

Review

Problems of water resource and approaches for revamping the agricultural sector of Nigeria

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Abstract

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Population and economic growth are putting pressure on available fresh water resources worldwide. Uncertain water availability is a challenge that many countries face, which can impact economic growth and agricultural development. This 'water challenge', and its links to economic growth, has multiple dimensions, one of which is access to safe drinking water and water suitable for irrigation purpose. This paper discusses some of the challenges of water resources development in Nigeria and strategies to transform the agricultural sector of the Nigerian economy through irrigation water. The traditional methods of water exploitation in Nigeria consist of (1) direct collection of rain water with pots, guards and other containers and (2) extraction from springs, streams, ponds and wells. The effects of water challenges are; Health, Hunger, Education and Poverty. Some major areas in which management development and training will be greatly required are; Agricultural development planning; organizing and managing production and service; resource management; maintenance management; organizing supplies and distribution; produce storage and processing; research - extension – farmer linkage; and management of cooperatives.

Keywords: Water Resources Development, Irrigation Water, Agricultural Transformation, Water scarcity, Food Security, Sustainable Agriculture

INTRODUCTION

Water is the most important input required for plant growth for agricultural production. Irrigation is a tool in the ensuring food security, replenishment of soil water storage in plant root zone through methods other than natural precipitation is irrigation. Irrigation is seen to have found its roots in the history of mankind since earliest beginning (Das, 1997).

Population and economic growth are putting pressure on available fresh water resources worldwide. Uncertain water availability is a challenge that many countries face, which can impact economic growth and agricultural development. This 'water challenge', and its links to economic growth, has multiple dimensions, one of which is access to safe drinking water and water suitable for irrigation purpose (Das, 1997). Improved access to water

has a direct positive impact on people and communities leading to significant social, economic and environmental benefits (Kavanagh, 2000). It is currently estimated that 1.1 billion people in the world lack access to improved water supplies and 2.6 billion people lack adequate sanitation (UNICEF, 2004). The global health burden associated with these conditions is staggering, with an estimated 4000–6000 children dying each day from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene (WSSCC, 2004).

An adequate supply of "clean" water is one of the most basic human needs – and one that is not met for more than half of the world's population. According to various estimates, one-half to two-thirds of the world's population

does not have access to adequate quantities of safe drinking water or sanitation. The United Nations declared the 1980s to be the "Water and Sanitation Decade" and directed the World Health Organization to carry out necessary actions to ensure that the world's people were provided with water and sewage facilities. With this, the mission statement of the Nigerian federal ministry of water resources is to provide sustainable access to safe and sufficient water to meet the Socio-Economic needs of all Nigerians through efficient water resources management for basic human needs, irrigated agriculture, hydropower generation for National food security, promote healthy population, while maintaining the integrity of fresh water bodies and the Vision is to be the vehicle of the Nation's water resources management for optimal socio-economic activities through comprehensive planning for integrated conservation, development and management of various water uses. To preserve the quantity and quality of fresh water for improved ecosystem and environmental protection as well as facilitate adequate access to safe water and sanitation nationwide (Adesoji *et al.*, 2006). We lay emphasis on the development of irrigated agriculture for food security and sustainable livelihoods and above all, to ensure equitable allocation of all the aforementioned amongst all riparian communities locally and internationally (www.waterresources.gov.ng).

Recent events of flood, drought and urban water shortages as well as water pollution in Nigeria and various parts of the world have underlined the need for the rational planning of Nigeria's water resources. It is not often realized except in times of shortages and drought that water is a unique resource that has no substitute. It is high time we stopped regarding water as an inexhaustible gift of nature. Water has to be transformed from its natural raw state and then transported to our homes and factories to satisfy man's needs because as Kavanagh (2000) put it 'the hydrologic cycle does not adapt itself to our space, time and quality requirements'. The importance of water to man cannot be over emphasized. He can survive longer without food than without water. He requires it for his cooking, washing, sanitation, drinking and for growing his crops and running his factories. Therefore modern man like his primitive ancestors is heavily dependent on water for his sustenance. But because water is freely available through rainfall, until recently man has tended to take this resource for granted. Developing countries now realize that it is a naive and futile exercise to put a major emphasis on rapid industrialization without a corresponding development of the basic infrastructures such as water supplies, electricity and a good and efficient transportation network. Apart from its industrial use water is a necessary social amenity. The provision of pipe-borne water can help in eradicating water-borne diseases and in improving agricultural productivity of Nigerian farmer thereby indirectly affecting the economy

positively (Annon, 2008). The aim of this paper is to review some of the challenges of water resources development in Nigeria and strategies to transform the agricultural sector of the Nigerian economy through irrigation water.

Water Resources Development in Nigeria

The traditional methods of water exploitation in Nigeria consist of (1) direct collection of rain water with pots, guards and other containers and (2) extraction from springs, streams, ponds and wells. Water shortages during the dry season are quite common as many of these sources dry up. People then have to trek long distances in search of water. Apart from the problem of irregular water supply from these sources, there is the problem that the water is untreated and therefore carries organisms parasitic to man. Mabogunje (1965) has reviewed the pattern of water resources development in Nigeria especially during the colonial period. As he pointed out one of the primary objectives of water supply development during this period was 'to improve the quality of drinking water and so reduce the debilitating effect of water-borne diseases on the population'. Because of financial limitations however, this development was concentrated in a few centers located along major trade and transportation routes serving the export-oriented colonial economy. The first modern water supply scheme in the country was established in Lagos in 1915 and by 1953, 27 other waterworks had been built in various parts of the country. Only a few of these water schemes were wholly financed by the colonial government, the others being partly financed by the native authorities. Between 1953 and 1960, the number of towns having modern water supplies increased from 28 to 67. The total water consumed per day also rose from 13.8 million gallons in 1953 to over 57 million gallons in 1960 (Adesoji *et al.*, 2006, Babatunde *et al.*, 2008).

It should be realized that adequate and readily available water supply both for domestic consumption and agricultural purpose is not only a social amenity but also an important factor for production. In the rural areas of Nigeria, water is still the most sought-after commodity and it ranks very highly on the people's scale of developmental preferences. Hence the launching in recent years of self-help water projects in smaller towns and villages aimed at bringing this commodity within easy reach of the people. This logically leads us to the question of the institutional framework for managing Nigeria's water resources and the relevant policy decisions. As Mabogunje (1965) has rightly pointed out, part of the crisis in the development of water resources in Nigeria is due to differences of opinion with regard to the objectives of economic development in developing countries. One school of thought sees the objective of economic development as that of increasing over a

period of time the real income of a country (Strauss, 1986). To achieve this, it is believed that development planning should concentrate on expanding infrastructural facilities in those places where their effects on the national economy are likely to be most beneficial. This appears to have been the overriding policy of the colonial government in developing Nigeria's water resources at least up to the early fifties when self-government was granted to the then regional governments in the west, east, and the north. The second school of thought sees the objective of economic development as the improvement in the standard of living of the people through an increase in their per capita income over a period of time. It is believed by proponents of this view that the provision of such amenities as good roads, pipe-borne water and electricity should be extended to areas where the immediate effects are likely to be no more than that of improving the quality of life of the people. The various states now have water boards or corporations charged with responsibility for the operation and maintenance of water supply schemes in the state concerned as well as the provision of water to those areas which at present lack modern water supply facilities. In the northern states where irrigation is practiced, irrigation works have been generally under the Ministry of Agriculture. The present administrative arrangements are obviously not suitable for multipurpose development of Nigeria's river basins since these basins in many cases cut across state boundaries (Blench, 2004).

Water resources development may be regarded as the modification of the hydrological cycle for the benefit of mankind. It involves not only the beneficial uses of water resources but also the prevention, avoidance or minimization of the effects of water excess (flood) or deficiency (drought) (Douglas, 1973). The Federal Government recently created a new Ministry of Water Resources with responsibility for irrigation and dams development and the planning and control of water supplies in Nigeria. The Government is at present studying draft national water legislation submitted by the country's Hydrological Technical Committee. If and when this draft legislation is passed a Water Resources Commission would be created to supervise and control water resources development and management in the country. The functions and powers of the newly created Ministry of Water Resources and those of the proposed Water Resources Commission should however be clearly spelt out to avoid friction and ensure maximum cooperation and coordination in the country's water resources development and management (Dauda *et al.*, 2009).

Urbanization and Economic Performance

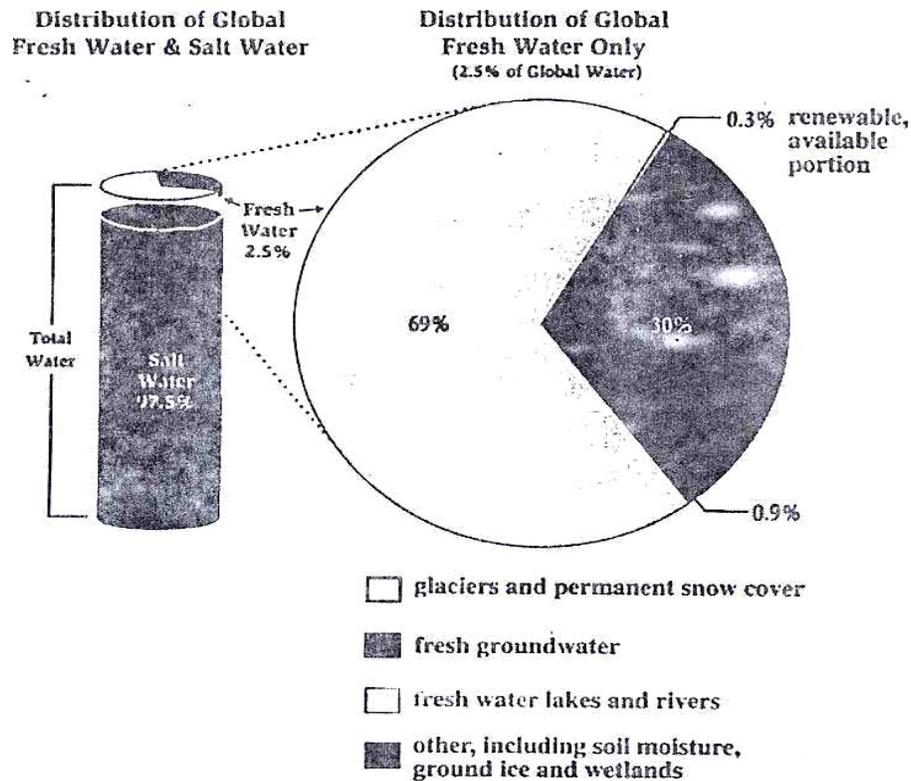
Environmental stresses imposed by population growth,

urbanization, industrialization and climate change have become a prominent theme of international concern. One of the most affected of the natural resources is that of freshwater. Demands upon the world's supply of freshwater resources are increasing the threats and risk to both the quantity and quality of a natural resource essential to human life, health, social and economic activities. These risks to water resources have raised political attention which has been translated into political commitment, within and between countries, for the protection of this vital resource. Growing concerns related to climate change highlight the urgency of the freshwater situation. Climate change impacts are expected to affect populations directly by more frequent extreme events such as floods and droughts, rising sea levels, changes in the seasonal distribution and amount and type of precipitation such as snow and rain. Climate change is also expected to impact on the storage components of the Water Life Cycle such as glaciers, snow pack and groundwater via recharge (FAO, 1999).

Nigeria is predominantly agricultural economy, the bulk of its population lives in rural area engaging in agriculture for livelihood. Nigeria's development is therefore primarily tied to the development of agriculture (Richards, 1987). The emergence of oil has broken this tie since 1970s. The huge oil revenues have been greatly used in urban construction and expansion of urban informal sector which according to Richards (1987) "has hardly unambiguously favored agriculture", as it engendered "rural-to-urban migration". This usually reduces the supply of prime age males who had been involved in agriculture. Thus, a vacuum which cannot be filled by elders, younger or female farmers for some technical and/or social reasons have been created. Rural-to-urban migration causes localized labor shortages and wage increases, which often push farmers into cost gulp. This practically causes farm profits to fall, and makes farm maintenance/management harder. Thus farmers may be forced to quit farm whereas urban population (that is, number of urban consumers) increase. This induces rapid expansion in food imports. The figure below shows fresh and salt water resources distribution (FAO, 1999).

Water Resource Challenges

The availability of water is a key factor in the restructuring of forest and grassland systems as the climate warms. Climate change is known to alter the likelihood of increased wildlife size and frequency. Many forest ecosystems in the tropics, high latitudes and high altitudes are becoming increasingly susceptible to drought and associated changes in fire, pests and diseases. Alcamo *et al.* (2004) also projected increases in water stress (Measured as the ratio of irrigation withdrawals to renewable water resources) in the Middle



(Adapted from Olasunmbo, 2001)

Figure 1. Fresh and salt water resources distribution

East and South-east Asia. The number of people living in water stressed river basins would increase significantly. If water stress is assessed not only as a function of population and climate change but also of changing water use, the importance of non-climatic drivers (income, water-use efficiency, water productivity, and industrial production) increases (Alcamo *et al*, 2007). Income growth sometimes has a larger impact than population growth on increasing water use and water stress (when expressed as the water withdrawal; water resources ratio).

Water is a finite and vulnerable resource, essential to maintain life, environment and development. It is intimately related to agricultural and rural development. Land is indispensable for agricultural production, yet it is water that determines success or failure. Traditionally, water resource management has been one-dimensional, with actions designed to address single-purpose needs such as hydropower, irrigation, or navigation. The recognition that water has an economic value has increased the relevance of water managers in the Nigerian society and this is also driving integration in water management for agricultural and economic development (FAO, 1999).

The development of water supply for all purposes is in dire need of re-evaluation, in view of the need to ensure

infrastructural development of Nigeria. Short-term considerations, lack of coordination and cooperation among the different agencies responsible for water resources development in Nigeria, inconsistency in government policies and priorities, are the bane of water supply in Nigeria. These are worsened by lack of basic data for planning, placement of personal benefits above social benefits and failure to adopt a bottom-up approach. A comprehensive evaluation of strategies for water development is needed, central of which should be the up-to-date acquisition and storage of data, not only related to water supply, but also related to other areas that would make for effective planning execution and management of water, in the long term.

Some major urban centers already face serious water shortages compounded by water pollution crises, the latter often originating from water-dependent and water-impacting agricultural and industrial activities. Questions relating to water resources management and usage cut across many economic and social sectors, including agriculture, fisheries, industry, urban development, energy, environment, tourism and public health. Integrated Water Resources Management (IWRM) principles and concepts are presently used to manage competition between users and even to mediate in disputes over access to water resources and its use.

With increasing economic and demographic demands coupled with climatic change stresses, the prospect of increased competition and serious disputes within and between states and sectors over water resources in the not-too-distant future become more conceivable. Water's special character of being essential to health as well as a key component in social and economic activities, has resulted in a special cultural status and consequently a special position in public policy. Freshwater resources have traditionally been regarded as something to which all members of the human community have rights to access. Access to clean water –and sanitation - is considered by many current international agendas and platforms as a basic human right, indispensable for leading a healthy and dignified human life. Most existing water supply systems are the result of public investments for social improvement, and as such are invariably subsidized. The use of water in the various social and economic contexts has typically either been unregulated by *tariffs*, or at most very low-cost; the contributions by consumers usually not able to cover the costs of operation and maintenance (NINCID, 2009).

There are important implications of subsidies and cost recovery in an era of water stress, among which are water profligacy and wasteful practices, or mismanaged water services and infrastructures. In the face of water shortages and environmental concerns, discussions in some international fora have called for water to be regarded as a social and public good and not to be available for the marketplace. However, regardless of where the responsibility of management is placed, costs must be met to ensure sustainability of services. There can be a clear distinction between the rights-based “value” of water and the value as represented by charges or tariffs for different consumer groups, but herein lie the roots of a dispute. The view which upholds water as a commodity to be bought and sold, in which the community and especially its poorer members might thereby lose their rights, cuts across deeply held beliefs and long-established ideologies, now upheld in some areas that access to water is a human right (NINCID, 2009).

Lack of a holistic perspective regarding water has led to dispersed and sometimes disorganized systems of water management. Responsibilities for the management of the resource in areas such as water transport and the construction of dams, pipelines, pumping stations, treatment plants, sewerage systems, and maintenance, are often allocated to a variety of different administrative departments (FAO, 1999). Water-related activities and their management are also present within a wide range of user sectors, are subsequently managed by that sector's institution, and result in often uncoordinated management. As the water resource is finite and its utilization needs to be equitable, efficient and planned, the challenge will be to bring all sector strands of management together (FAO, 1999).

The need to examine collectively the entire range of uses to which freshwater is put, and to design services which neither squander precious resources nor fail to respect other competing and complementary water needs, was translated into a policy and programme principle and strategy known as Integrated Water Resources Management (IWRM). This principle is the response to the growing pressure on water resources resulting from growing population and socio-economic developments. It comprises a holistic approach that makes the management and protection of water resources compatible with the development of systems serving all types of consumers. It is a vital part of the challenge facing water-related development cooperation today. IWRM contributes to the quantitative and qualitative sustainable management of interlinked surface waters, groundwater and aquifers and coastal waters, thus ensuring the social and economic development that is also dependent on vitally important ecosystems.

However, a change in strategic direction on water is underway. Given the complexities implied in the implementation of IWRM especially in sub-Saharan Africa, the concept of IWRM has been joined with the concept of ‘Water for Growth and Development. This concept re-emphasizes that water cannot be dealt with in isolation, but requires a high degree of collaboration and engagement between the ministry responsible for water ministries and the ministries responsible for driving social and economic development, such as ministries of infrastructure, energy, mining, agriculture and trade. Water is therefore seen more as a horizontal cross-cutting issue within many facets of development, rather than as a stand-alone ‘sector’ The concept of WfGD also aims for a better interfacing between water resources and water services issues with a strong focus on how both can together support growth and development. At the forefront of the concept is the assumption that links exist between the scale and range of investments in water and successful economic development, and therefore barriers to financing measures for water development must be overcome (FDP, 2005).

Classification of Water Challenges/Scarcity

Physical Water Scarcity

Water scarcity is not a factor of absolute quantity; it occurs frequently in both dry and moist climates. Rather, it is a relative concept comparing the availability of water to actual use. Desert regions, for example, do not classify as water scarce if demand for water is low. However, scarcity may exist in water-abundant areas if there is heavy population pressure, excessive pollution, or unsustainable consumption levels. Together, these forms of physical water scarcity affect every continent and

approximately one-fifth of the world population (Crystal, 2007).

Economic water scarcity

Economic water scarcity occurs when water resources are abundant relative to water use, but insufficient infrastructure or financial capacity prevents people from accessing the water they need. This dilemma plagues an additional 1.6 billion people worldwide, predominantly the rural poor and particularly in Africa. For this reason, additional investment in the water sectors of developing countries could play a transformative role in poverty alleviation (Crystal, 2007).

Water and Agriculture development

Agriculture accounts for 70 percent of global water consumption and up to 95 percent of consumption in some developing countries. Irrigated agriculture, which accounts for only 20 percent of cultivated land but over 40 percent of the global harvest, has significant implications for the future of water availability and food security worldwide (Crystal, 2007).

Effects of Water Challenge

The effects of water challenges can be grouped into these 4 broad areas— Health, Hunger, Education and Poverty.

Health

In many developing countries and in Nigeria in particular, people are forced to drink low quality water from flowing streams, many of which are contaminated. There are many water-borne diseases that people die of. Less water also means sewage does not flow, and mosquitoes and other insects breed on still (stagnant) dirty water. The result is the deadly malaria and other infections. Lack of water or quality water causes huge sanitation issues. Clinics, local restaurants, public places of convenience and many other places are forced to use very little water for cleaning. This compromises the health of the staff and people who use the facilities (www.eshooltoday).

Hunger

It takes a lot of water to grow food and care for animals. Experts say that globally we use 70% of our water sources for agriculture and irrigation, and only 10% on domestic uses. Less water means farming and other

crops that need water to grow have lower yield. It means farm animals will die and others will not do well without water. The result is constant hunger and thirst and low quality of life (www.eshooltoday).

Education

It is a bit hard to see how water and education is related. For many people in other parts of the world children (and teen girls) have to be up at dawn to collect water for the family. They have to walk for several miles to get water. The children get tired and some have to miss school as a result. Doing this for many years take away school times and the cycle continues. In other places girls and women are not allowed to go to school at all, so that they can serve the family by getting water and taking care of other family needs (www.eshooltoday).

Poverty

Access to quality water is key to economic prosperity and better living standards. Businesses and schools thrive when people come to work on time and not have to spend all morning looking for water. Restaurants, hotels and shopping places need to keep clean to attract tourists and foreign investments. Manufacturing activities, commercial farms, and mining processes all need a lot of water to thrive. Lack of water means no economic activities will happen and the people will be in constant poverty (www.eshooltoday).

Strategies for Optimizing the Benefits of Irrigation

The recent developments in the economy calls for a re-orientation of management training effort in order to guarantee continued relevance to the effective performance of the Nigerian agricultural sector. In this regard, the management of the agricultural sector in its adjustments to new developments in other related sector of the national economy calls for a greater concern. Some major areas in which management development and training will be greatly required are; Agricultural development planning; organizing and managing production and service; resource management; maintenance management; organizing supplies and distribution; produce storage and processing; research - extension – farmer linkage; and management of cooperatives. These issues are discussed below.

Resource Management

Resource management is another critical area of management responsibility. Here we are referring to

financial, natural (land and water) and human resources as inputs into development plans, programmes and projects in the Agricultural sector. The country's resources are characterized by low productivity and a high degree of wastage either at the national level or the farm level, due to weaknesses in organizational and management capabilities. Judicious management of the country's resources, not in isolation from the development plan, but as a means for plan fulfillment, should facilitate the achievement of planned goals and targets. Let us now examine the management of each of the resources mentioned above.

Financial Management

The low level of performance of the Agricultural sector over the years may in part be attributed to the low level of funding. There is no doubt that the adequacy of funds either in terms of volume or timing is prerequisite to proper organizational and management of Agricultural production and service. The sectoral budgetary allocation to irrigation farming over the years is dismally low. In addition, actual expenditure usually falls short of the amounts allocated. This problem is aggravated by the fact that less than 5% of the Federal capital budget may be spent on agriculture due to a number of reasons. These include administrative bottlenecks, especially delays in obtaining approval for programmes and untimely release of funds. These are the issues which management must address at Federal, State and Local Government levels. The relatively low budgetary allocation to Agriculture calls for prudent financial management of available funds. To achieve this, what we need in the Agricultural sector is programme budgeting by which resources are fully mobilized and allocated for different items of expenditures, each with clearly defined output. In carrying out the annual performance evaluation, management should be called upon to measure output against the expenditure incurred.

Land Resource Management

Nigeria is a large country with land area of 923,773 square kilometers. The fact that not all of this area is cultivable, coupled with the high population density has important implications for Agricultural land use planning. A World Bank mission in 1985 reports that there are about 9 million rural families in the country whose principal source of income is farming. The report assumes 7 persons per farm family, and that the farm population will grow at a rate of 3.3%. This implies that in 25 years the farm population will more than double, the consequences of which are obvious. There are about 52 million hectares of arable land in the country. This will provide by the year 2010 just under 2.7 cultivable ha per

farm family. This is about what a family is able to manage using its own hand labour. So in this scenario, if the family works to its full potential, the arable area would be almost fully farmed under continuous cultivation by the year 2010. Forest and livestock enterprises would be precluded from the arable zone, and the farm labour force will still be growing. According to the World Bank, the average cultivable area per farm family in 1985 is reckoned to be almost 6 ha. While the average cultivated area per farm family in the same period is reckoned to be about 2 ha. This implies that about two thirds of the cultivable area is now in bush or fallow. By the year 2010, a doubling of the farm population means that the fallow will have been at least cut in half and in a growing number of individual zones the fallow will have disappeared. This will represent a major shift in the nature of Agriculture throughout most of Nigeria, which has depended on fallowing to restore soil fertility.

Water Resource Management

There are at present, 11 river basin development authorities in the country. During the 3rd and 4th plan periods the Government made huge investments in these authorities. In 1985 for example, capital allocation to 12 of these RBDAs was N91.5m whereas actual expenditure was N83.6m. the corresponding 1986 figures were N69.5m and N79.3m respectively. Just as the capital allocation fell from 1985 to 1986, the areas under irrigation also fell by 9.5% from 32,600 ha in 1985 to 29,500 ha in 1986. This implies that a large proportion of water already impounded is not being utilized. Even the economic viability of these large-scale irrigation projects is in doubt. It has been shown that the economics of irrigated vegetables and other high valued dry season crops, and of supplementary or dry season water supply on cheap, informal rice schemes, looks favourable. On the other hand investments in irrigation to grow the principal irrigate grain crops, that is, wheat and rice, on large-scale schemes incur large loses. The concern of management then, is how well the already stored water can be managed, since the decisions to start new schemes will not be economically justifiable. The management of irrigation schemes calls for highly specialized skills since this operation are complicated and requires "intricate timing." While it is obviously true that all of Nigeria's Agricultural organizations require good management, large-sale irrigation projects must blend uniquely with a very wide range of technical skills, and administer them properly, since a breakdown in any one of the multiplicity of links can have negative repercussions thought. Nigeria does not have a sizeable pool of capable manpower to man these projects and as result there is a heavy reliance on expatriate professionals. This differs from other areas of Agricultural development where expatriate presence has steadily

diminished due to availability of qualified, trained indigenous manpower. It should be noted that only one statute of high learning in Nigeria trains irrigation engineers. Serious efforts must be made to reappraise all dimensions of irrigation management with a view of paying adequate attention to this area.

Human Resources Management

Nigeria is about to enter into another development plan period, and it must be acknowledged that the realization of goals and objectives contained in the plan is a function of two factors: a) the availability of skilled manpower on the one hand; and b) appropriate mobilization on the other. As experience has shown, one of the major problems of management in the sector occurs at the implementation stage. There is a general shortage of manpower in the junior, middle and top-management categories. A casual examination of the "establishment" positions of the various institutions involved in Agricultural development will confirm this. The current economic situation has made things worse as no organization wants to recruit and train inexperienced staff. The ADPs for example draw most of their staff from the line ministries in the states. They are able to do this because they are better remunerated and better organised. This situation affects the morale of the staff left behind in the ministries. In addition, the increased activities in the Agricultural sector in the recent years together with the wide proliferation of institutions, and the increased participation of the private sector had led to excessive turnover of staff in Agricultural institutions, especially among the experienced staff. In order to reverse this undesirable trend, management within the sector will have to address the question of morale, job security, remuneration and incentives, and career goals of employees. Also there is the need to adequately mobilize them to identify with the goals of their organizations.

Credit Management

Nigeria is dependent on the small-scale farmers for the supply of food and fibre needs. The low capital base from which these farmers operate calls into question the reality of Government's desire to attain self-sufficiency in most of the grain crops in the next five years. The case for providing production credit to small holders is a persuasive one. This is because, after research has developed profitable new technology, and extension has demonstrated its feasibility, widespread use may still be stymied because the numerous small farmers lack funds to purchase the inputs ordinarily required to adopt the new technology. The public credit programmes in Nigeria have absorbed substantial financial and human resources but there has been little success recorded.

Maintenance Management

Nigeria has invested huge sums of money on dams, irrigation channels and pumps, Agricultural machinery and equipment, storage facilities plus some other rural infrastructure such as roads, water supply etc, and will continue to do so in the next five years. Very often, expensive equipment machines and vehicles on which vast sums of money has been invested, go out of service within a few years of their being purchased or installed. Whenever these machines and equipment are brought back into effective operation, it is usually at a very high cost. What seems to be neglected and often ignored is the management of maintenance services with a view to prolonging the service life of these machines and equipment. Since most of the equipment is imported, the replacement costs of these machines are high, particularly now with the high foreign exchange rate. Fixed assets experience wear and tear, and require repairs and maintenance to keep them into form, for efficiency. Maintenance management requires a complement of qualified supervisors and technicians, as well as financial provisions. To cultivate a good maintenance management culture, management education has to be extended to this important area not in terms of the technical aspect of servicing machines and structures, but in terms of making allowance for the needed repair and maintenance requirements, providing funds and men, including these in the budgets and particularly in developing the right attitude to maintenance services.

CONCLUSION

On the whole, the agricultural and industrial sectors contribute significantly to Nigeria's GDP. The employment base of the Nigeria economy is largely dependent on these two sectors. However, the agricultural sector contributes only 5.6 percent to the economy while the industrial sector's contribution is about 34 percent. This level of disparity is due to the neglect of agriculture when oil was discovered in a commercial quantity in the 1970s. It is well over due for the Nigerian economy to diversify. The negative perception and orientation of the average Nigerian about agriculture and agro-based industries should be disabused so that these sectors can contribute optimally to GDP. The whole management principles discussed above should be implemented on the use of irrigation water to supplement the variable rainfall or to cultivate when and where there is no rainfall at all.

In all ramifications, water resources development and management for boosting agriculture and the nation's economy is for the people and therefore must be designed to meet their needs. This means that all development efforts must be derived from the felt-needs

and aspirations of the rural people and not in response to the needs of the urban political economy such as unemployment, food shortfalls and rural-urban migration. The present rural development situation poses great problems to all and sundry. Government should show the necessary leadership by matching words with action through evolving workable rural development approaches, proper co-ordination, funding and technical assistance. It should also encourage nation's experts to make useful contributions with their talents. Government has a chief role of building and financing an enduring political, social, cultural and environmental structure on which rural development can thrive, through the encouragement and recognition of the roles of cooperatives, NGOs, and private initiatives as their grassroots' appeals promote sustainable rural development.

Finally, the Federal Government should as a matter of urgency promulgate a decree outlining a water policy for the country and establishing a Water Resources Board or Commission charged with rational planning, conservation and management of the country's water resources both for domestic and agricultural use. Since river basins constitute natural subdivisions of water resources, the whole country should be divided into its component river basins and each basin administered by a river authority.

RECOMMENDATIONS

- There should be an explicit national agricultural research policy framework to provide a conducive environment for continuity and effectiveness in agricultural programmes/projects.
- Agriculture needs to become professionalized with educational training incentives and development of human capital in the direction of crop and livestock production. A better educated farmer would for instance be able to absorb new information faster on water management related issues.
- The Nigerian government should take a bold step to establish better-equipped weather stations as against the scanty and ill-equipped ones we currently have in Nigeria. With this, accurate weather forecast and predictions will be possible and this will help to prevent weather-related disasters through early warning and effective response/adaptation system. In addition, efforts need to be made towards tackling the dilapidated infrastructure in the country.
- With the increasing rate of erratic rainfall patterns, drought and desertification, drought resistant and short duration high yielding crops should be developed through research efforts and made available to farmers.
- Investment on improved agricultural technology by government and other stakeholders are very necessary for agriculture to be able to cope with climate change.
- The high climate variability that characterizes the African continent presupposes that people have developed successful indigenous adaptation strategies. It is therefore advocated that indigenous knowledge and practices should be integrated into formal climate change mitigation and adaptation strategies.
- There is need for effective capacity building to strengthen the most vulnerable group in agricultural production with requisite knowledge and information necessary for climate change mitigation and adaptation.
- Farmers should also have regular information on current issues related to water resources management and agriculture in relation to the nation's economy. This can be achieved through the strengthening of the nation's extension services perhaps by devolving the bulk of the services down to the local councils, which is closer to the farmers, and encouraging farmers to form farmer groups for enhanced capacity through group efforts. This may help them take advantage of the internet.

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