5. Sustainable Irrigation Option For Nigeria: The Large or The Small

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5.1 INTRODUCTION

Irrigation has been practiced in Nigeria for centuries, although on a small scale, and in the drier northern parts of the country. In the past it was restricted to the seasonally flooded or floodable floodplains along major savanna channels and/or the depressions on the adjacent terraces -- the valley bottom areas now known by its *Hausa* word fadama. It was a very valuable piece of land devoted to highly priced crops. Until the 1980's this small-holder irrigation was dependent on the shaduf system of lifting water, concentrated mainly on market gardening crops, and the plot size was very small, averaging 0.2 to 0.4 ha. A variety of the irrigation of that time was the one dependent on residual moisture utilization technique for the production of rice which was experienced in the extensive floodplains of the Hadejia River.

But the droughts of the early 1970's demonstrated the inadequacy of the system to satisfy the need of the ever-growing population in the face of inclement climatic conditions. The answer to such devastating drought was found in large-scale irrigation on the upland plains and river terraces. Although attempts had been made earlier in the century to irrigate on a substantial scale, the activities of the mid-1970's really marked the beginning of serious large-scale irrigation projects. Kano State (now shared between Kano and Jigawa states) was the leading actor, and remains the hub (and show case) of large-scale irrigation in the country today. Not surprisingly, large-scale irrigation came with the construction of dams to conserve water. Consequently, nearly all the large-scale schemes existing in the country today, except the South Chad Irrigation Scheme (SCIP) and Lower Anambra Irrigation Project, depend on the impoundment of water behind one dam or the other. The largest dam constructed mainly for irrigation in the country is the Tiga Dam in Kano State. The second largest is the just-completed Chalawa Gorge Dam also in Kano State. In fact these two dams effectively control the two major feeders of the Hadejia River system. Other popular dams built for irrigation, among other things, include the Bakolori in Sokoto State and the Goronyo in the same area. The SCIP depends on water extracted from Lake Chad. Although the states took the initiative for developing large-scale irrigation and dam construction, these exercises soon passed to the River Basin Development Authorities (RBDAs).

In spite of their initial benefits, it was not long before the undesirable effects of the large-scale irrigation projects, and particularly the concomitant dams and reservoirs became noticeable. Researches started to reveal physical, social and economic

adverse side effects. The call for a re-think and an investment in small-scale irrigation became resounding, championed by both home-based and foreign researchers (Adams, 1985; Matlock, 1985, and Turner, 1977, among others). The call was not lost on the World Bank which proposed and aided the establishment of Agricultural Development Projects (ADPs) whose main objective was to improve the age-long small-holder irrigation system in areas outside the control of the RBDAs, increase food production and correct the main setbacks of the large-scale projects. The states bought the idea and the ADPs grew rapidly in number and in strength. However, after ten years of the ADPs, the rosy picture earlier painted and initially achieved has become a mirage and it is clear that "modernization" is killing the sustainability of the traditional small-scale irrigation system, re-enacting the ills of the large-scale one. Indeed, a few of the ADPs (e.g KNARDA at Watari) has ventured into large-scale projects. The question that emerges from all this is: Which way then?

Using mainly the Kano/Jigawa states' experience as a case study, this paper examines the successes and failures of both the small- and the large-scale irrigation projects, highlighting the factors, and suggests what would seem to be the appropriate option to be adopted for a sustainable irrigation endeavour in Nigeria.

5.2 SMALL-SCALE IRRIGATION IN NIGERIA BEFORE LARGE-SCALE HYDRO-AGRICULTURE

The development of the seasonally flooded and floodable floodplains along major rivers and the depressions on low terraces (known as fadama land) in the savanna zone of Nigeria for small-scale dry season irrigation of rice, tomatoes, green vegetables, sugar cane, onions, pepper and the like, dates back to distant history. Irrigation was based largely on natural recycling of nutrient through annual silt addition by flooding rivers. The floodplain of the Hadejia and one of its main tributaries (River Kano) were especially noted for their dry season cultivation before the inception of dams and large-scale irrigation on the interfluves.

Before the era of dams two distinct zones of fadama cultivation existed. These are: the zone of defined storm channels with low terraces with or without narrow floodplains such as the headstreams of the Hadejia; and the zone of extensive alluvial channel complexes such as the Hadejia and Yobe complexes. In the first zone the shaduf system of lifting water from dugout pits at the edge of the storm channel, or ponds on the low terrace was popular. Calabashes were used on the shaduf to irrigate plots divided into basins. In the second zone, flooding was very extensive and lasted for longer periods. Thus, residual moisture utilization technique which required no water lifting device was applied. Climatic variations determined the extent of annual floods as well as the number of hectares cultivable each year. Needless to state that the uncultivable parts of the fadama provided pasture for grazing. In both zones the basin technique of irrigation was favoured. Inputs were limited, largely, to labour and seeds usually purchasable in the local markets, or from the last harvest. Labour was based largely on individual family labour (*gandu* or *gaiya*). Hire was not very common. The droppings of animals allowed to graze farm residues and occasional addition of household refuse (*tarki*) supplemented the natural silt to replenish the nutrient of the land. The materials needed to construct and operate the shaduf constituted the other additional inputs. The system was no doubt labour intensive.

Rice was very popular in the extensive floodplains, while tomatoes, sugar cane, pepper (tatatse), green vegetables, onions, and other market gardening crops were popular in the confined floodplains and low terraces. Rice and sugar cane occupied the wetter areas while the other crops were grown in better drained (slightly raised) sections. Also, inter-cropping of the green vegetables and relay planting were very common.

It was a sustainable, organically balanced system, although on a small scale and catering mainly for urban dwellers. But the dams and large-scale irrigation came under the River Basin Development Authorities, and the fadama land and its development have not been the same again.

5.3 THE INCEPTION OF LARGE-SCALE HYDRO-AGRICULTURE

5.3.1 The Dams and Their Effects

When the dams and large scale irrigation came, particularly in the Hadejia headstreams (Figure 5.1), flood water no longer reached the low terraces and the extensive Hadejia floodplain was left high and dry, as most of the wet season flow became restricted into a much narrower channel, while the dry season discharge from the Tiga merely trickled to the area. As early as 1977 a village head in the Hadejia Emirate had occasion to complain to the officials of the Water Resources and Engineering Construction Agency (WRECA) Kano that "the land is dying" (Kulatunga, et al. 1977). Indeed, in the numerous cases where no perennial discharge has been maintained downstream of the dams, the pre-dam fadamas have either been lost outright, or are impoverished. For example, Nichol (1991) has estimated a loss of 656 ha of the 876 ha pre-dam cultivable fadama downstream of the Jakara Dam, although 661 ha of the cultivable and uncultivable fadama has been open up for rainfed cultivation. She was certain that 611 ha of the pre-dam uncultivable fadama could no longer be classified as such in 1981, about two years after the inception of the dam. Similarly, Adeniyi (1973) has reported losses of fadama land amounting to between 44 and 70% of the pre-dam extent along a stretch hundreds of kilometres downstream of the Kainji when its gates were closed in 1968. Similar losses of fadama land have been reported downstream of the Bakolori at Birnin Kebbi and elsewhere in the Sokoto-Rima basin by Adams (1985) and O'Reilly (1981).

It has often been argued that some of the fadama land drowned under an impounding reservoir is gained through the cultivation of the drawdown (risk) zone. But it has been shown that the drawdown zone is but a negligible part of the farmland drowned, and a very small part of the pre-impoundment fadama. In her study, Nichol (1991) estimated a recovery of 10.2% of the pre-impoundment fadama in the Jakara case. In fact, the cultivation of this risk zone portends another danger: excessive soil erosion leading to a rapid reservoir siltation.

In all the known cases of savanna dams, it is only in the small stretch of about 60 km below the Tiga that a positive transformation of the storm channel has occurred. Here, between the Tiga Dam and the confluence with the Chalawa River, the magnitude of the perennial flow maintained in the channel (at first 9.6 m^3/s, and later about 13.2 m^3/s) has proved to be optimum to enhance positive metamorphosis of the pre-dam storm channel within the reach. Thus, the effective channel today is approximately 30 m wide and is incised into the former storm channel to a depth of

about 1.4 m creating an overbank zone (new low terrace) which is approximately 210 m wide (but not evenly distributed left and right of the new effective channel) on the pre-dam sandy accumulation. The new land is covered by post-dam nutrient-rich

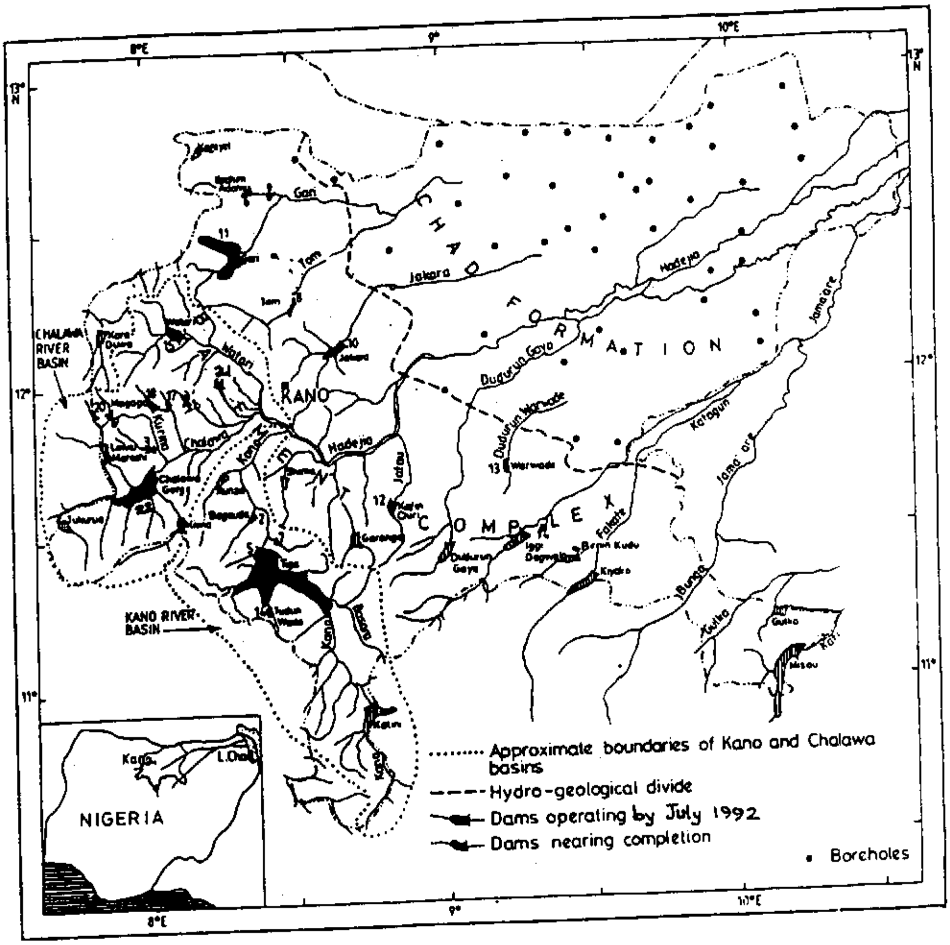

Fig. 5.1: Dams and Boreholes in the Hadejia-Jama'are Basin

silt + clay sediments which is more than 15 cm thick to evolve a new fadama land at least 1200 ha and already shown to be richer than the upland soils (Olofin, 1991a). In this reach, this new land is an addition to the pre-dam fadama land which could still be irrigated, although with artificial fertilization.

It is regrettable that such optimum perennial discharge is not maintained downstream of other dams in the region. Indeed, the water maintained downstream of the Tiga has not been sufficient to generate similar positive changes further downstream, say in the Hadejia area. In short, the gains in the creation of new fadamas are far short of the losses. These losses have some socioeconomic consequences not the least of which are: the loss of fadama land by some peasants who are usually forced to change their mode of production or migrate to urban centres; the reduction in the number and size of plots in respect of lucky ones who are still able to continue; the encroachment on pre-dam uncultivable fadama which are generally sufficiently drained for irrigation and the concomitant conflicts with the pastoralists which seem to multiply geometrically. For example, in a survey involving 389 farmers in Jakara and Warwade areas in 1987/88, Main (1988) found that the number of fadama plots per participating farmer decreased from a pre-dam 3.5 to a post-dam 0.1, while fadama land as a percentage of total cultivated land decreased from a pre-dam 56% to a post-dam 4%, and 85% of the total land lost was fadama land. Further, 57 respondents with an average of two plots pre-dam lost their plots completely and had to migrate to Kano metropolis to seek other occupations.

5.3.2 Large-scale Irrigation: Successes And Failures

Large-scale irrigation has produced a mixture of successes and failures. In the more successful ones such as the Kano River Project, the establishment of large-scale irrigation has increased the total production of particularly tomatoes, wheat, maize and rice, allowed for double cropping, increased farmers' income and achieved some measure of import substitution and improved the Gross National Product. In other words the projects have brought some gains (Olofin, 1992). Whether or not such gains have been cost effective in terms of the net national income is best left to the imagination. Where such projects have not achieved much success, such as the South Chad Irrigation Project and the Bakolori Irrigation scheme, large-scale irrigation has become a national waste-paper basket, justifying the criticism of researchers. In all cases, large-scale irrigation and its concomitant dam have led to the dispossession of peasants of their land, unsatisfactory resettlement schemes, and/or inadequate and delayed compensation (Jega, 1987); all of which have resulted in serious resentment, lack of cooperation, or outright revolt (as in the case of Bakolori 1980) on the part of the peasantry against the authority. In the face of such failures, rural urban migration has increased and many peasants have abandoned farming for other city jobs (Main, 1988 and Olofin, 1991b). Indeed, such large-scale projects have encouraged expropriation of land by the State, capitalization of holdings by a few rich farmers, commercialization of production, gross inequality in the project areas as a result of unequal access to inputs, finance and other means of production, and the emergence of absentee land owners. The peasant finds that he has become a hired hand to till his erstwhile farm.

Compounding the problem is the realization that large-scale irrigation with its over-dependence on agro-chemicals, is not kind to the land itself. Incidence of waterlogging, the removal of the fine soil particles, and a gradual but sure accumulation of certain salts are reported from several irrigated fields (Alonge, 1985;

Daniel, 1985 and Kodiya, 1988). More recently, Essiet (1990) has shown that between 1974 (before irrigation) and 1988 (after thirteen years of irrigation) the clay content of the soils in the irrigated fields decreased from 16% to 10% while the silt content decreased from 13 to 10%. Over the same period the exchangeable potassium (K) increased from 0.08 me per 100g to 0.90, exchangeable sodium (Na) from 0.1 to 0.43 and exchangeable Calcium plus Magnesium (Ca + Mg) from 5.16 to 7.22. Also total phosphorous increased from 40.0 ppm to 273.5 ppm while available phosphorous increased from 20.0 to 59.7 ppm. Although the levels of these elements are not critical, except those of silt and clay, the trend should be of concern for the future; especially when it is reported by the same author that between 1977 and 1990 silt and clay fractions, exchangeable Na and Ca + Mg in the soils of the un-irrigated tracts under small-holder rainfed cultivation within the same project area remained virtually unaltered, while exchangeable K actually decreased from 0.1 to 0.06.

5.3.3 Initial Management Response

Faced with these unfavourable effects (or pains) of large-scale irrigation and dam construction, it was easy for researchers to condemn such projects and advocate for small-scale ones as mentioned earlier. The argument was that improved numerous small-scale projects would yield the benefits of a few large-scale ones without the problems of the latter.

So the World Bank listened and brought the necessary funds and the ADPs multiplied. That of Kano/Jigawa known as Kano State Agricultural and Rural Development Authority (KNARDA) and its supply company (KASCO) provide a good case study to measure the performance of the ADPs. KNARDA financed by the World Bank and assisted by KASCO went about drilling tubewells and washbores, supplying, at an initially subsidized price, diesel and, later, petrol water pumps for lifting water, providing tractor hiring services, supplying improved (dressed) seeds, herbicides and chemical fertilizers. For example,in the extensive abandoned Hadejia floodplains, tubewells fitted with hand pumps provide water directly to plots in which they are sunk within the old channel beds, but through connecting hoses and petrol pumps to basins on higher meander terraces. It must be stated that the first set of water pumps were diesel types which proved very unsuccessful. Later the petrol pumps were introduced which have proved more effective, but getting out of the reach of the small-scale operator. Kimmage & Falola (1991) have reported that between 1983 and 1989, 1773 tubewells and 3111 washbores were sunk by the Kano State Agricultural and Rural Development Authority (KNARDA) in the Hadejia-Nguru floodplain, while the Kano Agricultural Supply Company (KASCO) sold about 44,582 3-cm petrol pumps to the farmers. The extent to which these pumps were adopted is illustrated by the fact that the supply by the KASCO represented only 54% of the pumps in use during the field survey in 1989.In another survey conducted in the Jakara area by Mr. N. A. Oyeniyi of the Geography Department, Bayero University, Kano in 1989 (Olofin, 1991b), wheat had become the most important crop in the fadamas and 95% of the 250 small-scale irrigators interviewed grew the crop in that irrigation season. This emphasis on wheat is confirmed by Kimmage & Falola (1991) in their own survey in the Hadejia-Nguru floodplain in the same season. Further, mixed cropping and relay cropping have been phased out in many areas as wheat has become the mono-crop over large areas.

The success within the first few years was sufficient cause for celebration in many quarters. But the ovation did not last long. First, as stated above, the dams have

reduced the extent of fadama land while the new incentives encouraged the clearing of larger tracts -- usually the former preserves of pastoralists -- for cultivation. Secondly, policy issues substituted new crops such as wheat and maize for the traditional ones. And finally, there emerged an unequal access to inputs, finance and other means of production. Thus, the self-same problems of the large-scale projects soon appeared in the "modernized" small-scale fadama . cultivation. Land expropriation, dispossession of peasants of their land, capitalization of holdings, commercialization of production, and social inequality have been reported under the improved small-scale system (Kimmage & Falola, 1991, and Olofin, 1991b). In addition are escalated pastoralist-cultivator conflicts (Hadejia 1991, and Kawuwa, 1991) and the overpumping of the groundwater in the areas of operation, leading to a progressive drying out of the fadamas. Indeed, the objectives and proposed mode of operation of FACU (Umar & Tyem, 1993) would most likely compound some of these problems rather than solve them.

5.4 AGGRAVATING FACTORS

It is appropriate to pause and ask: why are both systems performing less than expected? Some of the factors working against an acceptable measure of success in the operation of large- and small-scale irrigation are implied in the discussion above.

One of such factors is the poor management of reservoir water which denies areas downstream of adequate discharge. Except for the case of Tiga Dam where water is released into the natural channel as described earlier, none of the other dams serve downstream reaches with water. Thus such reaches are fixed permanently in an erosion phase and the fadama land along them are left high and dry. Further, it is such impoundment in the headstreams of rivers discharging into Lake Chad that is partially responsible for the drying up of the lake and the failure of the SCIP based on it. The claim that it is the current prolonged droughts that is the culprit is not stating the full truth.

A second constraining factor is the poor, inadequate and at times complete absence of feasibility studies for most of the projects, and the omission of environmental impact assessment for such projects. Most of the undesirable side effects are usually unexpected. Consequently, there are no contingent measures to tackle them when they emerge, resulting in crisis management rather than risk management. This inadequate knowledge of the variables involved in the projects is compounded by lack of post-implementation monitoring and periodic post-implementation evaluation of the projects. In many cases, it takes studies by academics in search of higher degrees, or materials for journal articles, to discover some of the set-backs. This factor is summed up by Umar & Tyem (1993) as weak agricultural services, especially national research. Another aspect of the lack of adequate knowledge is poor coordination among development agents such as the RBDAs, ADPs, NALDA, and FACU to mention a few. The result is that a measure of success achieved in one part of a basin may spell doom for efforts in another part (e.g. the case of SCIP stated above).

A third factor is the introduction of technologies which are beyond the ready understanding of the participating farmers and, particularly, without adequate back-up maintenance facilities including spare parts, trained technicians and so on. This constraint is contributive to the failure of the petrol water pumps; the inability of

tractors, harvesters and other farm machineries for large-scale operations to perform when they are needed most; and the wrong application of fertilizers and other agro-chemicals by farmers who only understand that "the more the better".

The procedure usually followed to formulate some of the policies including those informing the introduction of new technologies constitute the fourth constraining factor. In general, agricultural policy formulation since the colonial days till now has followed the top-to-bottom (top-down) approach where the experience and perception of the participants are not considered. Resenting participants are usually forced, rather than be persuaded to adopt such policies some of which alienate such peasants. For example, farmers who resent planting certain crops in the Kano River Project either leave plots ear-marked for such crops fallow, or rent out the plots to eager commercial cultivators (field experience). The process of outright sale of holdings starts that way.

A fifth constraint is what Umar & Tyem (1993) have listed as imperfections in the rural finance market which has limited access to institutional credits. The argument here is that the main problem is not a complete lack of credit facilities, but the creation of artificial scarcity which has resulted in unequal access to available credits. The rural farmer loses out while the city, big-time, absentee farmer smiles all the way home with an agricultural loan which he either diverts to other uses, or utilizes to buy off the rural farmer from the land. The same unequal access is experienced in inputs and extension services both for the large- and the small-scale projects, with an increasing concentration of means of production in very few powerful hands who fleece the actual farmers through expensive hiring services. For example, quite a number of non-farming businessmen in Kano own petrol water pumps which they rent out to willing (poor) farmers (field experience). It must be this unequal access to credits, technology and inputs that Umar & Tyem (1993) list as 'inefficient input procurement and distribution system, especially for fertilizer and seeds'.

A sixth factor is poor farm management characterized by over-dependence on chemical fertilizers to the neglect of organic manuring, annual or twice-a-year heavy tillage and uneconomic use of irrigation water. Such poor farm management has resulted in the depletion of soil nutrient, the removal of fine soil particles from the top layer, waterlogging and the accumulation of salts in irrigated areas, both large and small.

Compounding all the factors identified above is a nebulous, but very effective factor usually referred to as the "Nigerian Factor". This factor consists of a heavy load of constraints such as corruption, nepotism, sectionalism, bribery, falsehood and so on; all of which render the "truth" useless and dangerous, and make project-implementors pursue the unreal. This is the bane of the failure of both the large- and small-scale projects in this country. For example, although the SCIP has virtually stopped except for a couple of hundred hectares since 1983, official pronouncements state that the scheme is doing well, and that it was only marginally affected by the recent droughts. Also, a visit to the Bakolori Project would show that the elaborate hydro-power station has become a museum piece, the diesel back-up in shambles and only the national electricity grid supplies a limited amount of power that runs a negligible part of the sprinklers. A larger area, but drastically below the official claims, is under gravity irrigation which was not the major emphasis for the project. While some of the factors listed above may be responsible for the initial failure of these two cases, the Nigerian penchant for side-tracking the truth is

responsible for perpetuating the problem, and making it impossible to adjust each project to suit known realities.

5.5 WHICH WAY THEN?

From our survey, it is clear that neither of the two systems is working well, but we cannot abandon irrigation since it has its advantages. Such advantages should be cultivated, while the problems should be avoided, or minimized. To this end, the factors listed above must be removed, or reversed in each of large- and small-scale project. For example, reservoir water should be managed such that perennial flows are maintained in natural channels below the dams; continuous monitoring of soil and water in irrigated fields must be taken seriously, and the results from such studies used to take appropriate steps to safeguard the quality of both soil and water; whole-basin approach and comprehensive feasibility studies should be undertaken with accurate environmental impact assessment before projects (large or small) are undertaken; policy formulation should benefit from grass-root contribution; while the participating peasants should have priority access to facilities, credit and inputs. Farm management practices should be improved and indiscriminate introduction of exotic technology should be curtailed. For example, there is a need to teach efficient water utilization in all irrigation projects, to facilitate organic manuring and reworking of part of farm residues into the soils, to practise minimum, or infrequent tillage and to adopt other conservational techniques. The greatest task, however, will be scaling over the hurdle of the "Nigerian Factor".

5.6 CONCLUSION

To save the age-long sustainable small-holder irrigation from destruction, the construction of dams and uncontrolled modernization of fadama development must be given a hard look. Similarly, to get the best out of the large-scale irrigation projects the measures enumerated above must be taken. Unless these measures are taken, and promptly too, it may soon be found that the construction of dams for large-scale irrigation helps to transfer the problems associated with such large-scale projects to the fadama cultivation, and make irrigation an unworthy venture in the country. Yet the country needs both the large- and the small-scale projects, but in appropriate dimensions.

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