

Recurrence of Drought in Nigeria: Causes, Effects and Mitigation

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Abstract

Drought is defined as the protracted absence, deficient or poor distribution of precipitation. It is as an extended period – a season, a year, or several years – of deficient rainfall relative to the long term average rainfall for a region. It is the inability of rainfall to meet the Evapo-transpiration demands of crops resulting in general water stress and crop failures. Rainfall in the Nigerian Sudano –Sahelian region is characterized by considerable fluctuations and periods of diminishing annual totals especially in recent years. Drought or dry spells at the beginning or end of the season had a constant reoccurrence decimal since the beginning of the 20th century. Large areas of Northern Nigeria falling within the Sahel and Sudan ecological zones between latitude 9-14^oN are prone to recurrent droughts in one form or the other. The area is estimated to be about 38% of the total land area of Nigeria and it is the grain belt of the country populated by small scale subsistence farmers and nomadic livestock herders. The underlying cause of most droughts can be related to changing weather patterns such as low rainfall, reduced cloud cover and greater evaporation rates which are exacerbated by human activities such as deforestation, bush burning, overgrazing and poor cropping methods, which reduce water retention of the soil. The impacts of drought are mass starvation, famine and cessation of economic activity especially in areas where agriculture is the main stay of the economy. Drought is the major cause of forced human migration and environmental refugees, deadly conflicts over the use of dwindling natural resources, food insecurity and starvation, destruction of critical habitats and loss of biological

diversity, socio-economic instability, poverty and climatic variability through reduced carbon sequestration potential. The impact of drought could be reduced through irrigation, use of drought tolerant and early and extra early maturing varieties, reduction of post harvest crop losses, increased fisheries and micro-livestock production and strategic grain storage.

Keywords: Drought, causes, effects, mitigation.

1. Introduction

Nigeria is divided into six distinct vegetation zones of Coastal Mangrove Swamp Forest, Rain forest, Southern Guinea, Northern Guinea, Sudan and Sahel savannah vegetation zones. The vegetation varies regionally in consonance with the climatic pattern. Drought which is defined as the protracted absence, deficient or poor distribution of precipitation, is one of the anomalies that have plagued the Northern part of Nigeria since the beginning of the 20th century. Drought is as an extended period – a season, a year, or several years – of deficient rainfall relative to the long term average rainfall for a region. It is the inability of rainfall to meet the Evapo-transpiration demands of crops resulting in general water stress and crop failures. The probability of drought at the on-set and towards the end of the rainy season is usually very high in Northern Nigeria (ICRISAT, 1984; Adeoye, 1986; Tenkouano *et al.*, 1997;). Dry spells at the beginning of the season usually result in multiple plantings and low or no yields leading to low food security index. In the same vein, end of season drought could bring about water stress at critical periods of need during the reproductive stages of most crops thus resulting in crop failures and shrinking of yields. Large areas of Northern Nigeria falling within the Sahel and Sudan ecological zones between latitude 9-14°N are prone to recurrent droughts in one form or the other (Glantz and Katz, 1977; Apeldoorn, 1981; Adeoye, 1986; Nyong *et al.*, 2007). In fact, the 20th century started in the region with droughts and the resultant famines of 1903 and 1911-1914, respectively (Kolawole, 1987). Other droughts included those of 1919, 1924, 1935, 1951-1954, 1972-1973, 1984-1985, 2007 and 2011 (Apeldoorn, 1978, 1981; Kolawole, 1987; Mortimore, 1989; FME, 2000). Large number of inhabitants of the drought prone areas are smallholder farmers, who depend mostly on the highly variable rainfall for crop cultivation and maintenance of their herds. This paper attempts to look at the causes, effects and ways of reducing the risk of drought in Nigeria.

2. Causes of Drought

The underlying causes of most droughts can be related to changing weather patterns manifested through the excessive build up of heat on the earth's surface, meteorological changes which result in a reduction of rainfall, and reduced cloud

cover, all of which results in greater evaporation rates. The resultant effects of drought are exacerbated by human activities such as deforestation, bush burning, overgrazing and poor cropping methods, which reduce water retention of the soil, and improper soil conservation techniques, which lead to soil degradation. Between 1950 and 2006, the Nigerian livestock population grew from 6 million to 66 million, an 11-fold increase. The forage needs of livestock exceed the carrying capacity of its grasslands. It is reported that overgrazing and over-cultivating are converting 351,000 hectares of land into desert each year. The rates of land degradation are particularly acute when such farming practices are extended into agriculture on marginal lands such as arid and semi arid lands, hilly and mountainous areas and wetlands (Lester, 2006).

3. Effects of Drought

The impacts of drought in general include mass starvation, famine and cessation of economic activity especially in areas where rain fed agriculture is the main stay of the rural economy. It is common knowledge that drought is the major cause of forced human migration and environmental refugees, deadly conflicts over the use of dwindling natural resources, food insecurity and starvation, destruction of critical habitats and loss of biological diversity, socio-economic instability, poverty and climatic variability through reduced carbon sequestration potential. The impacts of drought and desertification are among the most costly events and processes in Africa. The widespread poverty, the fact that Nigeria's economy depend on climate-sensitive sectors mainly rain fed agriculture, poor infrastructure, heavy disease burdens, high dependence on and unsustainable exploitation of natural resources, and conflicts render the country especially vulnerable to impacts of drought. The impacts of droughts are well known and have been analyzed and elucidated by several authors (Apeldoorn, 1978; 1981; Kolawole, 1987; Mortimore, 1989). Jibrin (2010) highlighted the effects of Drought as follows: low or no crop yields resulting in low food security index; mass famine; death of livestock; low groundwater levels resulting in dry wells (which needed to be dug deeper and deeper to obtain water for drinking); drying of lakes and dams; loss of biodiversity and impoverishment of ecosystem; acute shortage of water for domestic use and for livestock; decline in GDP; migration into urban areas; separation of families; and increased indebtedness.

3.1 Effect of drought on agriculture and food security

The majority of the populations in the drought prone states live on marginal lands in rural areas practicing rain-fed agriculture. Drought threatens agricultural production on these marginal lands, exacerbating poverty and undermining economic development. The impact of drought and climatic variability in both economic and mortality terms is generally larger for relatively simple and predominantly agricultural economies. The drought of 1971-72 for example reduced Agricultural contribution to GDP in Nigeria from 18.4% in 1971-72 to 7.3% in 1972-1973. The poor crop yields or total crop failure due to drought result in mass poverty and starvation as agriculture is the

mainstay of Nigeria's rural economy. Although agriculture will remain for many years as major contributor to the economies of most developing countries (Van Crowder *et al.*, 1998), in some countries, however, its share of GDP will progressively decline as drought and desertification take their toll with food shortages increasing at the same time. The poor households that are affected by drought and desertification do not have adequate resources to deal with food shortages leading to food insecurity and hunger that affects millions of people. Agriculture is one of the main economic activities in Nigeria (which account for around 40 percent of the country's GDP and employs about 60 percent of the active labour force), thus drought would lead to a catastrophe with unprecedented repercussions. The most severe consequence of drought is famine.

3.2 Effect of drought on water availability

Drought influences water availability, which is projected to be one of the greatest constraints to economic growth in the future. Reduced annual average rainfall and its run-off would increase desertification in Nigeria. Most of the rivers and streams in the drought prone areas flow into Lake Chad. Drought, therefore exacerbate the shrinking of the lake. The rivers in addition to contributing in recharging Lake Chad are catchments to several dams built for irrigation and domestic water supply. This means that the regions will not have sufficient water resources to maintain their current level of per capita food production from irrigated agriculture - even at high levels of irrigation efficiency - and also to meet reasonable water needs for domestic, industrial, and environmental purposes.

3.3 Effect of drought on biodiversity

One of the most important effects of drought is the depletion of biodiversity. Existing fauna and flora that are not resistant to drought are likely to go extinct. Several animal and plant species are disappearing in the drought prone region of Nigeria. The combined effects of drought and bush burning (during dry season) have made the flora to go extinct and the animals to migrate to safer havens. Drought, land degradation and desertification have had serious impact on the richness and diversity of plants and animals in the region. Plant biodiversity will change over time, unpalatable species will dominate, and total biomass production will be reduced.

3.4 Effect of drought on energy availability.

The impacts of drought and desertification on the energy sector are felt primarily through losses in hydropower potential for electricity generation and the effects of increased runoff (and consequent siltation) on hydropower generation. In Nigeria, electricity is largely generated through hydropower thus drought is likely to reduce the volume of water in the dams and rivers and consequently lead to reduction in hydro-electricity generation and hence load shedding of electricity in the country. Load shedding as result of low water volume in Kainji and Jebba electricity projects has become more pronounced during the dry season thus compounding the energy crisis in Nigeria, Energy impacts can also be experienced through reduction in the growth rates

of trees due to drought. Majority of peasant people in Nigeria rely on fuel wood as source of energy.

4. Mitigation of Drought: Nigerian Experience

4.1 Irrigation

Irrigation is one of the most effective ways of coping with and reducing the risk of drought. As aftermath of the 1972-73 drought, the Federal Government of Nigeria established River Basin and Rural Development Authorities charged with the responsibility of developing irrigation infrastructure all over Nigeria. The surface water in Nigeria is provided by 22 major rivers and their tributaries. The annual flow of these rivers is estimated to be between 193-315 billion cubic meters (Shaib et. al., 1997). This network of rivers constitutes the basis of major irrigation development in Nigeria. At the end of 1990s, Nigerian Government had invested about \$3.0 billion (Mahmood, 1994) in irrigation and drainage on over 300 dams and reservoirs. Government has impounded 12 billion cubic meters of water in dams and reservoirs that are intended to command net irrigation area of 245,650 hectares (Rabiu, 2009). The overall total planned irrigable land areas in 2004 which included *Fadama* areas and states irrigation schemes was estimated at 624,408 hectares (Musa, 2008). There is a lot of capacity to increase the irrigated areas as indicated in the Tables. Irrigation facilities are presently being developed at Zobe dam with capacity for more than 8,300 hectares. Apart from the Federal Government dams and irrigation schemes, some states such as Kano and Katsina have made significant efforts at developing irrigation schemes. Table 3 showed the total potential land of over 3, 739,041 ha for the *Fadama* areas (Ingawa,1999). This potential can be exploited through exploitation of ground water by sinking boreholes and tube wells and use of solar pumps to lift the water. However, the overall performance of the major public irrigation schemes in Northern Nigeria was reported to be generally poor due to improper maintenance, unreliable water delivery as well as technical deficiency in the infrastructure (Abubakar, 2008; Othman *et. et.*, 2010).

4.2 Use of Drought Tolerant and Early Maturing Crop Varieties by Farmers

The predominant crops grown in the drought-prone region of Nigeria include cowpea, sorghum, millet, groundnut and maize in various mixtures. In drought areas which are characterized by erratic and unreliable rainfall in the beginning and towards the end of the season, the importance of drought tolerant crop varieties as well as early maturing varieties that could escape terminal drought cannot be overstated. These crops are used in various forms to provide energy, protein, oil and fat to drought prone communities. The International Institute for Tropical Agriculture (IITA) and the International Centre for Crop Research in Semi-arid Tropics (ICRISAT) in collaboration with the national research institutes such as the Institute for Agricultural Research (IAR), Zaria and Lake Chad Research Institute (LCRI), Maiduguri have released varieties of cowpea, maize, sorghum, groundnut and millet that are drought

tolerant and some of the varieties have earliness attributes which enable the varieties to escape drought. Table 4 shows the list of varieties released by the national research institutes and their characteristics.

Table 4: Some improved varieties of maize, cowpea, sorghum and millet released by the IAR, Zaria and LCRI, Maiduguri.

Crop	Varieties	Attributes	Yield Potential (tons/ha)
Maize	Sammaz 19	90 days to maturity and drought tolerant	5.0
	Sammaz 20	Early maturing and drought tolerant	3-4
	Sammaz 22	Late maturing, drought tolerant and also tolerant to low nitrogen	4
	Sammaz 23	Late maturing, tolerant to drought, streak and low nitrogen	6
	Sammaz 24	Late maturing, tolerant to drought, streak and low nitrogen	6
	Sammaz 25	Late maturing, tolerant to drought, streak and low nitrogen	7
	Sammaz 26	Medium maturing, tolerant to drought, streak and low nitrogen	4
	Sammaz 28	Early maturing, tolerant to drought, streak and low nitrogen	4
	Sammaz 29	Extra early maturing with drought escape ability	3
Sorghum	Samsorg 5	Early maturing and drought tolerant	2
	Samsorg 6	Early maturing and drought tolerant	2
	Samsorg 7	Early maturing and drought tolerant	2.5
	Samsorg 8	Early maturing and drought tolerant	2
	Samsorg 40	Early maturing and drought tolerant	2.5
	Samsorg 41	Early maturing and drought tolerant	2.5
Groundnut	Samnut 17	Medium maturing and drought tolerant	2.8
	Samnut 18	Medium maturing and drought tolerant	2.8
	Samnut 14	Medium maturing and drought tolerant	2.8
Cowpea	Sampea 4	Early maturing and drought tolerant	2
	Sampea 5	Early maturing and drought tolerant	2
	Sampea 7	Medium maturing and drought tolerant	2
Millet	Sammil 3	Early maturing and drought tolerant	2
	Sammil 6	Early maturing and drought tolerant	2
	Sammil 7	Early maturing and drought tolerant	2
LCRI Millet	SOSAT	Early maturing, High yielding and drought tolerant	3

	LCIC9702	Early maturing, High yielding and drought tolerant	2
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4.3 Reduction in Post-harvest Crop Losses

Agricultural production in Nigeria is characterized by high post harvest waste. These losses occur during harvest due to lack of mechanization and untimely harvest or during storage (caused by insect, pests, rodents, diseases and physical and physiological deterioration due to improper drying) and during processing (lack of processing tools and equipment). Post harvest crop losses could be as much as 50%. Jeon and Halos-Kim (1998) reported that in cassava post-production losses can be as high as 45%, with about 14% occurring during harvesting and 22% during processing. Qualitative and quantitative post-production losses in cereals and grain legumes have been estimated at 30-50%. The progress made in increasing crop yields could be negated by post harvest losses. Nigeria is familiar with the annual losses of tomato and fruits due to inadequate facility to process and store them. The grains consumed and destroyed by pests and ruined by micro organisms, and fresh fruits and vegetables damaged and deteriorated as they move slowly through a long chain of middle men, mostly in poor vehicles along bad roads in tropical climates means more deprivation for the poor and less food for the underfed (Sen, 1975). The developing countries including Nigeria mostly consist of subsistence farmers who must store the bulk of the grain after harvest in their own households. Losses are reported to reach 7-10% in the first three months of storage and may climb as high as 50% if the grain is stored beyond 4-6 months. Inefficient milling is another major source of post-harvest loss. Post harvest must be deduced drastically in order to harness the surplus grains and other food produce to be used to reduce the risk of drought.

4.4 Increase in Livestock and Fisheries Production

Incidentally, the drought prone areas are the major livestock production zone of Nigeria. In recent years, there has been development of commercial livestock industries with modern breeds of cattle, sheep, goats, poultry and rabbits. The use of modern techniques such as artificial insemination to improve the productivity of the local breeds in beef and milk production is being utilized. Few countries in the world are endowed with the potentiality of developing a highly productive fisheries industry like Nigeria. Nigeria is blessed with abundant fresh and marine waters, good stocks of fish and a large number of fishermen who have developed the skills through years of practice on the job. Apart from Rivers Niger and Benue, and their various tributaries, Lake Chad and the Atlantic Ocean offer the country rich sources of fish. The Country is further blessed with inland lakes, ponds and irrigation reservoirs. The country is currently enjoying a boom in private fish farming and cultures. The farmers should be encouraged to ensure quality food for all Nigeria. The artisanal fishermen should be encouraged to exploit our rivers, lakes and reservoirs. The catch from the fishing industry will provide readily source of protein for the drought areas in case of drought emergency.

4.5 National Strategic Grain Reserve

The Federal Government of Nigeria has established the strategic grain reserve in order to reduce the risk of drought and as coping measures for effects of drought. Currently, the scheme has twelve silos with a total storage capacity of 350,000 metric tonnes. In addition to the silos capacity, there are various warehouses for storage of grains. Contract has been awarded for construction of 20 additional silos with storage capacity of over one million metric tonnes and the project will soon be completed. Figure 2 shows the locations of all silos in Nigeria (completed and ongoing). When completed the total silos capacity will be one million, three hundred and fifty thousand (1,350,000) metric tonnes. The silos storage will boost the national capacity to reduce risks of drought.

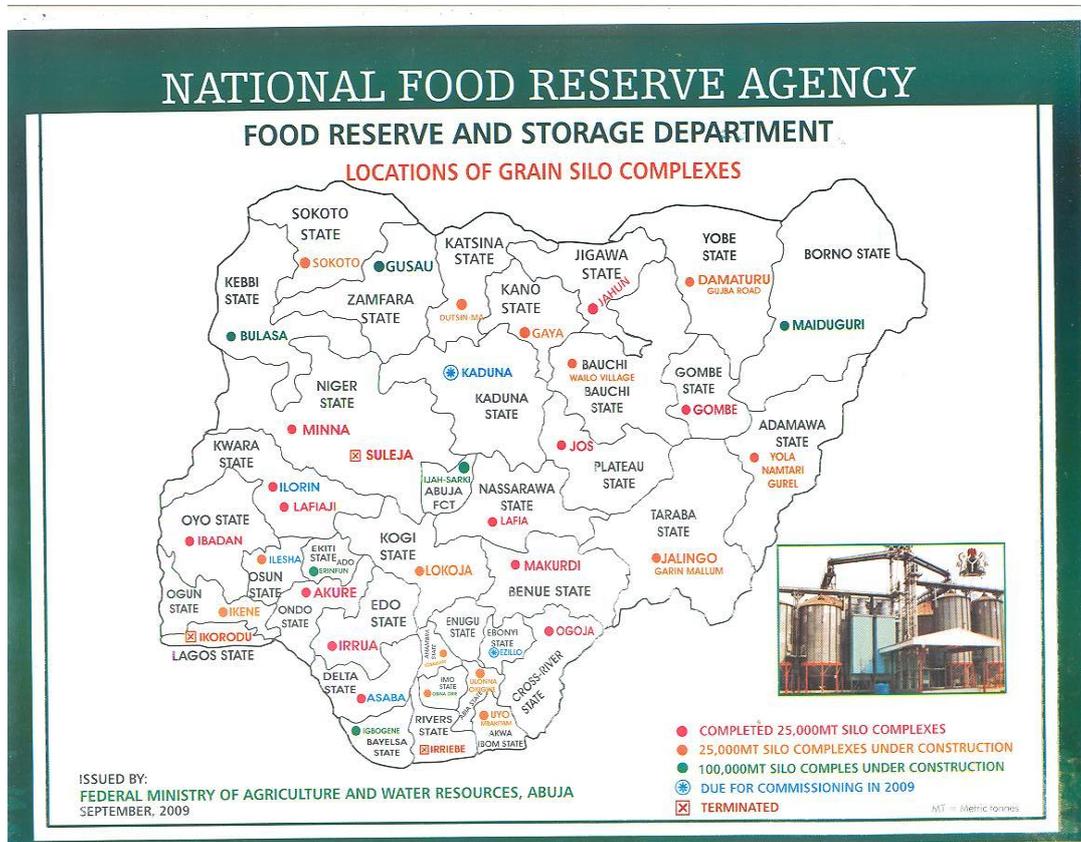


Figure 2: Map of locations of completed and ongoing silos projects in Nigeria.

4.6 National Emergency Management Agency

The National Emergency Management Agency was established by the Federal Government to provide emergency relief to victims of disaster including drought, floods and other natural disasters. The service of this agency is complimented by

numerous Non-governmental organizations (NGOs) involved in providing immediate reliefs to victims of natural disasters.

4.7 Weather and Climate Forecasting

The monitoring of natural disasters and studying other environmental issues using space technology have become an interesting development in the contemporary scientific research. In Nigeria, the Nigeria Meteorological Agency (NIMET) is vested with the responsibility of forecasting weather and climate variability including drought. The agency forecasts the onset and end of the rainy season to enable farmers to plan farming operations and also to decide on the crops to grow. One major limitation of the forecast is its inability to highlight the distribution pattern of the rain.

5. Conclusion

Drought affects Nigeria by affecting its economy, agriculture, environment and biodiversity, population dynamics, human nutrition and health, animal population and water resources and hydrology. The importance of measures to reduce the effects of drought cannot be overemphasized. Measures such as irrigation, development of drought tolerant early maturing and high yielding crop varieties, reduction in post harvest crop losses, efficient weather forecast, storage of excess production and development of fishery and livestock industries assist greatly in reducing the risk of drought.

References

- [1] Abubakar, I. U. (2008). Issues on Crop Production in Northern Nigeria: Poor Crop Yields and Irrigation. Paper presented at the first northern Nigeria submit on Agriculture: Policy and Finance imperatives for vision 2020 held on 28-30 July, 2008 at Kaduna. Pp. 18
- [2] Adeoye, K.B. (1986). An Evaluation of Drought Incidence and Hazard in Northern Nigeria. Paper Presented at the 22nd Annual Conference of the Agricultural Society of Nigeria, Zaria 1st – 3rd September, 1986.
- [3] Apeldoorn, G. J. Van. (1978). Drought in Nigeria Volume2: Lessons of the 1972-74 Disaster. Center for Social and Economic Research, Ahmadu Bello University, Zaria
- [4] Apeldoorn, G. J. Van. (1981). Perspectives on Drought and Famines in Nigeria. George Allen and Unwin Ltd, London. 184p
- [5] FME. (2000). National Action Plan to Combat Desertification. Federal Ministry of Environment, Abuja
- [6] Glantz, M. H. and R. W. Katz. (1977). When is drought a Drought. *Nature* 267: 192-193

- [7] CRISAT., (1984). Agrometeorology of sorghum and millet in the semi-arid tropics. *Proceedings of an International Symposium*, 15-20 November 1982, ICRISAT Center, Patancheru, India. 322pp
- [8] Ingawa S. A. (1998). National Fadama Development Project (NFDP): Achievements, constraints and prospects. In: *Irrigation for sustainable agriculture. Proceedings of the 12th National Irrigation and Drainage Seminar*, 14-16 April, 1998. Pp 188-201
- [9] Jeon, Y. W. and L. Halos-Kim (1998). Characterising the Desirability of Post-harvest Technologies for African Conditions. In Kwarteng, J. (ed.) *Enhancing Post-harvest Technology Generation and Dissemination in Africa*. Mexico City, Sasakawa-Global 2000. P. 36-46
- [10] Jibrin, M. J. (2010). Coping with Droughts in Nigeria's Sudano-Sahelian Zone. Paper for Presented at the US-Nigeria International Workshop: Exploring Strategies for Managing Drought Using Climate Forecasts and Indigenous Knowledge Nov 13-16, Bauchi Nigeria
- [11] Kolawole, A. (1987). Responses to Natural and Man-made Hazards in Borno, Northeast Nigeria. *Disasters* 11:59-66
- [12] Lester R. Brown, (2006): The earth is shrinking: Advancing deserts and rising seas squeezing civilization. Earth Policy Institute. <http://www.earth-policy.org/Updates/2006/Update61.htm>
- [13] Mortimore, M. (1989). *Adapting to Drought. Farmers, Famines and Desertification in West Africa*. Cambridge University Press, Cambridge 299p.
- [14] Musa, I. K. (2008). Strategies for Implementing Participatory Irrigation Management (PIM) in Nigeria to Achieve the Millennium Development Goals (MDGs) in the Irrigation Sub-Sector. *Proceedings of National Sensitization workshop on Participatory Irrigation Management for Chief Executives of River Basin Development Authorities (RBDAs) and State Irrigation Departments (SIDs)*, 24-25 June, 2008 at Abuja.
- [15] Nnaji, A. O. (2001). Forecasting seasonal rainfall for agricultural decision-making in northern Nigeria. *Agricultural and Forest Meteorology* 107: 193-205
- [16] Nyong, A., F. Adesina and B. O. Elasha. (2007). The Value of Indigenous Knowledge in Climate change Mitigation and Adaptation Strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global Change* 12 (5): 787-797
- [17] Othman, M. K., A. I. Arab, A. Ibrahim and M. S. Kallah (2010). Mitigating desertification through irrigation opportunities and challenges in Northern Nigeria. In book of proceedings of the 10th International Conference of the Nigerian Institution of Agricultural Engineering, 20-22nd October, 2010. P. 338-352.
- [18] Rabiou, A. B. (2009). Farmers Participation for Sustainable Irrigation Management. *Proceedings of zonal workshop for managers of 12 MDG irrigation projects*, ABU, Zaria, Nigeria.

- [19] Sen, S. (1975) Reaping the Green Revolution. Food and Jobs for All. Tata McGraw Hill Publishing co. New Delhi. pp.397.
- [20] Shaib, B., Aliyu, A. And J. S. Bakshi (1997). Nigeria: National Agricultural Research Strategy Plan 1996-2010. Research Report of Department of Agricultural Sciences, Federal Ministry of Agriculture and Natural Resources, Abuja. Pp. 335
- [21] Tenkouano, A., J. Chantereau, P. Sereme and A. B. Toure. (1997). Comparative response of a day-neutral and photoperiod-sensitive sorghum to delayed sowing or transplanting. African Crop Science Journal 5(3) 259-266.

