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THE IMPACT OF RIVER BASIC DEVELOPMENT AUTHORITIES ON NIGERIAN AGRICULTURE: A CASE STUDY OF NIGER RIVER BASIN DEVELOPMENT AUTHORITY

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Abstract

The paper traced the history of water resource development in Nigeria, and assessed the impact of the Niger River Basin Development Authority (NRBDA) on crop production in the region. The analysis of available data showed that although the NRBDA's activities resulted in improvements in crop yields, and farm incomes of beneficiaries, the impact on regional output and area cultivated was marginal since it accrued to only very few farmers. Moreover, the cost of generating such increments was outrageously high when compared to the incremental costs incurred by alternative development institutions in respect of similar activities. The NRBDA was not without its problems, among which were the adoption of inappropriate technologies which resulted in under utilisation of installed capacity and generated enormous negative externalities, financial constraints, poor management practices and marketing arrangements. The concluding remark stressed the need to re-examine the current River Basin Development approach to water resource development for agricultural purposes in Nigeria.

Introduction

For a very long time, water resource as a productive input in Nigerian agriculture was unexploited but left to the vagaries of nature to decide and control. It could be observed that years of significant crop yields were years with high and even distribution of rainfall. Now, with the ever-increasing population, rural to urban drift and the frequent occurrence of drought particularly in the areas where people gain their livelihood from farming, it was realised that the most sensible

approach was to plan for a more efficient exploitation and utilisation of the available water resources for agricultural and rural development. This culminated in the promulgation of a decree in 1976 establishing eleven River Basin Development Authorities (RBDAs), charged with the functions of developing and exploiting water resources for multipurpose uses.

It is the consensus that institutional approach to the development of water resources is more efficient than the private peasant approach. The reason often advanced is that water resource development results in externalities (both of secondary benefits and costs) and hence calls for a collective responsibility and public investment. However, it is also the belief that the present RBDAs may not be the most efficient institutional approach to water resource development given the present economic environment among the Authorities in particular and the country in general. In order to establish the last argument, it is imperative that a comprehensive assessment of the impact of the RBDAs on the agricultural sector be carried out.

The objective of this paper therefore is to assess the impact of RBDAs on agricultural production, with particular reference to crop yields, hectarages, output, farm incomes and costs. The rest of the paper is divided into four parts: a historical review of water resource development and the RBDAs in Nigeria is undertaken in Part I; in Part II, the methodology for assessing the impact of the RBDAs is considered; Part III contains an analysis of the results. In Part IV, problems and constraints facing the RBDAs are reviewed.

PART I HISTORICAL REVIEW OF WATER RESOURCE DEVELOPMENT IN NIGERIA

In Nigeria, water resource development received the first noticeable mention in the Reports of the International Bank for Reconstruction and Development (IBRD) on economic development in Nigeria (IBRD, 1955). The First National Development Plan (1962-1968) also examined the problem of Nigeria's water resources in terms of irrigation, as well as urban and rural water programmes (FMEDR, 1962). The period witnessed the formation of the Lake Chad Basin and River Niger Commissions (Olayide, 1979). Three major programmes sponsored by the commissions were the preparation of hydrological map of water resources, use of water resources as a means of transportation, and as a basis for comprehensive development of agriculture, fisheries and animal husbandry.

Although the Second and Third National Development Plans of 1970-74 and 1975-80 did not give specific attention to basin developments, the importance of dams in terms of

supply of hydro-electricity, fishing, flood control, irrigation and improved navigability was appreciated.

The most comprehensive and regional approach to the development of river basin in Nigeria was however adopted in 1976 with the enactment of the River Basin Decree No. 25 of 1976. (FMG, 1976). The Decree established eleven corporate bodies: Sokoto-Rima, Hadejia-Jama'are, Chad, Upper Benue, Lower Benue, Cross-River, Anambra-Imo, Niger, Niger-Delta, Benin-Owena and Ogun-Oshun River Basin Authorities. The authorities were charged with the following functions:—

- (i) to undertake comprehensive development of underground water resources for multipurpose use;
- (ii) to undertake schemes for the control of floods and erosion and for water-shed management;
- (iii) to construct and maintain dams, dykes, polders, wells and boreholes;

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- (iv) to develop irrigation schemes for the production of crops and livestock and to lease the irrigated land to farmers or recognised associations in the locality;
- (v) to provide water from reservoirs, wells and boreholes under the control of the authority concerned for urban and rural water schemes;
- (vi) to control pollution in rivers and lakes in accordance with nationally laid down standards;
- (vii) to resettle persons affected by the works and schemes in (iv) and (v) above or under special resettlement schemes.

In 1984, with the advent of a new military regime, the eleven RBDAs were reorganised into eighteen and redesignated River Basin and Rural Development Authorities (RBRDAs). The new RBRDAs were charged with same traditional functions as their predecessors. With the change in the government in 1985, the RBRDAs were reduced to their former number.

The Niger River Basin Development Authority was created by the Federal Military Government along with ten other RBDAs under Decrees Nos. 25 and 37 of June 15 and August 3, 1976 respectively (FMG, 1976). In addition to the general responsibilities of all the RBDAs, the Niger RBDA was specifically charged with the additional responsibilities defined by Decree No. 31 of April 20, 1977 to include:

- (i) development of fisheries and improvement of irrigation on the rivers, lakes, reservoirs and lagoons in the Authority's area; and
- (ii) the processing of crops and livestock produced in the Authority's area.

The area of operation of the Authority estimated at 20.2 million hectares, is the area drained by the River Niger and its

tributaries from its confluence with the River in the South (near Agenebode) up to its confluence with and including the Malendo River in the North (around Yauri). The area covers three States — Kwara, Niger and Kaduna. These States have good potentials for agricultural production, especially grains production. Average annual rainfall per State in the region is estimated to be between 950mm and 1200mm, while daily temperatures range from 13.6C to 18.4C (minimum) to between 25C to 37.3C (maximum). The vegetation is principally that of deciduous Savannah grassland with sparse trees, while the soil is sandy loams.

The Authority was formally inaugurated on March 4, 1977 with a management structure of three departments: Administration, Engineering and Agriculture. After inauguration, three major capital projects in the Third National Development Plan were handed over by the Federal Ministry of Water Resources to the Authority for implementation. These are:— Kainji Dam Irrigation Project, Kaduna and Kampe River Basin Projects. These three projects have, however, increased to eight by the end of 1983. The new projects are Niger, Gurara, Gbako-Gbakogi, Oshin-Oyun and Lower Kaduna River Valley.

It should however, be noted that the Niger River Basin Development Authority which was split into three separate Authorities — Lower Niger RBRDA (Kwara State), Kaduna-Karaduwa RBRDA (Kaduna State) and Upper Niger RBRDA (Niger State) — was reverted in 1985 to its former status defined by the 1976 Decree.

PART II ANALYTICAL FRAMEWORK

Theoretical Basis

An irrigation scheme is conceptually seen as an investment activity in which financial resources are expended to create capital projects that produce benefits over an extended period of time. Implicit in this, is that a project is worthwhile when the benefits derived from it exceed the costs. Within this context, a project will have a well defined sequence of investment and production activities and a specific group of benefits that can be identified and valued. Gittinger (1982) stressed that where there is adequate information relating to the primary benefits and costs, the most appropriate analytical approach will be the discounted measures of project worth. The overall economic viability of the project will be captured by indicators such as the Net Present Value (NPV), the Benefit-Cost Ratio (BCR) and the Internal Rate of Return (IRR).

There is no consensus however on the estimation of the benefits of an irrigation project from an economic point of view, especially so since there are enormous secondary benefits and costs associated with the project that cannot be easily valued. Martin (1979) suggested that water projects in total can be evaluated in the context of land-saving technological innovations in a general equilibrium. His approach is a static empirical approach which Carter (1979) in his criticism asserted that benefits attributable to a single innovation are complex, and that empirical approximations are rough at best.

Irrespective of these valuation problems, Stoevener (1979) concluded in his study, that irrigation development conveys to the region in which it takes place regional benefits which matter

from a national benefit-cost accounting stance. These benefits are the surpluses generated (in say, fixed, as well as variable capital stock and consumer surpluses) in "with" or "without" the public investment situations; and improved capacity utilisation of the existing resources in the region. This conclusion compared favourably with Renshaw's (1958) suggestion that the use of improvement in land values may serve as an indirect or *ex ante* proxy measures of the benefits of irrigation.

This is not far from Milliman's (1959) view that any increase in land values resulting solely from the provision of additional irrigation water represents a market capitalisation of the present value of expected future stream of value received from water minus the present value of stream of actual water service costs. On this premise, Milliman suggested that under this analytical approach, agricultural land should be treated as the only fixed factor of production, while water is assumed to be the primary causation of production, which requires treating all other variables as part of the land factor or not at all. Beale's (1978) multivariate model of land values disagreed with these views.

From the foregoing literature, it is obvious that an assessment of the impact of an irrigation project will include as evaluating criteria the partial contribution of irrigation to incremental production within a sub-region and improvement in the returns to the use of factors of production such as land, labour and capital.

Methodology

While it is accepted that the overall economic viability of the irrigation projects of NRBDA can best be captured using the discounted measures of project worth, inadequate data, coupled with the envisaged valuation problems and the relatively short time period for which data is available may not allow us to take advantage of the method. However, other methods of secondary benefit/cost estimation has been adopted. We have considered investment by NRBDA on irrigation as incremental costs to agriculture within the sub-region, while the increase in induced output of the region as incremental benefits. The view is that of surplus (increments in output) and improvement in factor utilisation in "with" or "without" the public investment situation. This is based on the assumption that the process by which such surpluses (i.e. increments) are implemented may be significantly influenced by the nature of primary investment itself. We are aware that the "with" and "without" approach has the shortcoming of attributing all incremental benefits and costs to the project even though a change in output or cost could take place without the projects. However, we agree with Milliman (1979) that if availability of irrigation water is the only variable input that non-beneficiaries of the projects did not have, we may be right to assume that it is the primary causation of the incremental benefits.

Against this background, we have adopted the following equations for our analysis:—

$$I_y = \left(\frac{Y_i}{y_i} - 1 \right) \times 100 \dots \dots \dots (1)$$

$$IQ = \left(\frac{Q_i}{q_i} - 1 \right) \times 100 \dots \dots \dots (2)$$

$$IF = \left(\frac{F_i}{f_i} - 1 \right) \times 100 \dots \dots \dots (3)$$

$$ITR_f = \frac{P_i(Q_i - q_i)}{N} \dots \dots \dots (4)$$

$$TC_A = D_A[r(1-v^n)-1] + M_A \dots \dots \dots (5)$$

$$NITR_f = \left(\frac{ITR_f}{ATC_f} - 1 \right) \times 100 \dots \dots \dots (7)$$

$$ATC_A = \frac{TC_A}{A} \dots \dots \dots (8)$$

$$AITR_A = P_i(Y_i - y_i) \dots \dots \dots (9)$$

$$I_c = \frac{ATC_A}{AITR_A} \times 100 \dots \dots \dots (10)$$

where

- I_y = Yield Improvement Index.
- Y_i = Average yields in crop i for farmers who are beneficiaries of NRBA irrigation schemes.
- y_i = Average yield of farmers who are non-beneficiaries of the irrigation schemes.
- IQ = Productivity improvement Index per farming household.
- Q_i = Output per farmer in crop i of beneficiaries of NRBD irrigation schemes.
- q_i = Output per farmer in crop i of non-beneficiaries within the region.
- IF = Farm size improvement Index of the farming household.
- F_i = Average farm size of the farming household benefiting from NRBDA irrigation.
- f_i = Average farm size of non-beneficiaries within the region.
- ITR_f = Net Incremental return in farm incomes per crop per farming household benefiting from irrigation.

- P_i = Unit price of crop i .
- N = Number of farmers benefiting from the NRBDA's irrigation projects.
- $NITR_f$ = Net improvement in farmers' incomes.
- TC_A = Average Annual costs incurred by the NRBDA.
- DA = Total Capital project cost to date.
- $r(1-v^n)^{-1}$ = Capital recovery factor used to capitalise and obtain annual project costs.
- r = interest rate used in capitalisation, in this case 10 per cent.
- n = Number of years, the capital irrigation project is expected to last, and over which it was capitalised.
- MA = Annual maintenance and operating cost of the NRBDA charged to irrigation and farm investments.
- ATC_f = Average annual costs incurred per farming household by NRBDA.
- $ATCA$ = Unit cost of land area developed by NRBDA.
- A = Total area of land developed by NRBDA.
- $AITR_A$ = Average Incremental total return per unit of land area developed.
- I_c = Cost Effective Index of a unit area of land developed and devoted to crop i .

Equations (1), (2) and (3) measure the improvement in the yield, productivity and farm size of the beneficiaries of irrigation schemes of NRBDA when compared to non-beneficiaries in the region. *A priori* expectation is that the yield, output and farm size of beneficiaries of irrigation schemes are higher than those of non-beneficiaries. Equation (4) establishes the incremental return or incomes per crop per farming household. This is the difference in farm incomes per farming household between beneficiaries and non-beneficiaries of irrigation schemes. Equation (5) estimates the average annual costs incurred by NRBDA. This includes annualised fixed irrigation costs using the capital recovery factor and the annual maintenance and operating expenses. Equation (6) measures the average cost of maintaining a farmer by the NRBDA, defined as average annual costs divided by the number of farming families. Equation (7) measures the net improvement in farm incomes, defined as the percentage difference between net incremental return per farming household and the average annual costs incurred by NRBDA per farming household. Equation (8) gives an estimate of the annual costs of developing a hectare of land by NRBDA, while (9) measures the incremental return per hectare of land developed. Equation (10) establishes the overall effectiveness of the NRBDA's investment in realising or generating incremental returns when compared with alternative projects.

Data: Sources, Adjustments and Limitation

The information required for the analysis will include basic data on:—

- (i) Area cultivated, production, number of farming families in the three States Kwara, Niger and Kaduna.
- (ii) Area cultivated, production, number of farming families that benefitted from NRBDA's irrigation project.
- (iii) Annual irrigation project costs.
- (iv) Average farm gate prices and Guaranteed Minimum Prices.
- (v) Basic economic indicators of efficiency of an Agricultural Development project (ADP) located in one of the states (Funtua ADP, Kaduna, State).

The data on (i) and (iv) were compiled from FOS Agricultural Sample Survey Reports and CBN Annual Reports. The data on (ii) and (iii) were compiled from the Annual Reports of

NRBDA for 1977 to 1983. Basic economic indicators of Funtua ADP were adopted from the study by Ojo (1984).

The data on (i) above are as shown in Appendix 1, while the data on (ii) are presented in Appendix 2. The data on (iii) are shown in Table 10, while those on (iv) and (v) are shown in Tables 9 and 10.

The basic data show that there are about 821,000 farming families cultivating 1.13 million hectares in the three States, while only 8,000 cultivating about 10,000 hectares were benefitting from the NRBDA's projects. The major crops grown in the area are maize, rice, millet and sorghum.

The project costs represented by actual expenditures incurred between 1977 to 1983 on the irrigation projects are made up of capital project costs, fixed assets, and operating costs. The data were adjusted to give annual costs of the projects based on the following assumption:—

(a) Only investment on irrigation projects for crop production activities by NRBDA were taken into account for the purpose of the analysis;

(b) Capital irrigation investments and hardware were assumed to have a lifespan of 30 years. Hence annual capital costs were estimated using the capital recovery factor of 10 per cent for 30 years;

(c) No provision was made for fixed asset costs, since depreciation charges were already made and included in the annual operating and maintenance costs;

(d) Operating and maintenance expenses charged to irrigation ventures for crop production purposes were assumed to represent 80 per cent of the total annual operating and maintenance costs of the NRBDA; and

(e) For the purpose of valuing incremental production, the farm gate price and the GMP were assumed to represent the shadow price of the crops.

PART III ANALYSIS OF THE RESULTS

Impact on Yields:

The major crops grown by farmers under the Niger River Basin Development Authority's schemes are rice, maize, sorghum, millet and vegetables. Analysis of the available data show that there has been appreciable improvement in the yields of these crops when compared to the average rural yields of the same crops grown within Niger, Kaduna, and Kwara States (Regional domain of NRBDA) (See Table 1). Rice yields for example averaged 3.5 tonnes per hectare between 1979-83 as against 1.3 tonnes per ha rural yields (see table 1). This represents 170 per cent improvement in yields. Similarly, the average improvement in yields of maize, sorghum and millet for the period were 76.5, 74.0 and 75.5 per cent, respectively.

This could be attributed to the adequacy and timeliness of the package of facilities provided by NRBDA to the farmers in addition to the irrigation water supplied. The package of inputs include fertilisers, herbicides, pesticides and improved seeds (see Table 2).

Impact On Regional Output:

In spite of the relatively high yields obtained by farmers within the NRBDA for the respective crops, the regional output of these crops did not show any remarkable improvement. The incremental output for Kwara, Kaduna and Niger States by NRBDA for rice was about 5.3, 8.3 and 17.3 per cent respectively for 1979, 1980 and 1981 (see Table 3). Except for maize that recorded an incremental output of 3.6 per cent in 1981, NRBDA made little or no impact on regional output of sorghum and millet. The reason for this could be attributed to the fact that the addition to total hectares cultivated of these crops by the NRBDA was insignificant. For example the total area devoted to rice by NRBDA represented about 2.2, 1.3 and 7.3 per cent of the total area cultivated of rice by the regional rural farmers (see Table 4). Although no records of the rural production level of vegetables were available, the Basin seems to be producing an appreciable quantity.

Impact on Farm Size:

The estimated average farm size per farmer within the

NRBDA was 1.25ha. This is about 3.4 per cent less than the regional average for Niger, Kaduna and Kwara States (see Table 5). Although the NRBDA provided mechanisation services to the farmers, an average farm size of 1.25 ha is peasantry. This result reveals that agriculture is yet to be practised as a large scale commercial venture by the farmers. Also, a capital intensive approach (imposed by the facilities provided by the NRBDA) is being practised alongside a labour intensive system. Perhaps, this is to be expected in a land scarce, labour surplus economy, since an attempt at complete mechanisation with its associated labour saving devices may result in outright unemployment and the resultant social malaise.

Impact on Productivity Per Farmer:

The estimated output per farmer within NRBDA area averaged about 4.3, 2.2, 2.2 and 2.0 tonnes for rice, maize, sorghum and millet, respectively. These figures give productivity improvement Index per farming household of 189.2, 89.5, 75.6 and 88.5 per cent, respectively, for rice, maize, sorghum and millet (see Table 6). These results can be attributed mainly to yield improvements. The average share of yields in the productivity of the farmer was about 80 per cent while increases in farm size accounted for 20 per cent (see Table 7). Again, labour productivity is low in spite of the package of high capital intensive irrigation technologies presently in use.

Although the analysis shows a relative improvement in the productivity of the farmers within NRBDA, the benefits accrued to only a small fragment of the regional rural farmers. Available statistics show that the total number of farmers within the NRBDA project area was 6,496 in 1981. This was a small fragment (8.7 per cent) of the regional total of 745,829 rural farmers in Niger, Kaduna, and Kwara States for that year. The limited spread and distribution of the gains have thus resulted in a negligible impact on the welfare/well being of the regional rural population.

Impact on Farm Incomes:

The valuation of the incremental output per farmer shows

that the average gain in farm incomes of the major crop produced were ₦1,553, ₦206, ₦216 and ₦198 for rice, maize, sorghum and millet, respectively (see Table 8). It is assumed that regional and NRBDA farmers enjoy the Federal Government subsidy programmes on farm inputs such as fertilisers, improved seeds and mechanised services provided by Agro-Service Centres. The additional aspect of costs to the Basin farmers is the rents paid on irrigated land. A more detailed analysis of the impact on farm incomes is carried out below to compare the incremental gains in farmers' incomes to the annual costs of maintaining a farmer in the project area by the NRBDA. Table 11 shows the summary of investments by the NRBDA on irrigation/crops production projects from 1977-83. A total of ₦123.5 million has been expended on fixed assets and capital projects while the operating and maintenance expenses totalled ₦36.1 million for the period.

Results on Table 10 show the estimated annual costs of NRBDA from 1977-1983, while Table 13 shows the average annual costs of maintaining a farmer by the Basin Authority. Between 1979-83, it cost NRBDA an average of ₦2,429 to maintain a farmer within the project area. The highest average cost of ₦3,689 per farmer was recorded in 1979 while the least was in 1982.

A comparison of the costs per farmer incurred by the NRBDA to the incremental gain in farm incomes showed that the average incremental gains which accrued to producers of rice, maize, sorghum and millet were 36.1, 91.6, 92.6 and 91.8 per cent less than the incremental costs. Except in 1982, when a positive differential for rice was obtained, the incremental incomes accruing to the other crops cultivated were consistently below the costs expended by the Basin per farmer.

It is however, worth mentioning that incremental farm incomes may have been under estimated with the valuation at Guaranteed Minimum Prices (GMP) since such prices were out of tune with the economic realities of the day. The GMP for the period under consideration have been known to be below the farm gate and retail market prices. When the current farm gate market prices of rice and maize were applied, a slightly different result emerged. In 1982 and 1983, net gain in farm incomes of rice producers was 49 and 9 per cent more than the cost expended per farmer by the NRBDA respectively. Also, maize narrowed the gap from a net loss which was more than 60 per cent to 24 per cent (see Table 15).

One deduction that can be made from the above figures is that, of all the grains, only rice producers seem to have the potential to gain from the irrigation schemes of the River Basin. This is because the incremental value added to the output of the farmers had the potential to be higher than the incremental costs borne by the Authorities.

Cost Effectiveness of Investment on NRBDA:

For the purposes of this study, the cost per hectare, incremental return per hectare and the cost of realising a unit incremental value of output has been computed for NRBDA and the Funtua ADP (for which data were available). The summary of the comparative analysis is presented on Table 16.

The results show that while it cost an average of about ₦2,000 to develop a hectare of land by the NRBDA, the Funtua ADP spends only ₦36 on a hectare of land. This is not surprising since NRBDA practise a capital intensive irrigation system, while facilities provided by the ADP is supportive and augmentary to those provided by the rural farmer. The value of incremental output per hectare of crops grown by the NRBDA is also higher than that of the ADP. While it averaged ₦1,246, ₦164.8, and ₦153.6 for rice, maize, sorghum and millet respectively in the NRBDA, average incremental return per hectare in Funtua ADP was ₦131.6, ₦71.82 and ₦32.45 respectively for maize, sorghum and millet.

When the cost per hectare is compared to the value of incremental output of each project, Funtua ADP is apparently more efficient at the use of resources. While it costs only ₦0.27, ₦0.50 and ₦1.11 to realise a ₦1.00 incremental value of output of maize, sorghum and millet by Funtua ADP, it cost as much as ₦1.60, ₦12.12, ₦13.07 and ₦13.01 to generate an equivalent ₦1.00 incremental value of output of the same crops by NRBDA.

It is noteworthy that the indicators computed are similar to an undiscounted cost-benefit ratio for each of the projects. The magnitude may be indicative of the system/project that is more efficient in the production of a particular crop. Hence we can conclude that the NRBDA system is more efficient in the production of rice, while sorghum, maize and millet can best be produced through the systems employed by Funtua ADP.

PART IV PROBLEMS FACING NRBDA

The NRBDA uses the capital intensive sprinkler irrigation system. From the analysis of the available data, this system is not the most beneficial in the situation because of many problems which include: inappropriateness of the technology, financial constraints, poor management and poor marketing arrangements.

Technically, all the components of the sprinkler irrigation system are imported and foreign experts are required to install them. As a result of lack of/or delayed arrival of the spare parts and major components, most of the schemes could not be completed as scheduled. For example only 3 of the 8 dam projects of the NRBDA have been completed, but the pipes for the irrigation works have not been installed. Because of this development, the installed capacity of the dams are under

utilised, thus hampering the technical efficiency goal for which the sprinkler system is known.

Economically, so much money has been sunk into the acquisition of the hard-ware. A total of ₦123.5 million has been expended to date in the projects and it is estimated that twice the amount will be required to complete the projects. It is questionable whether the orientation of the NRBDA to large irrigation schemes is economically desirable and viable. So far, returns to crop production investments of NRBDA have been unprofitable, apart from irrigated rice production that has the potential to be profitable. For now, sorghum and millet production may not be a profitable venture under the capital intensive irrigation system. Moreover, the small scale irrigation system employed by the ADP offers superior cost effectiveness than the large scale works both in terms of the

operations underway and the plans for future operations. While the Funtua ADP has demonstrated some efficiency in the production of maize, sorghum and millet, the NRBDA has carried out similar tasks at outrageous costs and treated as sunk costs. It is doubtful if additional expenditures will have a pay off that can compete with the alternative small scale gravity irrigation schemes.

Thirdly, apart from the inferior cost effectiveness of the sprinkler irrigation approach, other diseconomies are beginning to emerge from the operations of the NRBDA. Farm lands at the lower end of the Niger dams have been rendered useless without rains. This is due to the dams constructed across the draining streams that supply water to the farm lands. This singular but unavoidable action is the root cause of some serious socio-economic problems currently being experienced by non-beneficiaries of the irrigation facilities.

They have had to contend with the adverse externalities of the project such as unemployment, starvation, dry fishing ponds etc.

Finally, the socio-economic background of the farmers and the farming environment seem to be at variance with the pre-conditions for efficiency of the sprinkler irrigation approach. The approach pre-supposes the adoption of a large scale mechanised farming system, with characteristic large average farm size in the neighbourhood of 50-100 ha/farmer. Because of the poor land tenure system which is characterised by fragmentation and land acquisition problems, the NRBDA had no choice other than to rent out developed lands to a large number of farmers, most of whom were the original owners of the land. The resultant effect was that the average farm size was about 1.25 hectare per farmer which is indicative of a small scale labour intensive farming system. Evidently, it could be deduced that the super-imposition of the sprinkler irrigation system on a labour intensive agriculture resulted in the over-capitalisation and under utilisation of both human and capital resources. This probably explains why the ADP system which was primarily designed to cater for small scale farmers

is more efficient under the present circumstances and environment than the NRBDA.

Financial Constraints:

The huge investments so far made appeared to be inadequate considering the scale and size of the project embarked upon and those awaiting completion. Not more than three of the eight schemes planned by the NRBDA have taken off since 1980, while works on the others have ben grounded due to lack of funds. It must be mentioned that mis-management of funds during the political era further deepened the financial crisis of the Basin between 1979-83.

Poor Management Practices:

The Basin Authority suffered under a politically machinated management between 1979-83. The management was made up of politicians who knew little about irrigation schemes and farming but were more interested in contract awards. This led to decisions detrimental to the operation of the Authority. Contracts for land clearing were awarded even when there were no farmers to allocate them to. In most cases, the Basin had concentrated its expenditures on payment of compensation, resettlement and housing schemes to the neglect of its primary role of land irrigation and reclamation. There was no synchronisation of agricultural activities from land preparation to harvesting. Most projects were abandoned after mobilisation fees has been paid out.

Poor Marketing Arrangements:

One of the major problems facing the rural farmer is processing and marketing. While the Authority provided input and facilities at subsidised rates, no concrete effort has been made to assist the farmers with the processing and marketing of their products. The farmers are often saddled with the burden of harvesting, handling, processing and marketing of their grains using traditional methods.

SUMMARY AND CONCLUSION:

The analysis so far shows that although the NRBDA's activity resulted in improvement in yields, productivity and farm incomes of beneficiaries, the impact on regional output and hectares cultivated was marginal and negligible since it accrued to only very few farmers. Moreover, the cost of generating such increments were high when compared to the incremental costs incurred by alternative agricultural development institutions. The NRBDA was not without its problems, among which were the adoption of inappropriate technology, which generated enormous negative externalities, financial constraints, poor management practices and poor marketing arrangements.

The results of the case study of NRBDA point to the need to reconsider the current River Basin Development Authority's approach to water resource development for agricultural

development in Nigeria. Suggested adjustments that can lead to efficiency include:

(i) the shift of emphasis from the capital intensive sprinkler irrigation system to supportive small scale irrigation technology that will utilise available labour and other resources at moderate cost. In addition, irrigated lands should be devoted mostly to rice production and vegetables, while the other grains can best be grown through other farming systems; and

(ii) there is the need to reform and where necessary eliminate inefficient management practices. The key to the reformation is that the appointments to the boards of the Authority should be based on merit, while the primary objective will be to attain sound financial and economic performance.

Table 1

YIELD IMPROVEMENT INDEX OF MAJOR CROPS GROWN BY NIGER RBDA

Crop	Rice			Maize			Sorghum			Millet			
	Year	RBDA	RR	IY	RBDA	RR	IY*	RBDA	RR	IY	RBDA	RR	IY
1977	—	1.4	—	—	0.9	—	—	1.1	—	—	—	0.9	—
1978	—	1.0	—	—	0.3	—	—	0.7	—	—	—	0.9	—
1979	3.5	1.4	144.8	1.5	0.8	89.6	1.8	1.0	74.5	1.0	0.9	8.7	—
1980	3.5	1.2	189.2	1.8	1.1	62.7	1.7	1.2	40.3	1.6	0.7	126.8	—
1981	3.4	1.4	136.6	1.8	0.3	116.9	1.7	0.9	85.9	1.8	1.1	63.3	—
1982	3.4	n.a.	—	2.0	—	—	1.8	—	—	1.8	—	—	—
1983	3.5	n.a.	—	1.6	—	—	1.7	—	—	1.7	—	—	—
Annual Average.	3.5	1.3	170.0	1.7	1.0	76.5	1.7	1.0	74.0	1.6	0.9	75.5	—

RBDA = River Basin and Rural Development

Foot Note: RR = Production from Kwara, Niger and Kaduna States

* IY = % Yield Index

Sources: (1) Annual Reports of Niger River Basin Development Authority

(2) Federal Office of Statistics

Table 2

SUMMARY OF AGRICULTURAL INPUTS SUPPLIED BY NIGER RBDA

	1979	1980	1981	1982	1983
Fertilisers (tonnes)	6,000	8,000	13,259	8,351	5,078
Herbicides (litres)	11,000	20,000	67,004	69,300	72,255
Pesticides (tonnes)	—	—	1,005	1,050	—
Improved Seeds (tonnes)	35,000	8,000	1,300	—	—
Area Cropped	733	1,535	5,150	10,879	10,000
Fertiliser application rate	8.19	5.21	2.57	0.77	0.51

Source: Annual Report of Niger River Basin Development Authority

Table 3

SHARE OF NIGER RIVER BASIN DEVELOPMENT AUTHORITY IN REGIONAL OUTPUT OF MAJOR CROPS: 1977-1983
(*000 Tonnes)

Crop	Rice			Maize			Sorghum			Millet			
	Year	NRBDA	RR	%	NRBDA	RR	%	NRBDA	RR	%	NRBDA	RR	%
1977	n.a.	95.0	—	n.a.	100.0	—	n.a.	763.0	—	n.a.	505.0	—	—
1978	n.a.	64.0	—	n.a.	123.0	—	n.a.	494.0	—	n.a.	308.0	—	—
1979	1.1	20.4	5.3	0.3	53.0	0.003	0.3	536.0	0.0006	0.01	345.0	0.00003	—
1980	1.9	23.0	8.3	1.2	94.0	1.3	0.4	679.0	0.0005	0.1	276.0	0.0004	—
1981	5.9	34.0	17.3	3.9	108.0	3.6	1.2	653.0	0.002	0.5	451.0	0.001	—
1982	10.4	—	—	16.7	—	—	5.4	—	—	0.9	—	—	—
1983	1.3	35.0	3.7	2.1	249.0	0.8	1.8	1,006.0	0.2	0.6	505.0	0.1	—

Neg. = Negligible

Sources: (1) Annual Reports of NRBDA

(2) Federal Office of Statistics

RR = Niger, Kaduna and Kwara States

Table 4

NIGER RIVER BASIN DEVELOPMENT AUTHORITY'S SHARE OF HECTARAGES, 1977-1983
(*000 Ha)

Crop	Rice			Maize			Sorghum			Millet			Vegetables	
	Year	NRBDA	RR*	%	NRBDA	RR	%	NRBDA	RR	%	NRBDA	RR	%	RR
1977	—	70.0	—	—	110.0	—	—	763.0	—	—	564.0	—	—	—
1978	—	6.5	—	—	96.0	—	—	494.0	—	—	343.0	—	—	—
1979	0.3	14.2	2.2	0.2	69.0	0.3	0.2	536.0	0.003	0.01	374.0	neg	0.02	—
1980	0.5	43.2	1.3	0.7	86.0	0.8	0.2	679.0	0.0003	0.07	390.0	neg	0.03	—
1981	1.8	24.0	7.3	3.9	130.0	3.0	0.7	653.0	0.001	0.3	415.0	neg	0.03	—
1982	3.0	—	—	11.7	—	—	3.1	—	—	0.5	—	—	0.04	—
1983	0.4	—	—	2.0	—	—	1.1	—	—	0.3	—	—	0.03	—

Sources: (1) Annual reports of Niger RBDA

(2) Federal Office of Statistics

* RR = Niger Kaduna and Kwara States

Table 5

**FARM SIZE IMPROVEMENT INDEX OF FARMERS IN NIGER RIVER BASIN
DEVELOPMENT AUTHORITY — 1979-83**

Year	RBDAS (Ha/farmer)	Regional (Ha/farmer)	Farm Size Improvement Index (%)
	Ha/Farmer	Ha/Farmer	(%)
1979	1.10	1.07	7.8
1980	1.25	1.16	7.6
1981	1.05	1.40	-25.0
1982	1.32	1.20	10.0
1983	1.54	1.40	10.0
Average	1.25	1.25	—

Source: Derived from Appendices I and II

Table 6

**PRODUCTIVITY IMPROVEMENT INDEX OF MAJOR CROPS GROWN BY NIGER RIVER BASIN
DEVELOPMENT AUTHORITY, 1979-81
(Tonnes/Farmer)**

	Rice			Maize			Sorghum			Millet		
	NRBDA	RR	%	NRBDA	RR	%	NRBDA	RR	%	NRBDA	RR	%
1979	3.85	1.66	131.9	1.61	0.89	80.9	1.96	1.18	66.1	1.10	1.08	1.9
1980	4.34	1.39	212.2	2.24	1.28	75.0	2.18	1.44	51.4	2.10	0.82	145.1
1981	3.53	1.65	119.4	1.89	0.96	96.9	1.80	1.07	68.2	1.87	1.26	48.4
Average (1979-81)	4.28	1.48	189.2	2.16	1.14	89.5	2.16	1.23	75.6	1.96	1.04	88.5

Source: Derived from Appendices I and II

Table 7

**THE SHARE OF IMPROVED YIELDS IN THE AVERAGE PRODUCTIVITY OF THE
NRBD FARMERS, OF MAJOR CROPS, 1979-83**

Year	Productivity Output/Farmer	Yields Output/ha	Share of Yield in Productivity (%)
Rice	4.28	3.45	80.6
Maize	2.16	1.73	80.1
Sorghum	2.16	1.74	80.5
Millet	1.96	1.58	80.6

Source: Derived from Appendices I and II

Table 8

**NET IMPROVEMENT IN FARM INCOMES OF PRODUCERS OF MAJOR CROPS GROWN BY NIGER RBDA
1979-1983**

	Rice			Maize			Sorghum			Millet		
	ΔP	PC	ITR_r	ΔP	PC	ITR_r	ΔP	PC	ITR_r	ΔP	PC	ITR_r
1979	2.19	570	1,248	0.72	200	144	0.78	210	164	0.02	220	4.4
1980	2.95	570	1,683	0.96	200	192	0.74	210	155	1.28	220	282
1981	1.88	596	1,120	0.93	210	186	0.73	220	153	0.61	231	141
1982	2.84	596	1,693	1.35	210	284	0.91	220	200	1.19	231	275
1983	3.42	596	2,038	0.95	210	200	0.99	220	218	1.23	231	284
Average (1979-83)	2.65	586	1,553	0.98	206	204	0.83	216	199	0.87	227	198

$\Delta P = Q_i - q_i$ = Change in output per farmer in tonnes

PC = Guaranteed Minimum Price

ITR_r = Net Change in Income per farmer.

Derived from: (1) CBN Annual Reports

(2) Appendices I and II

**NET IMPROVEMENT IN FARM INCOMES OF PRODUCERS OF MAJOR CROPS GROWN BY
NIGER RBDA VALUED AT FARM GATE PRICES: 1979-83**

	Rice			Maize		
	ΔP	FGP	ITR _r	ΔP	FGP	ITR _r
1979	2.19	750	1,642.5	0.72	800	576.0
1980	2.95	750	2,212.5	0.96	800	768.0
1981	1.88	750	1,410.0	0.93	800	744.0
1982	2.84	750	2,130.0	1.35	800	1,080.0
1983	3.42	850	2,907.0	0.95	800	760.0
Average (1979-83)	2.65	770	2,040.5	0.98	800	784.0

ΔP = Change in output per farmer in tonnes

FGP = Farm Gate Price

ITR_r = Net Change in Income per farmer

Source: (1) Federal Office of Statistics

(2) Derivation from Appendices I and II

Table 10

**TOTAL CAPITAL IRRIGATION PROJECT COSTS, AND THE
OPERATIONAL EXPENSES OF NIGER RIVER BASIN DEPT. AUTHORITY, 1977-83**

	1977	1978	1979	1980	1981	1982	1983
1. Kainji Lake Basin	550	1,054	1,287	1,506	11,290	14,887	20,210
2. Kaduna River Basin	289	368	684	1,064	8,055	15,545	27,316
3. Kampe River Basin	284	454	1,148	1,907	5,172	7,696	18,367
4. Niger Valley	—	68	87	211	1,253	2,795	5,430
5. Oshin-Oyun	—	—	—	—	1,893	3,052	9,532
6. Gbako/Gbakogi	—	—	—	—	381	667	1,509
7. Guara	—	—	—	—	413	872	1,664
Total	1,123	1,944	3,206	4,688	28,457	45,514	84,028
Operational Expenses	638	1,904	2,642	3,254	7,364	8,432	11,834

Source: Annual Reports of NRBDA, 1977 to 1983.

Table 11

**FIXED ASSETS AND CAPITAL PROJECT INVESTMENTS BY NIGER RBDA,
1977-1983 (N'000)**

	1977	1978	1979	1980	1981	1982	1983	Total
Fixed Assets	1,240	4,142	4,223	3,841	6,899	6,627	12,482	39,454
Capital Projects	1,123	821	1,262	1,482	23,769	17,057	38,514	84,028
Total	2,363	4,963	5,485	5,323	30,668	23,684	50,996	123,482
Operating Expenses	638	1,904	2,642	3,254	7,364	8,432	11,834	36,068

Source: Annual Reports of NRBDA

Table 12

ESTIMATED ANNUAL ACTUAL EXPENDITURES BY NRBDA, 1977-83

Year	Total Project Costs to date (N'000)	Capital Recovery Sector n=30 at r=10%	Estimated Annual Capital Cost (N'000)	Estimated O & M Costs (N'000)	Estimated Total Annual Costs (N'000)
1973	1,123	0.106	119.04	510.40	629.39
1978	1,944	0.107	208.01	1,523.02	1,731.21
1979	3,206	0.107	343.04	2,113.60	2,456.64
1980	4,688	0.108	506.30	2,603.20	3,109.50
1981	28,457	0.109	3,101.80	5,891.20	8,993.00
1982	45,514	0.110	5,006.54	6,745.60	11,752.14
1983	84,028	0.111	9,327.10	9,467.20	18,794.30

Table 13

ESTIMATED ANNUAL COSTS OF MAINTAINING A FARMER BY NRBDA, 1979-83

Year	Annual Costs (N'000)	No. of Farmers	Average Cost Per Farmer N/farmer
1979	2,456	666	3,689
1980	3,110	1,228	2,532
1981	8,993	4,905	1,833
1982	11,752	8,242	1,426
1983	18,794	7,046	2,667
Average			2,429

Source: (1) Derived from Table 12
(2) Appendix II

Table 14

**ESTIMATED GAINS IN FARM INCOMES AND AVERAGE ANNUAL PROJECT COST
INCURRED BY NRBDA PER FARMER, 1979-83**

Year	Annual Cost per farmer ₦	Value of Gains in Farm Incomes/ Farmer/Crop				Gains/loss				Percentage Gains/Loss			
		Rice ₦	Maize ₦	Sorghum ₦	Millet ₦	Rice ₦	Maize ₦	Sorghum ₦	Millet ₦	Rice %	Maize %	Sorghum %	Millet %
1979	3,689	1,248	144	164	4.4	-2,441	-3,545	-3,525	-3,685	-66.2	-96.1	-95.6	-99.9
1980	2,532	1,683	192	155	282	-849	-2,340	-2,377	-2,249	-35.5	-92.4	-93.9	-88.8
1981	1,833	1,120	186	153	141	-713	-1,647	-1,680	-1,692	-38.9	-89.9	-91.7	-92.3
1982	1,426	1,693	284	200	275	267	-1,142	-1,226	-1,151	18.7	-80.1	-86.0	-80.7
1983	2,667	2,038	200	218	284	-629	-2,467	-2,449	-2,383	-23.6	-92.5	-91.8	-89.4
Average	2,429	1,553	204	179	198	-876	-2,225	-2,250	-2,231	-36.1	-91.6	-92.6	-91.8

Table 15

**NET GAINS IN FARM INCOMES OF RICE AND MAIZE PRODUCERS VALUED AT
FARM GATE PRICES, 1979-83**

Year	Average Cost per farmer ₦	Value of Incremental Output/farmer		Net Gains/Loss		% Loss/Gains	
		Rice ₦	Maize ₦	Rice ₦	Maize ₦	Rice %	Maize %
1979	3,689	1,643	576	-2,046	-3,113	-55	-84
1980	2,532	2,213	768	-319	-1,764	-13	-70
1981	1,833	1,410	744	-423	-1,089	-23	-59
1982	1,426	2,130	1,080	704	-346	49	-24
1983	2,667	2,907	760	240	-1,907	9	-72
Average	2,429	2,041	784	-388	-1,645	-16	-68

Derived from Tables 13 and 14

Table 16

**AVERAGE COSTS/Ha AND AVERAGE NET INCREMENTAL RETURNS/Ha OF LAND DEVELOPED BY
NRBDA AND FUNTUA ADP, 1977-1983**

Item	NRBDA	FADP'/
1. Average cost per ha	₦1,997.60	₦36.11
2. Average Incremental output-Ha of Major Crops		
Rice	₦1,246.80	n.a.
Maize	₦164.80	₦131.60
Sorghum	₦152.80	₦71.82
Millet	₦153.6	₦32.45
Estimated Cost of Realising ₦1-Value of Incremental output		
Rice	₦1.60	n.a.
Maize	₦12.12	₦0.27
Sorghum	₦13.07	₦0.50
Millet	₦13.01	₦1.11

'Source: Adapted from the study by M. O. Ojo (1984). See reference (15)

APPENDIX I

**NO. OF FARMING FAMILIES, AVERAGE FARM SIZE, AREA CULTIVATED AND PRODUCTION OF MAJOR CROPS
GROWN IN KADUNA, KWARA, AND NIGER STATES, 1978-1984**

Year	No. of Farming Household '000	Average Farm Size Ha/FF '000	Maize		Rice		Sorghum		Millet	
			Area '000 Ha	Production '000 tonnes	Area '000 Ha	Production '000 tonnes	Area '000 Ha	Production '000 tonnes	Area '000 Ha	Production '000 tonnes
1978	780	1.07	132.0	131.0	38	28	671	484	343	308
1979	801	1.07	66.3	53.0	14.2	27.4	523	536	374	345
1980	868	1.16	85.5	94.0	11.3	23.0	549	679	518	276
1981	746	1.40	130.0	108.0	24	34	713	719	415	451
1982	801	1.20	142.0	180.0	11.2	17	801	929	475	456
1983	870	1.40	255.0	490.0	25	33	885	758	539	505

Source: Federal Office of Statistics

APPENDIX II

**NO. OF FARMING FAMILIES, AVERAGE FARM SIZE, AREA CULTIVATED AND PRODUCTION OF MAJOR CROPS
GROWN BY NIGER RIVER BASIN DEVELOPMENT AUTHORITY, 1979-1983**

Year	No. of Farming Household '000	Average Farm Size Ha/FF '000	Maize		Rice		Sorghum		Millet	
			Area '000 Ha.	Production '000 tonnes	Area '000 Ha.	Production '000 tonnes	Area '000 Ha.	Production '000 tonnes	Area '000 Ha.	Production '000 tonnes
1979	666	1.10	0.2	0.3	0.3	1.1	0.2	0.3	0.01	0.01
1980	1,228	1.25	0.7	1.2	0.5	1.9	0.2	0.4	0.07	0.1
1981	4,905	1.05	3.9	3.9	1.8	5.9	0.7	1.2	0.3	0.5
1982	8,242	1.32	11.7	16.7	3.0	10.4	3.1	5.4	0.5	0.9
1983	7,046	1.54	2.0	2.1	0.4	1.3	1.1	1.8	0.3	0.6

Source: Annual Reports of Niger River Basin Development Authority 1979 to 1983

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