

NIGERIA



1. THE VISION

1.1 The Context

Human food requirement consists of four principal sources - water, agricultural crops, livestock and fisheries. Essentially, the demand for food depends on population and the dietary habits/per capita daily calorie intake of the people under consideration. On the other hand, the food requirement of the nation is dependent on an additional factor namely; food import and export balance. Consequently, there are basically three ways to produce this food requirement; through rain-fed agriculture, irrigated agriculture and food import. In all cases water is the most important determinant to increased food production and rural development.

More than 70% of the working adult population of Nigeria are employed in the agricultural sector directly and indirectly. Over 90% of Nigeria's agricultural output comes from peasant farmers who dwell in the rural area where 60% of the population live. The vast majority of these farmers have limited access to modern inputs and other productive resources and are unlikely to have access to pesticides, fertilizers, hybrid seeds and irrigation without some form of public sector intervention. It is also significant to state that the majority of these resource poor farmers are women.

The recent call for evolution towards "an agriculture machine that is sustainable, market-led and consumer focussed" needs to be carefully implemented to avoid social instability. For Nigeria (at least for some time to come) prosperous agriculture should continue to be the engine for poverty elimination, sustainable development and food security. The strategies should therefore be

primarily based on agricultural and rural development with expansion of irrigated areas to develop rural economies and to reduce the pressure in urban areas.

Policies for the allocation of water and other resources to food production and rural development must however consider the prevailing economic, social and environmental opportunities and constraints. To this end, we require a clear statement of our collective Vision for the future that is not contestable and that cannot be altered by any personal considerations. We could differ in the way we go about achieving the goals, but it is very essential that we have unity in the vision.

1.2 Vision Statement

At the heart of the vision of water for food and rural development is a healthy Nigerian population with access to adequate nutrition. This would require efficient and effective utilisation of water in a manner that is sustainable and equitable to the cultivators, and non cultivators of food, now and into the future. Specifically, the features of the Vision are as follows :

- * A vibrant nation whose population is living in security with reliable access to food, adequate social services, educational and employment opportunities in and out of agriculture.
- * A sustainable agricultural and rural development that promotes healthy natural environment that does not run down the ecosystems and natural resource based of tomorrow, in order to deliver the food and rural development requirement of today.
- * Creating an equitable, egalitarian and result oriented society that is focussed not only on input but output and outcome of every policy, activity, project and programme.
- * Promote communities that would be reasonably in control of their livelihoods and projects; while establishing reasonable equity in socio-economic amenities, services and conditions, including tenure and title to land and water rights.
- * The integrated development of water resources for the controlled water application in an extended or all year-round agricultural production, so as to stabilize food production; and to compensate for the production variability arising from insufficiency and non-uniform distribution of rainfall.
- * The improvement of socio-economic well being of rural community by providing gainful and all year-round employment and assured water supply to the rural areas; and the establishment of small-scale agro-industry.

1.3 Driving Forces of Change

A number of powerful and pervasive forces will drive and condition changes in all economic and social sectors of the nation over the coming years. These forces though are global in nature, yet the extent of their impact varies from one nation to another and from region to region. A realistic vision of the future must take them into account. Consequently to enable us realise the forgoing vision of the future of water in food and rural development, a number of the major driving forces, important opportunities, constraints, and issues would be briefly analysed.

The major driving forces are broadly classified under seven headings :

- * population growth;
- * urbanisation;
- * technological innovations;
- * energy prices;
- * market economics and trade liberalisation;
- * environmental awareness; and

- * global warming.

These together and/or individually would influence the demand for food, water for all uses, and rural development. These therefore are in a sense also the operating environment in which the vision would have to be achieved. The driving forces and the framework for establishing the demand for food, water, rural development and the required political environment would be briefly discussed later.

2. CURRENT SITUATION AND TREND OF FOOD PRODUCTION IN NIGERIA

2.1 Climatic and Physical Characteristics of Nigeria

Agriculture employs three quarters of the Nigerian working population, but agricultural landholdings are generally small and scattered. The average number of farm plots per household ranges between 2 and 28 plots and between 0.5 and 5.0 ha, increasing in size from the south towards the north. Farming is generally rainfed and of the subsistence variety.

The major crops grown in the country can be divided into two main groups: food crops (produced for consumption) and export products. Despite the importance of the export crops, the primary policy of agriculture is to make Nigeria self-sufficient in its food and fibre requirements.

Nigeria is listed by FAO among nations that are at the moment technically unable to meet their food needs from rainfed production at low level of inputs and appear likely to remain so even at intermediate levels of inputs at some time between 2000 and 2025.

Nigeria occupies an area of 923 768 km². The country lies between latitudes 4° and 14° north of the equator and longitudes 3° and 15° east of Greenwich. There are wide climatic and rainfall variations found in the country due to its location south of the path of the westerly winds in the north and almost out of equatorial doldrums of the south of Nigeria. Consequently, it is in the heart of the trade wind belt with generally "summer" rains and "winter" drought.

Rainfall averages over 2000 mm per annum in the southeast, 1000 mm in the centre reducing to as low as 500 mm in the north east. In the same areas the mean annual pan evaporation is 2450 mm and 2620 mm per annum respectively. Similarly, the vegetation of thick mangrove forests and dense rain forests in the south gives way to a near-desert condition in the northeastern corner of the country.

The country is divided into eight agro-ecological zones (as per Table 1) for the purpose of irrigation practices based on rainfall and temperature which are the most significant parameters.

2.2 Demand Projection for Food in 2025

2.2.1 Demographic Trends

The total population of Nigeria according to 1991 census was about 88.5 million people. The "Economic and statistical Review" published by National Planning Commission revealed that population growth rate has been stable at 2.83% while infant mortality has reduced. The estimated growth rates of population for 2000-2010, and 2010-2025 are estimated to reduce to about 2.70, 2.60 respectively. The notional "plateau" population of the nation is yet to be reliably

Table 1. Agro-ecological Zones of Nigeria with some Climatic Characteristics

Zones description	% land	Annual rainfall (mm)	Monthly temperature (°C)		
			Maximum	Normal	Minimum
Semi-arid	4	400-600	40	33-32	13
Dry sub-humid	27	600-1000	49	31-21	12
Sub-humid	26	1000-1300	37	30-23	14
Humid	21	1100-1400	37	30-26	18
Very humid	14	1120-2000	37	28-24	21
Ultra humid (flood)	2	2000+	33	28-25	23
Mountainous	4	1400-2000	32	29-14	5
Plateau	2	1400-1500	36	24-20	14

Source: Modified from FAO (1991)

determined. Some have however, suggested that around 410 million or about five times our current population may be all that can be supported by our available resources and that it would be reached towards the end of the twenty first century.

Table 2. Present and Future Population Project

Annual Growth%	1991-2000 2.83	2000-2010 2.80	2010-2025 2.75	2025 2.70
Population (in Million)	1991 88.517	2000 113.790	2010 145.896	2025 219.165

Source: Modified from JICA - Nigeria Water Resources Master-plan Study Report

As shown in the table above, the population is expected to increase from 88.517 million in 1991 to about 219.165 million by the year 2025, representing an increase of 248% over the years.

2.2.2 Nutrition

Food security, considered as the access to food at all times by all peoples, is one of the major concerns of the Federal Government of Nigeria. Food demand grows at the same pace as the population growth but because of the modification of the diet in the cities (increasing consumption of rice and wheat among the cereals), part of the demand would have to be met through food imports.

Taking a per capita allowance of about 2,200 calories per person per day to meet basic nutritional needs, and after making some allowances for wastage and conversion of grain into protein, it has been worked out that around 1 tonne of grain equivalent per year could well meet the basic needs of a typical family of five.

The most important component in the food basket of the nation is cereals and tubers, which includes rice, maize, corn, millet sorghum, yam and cassava. Millet, sorghum and maize are produced under rainfed condition, consequently their production is subject to large annual variations. More than 70 percent of the rice cultivated in Nigeria is grown from irrigated farmland, nonetheless its production is also subject to variations since the functioning of the fadamas schemes depends on the level of the flood and actually on the level of the precipitation in the catchment.

Projections by the World Bank suggest that the demand for all types of cereals will increase globally by 2.5 percent a year between 1990 and 2000, and with rising incomes, fall to 2.3

percent a year for the succeeding twenty five years. These figures are rather conservative for Nigeria and estimate that demand for cereals (especially rice) could well rise to 3.5 percent between 1990 and 2000 before dropping to about 2.5 percent between 2000 and 2025.

2.2.3 Food Export and Import

The physical output of agricultural exports in terms of aggregate index (base 1960) fell from 105.6 in 1970 to 63.8 in 1975. This sharp drop was attributed mainly to the five-year drought, but the situation has been aggravated in recent years by rural migration to the cities. Between 1966/67 and 1991/92 agriculture's share of General Domestic Product (GDP) fell from 59.7% to 35% as a result of reduced agricultural output and the greatly increased output of the petroleum sector.

In response to the production shortages, the country has been importing basic food items such as g rains, milk, fish, sugar and the like.

For the most recent years for which statistics are available, the food balance in terms of cereals is indicated in Table 3. Cereal imports mainly concerned wheat and rice. However, while local rice production represents between 60-63% of the domestic rice supply, the local production of wheat is negligible.

It is expected that the growing urbanisation will increase the wheat and rice consumption and consequently the imports of these two cereals, unless an important effort is made to develop the rice production locally or within the region. However, there is little hope to significantly develop the production of wheat, for obvious climatic constraints.

Table 3. Food balance in Nigeria in 1000 metric tons - Average 1994-96

Product	Production	Import	Total domestic Supply
Wheat	135	1,832	1,967
Rice	1,877	1,198	3,075

2.2.4 Cereal Requirement Estimate for the Next 25 years

It has been estimated that the gross cereal supply in 2025 would reach approximately 62,000 tons for the nation. When compared to the present production trend, the 2025 target does not seem to be unattainable.

According to FAO-IPTRID, rice production and imports would exhibit linear growth of an average of 122 000 tons per year and 83 000 tons per year respectively for the whole of West Africa. If we take half of this for Nigeria, in the absence of better parameter and assume the same pace would be maintained in the future, rice production and imports of Nigeria, would reach some 3 400 000 and 2 250 000 tons, respectively.

2.3 Potential

2.3.1 Rainfed Agriculture

In 1987, FAO prepared a working document on the "Need and Justification of Irrigation Development" which undertook a scientific assessment of the size of populations that the agricultural land resources of African countries can support. The report assumed a projected population for Nigeria in year 2025 of 238 million, 47.90 million hectares of potential rainfed land and 2.00 million and 3.73 million hectares potential shorter and longer transport irrigable land. The shorter transport irrigable lands was defined as land close to the source of the irrigation water i.e. transport distances were limited to those within one agro ecological zone. On the other

hand, longer transport referred to land further away from source: irrigation water may be transported from one agro-ecological zone to another. The potentials were calculated for three alternate levels of inputs namely, low level of inputs, intermediate level of input and high level of input.

Low level of inputs, corresponds broadly to customary practice, with fallow periods to maintain soil fertility and to control pests, with manual labour, no fertilizer and pesticide applications, no soil conservation measures and hence with full productivity losses arising from land degradation, and cultivation of the traditionally grown mixture of crops on all potentially cultivable rainfed lands.

Intermediate level of inputs, assumes the use of improved hand tools and/or animal power and simple implements, some improved genetic material, some fertilizer and pesticide application, some simple soil conservation measures lessening productivity losses farmland degradation, and cultivation of a combination of the traditionally growth mixture of crops and the most calorie (protein) productive crops, on all potentially cultivable rainfed lands.

High level of inputs, assumes complete mechanisation, full use of optimum genetic material, necessary farm chemicals and soil conservation measures, and cultivation of the most caloric (protein) productive crops on all potentially cultivable rainfed lands.

Table 4 shows the results of the study for Nigeria in relation to the population estimates in 2000 and 2025 and three levels of inputs.

Globally, for the whole of West Africa, the present population (2000) could scarcely be supported by the rainfed production with the low level of inputs without the assistance of irrigation. But more specifically, Nigeria along with a number of other countries in the sub-region have already exceeded the theoretical supportable population at low level of inputs and would exceed the supportable population at even intermediate level of inputs before year 2025. Obviously, measures have to be taken to improve not only i the level of inputs but also to develop irrigation.

The intermediate level of inputs would be largely sufficient to support the present population and even twice as much as the 2025 expected population in the sub-region, with a very limited contribution from irrigation. However, Nigeria and some countries would either have to substantially improve the inputs significant to be able to feed the population without irrigation and without imports.

Table 4. Population estimate and potential population supporting capacity of Nigeria (in million persons)

Country	Pop 2000	Pop 2025	Potential Low input	Population Int. Input	Supporting Capacity High input
Nigeria	128.8	238.4	54.4	206.5	700.7

2.3.2 Water Resources Potential (Extent and Distribution)

The water resources potential of the country is estimated to be 250,000 million cubic metres (MCM) comprising 190,000 MCM of surface water with the balance in the form of groundwater. This notwithstanding, water is still a limiting factor to agriculture in much of the country but most especially in the semi-arid and dry sub-humid zones lying above latitude 11o North.

A recent survey by JICA suggest that 39% of the land mass is potentially suitable for agriculture and out of this between 4.0 and 4.5 million ha (approximately 4.5 to 5.0%of the land) are judged suitable for irrigated agriculture but only 1.1 million ha can be supported fully by the water available, the remaining 3.4 million ha being fadama.

2.3.3 Water Regimes in Agriculture (Irrigated and Drained Fields)

The nation is believed to have short-transport irrigable land (land close to the source of the irrigation water i.e. within the same agro-ecological zone) capable of supporting about 16 million persons at intermediate and 32 million at high levels of inputs.

Overall, the nation has substantial resources of both rainfed and irrigable land. In view of differences in production potentials in various agro-ecological zones however, irrigation, which is already important will continue to be justified, particularly in the more marginal northern region, for the local production of high value perishables, and perhaps for rice and some export crops.

The development of water resources especially for irrigation purposes in Nigeria dates back to the Precolonial era. The traditional application of water to land for dry season farming in the Northern Nigeria was one of the earliest attempts made towards increasing agricultural production. This notwithstanding, Nigeria has not developed irrigation to the same extent as other developing nations, particularly in Asia. Only about a million hectare is currently irrigated in Nigeria. By contrast, India, which has about 3.5 times the land mass of Nigeria, irrigates nearly forty-five (45) times as much land.

As a result of FAO and US Bureau of Reclamation studies in the early 1970s, three pilot public irrigation schemes were developed, all in the sub-arid and dry sub-humid agro-ecological zones, namely: Bakolori Scheme, the Kano River Irrigation Scheme and the Chad Basin Scheme. The success of these pilot schemes coupled with the five-year drought (1970-1975) led to the establishment of 11 River Basin Development Authorities (RBDAs).

Until then water resources development for agricultural purposes was in the hands of the private sector for the production of sugar cane with only a minor role by states in the northern region of Nigeria. Irrigation practice was rudimentary, using residual flood waters and moisture in the low lands called fadama (flash flood plains), and supplemented with shaduf (a traditional device that lifts water onto the land). The main crops produced using these traditional methods of irrigation were vegetables and rice.

The initial case for development of irrigation in Nigeria was based in part therefore, on the need to sustain a growth in the food supply that would broadly lead to national food security. Records reveal that between 1976 and 1990, about US\$ 2000 million of public funds were invested in the development of large to medium scale public irrigation projects. Consequently, irrigated agriculture witnessed a spectacular growth, rising from slightly more than 25,000 ha of irrigated farmland in 1975 to the current 974,900 ha. Surface irrigation in its various forms (basins, borders and furrows) issued predominantly for water applications in both public and private irrigation schemes.

Areas under irrigation include areas equipped with full or partial water control, spate irrigation, equipped wetlands and inland valley bottoms (including fadamas), irrespective of their size or management type. From a survey undertaken by FMWR in 1995 it appears that irrigated areas in Nigeria amounts to some 974 900 hectares. However, the exact amount of land under irrigation is difficult to estimate, because there is no clear commonly agreed definition of irrigation that is adopted by all. It is often difficult to classify certain categories of water management like the residual fadamas and water harvesting methods which sometimes have some form of water control and/or sometimes are just cultivated wetlands with hydraulic structures for drainage but not for irrigation.

Estimates of irrigated area and of irrigated crops vary greatly from one source to the other. The most reliable estimate of the total water managed area is about 975,000 ha, but it is not clear if this includes double cropping. It remains that the accuracy and reliability of the information vary greatly between zones and categories of information, as does the year in which the data was gathered.

Three main categories of irrigation development exist in Nigeria today (see table 5), namely public irrigation schemes, which are systems under government control (formal irrigation); the farmer-owned and operated irrigation schemes (informal irrigation) that receive assistance from government in the form of subsidies and training; and residual flood plains fadama, where no government aid is supplied and is based on traditional irrigation practices. The most important irrigated crops are rice, wheat, and vegetables. Together they occupy about 90 to 95 per cent of the total water managed area.

Table 5. State of Irrigation Systems

Category	Distribution		1991 (ha)	1993 (ha)
Formal Irrigation (public irrigation Projects)	Full or Partial control	Equipped	118621	119350
		Actually irrigated	62086	71700
Informal irrigation (farmer-owned and operated irrigation projects	Full or partial Equipped wetland	Lift or shallow tubewell	101000	161700
		Flood control (improved fadama)	13200	18500
Residual fadama	Flood plains		723714	724000

Source: JICA, Adeniji, FACU and other works.

At 1998 price, the average cost for irrigation development was estimated at N750,000 per ha. Annual operation and maintenance costs ranged between N5,000 per ha for gravity systems and N22,000 per ha for pumping systems, and up to N30,000 per ha for sprinkler irrigation systems.

Based on past trends and on the present agricultural policy of Nigeria, we have tentatively elaborated a scenario of irrigation between years 2000 and 2025. The scenario does not foresee a significant increase of irrigated area between now and year 2025. According to our projection, land under irrigation has increased at less than 1% per annum in the last decade. It is not foreseen that the situation would change significantly because of many reasons. We therefore assumed not more than 2% annual increase which we see the nation increase the area under irrigation from the current 974 5000 hectares to 1 567 422 hectares in 2025, while the harvested irrigated areas would increase from the estimated current figure of $(974\ 500 \times 1.2) = 1\ 169\ 400$ hectares to about $(1\ 567\ 422 \times 1.5) = 2\ 351\ 133$ hectares in 2025.

2.4 Agricultural water use and the environment

2.4.1 Effects of other activities on agriculture

Because water is essential for agriculture, the most important external environmental effects on agriculture are related to the availability and quality of water.

Surface and subsurface water flows are changing due to changes in landuse in Nigeria. Important changes are due to agriculture itself, logging, urbanization and development of infrastructure. These reduce the water retention capacity of the land, especially if combined with drainage and trained rivers for flood protection. The quicker storm water runoff have resulted in higher flood with higher inundation risks downstream of most of our storage structures.

On the other hand, the quicker runoff provides less opportunity to recharge the groundwater and therefore the flows in dry periods will decrease. Consequently the need for additional storage

increases. Deforestation, resettlement, fish migration and the like are all issues that call for more integrated land and water management.

The urbanization will also increase withdrawals for domestic and industrial use resulting in less water being made available for agriculture. Though the quantity of water withdrawal for domestic and industrial uses might be relatively small, the quality of the return flows from both are often seriously degraded and makes its reuse difficult without expensive treatment.

The scarcity of freshwater resources may necessitate the reuse of drainage water for irrigation. However, the degradation of certain groundwater systems can be made even worse where recycling of water is practiced as the reuse of water may ultimately lead to an increase of undesirable chemical loads in the water. Similarly, effluents from industrial and municipal sources will be also used for irrigation. The use of such contaminated water would carry certain risks to human health and the flora and fauna ecosystem.

2.4.2 Effects of agriculture on the environment

Agriculture itself has also an important impact on the environment. Pollutant sources from land use and poorly managed agriculture is causing widespread deterioration of ground and surface water.

Over irrigation results in waterlogging and the consequent accumulation of salts will lead to salinization of top soils and groundwater if not provided with proper drainage. Intensification of agriculture may lead to an increase in degradation of water quality and irrigated land because of an increasing intensity of inputs in agriculture.

In water scarce region to the north of Nigeria, there will be an increase in use of brackish water and sewage effluents for irrigation. Recycling of water although it may improve efficiency of use of water, it could also reduce both surface and groundwater quality. Moreover, increased water withdrawals will lead to salt intrusion in estuaries and over-draughted coastal aquifers. Managing water quality to prevent these conditions requires careful assessment, and monitoring of inflows and effluent water. At the same time, recycling and reuse systems should take into account its cumulative effect over time, and its impact on the soil and water environment.

The protection of waters, however, does not only refer to the prevention of pollution but also to the recovery, conservation and the development of their self-purifying power. In this sense, the restoration of rivers and lakes is an important task to be accomplished.

Trans-sectoral measures on water retention in the catchments should be undertaken through a close interdisciplinary cooperation the awareness of flood hazards in areas protected by the dikes with a view to reduce the flood damage risks through regulated utilization of flood plains.

3. FOOD PRODUCTION, TRADE, AND RELATED WATER ISSUES IN THE YEAR 2025

3.1 Meeting Demands for Water and Food in 2025

Irrigation and drainage infrastructure is a vital and necessary leg of the Green Revolution triangle of seeds, fertiliser, and water control. As such, it has played a critical role in the prevention of famines and widespread starvation and in the rising standard of living of millions of farmers in parts of the nation. Nevertheless, the performance of many irrigation and drainage system is significantly below potential due to a variety of shortcomings. These include poor initial design, use of inappropriate technology, distribution system layouts that did not adequately reflect existing conditions, unsupportive governance environments, and poor management systems.

The most obvious manifestations of these shortcomings are unreliable main system water supply, water wastage and poor maintenance practices. Improvements in tertiary level water

management by farmers are often thwarted by unreliable water supplies. Users are discouraged from organising themselves and participating in the operation and management of the water delivery system, and unwilling to pay water charges when service is poor and unreliable. Insufficient funding for maintenance and ineffective use of the funds that are available results in rapid deterioration of infrastructure leading to further problems such as inequitable water distribution, waterlogging, and reduced productivity.

Irrigation management institutions fail to utilise women's skills and knowledge effectively. The importance of women farmers is increasing as fewer and fewer men farm. With the projected urbanisation, men would increasingly leave the rural areas to work in cities where they can earn higher wages, but often leaving the women behind to tend to the farms.

There is widespread concern about the financial sustainability of irrigation. Investment cost for developing public irrigation schemes were partly or fully subsidised. More importantly, the recurrent costs of operation and maintenance are seldom recovered directly from farmers, resulting in stagnation in further development of irrigated fields. Such short sighted operation and maintenance policies have reduced the economic life of irrigation facilities and led to impaired water delivery capacities. Nigeria need to shift emphasis towards rehabilitation and modernisation of existing systems, but the cycle of construction-deterioration-rehabilitation has to be broken through greater mobilisation of resources from the farmers themselves to ensure adequate O&M of the systems.

Before considering the options available to us in meeting expected demands for water and food, let us review the trends and forces affecting the future of agriculture. The most significant socio-economic change in the Nigeria, is related to demography in the form rapid population growth and urbanisation. Urban population is expected to grow at an average rate of 4.2%, i.e. slightly less than during the past decades when the urban growth averaged 6.3%. The increasing proportion of the urban population expected to reach 63% of the national population in 2025 will significantly modify the socio-economic landscape of the nation.

Major changes induced by urbanisation and by the resultant specialisation of the role of consumers/producers, will affect the diet: mostly wheat, rice and vegetables in the cities; traditional cereals, tubers and roots in the rural areas. Animal protein consumption will certainly increase in the urban environment while it will remain low among the rural populations.

Wheat can hardly be produced in Nigeria and will continue to be imported unless government can encourage the use of substitute cereals for bread. Using traditional cereals such as sorghum, millet and maize to produce bread will slow down slightly the increase of wheat imports which may reach some 2.5 million tons in 2025.

Assuming that the rice consumption would increase at the same pace as the urban population - 4.2% - the demand for rice would reach 11 million tons in 2025. To produce that amount of rice would require more than 2 million hectares, mostly irrigated, which would be difficult to achieve. Therefore, part of our rice requirement will continue to be imported. However, an important effort will have to be made to significantly increase the production, at least to maintain the present proportion of local production versus total demand, equal to 63 percent. This target would still require some 6 million tons of rice to be produced from at least 1.3 million hectares irrigated. The relatively lower price of rice from Asia will continue to make local rice less competitive unless efforts are made to substantially increase the performance of irrigation agriculture.

Some irrigation schemes were implemented with the object of reducing the dependence on imported rice, and wheat but very few were really successful. Kano River Irrigation Project and the case of Office du Niger in Mali are however a good example of successful irrigation schemes. Investment for expansion and rehabilitation would be constrained by the level of unpaid loans which remains very high and the cost of construction and rehabilitation is exorbitant although this is envisaged to decline as a result of the crusade to instill transparency and curb corruption which

would instill increased competition and farmers' participation in the financing the operation and maintenance.

An alternative for low-cost rice production may be in the development of fadama and the new Community Based Medium Scale Irrigation Schemes of RBDAs which will put substantial area under irrigation at lower cost per hectare.

A number of initiatives have been undertaken to promote rational lowland development, especially in narrow fadama, strips, which are scattered everywhere in Nigeria. Improved and locally adapted irrigation techniques are being promoted by several research institutes, led by the West African Rice Development Association (WARDA), which manages an Inland Valley Consortium composed of several national and international research institutes. Technical documents have been published both for the humid tropics and the Sahelo-Sudanian zone. Development projects are implemented in most countries with the financial assistance of bilateral and international donors.

Rice production exploiting surface water during or just after the rainy season has been the main objective of most of the projects, whereas shallow aquifers and lowlands areas may also be a reliable source of water for vegetable production during the dry season. New FAO initiatives in SPFS are underway to promote micro-scale irrigation using low-cost technologies to access water (e.g. hand dug wells) and to pump this water (e.g. treadle or small gasoline driven pumps).

A number of issues need to be addressed in order to assess the sustainable development potential of the fadamas :

- * Availability of manpower during the rainy season while most of the farmers are busy with the rainfed cultivation.
- * Availability of water resources for agricultural production and to address the environmental issues (extensive cattle husbandry, bio-diversity, etc).
- * Sustained assessment and monitoring of the aquifers to avoid their over-exploitation.
- * Since traditionally fadamas are mostly cultivated by women, efforts should be made to prevent their being sidelined from development projects.
- * Address the conflicts between agricultural development, environmental issues and cattle husbandry.

With the exception of a few favourable conventional irrigation schemes, fadamas are likely to be the main source of local rice production in the future. However, WARDA reports that significant potential for rainfed rice production exists, thanks to new varieties recently developed, but which still need to be disseminated among the farmers of the humid zone of the West Africa.

Fruits and vegetables production increased significantly during the last 20 years probably in relation to the growing urbanisation but also in response to change in the diet, even in rural areas. The sudden acceleration of vegetable production in the early 1980s correspond to the drought period when the Governments decided to promote small-scale irrigation projects, mostly based on shallow groundwater, in order to offset the cereal production deficit due to the drought. It is remarkable to note that vegetable production is twice as much as the rice production.

IMPACT model projects suggest that cropped area will expand only slightly (0.25% per annum) during the coming quarter-century while irrigated area grows by 0.6% annually between 1995 and 2020, less than half the annual growth rate of 1.5% during 1982-1993. The model predicts that cereal prices will remain stable until about 2010, after which they will fall modestly. This itself is a sharp departure from recent trends, which have seen cereal prices declining fairly rapidly over the past two decades. Stable prices will tend to encourage input use, tickling yield growth rates upward.

Population growth reduces the per capita availability of fresh water supplies, leading to stress or even scarcity. Under a new classification scheme, a country with an annual renewable fresh water supply per capita of more than 1,700 cubic meters (m³) will experience only occasional local water shortages. A country having a supply of less than 1,000 m³ per capita per year will experience chronic water shortages which will hamper economic development and lead to serious environmental degradation.

Nigeria has sufficient water potential to meet the 2025 requirements, but will have to more than double their efforts to develop water sources to do so. However, finding the financial resources to build enough water development projects to accomplish this will be extremely difficult.

3.2 Reallocation and Reuse

It is inevitable agriculture, as the largest water user in many river basins will be called upon to relinquish supplies it currently withdraws from the river to other users. We must not lose sight of the fact, however, that perhaps two-thirds of the water diverted by irrigation typically returns to the river downstream. Water is often used and reused many times on its way from an upper watershed to the sea.

Reliable systems of property rights for water are important precursors to orderly transfers of water among users and uses in future.

3.3 More crop per drop

With the trends described above, it is obvious that we would have to feed more people with less water. This requires application and further development of a mix of site specific solutions in the fields of technology, policies, management and institutions.

3.3.1 Technology/Crop Yields

There is an enormous potential in Nigeria through development of irrigation for higher yields, which could possibly be achieved by advances in bio-technology through development of higher producing, pest and drought resistant crops. However, seeing the present state of affairs, there is little likelihood of a substantial breakthrough. Only comparatively small advances in the order of five to ten percent may be expected.

3.3.2 Productivity of rainfed agricultural

More than three quarters of the national agricultural area is rainfed. In development of rainfed agriculture use can be made of the water fraction that otherwise would have returned back to the atmosphere through direct evaporation and transpiration. Increasing, the potential of rainfed agriculture would make a significant impact in the national food production. However, precipitation patterns differ across the agro-ecological areas and the potential to improve yields in rainfed agriculture is strongly related to these. Nigeria need to develop more vigorously the intermediate low cost water and soil conservation technologies which include water harvesting and soil tillage, mulching, bunding, terracing, etc; these could significantly reduce the water risk and lead to an substantial increase in yield.

The ultimately the risks associated with rainfall would only be minimised through a reliable supply of water in case of shortage and a good drainage.

3.3.3 Policies

* Level the playing field: subsidies and taxes

- * Fund research: agricultural, irrigation and drainage technology, irrigation and drainage management
- * Charging systems for water and power
- * Encourage private manufacturers of irrigation equipment and drainage pipe

3.3.4 Institutions

- * IMT
- * Reorient IDs
- * Links irrigation research, irrigation education, and system management organisations

3.3.5 Water rights

Clear, objective and transparent systems of water rights are a first condition for reliable services and accountability. One of the elements to be considered is the social function of water, especially the protection of rural poor. Such systems, would require appropriate administration for planning purposes but also to protect society and the poor against undesired market effects.

3.3.6 Water pricing and cost recovery

Water pricing provides a means of financing water services and is an essential element in service-client accountability mechanisms.

3.4 Expanding areas

More production can be realised by developing new areas. Expansion of rainfed agriculture will in most cases include conversion of natural forests, mountain slopes or marginal soils, resulting in disturbed ecosystems and increased erosion. To achieve a same production increment, less land has to be developed if provided with irrigation. However, the best places are already occupied and development of new areas will be more costly.

much attention has to be paid to the rehabilitation of poorly performing systems, especially those degraded due to poor management. Development of drainage systems and improved water management practices could return large areas to productive use.

4. CONCLUSIONS

Rainfed agriculture will remain the main producer of traditional cereals and tubers. Self sufficiency of traditional cereals is important for the household food security of rural populations. Rainfed production will grow at the rate of the rural population.

Irrigation will grow as fast as the urban demand in fruit, vegetable and rice. However, at the national level, wheat will continue to be imported, while rice production will increase yet the percentage of import may have to be kept at its present level. Local rice production would mostly come irrigated farms and be supplemented from fadamas and rainfed production.