consists of an improved maize variety and Sasakawa technology with suitable agronomic practices, while the second treatment consist of farmer's variety which were retained seed by the farmers.

2.3 Experimental Procedure

Land preparation: The land was cleared using hand hoes, pre tillage before ploughing, harrow and levelled properly. A bund was constructed to retain water using hand hoe. The field was irrigated for about three days and well-leveled. Drainage outlet was created to control flood and watering. The channels were created and sunken beds made for easy retention of water and distribution for crops. Farmyard manure was applied in each plot during the land preparation and then watered thoroughly.

Sowing and Spacing: The seeds were sown in the plot at the rate of one seed per hole to a depth of 2 – 3cm in well leveled soil with a spacing of 25 by 25cm and 75cm by 75cm.

Gap filling: The empty spaces were filled 10 days after sowing using left over seeds.

Fertilizer Application: A well compounded inorganic material of NPK 20:10:10 was applied at the recommended rate of 8 grams per plant the same day of sowing the seeds. Second application of urea was done after 3 – 4 weeks at the rate of 2 grams per plant by sowing or burying the fertilizer between plants.

Weed control: Weeds were hand pulled and hoed. The bunds were maintained throughout the growing time while water and fertilizer were effectively utilized.

Data Collection: The data was collected on the followings:

Plant Height: Plant height was measured from the base of the plant to the last flag leaf of the plant using the measuring tape at 30,45, 60, and 90 days after sowing.

Flowering Percentage (50%): Flowering was recorded during and shortly after weeding when the flowers started open its pollinated and close. The number of days to 50% flowering was recorded.

Number of Cobs per Plant: The highest number of cobs was recorded, with 2 among the varieties that gave highest yield and productive per unit area.

Length of Cobs: The length of cobs were measured with measuring tape on randomly selected plants.

Cob Weight: The weight of the cob was recorded based on their size.

Number of Seeds per Cob: The Number of seeds per cob was counted and recorded.

1000 Grain Weight (g): The weight of grains was taken and recorded.

Plot Yield: The plot yield was recorded by grain yield from 10 by 10m ($100m^2$) plot size.

Farmers Plot: All the operations carried out in the experimental site were done on farmer's plot using the same treatment and operations.

Data Analysis: Data collected were analyzed and presented in percentage performance over that of farmers.

Harvesting: Harvesting was done when the crop matured i.e. when the kernels reached hard dough stage. When black layer was shown at the point of attachment of the grain to the cob. The cobs were picked up and dried to safe moisture content and the grain was weighted using weighing balance.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Distribution of Farmers

Based on distribution by age, 63.34% of the farmers were middle aged ranging from 30-49 while the least was 10% which fall at the age of above 60years. it pre-supposed that many of them were at their active years. This agrees with the finding of [5] that maize producing farmers are in their active farming years and is likely to enhance their production.

The result also shows that 43.33% of the farmers in the study area had western education while 33.33% of the farmers were Non formally educated. The latter category of farmers, reacted positively to innovations which enhanced their production. This also agrees with the findings of [12], that, education enhances rate of adoption of innovation by farmers.

The Table 1c indicated majority, 80% of the farmers were males, but females also participated in irrigated farming with 20%. This is in agreement with [9]. That, in agriculture, irrigation is majority carried out by men.

Table 1a. Distribution of farmers by age

Age	Frequency	Percentages (%)
Less than 30	4	13.33
30-39	7	23.34
40-49	12	40.00
50-59	4	13.33
60 and above	3	10.00
Total	30	100

Source: field survey 2016-2017

Table 1b. Distribution of farmers by level of education

Educational status	Frequency	Percentages (%)
Non formal education	10	33.33
Quranic education	7	23.33
Primary education	4	13.33
Secondary education	6	20.00
Tertiary education	3	10.00
Total	30	100

Source: field survey 2016-2017

Table 1c. Distribution of farmers by gender

Gender	Frequency	Percentage (%)
Male	24	80
Female	6	20
Total	30	100

Source: field survey 2016-2017

Table 1d. Distribution of farmers by marital status

Marital status	Frequency	Percentage (%)
Married	23	76.66
Single	5	16.66
Divorced	3	6.66
Total	30	100

Source: field survey 2016-2017

Table 1e. Distribution of farmers by house hold size

Size of household	Frequency	Percentage (%)
1-5	11	36.67
6-10	15	50.00
10 and above	4	13.33
Total	30	100

Source: field survey 2016-2017

The table showed that, 76.66% of the farmers were married, 16.66% were single while 6.66% were divorced. This implied that married people were more in maize production in the study area, it could be as a result of responsibilities they were saddled with as married men who had the role for providing house hold needs for their families.

The result further indicated that 36.67% had more than 10 people in their homes. This indicates that, the farmers have fairly large house hold which might serve as an insurance against short fall in supply of farm labor. Household size has great role to play in family labour provision in agricultural sector. On the other hand, large sized families have negative impact on resource allocation as income might be diverted to consumption needs [13].

The results in Table 2 shows that majority of the farmers 11 (36.67%) were faced with the problems of spacing and sowing method to increase their production. The result also indicated that 9 (30.00%) was fertilizer application method and 5 (13.56%) indicated lack of improved seeds, while 3 (16.66%) was finance and 2 (6.67%) was pest's infestation respectively as their problem to low yield of irrigated maize production in the study area.

The result in Table 3 shows that Sasakawa technology in irrigated maize reached 50% flowering 9 days earlier with hybrid variety than that of farmer's local variety. It also indicated that experimental plots matured earlier than that of farmer's plots. The results further indicated that Sasakawa technology plots produced 472 numbers of grains per cob more than the farmers plot with 309. This result disagreed with that of [14,15], that fertilizer side placement and more spacing usually produced more grain yield than burying of fertilizer and shorter spacing.

The result in Table 4 indicated that Sasakawa technology experimental plots exhibited plants faster in growth at 3 weeks with 40.7 cm while farmers plots had 30.2 cm (34. 77%). At 5 weeks was 82 cm while farmers plots had 69 cm (33.33%) and at 7 weeks Sasakawa plots recorded 121.5 cm while those of farmer's plots was 192.20 cm (18.88%). The results agreed with the findings of [5]. That Sasakawa technology outperformed the farmers' plots during their trials.

Table 2. Farmers production constraints for irrigated maize at Krumi Mayolope, Hong in 2016-2017

Constraints	Frequency	Percentage (%)
Spacing/sowing of seeds	11	36.67
Fertilizer application method	9	30.00
Improved seeds	5	16.66
Finance	3	10.00
Pests	2	6.67
Total	30	100

Source: field survey 2016-2017

The result in Table 5 indicated that Sasakawa technology experimental plots produced 2 cobs per plant with performance percentage of 100%, while that of farmer's plots was 1 cob per plant. The length of cobs for Sasakawa plots was 23cm, while farmers plot was 19cm length of cobs.

Result in Table 6 indicated that Sasakawa technology experimental plots produced the heaviest cobs weight of 1.2 kg (80%) more than the farmers plots that produced 0.7 kg cobs weight. The table further shows that the grain yield performance of demonstrated varieties and grain yield was higher in Sasakawa technology experimental plot than the farmers plot, and Sasakawa technology experimental plots of maize gave the highest yield of 29 kg (45%) per 100 m2 and the farmers plots was 20kg per 100 m2 equivalent 2900 kg/ha and 2000 kg/ha respectively.

The major yield component in maize are number of grain per cob, cob weight and individual grain weight express as 1000 grain weight. Sasakawa technology was observed to have outperformed during maturity period, cobs weight 1000 grains weight and grain yield indicated that Sasakawa technology plots were more than the farmers plots in number of cobs per plant, number of grain per cob, cob weight, 1000 grain weight and grain yield. This is an indicator that high yield of Sasakawa technology experimental plot of maize

Table 3. Comparative percentages performance of some technological and yield parameters of Sasakawa experimental plot and farmers' plot during 2016-2017

Treatments	Days to 50 % flowering	Days to maturity	Grains per cobs
Experimental plot	56	86	472
Farmers plot	68	102	309
Percentage performance of Sasakawa experimental plot to farmers plot	17.60	15.68	54.36

Source: field survey 2016-2017

Table 4. Comparative of Sasakawa Technology plot and farmers plots with respect of plant height

Treatments	Plant height (cm) (3rd weeks)	Plant height (cm) (5th weeks)	Plant height (cm) (7th weeks)
Sasakawa technology	40.70	82.00	121.50
Farmers plot	30.20	69.00	192.20
Percentage performance of Sasakawa technology plot to farmers plot	34.77	33.33	18.88

Source: field survey 2016-2017

Table 5. Comparative percentage performance of Sasakawa technology experimental plot and farmers plot of maize in respect of cobs/plant and cobs length

Treatments	Cobs/plant	Cobs length (cm)
Sasakawa technology experimental plot	2	23
Farmers plot	1	19
Percentage performance of Sasakawa technology plot to farmers plot	100	21.05

Source: field survey 2016-2017

Table 6. Comparative percentage performance of Sasakawa technology experimental plot and farmers plot of maize in terms of cobs weight and grain yield (kg)

Treatments	Cobs weight	Yield (kg)
Sasakawa technology experimental plot	1.2 kg	29 kg
Farmers plot	0.7 kg	20 kg
Percentage performance of Sasakawa technology plot to farmers plot	29.80	45.00

Source: field survey 2016-2017

might be due to these traits. The results are in conformity with the findings of [16,4].

4. CONCLUSION AND RECOMMENDATION

Sasakawa technology on irrigated maize plots matured earlier with hybrid variety than the farmer's with plots of local variety with a different of 9 days. The results further indicated that, performance of Sasakawa technology maize plots in terms of number of cobs per plant, number of grains per cob, cobs weight, cobs size and grains yield out performed than that of local farmers plots significantly. It further indicated that, farmers output were less due to their in ability to adopt new method and technology of maize production.

The study revealed that, Sasakawa technology on irrigated maize plots has superior performance over the Farmer's plots. Sasakawa technology on irrigated maize plots has huge potential in solving Farmers constraints and increasing maize productivity in the study area.

4.1 Recommendation

It is recommended that burying (sowing) of fertilizer and spacing at 25cm x 25cm between plants, 75 cm x 75 cm between rows with one seed per hole at sowing should be adopted by farmers. Timely availability of improved seeds at a subsidized rate to farmers by Government and Non-governmental organizations to increase maize production, better the standard of living and to eradicate poverty of the farmers are recommended.

Effective extension services should be extended to the study area to intensify the use of Sasakawa cropping practices by farmers for maize production.

Farmers should also be given necessary training and demonstration on maize production by appropriate extension service agents on correct use of recommended technology packages in other to make significant contribution to maize production.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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