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# REPUBLIC OF KENYA

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## BURA IRRIGATION SETTLEMENT PROJECT

### MID-TERM EVALUATION REPORT 1984

### MAIN REPORT

EXTRACT FROM FINAL VERSION

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option 1 (2,500 ha of settlement with pump-supplied water) has the lowest net present value of expenditure, at KSh 310m. Option 5 (5,040 ha of settlement with a fixed weir) has the highest net present value of total expenditure, at KSh 483m. The ranking obtained by using the lower cotton price is only slightly altered by using the higher cotton price of KSh 5.7/kg. Then, option 4b (3,200 ha of settlement and 1,840 ha of commercial farm, supplied by a gravity intake) is the lowest cost option, with a net present value of total expenditure of KSh 253m. The ranking of the first three options (4b, 1, 3) alters slightly but there is almost no difference in the expenditure required for these three options. Other options incur much higher expenditure. Thus, if government policy is to minimize expenditure on Bura after meeting a target minimum income for settlers, then at the present cotton price, or at a cotton price 20 per cent greater, option 1, 4b and 3 appear to be very favorable. Option 2 (3,900 ha of settlement based on pumped water supply--the nearest option to NIB's revised project decided in 1983) ranks only fifth in Table 4.6. In other words, NIB's revised project is far from being the least cost option.

#### Financial Impact of Project at the Government Level

4.34 NIB's operating deficit must be funded from the treasury. But the treasury does receive some receipts from the Bura Project that have not, thus far, been mentioned. For example, import duties and taxes that the project pays are project costs but are receipts to the treasury. These taxes (assumed, alternatively, to be 10% and 15% of total project costs) are excluded from the financial costs to government in the lower half of Table 4.7. Again, net present values are presented over the project life (30 years) discounted at 10%. The net present value refers to the subsidy from government to NIB to maintain the Bura project. There are several rankings presented, at two level of taxes (10% and 15%) and two different cotton prices (KSh 4.75/kg and KSh 5.7/kg). Option 4b is again the least expensive to the treasury, except for the model with the assumptions of the current price with taxes equal to 10% (in which case option 1 is the least expensive). Again, option 2, 3,900 ha of settlement with pumps-- the nearest option to NIB's revised project decided in 1983 --ranks only fifth. The barrage, again, is by far the most expensive option.

4.35 It should be mentioned that financial costs at the treasury level, even after accounting for project taxes, are still overstated because of the present cotton price structure. Part of CLSMB's charges, for example (see Table 4.5) are used to pay debts the CLSMB incurred in the 1970's. Without Bura cotton production, then, the government would have to cover some of these CLSMB deficits.

#### Economic Analysis of Project Options

4.36 Turning to the economic analysis of the options, Table 4.8 presents the economic rate of return for each option and the net present values using a discount rate of 10 per cent. For both calculations, it has been necessary to assume an overall average rate of import duties and taxes included in input costs. The mission estimates that the average rate lies between 10 per cent and 15 per cent; consequently, the economic rates of return and the net present values have been calculated using both these tax/duty rates to give an idea of the range of the results.

Table 4.8  
ECONOMIC ANALYSIS OF PROJECT OPTIONS

Eventual Hectares*	Water Source	Economic Rate of Return		Net Present Value** (K sh 000)		Ranking of Options by Net Present Value (High to Low)
		taxes=15%	taxes=10%	taxes=15%	taxes=10%	
2500 ha of settlement	Pumps	11%	5%	5400	-17800	Option 4b Option 4c Option 4a
3900 ha of settlement	Pumps	18%	14%	60700	29400	Option 2 Option 3 Option 5
2800 ha of settlement; 1100 ha of commercial	Pumps	18%	13%	52658	20000	Option 1
3200 ha of settlement; 1840 ha of commercial	Pumps	22%	17%	99800	61600	
3200 ha of settlement; 1840 ha of commercial	Pumps then Gravity	22%	18%	141500	105000	
5040 ha of settlement	Pumps then Gravity	18%	15%	113700	76600	
5040 ha of settlement	Pumps then Barrage	12%	9%	27500	-11200	

Commercial hectares could be replaced with settlement after commercial lease expires  
Discount rate=10%

for detailed tables see Statistical Annex

Assumptions Used in Analysis

- Foreign exchange is shadow priced at K sh 16.5 = US \$ 1. Foreign inputs are assumed to make up 50% of total project costs, so that given a 10% foreign exchange premium, total costs increase by 5%. Cotton is assumed to not be exported, so that the foreign exchange premium on exports applies only to the grass seed crop for options with a commercial component.
- Family labor is valued at K Sh 4000 per year.
- Project life is 30 years.
- Only incremental investment is included (all sunk costs are excluded, including investment already committed in 1984/85). 20% of recurrent costs for 1984/85 are excluded because they are already incurred. Incremental benefits (resulting from incremental investment) exclude all benefits from the cotton crop from 1984/85 but include other crops in 1984/85 and all crops thereafter. These benefits are truly incremental because they can be achieved only with improved water reliability and additional crop inputs.
- Taxes are assumed to be either 10% or 15% of total project cost.
- Fuelwood is valued at K Sh 400 per cubic meter of solid wood (based on the cost of importing fuelwood from the coast).
- As was done in the Appraisal Report, only 75% of the costs of additional social infrastructure are included (schools and houses).
- As was done in the Appraisal Report, only 25% of the costs of operation and maintenance of drinking water are included.
- Cotton is valued at export parity (K sh 6.2 per kilo of lint). See text for explanation of cotton price.
- Physical contingencies chosen are the same rates used in the Appraisal Report.

4.37 Other assumptions used in the economic analysis are stated in Table 4.8, including the proviso that only 75 per cent of additional social infrastructure and only 25 per cent of the cost of operation and maintenance of the drinking water system are included as economic costs, on the grounds that the economy of Kenya would have borne much of these costs anyway, whether Bura had been constructed or not.

4.38 The economic rates of return vary from 5 per cent to 18 per cent at the lower rate of taxes, and from 11 per cent to 22 per cent at the higher rate of taxes. It is notable that option 4b (gravity intake, settlement with commercial farming) again features among the options with a high economic rate of return. Ranking the options according to their net present value (discounted again at 10 per cent), option 4b has the largest positive value whatever rate of taxes is used. Notably, option 1 ranks lowest, whereas it ranked among the top two as far as the financial cost was concerned. Options 2 and 3 achieve an adequate rate of return, the difference between the net present values reflecting the higher investment necessary for option 2.

4.39 Even though option 5 (fixed weir with 5,040 ha of settlement) has the lowest risk of all options, it also requires the greatest expenditure, spread over a six year period, which makes it a doubtful venture for serious consideration.

4.40 Given the very approximate assumptions used in the economic analysis it is important to test the sensitivity of the results to these assumptions. A discussion of these results is summarized here and detailed information is contained in Tables 25 and 26 in the Statistical Annex.

#### Sensitivity Analysis

Assumptions on Project Costs: The economic analysis is very sensitive to major changes in project costs. If project costs are understated in the analysis by 20%, for example, then the economic rate of return falls considerably— by about 4 percentage points for options 4b and 4c, 6 percentage points for option 4a, and 7 percentage points for options 2 and 3. Option 1 has a negative net present value if project costs are understated by only 10%.

Discount Rate: The model is not very sensitive to the discount rate used in the present value calculations. Ranking of project net present values remains much the same with alternative discount rates that range from 8% to 14%. Options 4b, 4c and 4a remain the three highest, and with option 4b the highest.

Shadow Pricing Foreign Exchange: If the assumption to shadow price foreign exchange is dropped, then all options improve considerably, as it is equivalent to reducing project costs by 5%. The economic rate of return of option 2, for example, increases from 13.8% to 18.1% (with 10% taxes).

Taxes: It is unclear what level of taxes the project actually pays, but it was judged to range between 10 and 15%. From the results in Table 4.8, it is clear that the rates of return are sensitive to what level of taxes is used.

Opportunity Cost of Labor: The assumption that the opportunity cost of labor is KSh 4,000/year was tested and results are sensitive to the values used. If the opportunity cost doubles, for example, then the rate of return for option 4b falls from 18% to 12% (with taxes=10%).

#### Implications of the Economic Analysis

4.41 Although the analysis uses very approximate assumptions, the results do identify the least viable and relatively more viable directions for Bura. Future policy for Bura will be determined by the funds available. Not only government funds enter the equation, but so do possible funds from donors (the Kuwait Fund offer of finance for a river offtake structure may be resurrected). If total available funds are absolutely constrained, for example, by the project period ending in June 1985, then the lowest financial cost option, option 1, may be the only one applicable, even though it has the lowest ranking in economic terms. In effect, the project would be frozen at its present size, and pump rehabilitation would be the major investment expense. Risk of water shortage, however, would remain high, and the economy would gain only minimally from a successful implementation of the option. If funds are less constrained, and investment in and beyond the third year is possible then there is everything to be gained by implementing an option which secures water supply through a gravity feed, i.e. by implementing option 4b or 4c. Option 4b appears to be the best, from both a financial and an economic point of view. Under this option, settlement would be restricted to 3,200 ha and a commercial farm would operate the remaining 1,840 ha. If large scale commercial farming is indeed the correct mode of development for the remote and difficult area of the lower Tana basin, implementation of option 4b will demonstrate that conclusively.

4.42 If funds cannot be made available for the time required to develop option 4b, then only option 1, 2 and 3 can be considered. Amongst these options, options 2 and 3 are better in economic terms than option 1. However, option 3 is superior over option 2 from the financial point of view. In addition, option 3 imposes a lighter management burden on the NIB.

4.43 One option which is not illustrated in Figures 4.1 and 4.2 nor in Tables 4.6 and 4.7 is the close-down option. For a sum of about KSh 40 m, the existing settlers on the Bura scheme could be partially compensated and returned to their area of origin. Contractors' claims could be settled, and the project could be either completely abandoned, or leased by NIB to a commercial firm as a potential plantation site. If the NIB were to provide water after securing adequate water supplies and paying for the operation and maintenance of a very large irrigation system, NIB would need to charge the commercial venture a very high land and water cost, estimated at up to KSh 5,000/ha just to cover its costs. It is unclear what NIB would gain from this venture, and if a commercial firm would be interested. If the government would be willing to lease all the facilities to a commercial firm including the irrigation system, then the government could make a profit from the lease. The commercial firm would maintain agricultural production, and provide minimal employment. But the social goals of settling the landless and increasing employment would not be realized, and much of the social infrastructure built by the project would not be maintained.

4.44 Given the difficulties of completely abandoning the scheme, resort to some development option is imperative. There are no easy choices, and all options considered here require large annual government subsidies (see figures 4.1 and 4.2). All options require substantial improvement in management. Without these improvements the costs of the options presented are underestimated and the benefits overestimated. If management is not improved, the risks to long run project viability are very high. The team believes that:

1. Improvement in management is a necessary condition for any of the development options presented;
2. For technical, financial, and economic reasons we strongly recommend that option 4b be pursued if adequate funding can be mobilized. The first step towards option 4b is to have a feasibility study for the river diversion structure. Until this study is completed, we recommend that the Bura project be consolidated at 2,500 ha unless improvements in NIB's capacity to manage the scheme justify an expansion to option 3 as an intermediate step towards option 4b;
3. A significant increase in cotton price for Bura farmers is justified and will improve NIB's ability to recover more of the project costs while maintaining a target settler income. Long run operating deficits could be further reduced by measures to minimize operating costs and to raise yields; and
4. We further recommend that if the adopted option includes a commercial operation that serious consideration be given to the commercial company assuming management responsibility for the entire project. Any agreement must include adequate safeguards to fully protect tenant welfare.

APPENDIX 1

SUMMARY OF LESSONS AND RECOMMENDATIONS

(From Main Report Chapters II, III, IV and Annexes I, III, IV and V)

Chapter II

See Paragraph

- 2.10 It is the mid-term evaluation mission's view that there is no justification for large scale settlement irrigation on the east bank of the lower Tana at this time.
- 2.11 Recommends the cotton planting season should not exceed two months.
- 2.12 Recommends for the pump station: (1) an immediate overhaul; (2) an operation and management contract with a local engineering firm; (3) a training program for operators and mechanics; (4) spares for engines and pumps be held at Bura; and (5) a report on the condition of the pumps and engines be obtained from an independent mechanical engineer.
- 2.13 Recommends a review of pump station efficiency in July 1985.
- 2.17 Recommends that "furrow in basin" irrigation as an alternative to furrow irrigation should be used in areas where slopes are too steep or too shallow.
- 2.18 Recommends more effective monitoring of water use.
- 2.19 Recommends regular maintenance of all irrigation infrastructure.
- 2.29 Recommends all cotton planting be completed by mid-April.
- 2.35 Recommends that the procedure to be adopted for the protection of the riverine forest be discussed and agreed with the project steering committee; and responsibilities of agencies involved in the forestry development be more precisely defined.
- 2.36 Recommends the introduction of wood burning jikos.
- 2.37 Recommends support for management of the Tana River Primate Reserve.
- 2.39 Recommends additional drinking areas be provided for animals.

Appendix 1

- 2.40 Recommends a biocide monitoring program be undertaken.
- 2.41 Recommends that NIB consider tractor and hand spraying as an alternative to aerial spraying.
- 2.42 Recommends an Integrated Pest Management (IPM) system be introduced and funded from the research budget, KARI or through TA from FAO.
- 2.45 Recommends tenants receive larger vegetable plots.
- 2.50 Recommends measures be taken to improve tenants incomes: by a more timely supply of all inputs, a higher cotton price, and the institutionalization of crop advances.
- 2.52 Recommends services be taken over by the appropriate ministries as soon as possible.
- 2.62 Recommends: the temporary water purification system be maintained and if necessary supplemented by pumps and storage tanks from the permanent system.
- 2.63 Recommends that the Ministry of Water Development takes over responsibility for the permanent plant by July 1, 1985.
- 2.73 Recommends that: a decision be made concerning responsibility for house construction and type and quality of housing be made; and questions related to tenants' legal status affecting ownership of property under the Irrigation Act be referred to governments' legal advisers.
- 2.76 Recommends that the three missing vehicles be handed over to the Bura health center or replaced without delay by the Ministry of Health .
- 2.77 Recommends steps be taken to control malaria.
- 2.78 Recommends timely allocation of garden plots and where justified allocation of larger garden plots; and larger WFP rations for needy families.
- 2.79 Recommends treated water be extended to the Manyatta.
- 2.80 Recommends the schistosomiasis control program be strengthened.
- 2.81 Recommends that a senior officer with overall responsibility for health be appointed.
- 2.82 Recommends all aspects of health care be strengthened.

APPENDIX 1

- 2.86 Recommends the introduction of wood burning jikos on a large scale in order to reduce fuelwood requirements, and that extension and training in jiko use be directed at women.
- 2.87 Recommends support for womens' groups including the allocation of communal vegetables plots.
- 2.92 Recommends: the Irrigation Act be reviewed; and new regulations be drafted under the Act governing the development of irrigation schemes for which NIB is responsible.
- 2.96 Recommends the agricultural management team comprise both consultants and local staff and localisation proceed as qualified and experienced staff are identified.
- 2.97 Recommends that funds be released by the Treasury in advance of their commitment.

Recommends a system of Integrated Pest Management (IPM) for timely farming operations for cotton.

Recommends a large measure of autonomy be given to Bura

Recommends that a steering committee be established and chaired by the Chief Secretary or his nominee to guide on major issues and policy matters and the Interministerial Committee continue to function.

A contract of this type with substantial investment in infrastructure and services imposed a large financial burden and increases the overall financial, if not economic size; a compensating genuinely higher financial and economic rates of return should have been sought.

Recommends that project funds be released six months in advance by the Treasury.

Large scale irrigation schemes as a means to prevent settlement are costly and questionable.

Judged purely on financial and economic terms the Bura scheme should not be replicated in other semi-arid areas of Esaya.

Chapter III

See Paragraphs

- 3.03 Continuous monitoring of soil conditions and crop yields is strongly recommended.
- 3.04 Further research prior to appraisal would have expedited the selection of suitable crops and varieties.
- 3.05 Repeats the recommendation that all engines and pumps: (1) should be overhauled; (2) there be an operation, maintenance and training contract for the pump station; (3) stocks of spares should be held at Bura; (4) radio communications be installed; and (5) a report from an independent mechanical engineer be obtained.
- 3.06 Recommends that future earthworks contracts be the subject of open tender.
- 3.07 Recommends a system of Integrated Pest Management (IPM) and timely farming operations for cotton.
- 3.08 Recommends a large measure of autonomy be given to Bura management.
- 3.10 Recommends that a steering committee be established and chaired by the Chief Secretary or his nominee to guide on major issues and policy matters and the Interministerial Committee continue to function.
- 3.11 A project of this type with substantial investment in infrastructure and services imposes a large financial burden and increases the overall financial, if not economic risk; to compensate genuinely higher financial and economic rates of return should have been sought.
- 3.12 Recommends that project funds be released six months in advance by the Treasury.
- 3.13 Large scale irrigation schemes as a means to promote settlement are costly and questionable.
- 3.14 Judged purely on financial and economic terms the Bura scheme should not be replicated in other semi- arid areas of Kenya.

APPENDIX 1

- 3.15 Where the technical base is lacking further research or a pilot project is recommended.
- 3.16 Sound management with autonomy for Bura is essential and is recommended.
- 3.17 Development of the Lower Tana basin may be better suited to large-scale irrigation schemes run by commercial organizations.

Chapter IV

See Paragraphs

- 4.05 Recommends the construction of the 8 km main canal to Masabubu rather than partial construction in the form of a flood protection bund.
- 4.17 Recommends that an independent consultant make an assessment of the technical viability of the inclined pumps before the pump station is considered "permanent". Studies are needed of the gravity fed option; until this study is completed it is recommended the project be consolidated at 2,500 ha.
- 4.22 Recommends that government, NIB and CLSMB prepare a ginning plan for Bura.
- 4.30 Recommends that more of the financial value of the cotton be passed on to the farmer.
- 4.32 Recommends that NIB undertake a review of opportunities for reducing costs.
- 4.44 Recommends option 4b (with gravity intake) be pursued if adequate funding can be mobilized and that a feasibility study for the river diversion structure be undertaken. Until this study is completed the Bura project should be consolidated at 2,500 ha. If the option includes a commercial farming component consideration should be given to the company to assume management responsibility for the entire project.
- Preparation operations is justified for reasons of soil conservation with no significant reduction in yields but a saving in time and cost.
- Tenants debts incurred due to pump station failure should be written off by the NIB.
- Improved pest control management is required.
- Improved field water management is required. The project irrigation efficiency is estimated at 60%.
- Appointment of the Bura Agricultural management team has been seriously delayed. When appointed in early 1983 it should be given a large measure of autonomy.

A review of the Irrigation Act (1966) is necessary.

Agriculture: Annex I

Incentives to improve farmer's productivity should be encouraged and the decision by MP to increase the main plot holding from 1.25 ha to 1.5 ha is endorsed.

See Paragraphs:

4-6

Yield projections were generally over optimistic.

7

Marginal land should have been excluded from land selected for settlement.

12

Land cleared of vegetation in advance of development is suffering from wind erosion (Pumwani and Masabubu).

13-15, 64

Long furrow irrigation adopted by the project requires modification over part of the project area.

21, 57

All cotton planting should be completed by mid-April otherwise serious pest problems will occur.

22

To increase maize production improved water management, better suited varieties, more effective extension and sound cultural practises are required.

25

Before introducing a new cotton variety which may be justified further analysis and field trials are required.

36

Land preparation has taken much longer than planned resulting in an extended cotton season beyond its optimum, increasing pest risks and interfering with the timing of maize planting.

38

A reduction in the number of mechanised land preparation operations is justified for reasons of soil conservation with no significant reduction in yields but a saving in time and cost.

54

Tenants debts incurred due to pump station failure should be written off by the NIB.

57

Improved pest control management is required.

64

Improved field water management is required. The project irrigation efficiency is estimated at 40%.

70, 71

Appointment of the Bura agricultural management team has been seriously delayed. When appointed in early 1985 it should be given a large measure of autonomy.

74 A review of the Irrigation Act (1966) is necessary.

75 Incentives to improve farmer's productivity should be encouraged and the decision by NIB to increase the main plot holding from 1.25 ha to 1.5 ha is endorsed.

Index summary

78 With an increase in the number of gins, the ginneries at Hola and Malindi can handle future production.

3 and 4 Health services including operation and equipping of the Health Center for schemes like Bura must not be allowed to lag behind other developments.

3 Lack of transport has reduced health service field based activities.

6 Control programs for Schistosomiasis initiated at this stage would facilitate disease control in the longer term.

7 Primary health care programs should be developed at village level.

8 Regular monitoring of the health status of settlement population should be carried out combined with disease control programs and community based treatment for important endemic diseases.

Paragraph

4.5.2 Village health units are required and proposals for their use should be formulated.

6.2B 4 (page 34)

There should be a senior person in overall charge of the health division.

Health Sector-Annex III

Annex summary

- 1 Malaria has been the most important problem associated with early development of Bura. Further epidemics can be anticipated.
- 3 and 4 Health services including operation and equipping of the Health Center for schemes like Bura must not be allowed to lag behind other developments.
- 5 Lack of transport has reduced health service field based activities.
- 6 Control programs for Schistosomiasis initiated at this stage would facilitate disease control in the longer term.
- 7 Primary health care programs should be developed at village level.
- 8 Regular monitoring of the health status of settlement population should be carried out combined with disease control programs and community based treatment for important endemic diseases.

Paragraph

- 4.5.2 Village health units are required and proposals for their use should be formulated.
- 6.2B 4  
(page 34) There should be a senior person in overall charge of the health division.

Wildlife and Ecology-Annex IV

See Annex paragraphs

- 7-9 Protection and introduction of a forest management plan for limited exploitation of parts of the riverine forest on the Tana river between Garissa and Garsen is required.
- 10 Support for the Tana River Primate Reserve is recommended.
- 27 Maize should be protected from wildlife damage by the installation of an electric fence.
- 30-36 Aerial spraying of biocides may present serious short and long term environmental problems, health risks and the emergence of resistant pest varieties. A monitoring program and an Integrated Pest Management Research Program (IPM) should be undertaken.
- 41-42 Establishment of an environmental unit in NIB is recommended.
- The irrigated plantations security plantings and shelter belt planting program should be implemented in accordance with the forest action plan currently being prepared. This plan should include harvesting and transport arrangements.
- A socioeconomic study will form part of the forest sub-project and will address all aspects of fuelwood production, provision and use.
- The institutional framework for undertaking the security program should be planned including a village education program.
- Silvicultural research should be extended to cover forest improvement in the Tana riverine forest, species for establishment in semi-arid areas and plantations where limited irrigation is available.



Forestry-Annex V

See Annex Recommendations

- 1 Fuelwood should be supplied to the Bura population from irrigated plantations, the Tana riverine forest (controlled by a forest management plan), agricultural residues and brushwood cleared from the project area;
- 2 Wood burning jikos should be introduced to improve fuelwood utilisation, and control or banning of charcoal production and imports of charcoal should be considered.
- 4 Exploitation of the Tana riverine forest to be strictly managed and the limited supply available to be augmented by imports from the Lamu mangrove forests until the Bura irrigated plantations provide adequate fuelwood and poles.
- 5, 8 A forest management specialist should as a matter of urgency prepare the management plan for the forest sub project including the plantations, riverine forest and amenity planting.
- 6, 10, 11 The irrigated plantations amenity plantings and shelter belt planting program should be implemented in accordance with the forest action plan currently being prepared. This plan should include harvesting and transport arrangements.
- 7 A socioeconomic study will form part of the forest sub-project and will address all aspects of fuelwood production, provision and use.
- 12 The institutional framework for undertaking the amenity program should be planned including a village education program.
- 13 Silvicultural research should be extended to cover forest improvement in the Tana riverine forest, species for establishment in semi-arid areas and plantations where limited irrigation is available.

