THE ECONOMICS AND POLICY IMPLICATIONS OF GOVERNMENT INVESTMENT IN WATER AND IRRIGATION DEVELOPMENT IN ZIMBABWE

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ABSTRACT

The study examines and analyses the Government of Zimbabwe's investment policy in water and irrigation agriculture between 1980 and 1985 from an economic and policy approach. The approach emphasises both the economic and policy implications that result from such public investment. The major objective of the study is to assess whether or not public investment in water and irrigation has satisfied Government economic and policy objectives of 'growth and equity'.

The cost-benefit framework has been adopted in the assessment of the performance of the commercial irrigation sector. Using this framework, the study seeks to show whether chosen policies have optimized such economic benefits as economic growth, profitability, foreign exchange earnings, and employment creation, for the costs incurred.

Small-scale peasant schemes are assessed using cost-effective analysis framework. On the basis of this method, the study examines the extent to which chosen policy strategies and projects have maximized equity objectives such as the increase in food production, improvement in standard of living, and increase in income earnings etc, at least cost of production.

Throughout the analysis of the two sectors, the role played by public subsidies in all the cost structures is examined. In the case of peasant schemes the costs are compared with those of the rain-fed peasant agriculture in order to assess the incremental equity, or lack of it, due to irrigation.

Social and environmental effects of these policies and their impact on costs and benefits are also discussed both qualitatively and quantitatively.

The whole analysis takes place against the background of national economic decline, rising investment costs and rising public debt. The question of the economy's ability to support a subsidy-based investment policy is central in the whole study as this raises serious implications for future investment. Alternative investment strategies and future research areas are suggested.

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Acknowledgements

The subject of this study has been an area of interest to me over a very long period of time, starting over the period 1979 to 1982 when I was an economic planning student at the University of Aberdeen. At that time, the main theoretical interest was on the improvement of efficiency in public investments. A theme explored during the writing of the Master of Science dissertation on 'Livestock Production and Trade in Sierra Leone.'

Upon joining the Ministry of Finance Economic Planning and Development as a civil servant in the Government of Zimbabwe (1982-1987), I was in charge of the programming of investment resources to several sectors, including water and agriculture. Over that period, it became clear that the allocation of investment resources by Government to various sectors, especially the water and irrigation sectors, was not guided by the principles of allocative efficiency (as defined in welfare economics) nor was any attention being paid to the costs being incurred in relation to the benefits realised.

The people who have influenced my thinking and the shaping of my ideas are too many to mention individually, but their anonymity does not diminish my gratitude to them. I would however like to pay special tribute to those friends and colleagues whose support at the very early stage made it possible for me to register as a student at the London School of Economics and Political Science. Among these are Mr G Msipa, the then Minister for Water Resources Development, whose letter of support was crucial in getting the Commonwealth assistance, Dr Norman Reynolds who handled all the bureaucratic issues pertaining to the granting of leave of absence from duty, Mr Phillip Velaphi and Mr Vimbai Vudzijena who endured long boring hours of listening to the readings of the first draft. Their comments and encouragement were invaluable. It would be remiss of me, not to acknowledge the encouragement received from Dr N Ngongoni of the University of Zimbabwe and Dr Kejeh the

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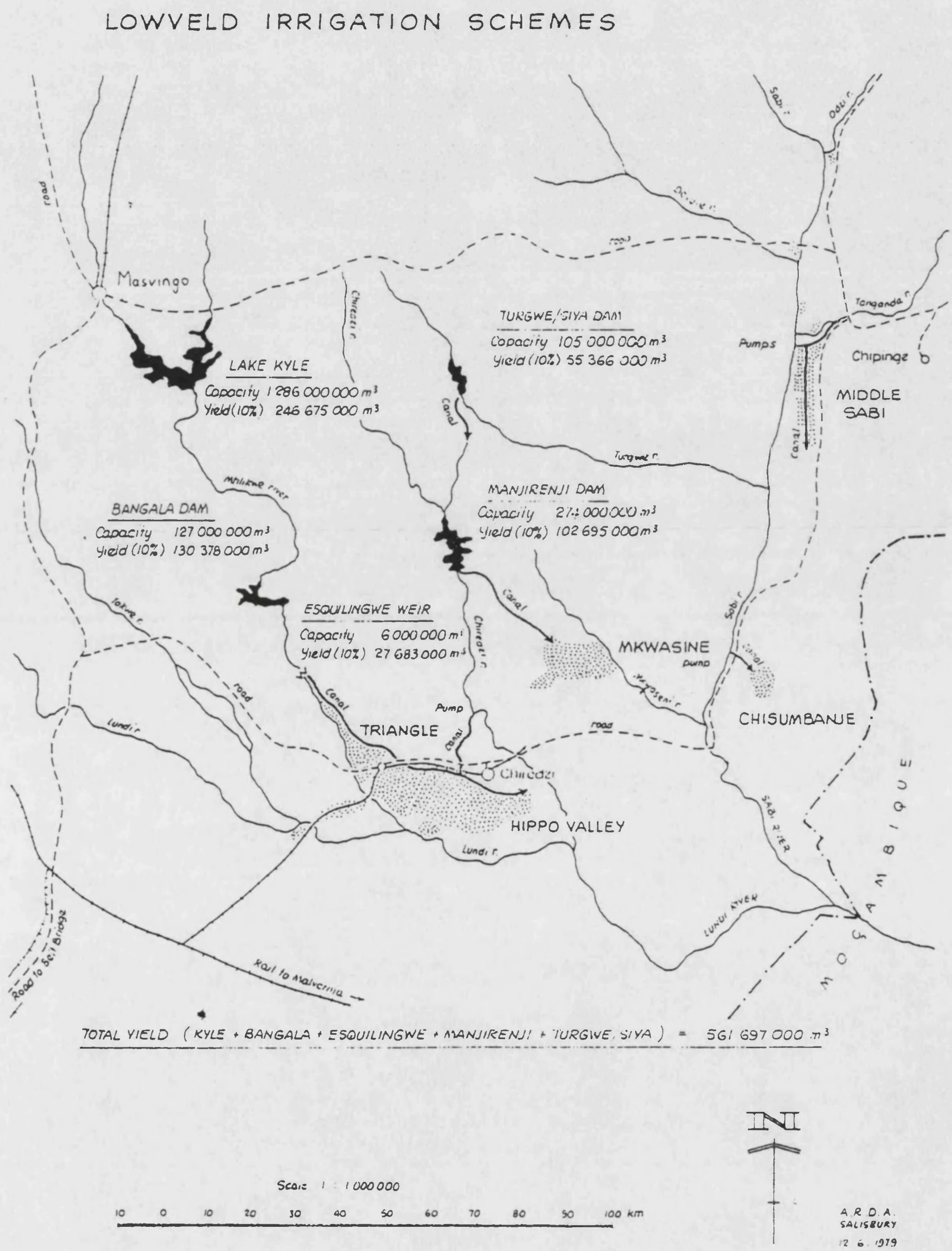
Last but not least is my gratitude to Dr Judith A Rees my supervisor, who has dutifully and patiently advised on the development of this study.

Fig. 1.1


LOWVELD IRRIGATION SCHEMES
road
Masvingo
LAKE KYLE
Capacity 1 286 000 000 m³
Yield (10%) 246 675 000 m³
Chiredzi r.
TURGWE/SIYA DAM
Capacity 105 000 000 m³
Yield (10%) 55 366 000 m³
Sabi r.
Odzi r.
road
Tanganda r.
Pumps
Chipinge
MIDDLE SABI
Canal
Turgwe r.
Mtilikwe river
BANGALA DAM
Capacity 127 000 000 m³
Yield (10%) 130 378 000 m³
MANJIRENJI DAM
Capacity 274 000 000 m³
Yield (10%) 102 695 000 m³
ESQUILINGWE WEIR
Capacity 6 000 000 m³
Yield (10%) 27 683 000 m³
Tokwe r.
road
Lundi r.
Canal
Pump
TRIANGLE
MKWASINE
pump
Sabi r.
CHISUMBANJE
road
Chiredzi
HIPPO VALLEY
Lundi r.
SABI RIVER
LUNDI RIVER
MOCAMBIQUE
Road to Sai Bridge
Rail to Malvernia
TOTAL YIELD (KYLE + BANGALA + ESQUILINGWE + MANJIRENJI + TURGWE, SIYA) = 561 697 000 m³
N
Scale 1 : 1 000 000
10 0 10 20 30 40 50 60 70 80 90 100 km
A.R.D.A.
SALISBURY
12 6 1979

CHAPTER ONE

INTRODUCTION AND THE OBJECTIVES OF THE STUDY

INTRODUCTION

The aim of this study is to evaluate irrigation policy in Zimbabwe; assessing both investment in bulk water storage capacity and the allocation of available supplies between consumers. Although attention will be focussed on activities during the first six years of the post independence period, current policy cannot be evaluated meaningfully without a clear understanding of the historic development of irrigation and agricultural land use, the legacies of which are still critically important today. Nor can irrigation be assessed as a purely technical or economic exercise; it must be firmly placed in its political context.

Throughout, it will be necessary to make a distinction between irrigation designed to serve peasant farmers and that developed for commercial agriculture. In the former case, irrigation was first developed as a reaction to land hunger following the removal of African peasant farmers from land that had been designated as 'European Areas'.

During the 1930s, the then Government of Southern Rhodesia, through the Native Agriculture Department, became involved in irrigation in a way which can only be viewed as an attempt to politically control potentially violent landless peasants. The forced settlement of peasants in dry and edaphically marginal lands, in numbers exceeding the basic carrying capacity of the land, that followed, produced a situation in which irrigation was seen as the obvious solution to the resultant food shortages. This process continued after the passing of the infamous 1930 Land Apportionment Act, with irrigation being expanded for political reasons at high cost to the Government, at the neglect of economic considerations. Only after all the best agricultural land had been consolidated in European hands, and the African peasants had been shifted to the so called 'Tribal Trust Lands' did the Government begin to demand that small scale (peasant) irrigation schemes were only to be developed if they could be justified economically. Thus during the 1960s, and in the early years after the Unilateral Declaration of Independence (UDI) in 1965, support was withdrawn from peasant irrigation agriculture development. High production costs and an unfavourable product pricing system brought insolvency to many farmers and set in motion the gradual abandonment of the existing irrigation schemes; a process which was accelerated by the disruptive war of independence. As a result by 1980 virtually all small-scale irrigation projects had become inoperative.

By way of contrast, the development of commercial irrigation projects escalated during the 1960s. 'European' farmers were attracted into irrigation by the potentially high profit margins from crops such as sugar-cane, coffee and winter wheat. Profitability was high not only because of low input costs, with cheap labour and highly subsidized water rates, but also because of lack of competition from the peasant sector and the existence of a racially determined crop pricing system which favoured 'European' farmers. As a result commercial large scale irrigation expanded rapidly until by the early 1980s when it accounted for 93% of all irrigation activity in the country (World Bank 1983).

After independence, the present Government adopted, as its overall policy objectives, the concept of 'Growth with Equity'. To serve this objective it has revived the development of small scale (peasant) irrigation schemes, embarking on new projects and resuscitating the old abandoned ones. However, this expansion is occurring only with heavy public subsidy; thus compounding the financial problems of an exchequer already heavily burdened by the costs of subsidizing commercial irrigation and other sectors of the economy. A key theme of this study is that irrigation development has taken on a life of its own, with little assessment of its effectiveness in meeting the ultimate policy objectives set out by the state and with little evaluation of the opportunity costs of the resources involved.

A second major problem addressed in the thesis is the potentially contradictory nature of the "Growth with Equity" concept as it relates to irrigated agriculture. Maximization of economic growth may not be compatible with distributive equity. Indeed as the study will attempt to show, given the inherited racially divided dual agricultural system, the pursuit of growth may be a force for greater inequality, as the already relatively rich farmers are better able to take advantage of loans and subsidized inputs, including water, to expand their production. Thus the major question running through the thesis is; whether investment in irrigation can be the best way to promote equity objectives and whether other alternative measures would be more cost-effective methods of achieving the Government's policy goals.

The Hypothesis

The main hypothesis of the study is to determine whether, for both private commercial and small-scale peasant schemes, public investment in water and irrigation agriculture in Zimbabwe, has been the most cost effective and beneficial way of achieving the public objective of 'growth' and income equity, as defined in the Government's "Growth with Equity" policy guide-lines of 1980.

The study will attempt to assess whether irrigation development has the capacity to fulfill these policy objectives given the constrains inherent in the structure of the irrigation industry itself, its investment strategies and operating practices. The study will also attempt to identify sources of inefficiency within the industry and the extent to which the following feature in the case of Zimbabwe:-

a. The tendency to over invest, that is, the extent to which capacity has typically been developed prematurely on an over-ambitious scale before the farmers were prepared or were able to pay the full costs involved;

b. The over reliance on water supply capacity extension to solve water shortage problems instead of the adoption of water management techniques that would improve the use of existing water resources by farmers, and the extent to which use has been made of the price mechanism to help solve short-term water shortages and to control demand for water over time;

c. Whether the Ministry of Energy and Water Resources Development (MEWRD) has developed excessive supply safety margins, indicating the Ministry's extreme aversion to the risk of supply shortfalls. In the pursuit of supply safety margins, has capacity construction normally taken place well ahead of farmers' needs, to meet uncontrolled needs; and to guard against infrequent (location- specific) drought occurrences? In the establishment of safety margins, has attempt been made to evaluate the costs of this high level of security against the derived benefits?

d. Do existing pricing policy arrangements encourage the tendency to over investment in supplies and wasteful and low value water usage? In addition, does the likelihood therefore, exist that supplies are misallocated between farmers and does the pricing system typically operate to the disadvantage of those farmers drawing water from costly new dams?

e. To what extent is the water and irrigation industry characterised by constant miscalculations of the costs and benefits of investment? Are the benefits from water supply and from irrigation over estimated? If there is an over estimation of benefits, to what extent is that based on the assumption that, as some units of water are essential for plant growth, all supplies to irrigation agriculture are equally valuable, and that as irrigation water supply can help solve crop failure problems, all irrigation projects will act to remove the dangers of crop failure? In the benefit/cost calculations is the assumption also that water for irrigation alone can produce the expected benefits, ignoring the plethora of other inputs (farm credit, extension services, fertilizers and so forth) which are crucial to the success of projects? Is the assumption by MEWRD, and by government true, that water and irrigation projects can induce economic development; and is there evidence to suggest that irrigation has been the force for growth?

f. Have the operations of MEWRD and the Regional Water Authority been characterised by deficiencies in demand forecasting procedures? To what extent have estimates of demand for water been based mostly on unresearched and uncoordinated statements from farmers' organisations (who have a high propensity to overstate the demand), or on extrapolation of past trends at existing prices and water management practices? Is it possible that such forecasts tend to be made on a once-only basis, when the need for further large scale investments is perceived. Has any attempt been made to revise demand projections in line with increased water charges or with other determinants of demand such as product prices? Has the relationship between water use, farmers behaviour and the determining physical and socio-economic variables been assessed?

   Extrapolation is often based on the assumption that the demand determinants will continue to operate in the same way as they have done in the past. Clearly, misleading projections will result if this assumption is not valid;

g. To what extent has cost-benefit analysis been used as a project selection procedure? Is it assumed that the development of all physically and technically feasible schemes is desirable and that these will therefore be constructed over time? Where cost-benefit analysis has been employed, was it used to lend supposed objectivity to preconceived notions or decisions?

h. To what extent is the existence of uneconomic management practices linked to the dominance of, on the one hand, engineers who see physical capacity extension as the answer to all water supply problems, and on the other hand, the agronomists with a fervent mission to push irrigation agriculture to every corner of the country, regardless of the costs?

i. Finally, can it be argued that the pursuit of irrigation agriculture has affected the mix of crops produced and what implications, does the dominance of export crops (sugar-cane, coffee, tea and cotton) has for development planning, and on the development of crop production technologies? To what extent have the technological changes and developments to improve the productivity of rainfed agriculture been neglected? Can it be argued that an alternative to full-scale irrigation agriculture development must be sought in the expansion and improvement of less costly rainfed agriculture to its full potential?

While the study does not argue for the removal of irrigation agriculture per se, its continued existence in Zimbabwe's agriculture system, must be justified (like all other investment activities), in terms of its ability to fulfill the set objectives of Growth with Equity' through the most optimal use of scarce investment resources.

Development of Research Interest

There has been a growing concern in the Less Developed Countries (LDCs) and among donor agencies that massive investments in water for irrigation have not produced the expected benefits. This concern is taking place against the background of heavy Third World indebtedness to international banks and donor agencies, and of the cry for greater efficiency in the use of scarce investment resources. In the irrigation sector it has become evident that despite heavy investment in numerous irrigation schemes, hunger and poverty (as well as high levels of individual indebtedness) have tended to grow instead of decline and that most schemes have tended to increase social income differences instead of narrowing this gap as evidence from The Green Revolution shows. In addition, there is growing evidence of the increase in water-based diseases around most schemes. In some countries, the disease infested schemes have become the source point for the resurgence of such vectors as mosquitoes and snails in areas that had hither-to been declared safe (Biswass 1978).

Early studies of water development tended to be uncritical inventories of man's achievements in controlling the physical system. It was simply accepted that irrigation brought major beneficial gains and acted to generate regional economical development. Little critical analysis occurred of the costs of irrigation, the way the water was allocated between uses and users, and of the distribution of the resultant benefits. However, during the 1950's this unthinking acceptance of the assumed benefits of irrigation began to be challenged, first by economists and later by environmentalists. This more critical appraisal was started in the USA by a number of outstanding economists (Otto Eckstein, 1958; John Krutilla, 1955; Roland Mckean, 1958; Haveman, 1965; Margolis, 1957; Moreel, 1956 and Hirschleifer et al 1960). Most of their work resulted from an outrage, both within academic circles and the political arena, over the massive scale of investments undertaken by the Federal Government, the State and Local supply agencies, in the water sector.

Investment in water for irrigation and flood control had escalated until water development was the largest single item in the whole Federal non-defence expenditure budget. In all, expenditure was spread among 25 agencies (Eckstein 1958), but by far the largest spenders were the Corps of Engineers and the Bureau of Reclamation. Individual states, especially the dry southern and western states were also taking keen interest in water projects for irrigation. However, the low returns on capital invested in water construction projects became a matter of great public and political concern. Eckstein and McKean (1958) noted that the political justification for irrigation was to increase the income of poor farmers and to encourage the occupation of the drier lands in the west as part of the frontier policy. These political objectives submerged discussion on the economics of irrigation, and it was established by the Hoover Commission in 1955 that irrigation projects and schemes were only repaying between one quarter and a third of the total capital costs. Eckstein, McKean (1958) and Morrell (1955) in their analysis of water investment programmes, criticized the objectives adopted by the agencies, particularly by the Corps of Engineers for the construction bias in their development. They also criticized the investment appraisal techniques that were employed to evaluate projects. The techniques were found to be defective from the view point of economic efficiency, a criterion that was increasingly being adopted by Congress. Investment analysis had thus been abused, as an evaluative tool, to justify the construction of non-economic irrigation projects (Renshaw, 1957).

Studies on the efficiency of Federal irrigation schemes concentrated on correct procedures of evaluation aimed at achieving economic efficiency. However, these early analysts were aware that all irrigation projects were designed to serve multiple objectives, and they developed techniques which allowed consideration of regional development as a measure of the worth of an irrigation scheme, as well as the assessment of the income redistributive effects of projects. Haveman (1965) gave detailed analysis, as to why, despite public and political concern over the construction of uneconomic and inefficient projects, Federal expenditure continued to be poured into those projects. The following were some of the major reasons he cited for the continued expenditure and these are equally relevant to this study:-

a) <u>Delay in Plan Implementation</u>

The time taken for project acceptance and the allocation of appropriation funds tended to be so long, that given the cost escalation in the construction industry, the final cost far exceeded the original estimates. There was furthermore, no political commitment to pull-out once the project was accepted.

b) <u>Favourable Water Charges to Farmers</u>

Given the political objective of increasing the income of poor farmers, water charges were based on affordability criteria and the rates were therefore set low enough to leave enough income in the hands of the farmers. The period of repayment of capital costs extended over many years, starting only after 40 years. Low water rates allowed the misuse of water to continue and created problems associated with over application of irrigation water.

c) <u>Political Log-rolling</u>

The committees that looked after irrigation projects were headed by irrigation advocates, who supported projects in constituencies of fellow politicians, in the hope of receiving similar favourable treatment for their own areas.

d) <u>The Bureaucratic Impediment</u>

The bureaucratic chain through which a project had to pass through before permission to construct was granted was time consuming, costly and sometimes wasteful as a process of scrutiny. Moreover, it did not stop politicians proposing uneconomic schemes.

e) <u>Multi-purpose Objectives and over Investment</u>

The arguments for investment in water resources had been articulated politically in terms of multi purpose objectives such as irrigation, electricity, domestic water supply, regional development, conservation etc. Given this range of objectives, it was possible to load the capital repayment costs onto electricity generation and domestic water supply while irrigation, though taking the largest share of the water (two thirds) was often exempted from paying such overheads. The multi-purpose argument had been used to justify investment with little or no study of the cost allocation to prospective users or of the benefits derived by each user class. In the absence of optimal pricing policies for irrigation water, problems of over investment, salinity and water wastefulness, were the result, with considerable misallocation of water both between irrigation and other water uses and within the irrigation sector itself.

f) Erroneous Calculation of benefits and costs:
The benefits derived from irrigation had typically been over estimated primarily on the assumption that water alone was the key constraining factor, and all other inputs were treated as either cheaply plentiful or available. The farmers were assumed to possess the same high standards of agricultural competence, and that they would automatically adjust their cropping practices to maximize the profits from irrigation. It was also assumed that water could induce economic and agricultural development, although studies suggested that water was a passive factor allowing but not stimulating growth.

Sometime has been spent outlining the factors promoting uneconomic irrigation projects in the United States in the 1950s and 1960s because it is striking how similar they are to the experience of the less developed countries today. Little has been learnt from the United States case or from the pioneering cost benefit appraisals of the 1950s . Numerous studies have shown that irrigation far from being the often assumed panacea can be an economic disaster, yielding minimal returns on capital (see for example Davidson 1969 - Australia, Carruthers 1981 - Pakistan, Hazelwood 1978 - Tanzania, Hagen 1967 - India, Baron 1975 - Afghanistan, Biggs 1977 - Bangladesh).

Clearly the problems of uneconomic investment are critically important for poor nations where resources are scarce, rates of capital formation are low and where there is limited managerial capacity to make the most effective use of the water resulting from such investments. Although it will be argued that a more economically efficient approach to irrigation investment is crucial in Zimbabwe and other LDCs, the current study will depart from earlier assessments which took efficiency as the sole objective of management by attempting to appraise government investment strategies for water and irrigation as policy tools for the achievement of both economic growth objectives and the social welfare objectives of distributive equity. In order to achieve this goal the study will investigate not only the costs of producing water and of irrigation development, but also investigate the full range of inputs required, as well as the human and institutional changes that have taken place, the role of the state and the extent to which these have contributed to or hindered irrigation development.

The need to evaluate public investment in water and in irrigation agriculture in Zimbabwe was due to a number of observations made by the researcher as an employee of the Government, responsible for the approval of most investments in water and irrigation agriculture. It had become clear that:

a) Appropriations for dam construction had continued to grow, and that no attempt was being made to assess the opportunity cost of these resources;

b) No assessment was being made of the cost to the economy of an open ended subsidy policy;

c) Uneconomic small scale peasant schemes were being embarked upon without questioning their viability, or capacity to sustain themselves;

d) Government was experiencing financial constraints and this had raised questions of efficiency in investment;

e) Zimbabwe's irrigation based export crops were being sold in a price-depressed international primary commodity market, but very little diversification had been attempted;

f) Irrigation increased social and environmental costs which warranted research;

g) The benefits and costs of irrigation agriculture had not been systematically studied before,and in the absence of any research, it had become accepted that irrigation was beneficial; a belief that required verification.

In strict financial terms, investment in water for irrigation is no longer a minor item of expenditure in Zimbabwe's national appropriation accounts. The costs are even more significant when consideration is also given to the fact that the irrigation industry is a heavy user of machinery, spare parts, fertilizers and insecticides, all of which are imported at very high cost, requiring scarce foreign exchange resources. For example, in the 1983-1986 National Plan, the Government of Zimbabwe committed itself to spend over Zimbabwean Dollars 500 million over a three year period on the water industry, and this was 20% of the total national budget of Z$2.5 billion over the same period. While the worry over the ever increasing capital cost could be assuaged by borrowings from international donors, it had become clear that the heavy burden of operation and maintenance costs could only be met by the developing countries themselves. Available evidence (Carruthers 1977, Clark 1971, Blackie 1984, and Palmer-Jones 1976) showed that operation and maintenance costs involved a massive commitment of resources which very few poor countries had been able to provide. Their scarcity had resulted in large scale abandonment of schemes, so allowing costly canal and dam infrastructure to lie idle, or to remain under utilized and thus unable to repay the loans used for construction. No donor agencies or banks lent for operation and maintenance costs, and the recipient farmers were unlikely to be able to meet the full costs involved. Clearly, implied in this is the fact that irrigation could not on its own meet all the operation and maintenance costs, and that LDC countries had to accept the choice and responsibility of either having to continuously subsidize irrigation agriculture, or scrap irrigation agriculture altogether.

It also has not escaped expert notice that despite the massive resources that have been injected into irrigation, poverty and malnutrition had continued to exist among the irrigators. In some countries like India and Bangladesh, the poor farmers had become heavily indebted to both rich farmers and the banks, and in certain cases, had actually lost their lands to their lenders. In Kenya, Swaziland and Sudan, irrigation agriculture, because of the need to repay the loans, had become wholly commercial, export crop based, with little or no link to the food supply problems of the countries, even during years of drought. In addition, all countries of tropical Africa that had embarked on irrigation, had experienced a wide range of environmental effects such as the widespread incidence of water-borne diseases such as malaria and bilharzia. Clearly, irrigation agriculture could worsen both social and environmental effects in the LDC's.

It has therefore been essential, given the foregoing background, to ask in this study the question; can irrigation as practiced in Zimbabwe be any different?

In attempting to answer this and many other questions the study has been restricted to the period 1980 to 1985. The choice of the period has been influenced largely by political events, which have a strong bearing on policy formulation and the economic development of the country. Zimbabwe became constitutionally independent from the British Government in 1980; and saw the assumption of power by a socialist government. The timing for this study on investment efficiency in irrigation has been opportune in that it allows for an in depth assessment of the post 1980 policy formulation process against the background of the pre 1980 policies and investment activities. The new government embraced a humanistic philosophy of 'growth with equity' as the main framework for public and private investment. The period of six years is adequate in that it allows the study to follow the policy from its initiation through adoption and implementation, and allows the results of most schemes started and rehabilitated from 1980 on, to be assessed at least preliminarily.

Above all else, the study is the product of the researcher's eight years interest in the area of efficiency in government's investment policies, an interest that developed as a student of development economics at Aberdeen University in Scotland and was strengthened by the first few years of experience as an employee of the government of Zimbabwe in a ministry responsible for public investments. The study is therefore raising more questions than answers. But before the questions so far raised can be addressed, it is essential that data sources consulted are reviewed, as they have a strong bearing on the quality and authenticity of the conclusions reached.

Data Sources

This study is not about irrigation as seen by an agronomist or water as seen by an engineer. The study's interest in water is not limited to its acquisition and storage only. Water is essentially a passive flow resource, that acquires usefulness only in its functional role. Benefits from any investment in water, will therefore accrue outside the water industry itself, that is, in the major water consuming sectors of the economy. It is therefore necessary to attempt to evaluate what role water plays in increasing the productive output of water consuming sectors. However, this is not an easy task since it is difficult to isolate the benefits from water taken alone; a range of other inputs are also necessary before water use can yield returns. Moreover, it is always difficult to address what is essentially a contingent question: What returns would have been produced if the investment in water and irrigation had not taken place, and funds used for other purposes?

In order to fully address all the issues raised above, a considerable amount of data are required. The task of collecting such data was never underestimated right from the beginning. The difficulties involved in data collection were considerable, and inevitably there were major deficiencies in the quality of available information. Among the many problems, the most crucial were;

1. The absence of any statistical data on small scale schemes;

2. Discontinuity in the recordings of the activities of most crop producers due largely to the 15 years of civil war. In the commercial crop production sector data collected and records are not disaggregated between rainfed and the irrigated part of agriculture, and the picture is further distorted by the prevalence of supplementary irrigation for most rainfed cereals. Even crop export figures are not disaggregated between irrigation and rainfed except for perenials like sugar and coffee, and as such it had been difficult to visualize the singular contribution of irrigation both to economic growth and to foreign exchange earnings. At the end of UDI rule most historical records contained in government files were destroyed by the outgoing government together with all records considered secret or damaging.

Perhaps most discouraging has been the unwillingness of the corporate agribusiness to provide any detailed information about their operations other than the information contained in their annual reports. Although this information is useful as a general pointer to the activities of the corporations, it however provides a very partial picture. Discussions with the major corporations in the irrigation sector bordered more on the generalities and less on the specifics.

At the start of the field work, a number of data collection methods were adopted; namely the use of postal questionnaires, consultation of existing records, interviews with various organisations and individuals in the water and irrigation industry, written and telephone communication with individuals and organisations, and through a number of visits to schemes, dams and canals for on-the-spot evaluation and assessment. The questionnaire method was largely abandoned when it became clear that; issues involved were complex and could not be recorded on the rigid frame of the questionnaire, without losing the critical parts of the total picture. For example, in the case of the small scale schemes the fact that their produce, mostly green mealies and vegetables, were sold in small unmeasured quantities at irregular and unmonitored times, meant that yields volumes could not be easily recorded on the questionnaire designed on standard measurements.

Among the consulted records were the following:-

a) Central Statistics Organisation: various crop production records for both the commercial and communal sectors for the period 1980 to 1985, where such data existed;

b) Quarterly Reports of Government Statistics: information on crop exports, imports, balance of payments and gross domestic product up to 1985;

c) Medical Research Report from Blair Research Centre: data on the incidence of malaria and bilharzia, and on the cost and attempt at control;

d) Feasibility Study Reports on Irrigation: as part of normal duties in the Ministry of Finance reading through all feasibility study reports on irrigation and water projects;

e) Data collected as part of the project appraisal exercise of water and irrigation projects for the Department of Irrigation (AGRITEX);

f) Data from Seminars, symposia and conference reports on topical issues in the irrigation sector;

g) Agricultural Marketing Authority: annual reports on crop deliveries and sales and on crop exports (1980-1985);

h) Hippo Valley Estate; annual reports and budget statements 1980 to 1985;

i) Agriculture and Rural Development Authority (ARDA)

Annual Reports: budget statements and production statistics 1980-1985;

j) Regional Water Authority annual reports: end of year reports and budget statements and problems (1980-1985);

k) The Zimbabwe Herald: occasional reports on the water and irrigation sector;

l) The World Bank Sector Studies: irrigation agriculture 1983-1984;

The range of issues involved is so vast that many areas were inevitably left out, and it is doubtful whether any effort for a comprehensive coverage could have altered the conclusions that have been reached on the basis of the data used. Because of the absence of important items of data, certain conclusions will border on speculation and in some cases are based on the author's personal experiences and judgement.

Research objectives

As a result of UDI, Zimbabwe was locked out of the International community for over 20 years. Over that period, little or no research was conducted on various aspects of the economy. Outside research interest in the country's irrigation agriculture stopped in 1965, with Roder's work on the Sabi Valley. At the same time, internal research within Zimbabwe was curtailed physically by the turbulent political situation, and institutionally by the racial policies of the Government of the day. In the absence of any socio-economic studies, the expansion of irrigation was left to the politicians, and to the engineering and soil scientist dominated institutions. What little research and investigation has been done is heavily biased towards the physical aspects of the industry; a lot of attention has been directed towards studying river catchment behaviour, soil erosion, sedimentation and plant-soil and water relationships. The emphasis throughout these studies is on the increase of crop yield, and on further expansion of water capacity, a situation exasperated by the recurrent cyclical droughts. Studies of a critical nature have been conspicuous by their absence until recent work by the World Bank, especially the work on Chisumbanje Irrigation Scheme.

In view of the absence of previous comprehensive critical work, there is a need first to review past policies and practices and to establish the historical causal relationships behind the development of both water and irrigation agriculture. The aim is to draw conclusions from the past that may have a bearing on present policy and investment strategies and direction.

In this essentially descriptive part of the study, special attention is focussed on the historical reasons behind, on the one hand, the demise of the small scale peasant irrigation schemes, and on the other, the rapid growth of the large scale commercial irrigation sector. This assessment will be carried out against the background of the economic fortunes of the country.

The next objective will be to review current investment practices in the field of water and the expansion of irrigation, especially the revival and the rehabilitation of the small scale subsistence sector. The aim is to assess the extent to which recent investment policies, and levels of resources invested, can achieve economic growth and distributive equity. In the process of fulfilling this objective, uneconomic water and irrigation practices, especially those unlikely to meet the political aims of growth and of equity, will be assessed.

Before such an assessment is possible, it is clearly essential to establish the nature of benefits that are associated with this type of investment, to whom they will accrue, the politically optimal way of distributing them and their effect on further investment policies. It is also essential to establish the costs involved, the allocation of responsibility for meeting the costs and their effect on policies for the further expansion of irrigation. The negative aspects (intangibles) inevitably associated with investment in water and irrigation agriculture will also have to be assessed, so as to bring into full view the total range of social and environmental costs that have to be paid and by whom.

And further, the most central objective is to assess the institutional organisations that have been put in place for plan formulation and implementation. It is important to establish how these institutions are structured, work, and formulate plans and projects, what criteria they use in project appraisal and how they achieve the set goals of growth and equity. During the analysis problems that impede implementation and the realisation of set goals, will be explored. Of interest is the role of public subsidies in the industry and the effect of this on investment patterns and on policy implementation especially with regards to self-sustaining investments. The question of subsidization is closely associated with water pricing and capital cost recovery policies, both of which have a direct effect on investment resource outlays.

The last objective of the study will be to look at the physical and economic limits to the expansion of irrigation in Zimbabwe, and to suggest alternative ways of achieving economic growth and distributive equity, through either land reform aimed at making land accessible to every able-bodied rural person, or through greater exploitation of rainfed agriculture to its fullest capacity, as well as recommending for future study the assessment of the possibility of using inter-regional food transfers. None of these alternatives have been fully investigated in this study or tried, and their consideration here is an attempt to point out that alternatives to irrigation do exist, that they need to be assessed and that they could offer greater benefits to the majority of the peasants, at present overcrowded on climatically marginal lands.

Before embarking on the evaluation of policy and practice it is necessary to establish an analytical framework. An attempt will be made to do this in Chapter 2. In it the theoretically optimal evaluative and analytical tools will be considered. Throughout, the twin policy objectives of growth and equity' are employed as the criteria against which investments in water and irrigation are judged. Growth implies increased output and high levels of reinvestment of returns to promote a rapid expansion in the size of the national economic cake. To achieve this, the Government of Zimbabwe, in its choice of investment areas, will have to select those areas of the economy where it can pursue an 'economic efficiency' policy. Scarce resources will be invested to produce maximum financial and economic returns. The chosen evaluative tools for this study are cost-benefit analysis and cost-effective analysis, these will be employed as frameworks to find out whether investments in water and irrigation have been maximizing output, or financial and economic returns. Equity, and in this case, distributive equity, is more of a consumption policy objective, whereas a growth policy emphasizes savings and investment. Government's commitment to equity means the achievement of a more equal distribution of the rewards from investments for the purposes of consumption. This consumption is measured in terms of the size of the income of every consumer, which in turn is a measure of the standard of living attained as a result of the redistributive policy.

Public investment can be used to deliberately influence either growth or equity, depending on the priorities of government. But growth with equity, as a policy objective, guiding national investment efforts, can be both contradictory and arguably unachievable. It is clear that a policy designed to promote growth must limit current consumption.

This makes it essential that more attention be paid to ensuring that scarce resources are used effectively. It may be politically and ethically desirable for government to diverge from an economically optimal investment strategy, as seems to be the case in irrigation, but if this is so, the economic and financial costs of such departures should be established, so as to be taken into account when policies are formulated.

Chapter 3 traces briefly the causal factors behind the history of development of the water and irrigation industry, placing emphasis more on the shift of the policy frame and on the practical fortunes of the schemes. This fairly narrative part of the study also looks closely at the institutional and political arrangements that have had lasting effect on the industry. The aim is to elucidate from history, the origins of the current investment policy. The chapter ends by giving background to the economy during the period of the study against which investment plans and programmes in water and irrigation are evaluated.

Chapter 4 attempts to bring together all the cost outlays involved in the commercial sector; namely the capital outlay for the construction of water storage facilities for commercial irrigation, canals and other relevant infrastructure. But because water is not the only input required for irrigation agriculture to produce benefits, the cost of a range of other inputs, and their availability are also assessed. This assessment takes into account allocation of responsibility in meeting the costs involved, and inevitably, the question of subsidies is addressed. The organisational structures and their operations are also analysed so as to understand the role they play in the losses and or gains of irrigation agriculture. Most of the evidence and reference in this chapter is drawn from the commercial irrigation sector.

Following this discussion on the cost outlays, Chapter 5 assess the benefits arising from that expenditure. This is done through the assessment of the agribusiness's financial return for the period of the study, and the yields that the use of irrigation has enabled to be realised. Since commercial irrigation is expected to fulfil more the policy objective of growth than of equity, the chapter will not only concentrate on the profit margins accruing to the producers, but on the economic benefits or the linkage effects with the rest of the economy. But since commercial irrigation is export-crop based, the chapter will assess the international market price behaviour for these crops , as this will indicate the level of foreign exchange Zimbabwe has been earning from exporting the crops as well as the self-financing capacity of the schemes.

Whereas Chapter 5 will discuss issues relating to growth maximization, chapter 6 focuses on the small scale peasantry sector. The central theme of the chapter is the extent to which small scale irrigation agriculture has acted as an effective system of producing equity benefits, compared to, say, rainfed agriculture or any other system operating in the economy. The question to be addressed is of the relationship between public expenditure (mostly subsidies) in support of small scale irrigation schemes and the nature and level of benefits obtained. Since the Government expects small scale irrigation to fulfil a multitude of objectives within the peasantry sector, the chapter attempts to assess the degree to which these are fulfilled.

Although almost all cost outlays are discussed in Chapter 4, a set of peculiar costs are not discussed there. These costs are collectively referred to as the intangibles' and in some cases they also include benefits. Intangible costs and benefits are the unplanned for outcomes concomitant on the planned investments. Chapter 7 discusses the range of the observed intangibles associated with irrigation agriculture in Zimbabwe.

The aim is to assess the effect, the addition of these intangibles to the appraisal and evaluation of irrigation agriculture, will have on both the benefits and cost outlays, and indeed on the justification for irrigation agriculture. By their nature, most of these intangibles defy quantification, and as such, they are qualitatively discussed.

Lastly, Chapter 8 attempts to draw together major conclusions arising from the discussions in the previous chapters, and also makes recommendations intended to point the way forward in the light of the experiences discussed in the main text of the study.

CHAPTER TWO

THEORETICAL TREATMENT OF PROJECT ASSESSMENT TECHNIQUES

INTRODUCTION

The Government of Zimbabwe, like any other government invests scarce material and human resources to meet or realise set policy objectives.

It does not necessarily follow, that in the process of investing these resources, the employment of the resources would be effective. As McKean (1958) has already shown in the experience of the United States of America, governments are not necessarily guided by the economic ethos of efficiency in resource employment. Resource under-utilization, in opportunity cost terms, has been found to be very wide spread (McKean 1958). However, this must not be taken to mean that governments do not wish to realise value for their resources, especially in the Third World where resource scarcity is rampart.

It follows therefore that in the assessment of how the Government of Zimbabwe has used scarce resources in the water and irrigation sector to meet its objectives of economic growth and of income equity, the key questions to be asked are those pertaining to how the resources have been used and whether this was the best way of using these resources in relation to the benefits realised. Answers to these central questions can not be arrived at easily. There is therefore a need to employ some analytical tools that would indicate whether the set objectives were being met and at what price.

In attempting to assess the role of irrigation in meeting government policy objectives, two analytical criteria have been used as frameworks for analysis. No new criteria has been developed for this study, and the criteria adopted here have largely been employed as they are theoretically developed by other researchers with minor modifications where the absence of data did not allow for full adoption. For the large-scale commercial sector, cost-benefit analysis

(CBA), and the normal criterion of maximizing net benefits, is adopted as a framework for assessment. However, Cost-Effectiveness Analysis (CEA), as the criterion of cost minimization, is used as a framework to assess performance and goal achievement in the small scale irrigation sector. The difference between the two methodologies is a matter of degree. They are both rooted in the notion of economic efficiency, but the latter is more suited to projects designed to meet the political objectives of equity.

In the small scale irrigation sector, production is mainly geared towards meeting subsistence requirements of individual families, and any sales of the surplus are also for the same purpose. The main characteristic of the sector is that output is unquantified in money terms as no real measurement takes place. It is however possible to estimate the level of yield realised, and to apply some sort of monetary value to it, although this is not done as a matter of procedure. What perhaps is important in the assessment is not the yield per se, but the level of output of consumables which can be realised by irrigators from a given set of resource inputs. In other words, the study is interested in finding out whether small scale irrigation is the most cost-effective or least cost method of fulfilling consumption requirements on a self-sustaining basis for the peasantry sector. There is, therefore, a comparative element to the assessment. In Zimbabwe the small scale irrigation sector comprises, those farmers both in the communal and resettlement areas with land holdings of less than 5 hectares. The widespread use of public subsidies in this sector could distort the economic choices to be made.

It is important to note that these two methodological techniques are not actually employed by the government in the selection of projects, even when donor agencies have insisted on these as part of the pre-condition for financing and implementing a project. Most of the nearly 183 small scale projects and many large scale commercial projects have already been selected on other grounds. By taking a sample of these projects and assessing them using cost benefit analysis and cost-effective techniques, it should be possible to establish how far the chosen projects have or are likely to fulfil the objectives of 'growth' and 'equity'. In some cases the assessment can be reduced to the hectare level using generalised costs and benefits for any given crop. In addition, since one of the objectives of the thesis has been to consider alternative methods of achieving 'growth and equity' it has also been necessary to consider the effectiveness of the Land Resettlement Programme which is designed to develop dry land cultivation and to promote an equitable share of production inputs such as land, finance, capital and human capital. Equally important is the consideration of intra-regional food transfers, in so far as this concept recognizes the essence of respecting climatic and edaphic characteristics in crop production.

Cost-Benefit Analysis and its role in Commercial Irrigation Development

Commercial irrigation comprises 93% of all irrigation activity in Zimbabwe. The justification for the use of Cost Benefit Analysis (CBA) for this sector lies in the fact that the sector employs resources with the aim of maximizing profit, that resources used are recorded in money values and output is mostly for sale; the inputs and outputs are therefore quantifiable in monetary values. The sector therefore can appropriately be evaluated by employing the economic efficiency criterion in the allocation of resources. In the process of pursuing profit, high crop productivity should be achieved, and hence economic growth should be realised. However, whether growth maximization actually occurs will depend on whether profits are actually re-invested within the economy. This is a very important consideration, especially when it is considered that the dominant factor in Zimbabwe's commercial irrigation is the existence of corporate multinational agribusinesses producing high value export crops, and the high possibility of externalisation of dividends.

As an investment assessment criterion, the notion of economic efficiency is basic to neo-classical economics and provides one of the key rationales for the free market system (Rees 1985). For this reason, it is chosen here in the assessment of commercial irrigation, a sector still strongly linked to the free market system. The assumption is that private farmers and agribusiness have a predisposition towards efficiency, albeit - with some recognized imperfections, which could, at least in theory, be corrected. Furthermore, it is increasingly becoming common for the government to require public sector agencies to work to the same objectives and to do so by adopting more 'commercial' attitudes. All parastatal bodies and state farms in Zimbabwe have, at least at the level of rhetoric, been encouraged to operate on private sector lines and to show evidence of profitability (Zimbabwe Herald, February 1986). The Commission of Inquiry into Parastatals set up in 1984/85 was conceived within this vein of thinking. Although the results of parastatal operations have fallen far below policy expectations, this does not however negate the spirit of the intention.

Before cost-benefit analysis can be employed in the assessment of Zimbabwe's commercial irrigation, it is important to appraise the theoretical basis of the methodology, so as to understand both its limitations and strengths, and their implications for the present study.

The Theoretical Basis

Cost-Benefit Analysis is an application of the theory of resource allocation. The rationale for such an analysis, along with the allocation theory, can only be understood and vindicated by reference to propositions at the centre of welfare economics. Traditional welfare economics is concerned with the maximization of social welfare, assuming that individuals are the best judges of their own personal utility functions. The concern is with the realization of total welfare (present value) irrespective of the distribution between people. Theoretically, changes in people's welfare should be measured by their willingness to pay for the benefits of a project. These benefits and costs borne by individuals are aggregated into benefits and costs by simple addition. However, because of the existence of externality costs, governments intervene in order to attempt to socialise the costs as well as the benefits, at national level. Accordingly, a project is to be undertaken if its social benefits exceeded its social costs, that is if its 'net social benefit' is positive.

However, public and private investments do not always seek to maximise efficiency. There are problems of equity, the solutions of which cannot be realized within the limitations of this criterion. It is clearly evident, therefore, that the limitations of the theory have rendered Cost Benefit Analysis unable to fully address the equity issue, and these have become very central to every investment process. Hence the criterion is used in this study as a framework only where key objectives of government, like equity, are less important.

The Assumptions

The major theoretical assumption upon which Cost-Benefit Analysis is built is that of a perfect competitive market. For market mechanisms to automatically produce welfare maximization, the following conditions must hold:-

1. Consumers of goods and services must be rational beings and consistent in their pursuit of maximizing individual utility from their consumption.

2. The consumers' (of project benefits) preference must be such that their willingness to substitute one commodity or benefit for another in response to price changes, diminishes as more and more is substituted.

3. Consumers' preferences (reflected by their willingness pay) must be independent of the purchasing activities of others, for otherwise the consumption of one household may violate Pareto Optimality rule, by leading to a loss of satisfaction in another; an aspect which will not be reflected in the prices of goods.

4. The producers, on the other hand, must pursue consistently the principle of profit maximization in project implementation and general investment.

5. Production must be carried out under conditions of decreasing returns so that there is no threat to competition by large monopolistic corporations.

6. There must be no physical interdependence among the production processes of different agencies, that is, there should be no externalities resulting from production.

7. The market where goods and services are exchanged must be perfect. This means that all participants in the market must have complete information about prices and commodities, and that all of them, on both sides of the market, are so small that they can force no influence on the prevailing prices.

8. In order for exchange to be possible, commodities must be of a form which is marketable, that is the sellers must be able to withhold the product from individual buyers, and thus forcing the buyers to pay the market price if they are to obtain goods and services.

9. The Pareto basis of the CBA model also pre-supposes that the resultant distribution of income is appropriate, and that exchange is taking place in a state of economic stability or equilibrium.

10. The resources in the economy are assumed to be fairly mobile, and moving to optimal uses. Such a movement is regarded as a natural consequence of profit maximization, which allows owners to sell to the highest bidder. The cost of transport enters profit maximization calculus in an optimal spatial flow of resources.

11. There should be full employment of both human and material resources.

12. Most crucial of all, the price in the market is taken to represent the value of the commodities, and therefore consumer preference (expressed by their willingness to pay) reflects consumer sovereignty, in the pursuit of individual welfare. Prices therefore are regarded as a measure of the marginal social cost and marginal social value.

While these assumptions are necessary for the theoretical development of the CBA model, in practice none of these assumptions can ever be fully met. Does this nullify the usefulness of the model in the analysis of practical situations? Not necessarily. Although the assumptions are inapplicable, and can in some cases cause methodological confusions and problems, it has to be accepted that the assumptions play an important role which must be taken into account in any practical Cost-Benefit Analysis. For example, since all investors, public and private, would seem to be concerned with the efficient use of resources regardless of the objectives being maximized, the assumptions would help by establishing conceptual frameworks within which such thinking or concern could find expression. The real world operates under imperfect market conditions where there is prevalence of monopoly, massive unemployment of both material and human resources, political interference in optimal decision processes, and acute poverty and unequal distribution of incomes as well as numerous unstable, inflation ridden economies. The existence of all these factors that negate the theoretical requirements for a CBA model, have not stopped the search for the improvement of the CBA as a tool to aid efficiency in decision making.

Recent Advances

Recent modifications of the CBA model, started as far back as 1968 and are largely associated with developments in the Less Developed Countries (LDCs). The use of CBA in these countries has been associated with the activities of donor agencies from the developed countries, such as the World Bank (IBRD), Oxfam, IMF, UNDP, FAO, as well as bilateral aid agencies like the Overseas Development Administration (UK), United States Aid for International Development (USAID) and many others. The modifications and additions are nearly all due to the fact that the basic Paretian assumption of the perfect market upon which the CBA mode is founded, although not fully applicable in developed countries, are non-existent and inapplicable in all LDCs. In the LDCs there is universal absence of economic stability, and all governments, without exception, are heavily involved in the economic activities through either a chain of fiscal controls affecting domestic price fixing, export controls, import restrictions, subsidies on domestic consumption and various taxation measures, or through direct participation in the production process using parastatal organisations.

Given that the criterion uses large sets of data, the absence, in some countries of correct sets of data, and the complete absence in others of a data collection tradition, has meant that some modification of the model is inevitable. Part of the drive behind the modification has been the need to embrace the equity issues neglected by the classical theoretical CBA, given the massive poverty in most LDCs and chronic inequalities between the urban and the rural communities. Because of this new concern for the poor, donor agencies have sought to load CBA with tools to interpret this bias.

Perhaps the most important factor has been the insistence by donors for some mathematical logic and accounting system in project formulation, planning financing and implementation. Modifications have been carried out by economists and analysts, working singly or for aid agencies as indicated on Table 1.

These contemporary methods focus attention upon questions of relative valuations, timing and the incidence of costs and benefits. The values of factor prices and outputs of projections have been estimated by determining shadow rates which represents the social opportunity cost of resources. There has been less emphasis in LDCs upon simulating the values of unpriced items. Analytical procedures have tended to cope with distorted market prices and have dominated the rural planning literature at the neglect of risk assessment, and hence there has been considerable divergence between project expectations and outcomes.

TABLE 1

RECENT ADDITIONS TO PROJECT APPRAISAL METHODOLOGY

Main Authors	Little and Mirrless	Dasgupta Sen and Marrglin	Gittinger	Squire and Van Der Tak
Sponsoring Organisation	OECD	UNIDO	IBRD	IBRD
Year	1968	1970-72	1972	1975
Main Users	Research ODA (UK) KFW (West/ Germany)	UN Agencies	World Bank FAO	IBRD Research
Numeraire	Foreign Exchange At Disposal of Government	Consumption In Domestic Currency	Value added In Domestic Currency	Public Income In Foreign Exchange
Main Thrust	Consumption vs Investment	Consumption vs Investment	Economic Efficiency	Income Distribution

Evaluation of development experience in the LDCs since Second World War has shown that although laudable increases in Gross National Product (GNP) have been achieved in many countries, the benefits from this economic growth have failed to trickle-down to the poorest, and that the differentials in real income between the richest groups and the poorest have widened (I D Carruthers, 1978). There has therefore been a shift from the preoccupation with growth as depicted by the efficiency criteria, of the 1950's and 1960's. The most recent writings on project appraisal (especially the work by Squire and Van der Tak 1975) focus on the dilemma of project income distribution, and suggests ways, in which the project selection procedure itself, by weighting benefits received by the poorest, can help mitigate or eliminate the existence and growth of abject poverty.

Since the late 1960's CBA has been developed as a tool to obtain a better distribution in resource disposition between savings (investment) and consumption. Most of these recent additions associated with LDCs have been developed by welfare economists from developed nations and therefore there is an implied internationalization of standard procedures. Gitternger (1972) is primarily concerned with the importance of distribution between financial and economic returns, that is, with establishing the value added to national wealth from a project, but still ignores income redistribution. Little and Mirrless (1968,1974) concentrate on the fact that in LDCs, savings necessary for investment are suboptimal. They therefore propose a scheme for creating shadow prices which indicate the opportunity cost of consumption rather than investment. Squire and Van der Tak (1975) recognizing the inabilities of the LDC governments to determine the distinction between savings and consumption, advocate a greater income redistribution, through weighting of income, in favour of the poor. They believe that the best way of effecting income redistribution is at the project design and appraisal stages. They call shadow prices for the calculation of growth, efficiency prices, and those for income distribution, as social prices. This trend of assessment has given birth to the currently fashionable policy of 'Growth with Equity' adopted by many LDCs, and is currently the subject of assessment in this study on Zimbabwe.

By putting greater emphasis on the use of shadow prices, (international prices) all these additions have one common fault. They require huge sets of data that very often are not available in the LDCs, and they are mathematically involved requiring skills that are not always available and are therefore very, very costly. These advances have clearly expanded the practical horizon and scope of project assessment beyond the limitations of the Paretian frame.

The Practice of Cost-Benefit Analysis

All forms of Cost-Benefit appraisal are exercises, using limited information, to make predictions about future 'with' or 'without' situations. They are therefore always subject to uncertainty and are critically dependent on the quality of the basic data. Moreover, the analysis is complicated by the need to identify all relevant costs and benefits. The selection of the relevant parameters is always a matter of judgement.

In this ex-post evaluation of the water and irrigation sector, costs and benefits are divided into two categories: Primary costs incurred and benefits received refer to direct project inputs and outputs, immediate to the project; Secondary cost and benefits assessed in this study are those which projects under review may have caused elsewhere in the economy. These costs and benefits exist where a project enables resources to be used more efficiently in the economy or leads to extra claims on resources elsewhere. Tracing the total impact of a project can be very difficult either because the impact cannot be readily identified or cannot be easily priced.

Ex-post evaluations of this nature are particularly affected, in addition to the above, by the absence of data collection traditions, and by the fact that all impacts concomitant to the project are not necessarily the result of the project, but of other activities that are external to the project. There is therefore an obvious problem of project delineation or boundary, that any practical CBA has to tackle. For example, it is not very clear whether the impacts of irrigation projects under review could be restricted to the schemes themselves, or should be broadened to include the credit banks, the input suppliers, transporters of inputs and the consumer. Although all these have links to the projects, to include them would result in claiming unfairly to the projects, activities that would still exist in the absence of irrigation because of the universality of these activities. Unless it can be proven that an activity would not be there in the absence of irrigation, the study will otherwise not include all other impacts remote from the project; other than as externalities. Valuation of these is the next problem.

The difficulties which arise in any CBA are particularly pertinent in the present study, since major data deficiencies were encountered and there were also problems in calculating the true opportunity cost of inputs used by most projects in a society where subsidies, unemployment and product price fixing are all endemic. The problems that are faced by the present evaluation can be demonstrated by looking in detail at the steps that are taken in any CBA. As this is a sort of 'hindsight' evaluation of projects that have long been implemented, and not the normal ex-ante appraisal of the projects-to-be, it has particularly, been difficult to have an appreciation of the 'with' and 'without' project situations, and the relative values of resources used.

Theoretically, CBA calculation in an ex-ante appraisal situation would follow the following steps:

Step 1:

The undertaking of any project can only be justified in relation to some normative objectives. Therefore the first step is the identification of all the sets of objectives to be fulfilled by the projects. In Paretian terms, the main objective would be economic efficiency. All projects would be expected to optimise resource use in order to achieve this. However, in the real world, and in the Third World, it is not uncommon for government to expect a lot more out of the projects. As a result of these expectations, problems arise due to a multiplicity of objectives, most of which can not be measured quantitatively. Although these objectives are important in their own right, to require that every project undertaken should fulfil them raises problems relating to calculations. It is also conceivable that the apparent lack of focus on one or two objectives would lead to considerable sacrifices of important aspects of the projects.

Clearly, issues of regional balance, or any other objective for that matter, can only be achieved at the expense of other, equally valuable objectives. The analyst's problem, is that it remains unclear as to who will decide on the relative importance or weight of each objective. The analysts cannot prioritize, without appearing to be usurping from the politicians their right as elected representatives of the people, to take decisions. To trust the politicians assumes that they have no biases and personal interests in the projects, a situation that is highly unlikely, given constituency interests.

Step 2:

If the multiplicity of objectives is a problem, the identification and calculation of cost streams is not always easy. Project costs represent any direct and/or indirect consequences arising from the decision to invest. The cost of a project can be divided into variable and fixed costs (quantified in money terms) and intangible costs (not easily quantifiable). Tracing of the streams of variable costs of a project, namely the inputs of raw materials; labour, etc and the fixed costs (maintenance, administration etc) is usually relatively easy. The intangible costs present both methodological and practical problems, in that on the one hand the boundary of costs related specifically to the project are not easily identifiable, and on the other hand most of the costs associated with the project cannot be expressed in money terms or quantified in any conventional unit of measurement. Theoretically pecuniary externality costs have been excluded from any CBA exercise, because they have traditionally been regarded as transfers of resources and not reflecting total real gains or losses, so they were simply ignored.

However, in the real world and in LDCs in particular, where the absence of a perfectly competitive market is exaggerated and price formations distorted by an array of public policy regulations, the valuation of the cost of inputs to a project represent major problems. Almost all CBA practitioners, in particular Little and Mirrless (1968-1974) and Squire and Van der Tak (1975) have advocated the use of shadow prices that approximate the pareto-efficient prices as a way out. For example, in an economy where there is less than full employment like Zimbabwe, the current price of labour will overstate the social case of employing an unemployed person, whose opportunity cost can be regarded as minimal. However, if labour is priced at zero but has actually to be paid for, then the project might loose money. The problem with this solution, is that there is often no data that can be used to estimate the opportunity cost of resources used in a project, and where non-traded goods constitute a larger part of the input, the problem becomes more complicated.

Step 3:

In any practical CBA, there is a problem of tracing the stream of benefits (quantitatively) arising from a project, especially since most of the benefits accrue at a future time. A lot of unforseen interferences could hinder the future realisation of planned benefits in the intervening period. Apart from the problem of tracing the stream of benefits, there is also the problem of valuing and quantifying as well as distributing these benefits. Today, decision makers are no longer interested in output maximization per se, but in influencing the distribution and consumption patterns of the benefits produced. In the LDCs where disparities in income and accumulated wealth are very wide between social groups, with the majority of the people in the category of low income, the achievement of equitable income distribution has become a forceful objective to be addressed by every investment project. Squire and Van der Tak (1975) have attempted to approach these issues through their Social Cost-Benefit Analysis, which lays greater emphasis on the selection of projects for investment, on those that would specifically reduce income inequality, ameliorate famine conditions and eradicate poverty, or those that increase the standard of living of the poorest in the society. Except for huge data sets required, this method would be appropriate for evaluating projects for the poor, including small scale irrigation.

Several methods (MacAllister 1980) have also been proposed for determining weights that would be applied to the benefits received by people at different income levels. One method advocated is to determine the weight from the schedule of income tax rates by income level. The basis of this approach is the notion that society takes a smaller percentage of the last dollar earned by the low income earner than from the high income person, because the dollar is judged to be more valuable to the poor person than to the rich person. There are many variations of the weighting method that have been tried; and all of them are attempting to put some objective rationality to the question of distribution instead of relying on the politicians and the market to do so.

Whatever methods are used, the distribution of the benefits of any projects will always be unequal. The equity issue is addressed at length separately.

Step 4: Time value of money and discount rate decision

When the streams of costs and benefits have been identified for every project, the common practice in CBA is to discount the cost and benefit streams to their present values. This is done by the use of discount tables. The reason why discounting is necessary is because costs and benefits take place in different time periods and are therefore not directly comparable over the project's lifespan. The total discounted benefits are added up and compared with the total discounted costs; and if benefits are more than costs, investment can go ahead. The theoretical basis for the procedure is the fact that people are not willing to pay as much for something they are to receive at some future date than if they can have it immediately. Opposing this view are those who believe that present activity must take into consideration the needs of future generations. According to the theory, there exists a quantitative ratio between present and future gains to which a person is indifferent, and this ratio can be expressed by a rate of interest, or a compound interest equation (MacAllister 1980):

$$Vt = Vo\,(1+r)t \quad \text{or} \quad Vo = \frac{Vt}{(1+r)t}$$

Where Vt = Value at the end of year r
Vo = Present value
r = Rate of interest
t = Time in years

In project analysis, the interest rate is called the discount rate, which is compound interest in reverse. Since benefits and costs occurring at different points in time are not equally valued, they are like oranges and apples, requiring some adjustment in their measurements, using a pre determined discount rate, as indicated above.

The adjusted values are then added to arrive at the total present value of the stream of future values. CBA evaluations seldom consider impacts beyond 25 years, because however large the impacts maybe, once they are discounted to present value using even a comparatively low discount rate, they do not amount to much. It is therefore common practice in CBA to use 25 years as a cut-off point, beyond which all impacts are ignored.

The difficulty arises over the choice of the correct discount rate. The type of discount rate to use is very important, and it has an effect on the type of projects selected. There is a great deal of disagreement theoretically and practically over the correct discount rate to be used in assessing public projects. Rates from 4 to 12 percent are commonly encountered in the literature. A variation of only 2 or 3 percentage points can make the difference between accepting or rejecting many large scale public projects like irrigation schemes.

The arguments are directed principally on the implication of choosing higher or lower rates. The theoretical argument centres on the implication of any choice: The use of lower rates will increase the number of long-term capital intensive public projects. Those in favour of this argue that the present generation should invest more of its resources for the benefit of the future generations and that present generation should devote more of its resources to long-term programmes and projects for conserving the natural environment. On the other hand, the use of a higher discount rate will reduce the number of long-term capital intensive public projects and make more money available for private business investments and for short-term public programmes. Higher rates would release funds needed to deal with more immediate social problems that are urgently in need of attention, and are far more important than making long-term investments for the benefit of future generations, (who, it is theoretically argued, will have much higher per capital incomes, and, therefore, will be quite able to take care of themselves without the present generation's help), and that higher rates would reduce the number of large scale public projects that destroy the natural environment hastening the depletion of non renewable resources, and foreclosing future options.

The implications to the present study of these arguments are obvious. Irrigation schemes and reservoir construction projects are by their nature, long-term capital intensive programmes. The streams of costs and benefits stretch far in the future, and these projects typically absorb vast amounts of scarce resources both in the short and long-term. The choice of a correct discount rate is therefore very paramount.

Step 5: The Decision Rule

Once the discounted costs and benefits have been established, it is necessary to apply some decision rule to test whether the project is economically viable. Three basic rules have theoretically been devised; the net present value, the cost benefit ratios, and the internal rate of return. These decision rules apply equally to economic and financial analysis.

The Internal Rate of Return (IRR) is the discount rate at which the streams of cost and benefits are equal. The higher the IRR, the better the project, so irrigation projects, for example with a higher IRR are to be preferred to those with a lower IRR. The IRR method has the convenience that it enables a comparison to be made between the rate of return of projects and the minimum, or cut-off rate, that the government or financing agency may stipulate, and rates of return on other feasible investments. The IRR criterion enables decision makers to accept or reject projects that come out respectively above and below a reference predetermined rate; say the economic cost of capital, if all projects are funded from borrowed capital resources, as is the case with most dams and commercial irrigation schemes. All projects are ranked according to how high or low the value of their IRR is to the reference rate. The limitation of this ranking is that, like the cost benefit ratio, it does not single out the initial investment capital outlay as a crucial factor.

The IRR can be defined as that discount rate at which the Net Present Value (NPV) of a project is zero. The IRR and the NPV are thus linked by definition. The NPV is simply the difference between the discounted streams of benefits and costs. It is the value, discounted to the present, of doing the project, rather than not doing it. The NPV can only be worked out from a pre-determined discount rate. This needs to be the same for each project compared. One approach is to estimate what real rate of return is available on investments in the private sector, and to require that all public investments, like the irrigation schemes, achieve at least the same, or to accept the government's own estimate of the minimum acceptable rate of return on public investment, and use this as the discount rate. However, NPV is concerned only with the total net benefits and neglects the way such benefits are allocated between social groups. When equity is an objective, it may then be necessary to use some form of distributional weights before the 'accept' or 'reject' decision is made.

The NPV can be supplemented by the Benefit-Cost Ratio (BCR). The BCR is the ratio between the discounted total benefits and costs. Thus, if the discounted total benefits of an irrigation scheme are 140 and discounted total costs 100, the benefits cost ratio is 1.4:1 (and the NPV is 40). This ratio enables the decision maker to distinguish projects whose NPV is high because it is large from projects that have a genuinely high rate of return (IRR). As such, both the BCR and the NPV should not be quoted without stating the discount rate that has been used.

In most cases the three decision rules will produce the same ranking of projects according to their attractiveness. There are however, cases where the use of the IRR on the one hand and the NPV and BCR on the other will produce different results. Generally, the three rules are affected by changes in crucial data, and are sensitive to variations of assumptions during the appraisal process.

Step 6: Dealing with risk and Uncertainty and the Use of Sensitivity Tests

Future benefits and costs cannot be predicted with certainty, which always makes the results of CBA prone to error. The accuracy of prediction must recede the further the analysis is pushed into the future. With regards to agricultural projects which are at the mercy of erratic weather regimes, insect epidemics, droughts, and farmers' general ignorance, future predictions of a year or two from the present could be highly inaccurate. Uncertainty is therefore inherent in project analysis, especially when it is considered that estimate of costs of shadow prices and of consumer surplus and externalities are all approximates. Uncertainty increases when these estimates are projected into the future as required by the CBA analysis. CBA does not treat uncertainty, but deals with most elements of risk (McAllister 1980).

Since benefits associated with public investment can only be realized though a complex chain of 'risky' events, calculation of risk is essential. McAllister (1980) developed the following risk expectation equation:

$E(x) = xip(xi)$

Where $E(x)$ = the expectation of x

xi = the outcome of event i (e.g. - drought or locust epidemic)

$P(xi)$ = the probability that i (risk) will occur.

When the probability of events affecting the magnitude of impacts cannot be ascertained, the expected loss cannot be calculated. In such situations the recommended method is to carry out a series of sensitivity tests.

Sensitivity analysis involves considering the effects of plausible variations in some of the assumptions made on the outcome of the results given the nature of the data. The objective of carrying out the sensitivity analysis is the belief that this would lead to:

a. Improvement in the understanding of the nature and workings of projects;

b. Increasing expected net-benefits by improving the design of the projects; and

c. Reducing risk by suggesting precautions to be taken.

Most irrigation projects are, in practice, sensitive to variations in the discount rate, because the discount process affects the costs and the benefits disproportionately. This is especially the case in projects for which benefits and cost coincide least in time. The most practical example is the construction of reservoirs, that will start to generate, in the distant future, a string of benefits over a long period.

Sensitivity analysis is therefore a check on the results of a project analysis if crucial variables were to differ from the estimated expected values used in the analysis. While it may enable the identification of areas needing further investigation, on its own sensitivity analysis does not remove the risk and uncertainties associated with all investments, but merely reveal to decision-makers the tenuousness of their choice.

<u>Step 7</u>: <u>List All Intangibles</u>

There are analytical problems arising from consideration of the intangible effects. Traditional CBA has ignored the question of externalities because they present problems of measurement, and the fact that some of them are considered to represent resource transfers and not appropriations. The practice has been to consider them theoretically as being minor or insignificant. Studies have consistently shown that, particularly in the case of agricultural projects, spill overs can affect the actual cost and benefit calculations. It is possible that externality price effects caused by the projects may lead to higher prices for the inputs that the project require and lower prices for the outputs they produce.

Since nearly all projects produce some externality effects it has become necessary that these be taken into consideration in any appraisal exercise. How this can be done remains still a major problem for both governments and analysts alike. The problem arises from the fact that most externality effects are unquantifiable and may have no market value. In the agriculture sector the externalities that present quantification problems for example, are those relating to pollution by fertilizers and insecticides, the increase in the incidence of bilharzia and malaria following the set-up of irrigation schemes, and disruption of social life resulting from large surface water impoundment. Attempts at surrogate pricing as a way of arriving at the value of such impacts have had little applicable relevance. In most cases it is sufficient to list these impacts and carry out a qualitative assessment of their influence on the cost outlays or streams of measurable costs and benefits of projects, as part of the main appraisal of projects. In this study externality effects are discussed in Chapter 7.

Criticisms of the CBA method

Notwithstanding all the systematic steps presented above, the CBA method has its own weakness and strengths that must be considered and appreciated before the use of the method. Clearly no methodology has been subjected to such bitter and extensive criticism throughout its development as the CBA method. It would be futile to try to capture all the criticisms that have been laid at the door step of the method. It is essential to restrict the analysis to those relating to the current study on Zimbabwe. This, in essence is a critique more of the Little and Mirrless Method and that of Squire and Van der Tak which are considered suitable in the assessment of this study.

Objections to the methodology already raised in the literature can be divided into two major areas; those concerned with the theoretical aspects of CBA, and those that look at its practical application in LDCs. Theoretically, critics have called into question the whole conceptual basis of the CBA method. Kornai (1976) rejects entirely the neo-classical framework on which it is based, and especially the whole premise behind shadow pricing. Some critics contend that CBA's central notion of social welfare function is too simple. They contend that a social welfare function does not exist in any meaningful way because of the diversity of interests within the developing countries, because of the rapid change in the mix of official objectives, and because of the common propensity of governments to ignore declared objectives.

Then there are those critics who accept the theoretical framework of CBA, but who have very serious reservations about particular aspects of it. Among these are people like Mishan (1972), Stewart (1971) and Streeten (1972) and lately Carruthers (1981), Amin (1977) and Sadik as well as Colin Leys (1979). Weckstein (1972) rejects all shadow pricing procedures as harmful, because of the belief that socially profitable projects, which are unprofitable at market prices will require a lot of subsidies, which in turn would demand more resources to assess their impact. Some economists now accept the need to take direct account of income distribution effects of any project both overtime and between individuals. However, they despair as Amin (1977) has shown, over the fact that it is deemed necessary to try to accommodate by reference to welfare economics, a theory which assumes (unrealistically) that compensation to losers by gainers can be effected, that interpersonal and intertemporary comparisons of utility are impossible, and that equity and growth are in direct conflict.

Operational objections which are emerging following practical experience, are more serious. The mathematical sophistry of the method has come under attack. For example, most LDCs do not have sufficiently trained staff to appraise all projects according to the method of Little and Mirrless or Squire and Van der Tak. But unless all projects are so appraised, there arises the problem of unequal treatment of projects and consequent problems of interpretation and of establishing priorities. According to Carruthers (1981), the mathematical factor reduces the usefulness of CBA as practiced in LDCs today, and states correctly that "a practice has not much to recommend it if the workings of the method and the decision criteria are not evident to the decision-makers ....". Another problem is related to the derivation of a social welfare function through the use of weights. Who decides upon the weights? The politicians, the planners or the aid donors? Amin (1977) argues that the use of government weights represents no shift in the status quo and the use of those decided upon by the analyst, would amount to the usurpation of political power from democratically elected representatives.

Stewart (1971) argues convincingly, that social values must inevitably reflect the interests of the group making the value judgments. It has also been noted that the weighting of objectives as suggested by Squire and Van der Tak (1975) suffers from the political imprecision surrounding policy objectives, as well as price forecasting. Moreover, the laborious process of shadow pricing absorbs an undue amount of skilled effort, while expert evaluation reveals that in agriculture for example, the factors which determine project success or failure are not primarily related to these aspects of planning.

Another source of dissatisfaction with modern CBA is the age-old neglect of externalities. All mathematical logic and sophistication implied by shadow prices and weights, has been unable to take on board the issue of externalities. Studies that have attempted to quantify these costs using monetary values derived from complicated surrogate pricing calculations, have equally been attacked for producing "incredible" figures that have no basis in reality (Self 1970). The principal lacuna in the analytical structure of the modern CBA, is the lack of precise statements about the assumptions that are being made about government policy. Government rationality is taken for granted.

The method also fails to deal with human, institutional and managerial constraints which unfortunately have contributed greatly to project failure more frequently than the mere lack of capital which is often replenished through borrowings. As Ruttan (1977) stated, the LDCS are still trying to cope with the debris of non-viable institutional innovations: with extension services with no capacity to extend knowledge or little to extend; cooperatives that serve to channel resources to village elites; price stabilization policies that have the effect of amplifying commodity price fluctuations; and rural development programmes that are incapable of expanding the resources available to rural people.

If the opportunity cost of using some of these methods was to be assessed, their usefulness in the LDCs could be found to be of doubtful significance compared with plain decision making based on limited computation backed by consensus value judgments. Rather cynically, CBA actually incorporates an enormous amount of value judgement and intuition on the part of the evaluator; There is judgement as to the course of future prices, judgement as to whether the commodities are likely to be imported, exported or non-traded, judgement as to capacity utilization, externality etc. At the end of the day CBA evaluation is no better than the judgments of the evaluator. The aggregation of costs and benefits tends to lend scientific objectivity to this sum value of judgments of what would have happened in the absence of the projects. After all CBA appraisal is about forecasting, and in forecasting estimates are value tainted.

Implications for Irrigation Projects

Water development and irrigation stand for a multitude of technical measures designed to influence both the hydrological cycle and the agrarian systems for the purpose of creating benefits for the society as a whole. Attached to irrigation therefore, is this element of technological transfer, and any success of such transfer must rest upon the presence of financial resources, human and institutional factors, political will and the general stability of the economy. Any CBA method should attempt to answer as many questions as is possible, and at the same time remain flexible enough to allow the inclusion of those elements or variables that are unquantifiable.

<u>Justification for Choosing CBA for the present study</u>

Despite the foregoing criticisms of CBA method in project appraisal, it is argued here that the criticism should not serve as the basis for rejecting Cost-Benefit Analysis, but as a basis for highlighting shortcomings and point to possible future research areas, all aimed at improving the technique so that it can do the job society expects from it. Cost-Benefit Analysis is only a tool in the decision-making process, and not a substitute for decisions. Like any technical tool it has its weaknesses and its strengths. What is important from the planning point of view, is for the analyst to accept the limitations of the method and the assumptions, and to state them with the results of any appraisal so that the decision-maker knows when to take over beyond the limits of the technique. There should be no attempt at mystification of the technique's subjectivity or lack of objectivity beyond that of the society in which it is employed.

The above sentiments arise from the fact that CBA is the only technique that has been fully developed and is in practical use, despite its imperfections. It has been chosen as the framework for evaluation and assessment in this study for the following reasons:

a) CBA improves analytical consistency (as all variables will be assessed by one criterion), clarity and rationality, by evaluating systematically and then comparing costs and benefits, instead of relying on unresearched and unsubstantiated intuitive judgement which might prove to be random and inconsistent from case to case.

b) The method provides a way of incorporating government's multiple objectives in a systematic way that forms the basis for replication from project to project.

c) As an investment assessment criterion, CBA and the notion of economic efficiency is basic to neoclassical economics and provides one of the key rationales for the free market system. For this reason it is chosen here to assess commercial irrigation agriculture which is dominated by corporate agribusiness.

Calculations in the Present Study

The study uses the CBA framework to assess, as far as data allows, all the costs incurred on behalf of commercial irrigation agriculture, in particular the cost of building the numerous dams. The water pricing system is analysed in relation to the capital cost outlays so as to determine both the level of state subsidies built into the pricing system and the capacity of commercial irrigation to service the foreign loans and local resources spent on dam construction, as well as its ability to self-sustain itself as an industry.

Clearly the study is attempting to assess the performance of irrigation schemes that started operations long ago, some as early as the 1930's and 1950's (see chapter 3). As such, this is an ex-post evaluation of an industry that has, like many others, not had a continuous data keeping system. This has made assessment of the impact of commercial irrigation on growth and equity difficult.

Small scale irrigation agriculture has been beset by problems of abandonment at some stage of their existence and the absence of data recording or keeping traditions as well as the numerous occupancy changes on the schemes. To this we can add the 107 schemes that previously belonged to the commercial sector and have now been rehabilitated for peasant ownership. Clearly, the apparent production discontinuity coupled with constant changes in ownership or occupancy does not augur very well for data and record keeping. The change in government in 1980 and the subsequent exodus of most of the long-serving civil servants has resulted in the loss of records on subsidies and the destruction of government files, some of which were on irrigation agriculture.

Using the CBA framework, the streams of benefits from irrigation are assessed. The role of the international commodity market is analysed and its effect on foreign exchange earnings from the export of the irrigated cash crops evaluated. The extent to which commercial irrigation is able to meet other equally important societal objectives, other than the private profitability of the farmer are assessed. These include the ability of commercial irrigation to generate employment and to assure the nation that food security matters are being met.

Most important of all is the impact or linkage between commercial irrigation and the rest of the economy. In this study it has not been possible, nor indeed desirable to carry out a project-by-project CBA, in the absence of comprehensive data. Instead an industry-wide assessment using the CBA framework has been adopted, with the view to arriving at general conclusions for the whole sector.

Cost-Effective Analysis and the Subsistent Irrigation Sector

The subsistence irrigation sector comprises 76 communal areas schemes and the 107 resettlement irrigation schemes. As discussed in Chapter 3, some of the communal peasant areas have had a long irrigation history dating back to the early 1930's, peaking in the early 1960's and disappearing in the 1970's. For the period covered by this study starting in 1980, the present government has been busy rehabilitating some of the schemes that had fallen into disrepair following either voluntary abandonment by the peasants and/or damage during the 15 years of civil war. Apart from rehabilitation, new schemes have also been started. The resettlement irrigation schemes were started as part of the commercial sector irrigation programme and have become small-scale schemes following the purchase of these farms for the resettlement of some of the peasant farmers. Most of these are also being rehabilitated and redivided to meet the requirements of the new owners. As most of these resettlement schemes are just coming into production now, not much information is available about their operations.

The 1984 field survey occurred at the peak of a three year drought and a period of inactivity, and at a time when the process of land acquisition and redivision and relocation was at its inception in most cases. However, it is inconceivable that the operational mode and the resultant benefits would be far different from the existing communal schemes, given the similarity in approach. Within the broad policy focus on Growth with Equity, the subsistence irrigation sector projects are intended, by Government, to represent poverty-focused development programmes, which are aimed at providing opportunities for increased production and for permanent employment, as well as being capable of enhancing the lives of the rural poor. It follows therefore that most of the benefits relate to the satisfaction of consumption and the enhancement of the quality of life and the raising of the standard of living of the peasants on the schemes. Theoretically, there is a direct relationship between consumption patterns and the working capacity, which emerges starkly when people are suffering from famine and or malnutrition. Increasing the consumption of basic foodstuffs may therefore be a necessary, though not a sufficient condition for improving the productive capacity of the rural poor.

In direct contrast to the commercial irrigation sector, the subsistence irrigation sector projects are 'social projects' aimed at alleviating social problems. The belief is that what is being optimised through this form of investment, is the reduction of poverty and its attendant ills, to levels predetermined by the policy makers as acceptable. The benefits accruing to the cliental peasants are therefore exceedingly difficult to quantity and or express in monetary value terms. A lot of theoretical work has been done (McAllister 1980) in an attempt to place monetary value on these benefits through various forms of surrogate evaluations; for example the use of the cost of not investing in these projects being used as the value-equivalent of the benefits from the projects. No attempt is made here to go into all these calculations, as that will not shed any new insights to the present work, and especially in the absence of data.

Equity and the irrigation Sector

'Equity' has been defined, in the context of Zimbabwe's 'Growth with Equity' policy, to imply the need to achieve an equitable distribution of income through investments directed to the poor section of society, the peasants. It is the contention of this study that subsistence irrigation schemes, practically or theoretically, cannot be the basis for the achievement of equity, for as long as small-scale irrigation implies subsistence. The policy of subsistence irrigation would appear to be a basic needs policy aimed at securing the provision of essentials of subsistence, namely, food, housing, health etc, with limited surplus sold in order to augment subsistence. Accordingly the irrigation schemes are set up in areas that are prone to drought and experience food shortages and where the irrigation potential does exist. The same level of investment is not accorded other poor peasants in regions where irrigation opportunities do not exist, even if the degree of the marginality and severity of climate is similar. Above all, because of its absolute physical spatial limitations irrigation can only cater for a few peasants, and because of its high requirement for capital resources, it is inevitable that the better off peasants often end up being the beneficiaries of all such schemes contrary to the expressed policy to help the poorest.

Aims of the study for the subsistence sector

The study seeks to identify and assess: the beneficiaries of the benefits from the irrigation projects; the cost to government of investing in these schemes; the subsidy burden on the treasury; the opportunity cost of the resources spent on this sector as compared to other sectors; assess the extent to which the Government could continue to subsidize this sector, the changes in the standard of living of those on the schemes as compared to those in the rainfed sector or in alternative employment, etc. The impact of the schemes on land pressure release and food availability in the areas of location as well as on employment, is assessed.

Justification for Using CEA Framework

The choice in this study of using a CEA framework for the appraisal of the subsistent irrigation schemes arises from the following considerations:

a) Projects in this sector are not concerned with financial or economic profitability, but with the provisions of the basic necessities of social reproduction. The concern here is therefore over the least-cost production method that will make it possible for these social objectives to be realised. CEA is the most suitable analytical framework to assess whether these irrigation projects can meet these objectives in the most cost-effective way.

b) For the commercial irrigation sector, scarcity of capital both at the initial investment stage and subsequently for operation and maintenance as well as for the purchase of inputs, plays a major role in the cost-benefit analysis. In the subsistent sector, the concern is more focused on the recurrent costs and the role of subsidies in the fulfillment of government objectives.

c) The benefits produced by these projects are largely non-traded goods, and in some cases unquantifiable and destined for consumption.

d) Using CEA, it is possible to compare the dollar costs with units of output, with the intention of assessing the extent to which irrigation projects maximise output from a fixed budget, compared to rainfed agriculture for the same level of budget.

e) Because of its less rigid dependence on monetized inputs and outputs CEA can be flexible enough to accept the evaluation of the fulfillment of project objectives, unlike CBA.

f) CEA allows for the opportunity to look at alternative investment strategies outside irrigation which can perform the same functions, i.e. alternative investments that would be able to satisfy the same objectives at lower costs than those for irrigation.

Steps Followed in this Study

In this study, CEA is not used as a criterion for the choice of the right project among alternative projects, because this decision has long been taken at the highest political level. CEA is used to find out if the government policy objective of increasing income redistribution is being fulfilled by the schemes so far chosen and at what cost, and whether there are alternative investment strategies that can do so at a much lower cost. Theoretically CEA like CBA is a product of welfare economics and suffers from largely similar limitations.

The following are some of the steps to be followed in the assessment of these schemes using the CEA framework.

Step 1:

As these projects have all been started, except for a few that have started recently after 1980, it is important first to list all the objectives the state would like these schemes to achieve. Most of the objectives may appear contradictory or too ambitious. It is at this stage that the correctness, consistency and compatibility of the numerous policy objectives are discussed.

Step 2:

The next stage is to identify the type of peasants that have been selected to settle on each scheme. The identification of the beneficiaries must be followed by the analysis of the criteria used by the decision makers in selecting the farmers. Of equal importance is to find out the plot sizes allocated to each family as this may have a bearing on the realization of some of the policy objectives, such as the increase in food output, or land pressure release. The average size of each family on the scheme has also to be known for reasons of labour supply and/or for other reasons relating to the main objectives.

Step 3:

An assessment of the flow of public subsidies to the small scale schemes as the main public cost outlay has to be carried out as well as the contribution by farmers. This assessment will be compared with the results of an assessment of public subsidies to the rainfed agriculture.

Step 4:

The benefits from small scale irrigation schemes computed from the values of the crops grown, by quantity, are compared with the values of the crops from the rainfed farms for a comparable land size.

Step 5

The net incomes will be calculated, i.e., for the irrigation sector, by first calculating the net income "with" public subsidies and "without", and the results compared with similar calculation for the rainfed sector.

Step 6:

Assess the results' sensitivity to higher water tariffs, (in the case of irrigation) designed to recover fully the operation and maintenance costs. The results should enable us to tell whether in theory as well as in practice, the schemes as they are designed, can be charged the economic rate of water that would allow for cost recovery. It should be possible at this point to arrive at the optimal mix of plot size and yields that would become economically viable enough to exist without subsidies for operation and maintenance.

Step 7:

Using assets acquired as indicators of a rise in the standard of living, is not a very sound method, as it suffers form the analysis-boundary problem as well as from the presence of inheritance or extra incomes acquired elsewhere including from the extended family system. Nevertheless, a glance at the levels of these assets between those peasants on the schemes and those practicing rainfed agriculture would throw some light on the properties each system can afford the beneficiary.

Step 8:

Lastly, a checklist method should be used so as to see if the small scale irrigation sector has fulfilled all the set objectives at the least cost possible, compared to say rainfed agriculture or any other alternative investment programme designed to achieve the same objectives. For example, a system of intra-regional food transfer, between the wetlands suitable for food crop production and the dry but suitable areas for ranching. The food transfers option is looked at as a serious alternative, despite the fact that little is known about it and is recommended as an area for future research.

CHAPTER THREE

THE PHYSICAL AND SOCIO-ECONOMIC BACKGROUND

INTRODUCTION

It is very necessary that the analysis of the implications of the private and public investment policy and practice in water and irrigation be understood within the context of Zimbabwe's physical and historical socio-economic circumstances. This is largely because a historical input in this type of study lays bare past policies and practices that have helped shape present day investment policies and the structure of the water and irrigation industries.

Of the three main factors indicated above, the physical environmental factor lays out the available natural resource potential upon which public and private investment has taken place. The physical environmental resource base can be divided into three sub-sections, the interaction between which is a central factor to the development of bulk water supplies and of irrigation agriculture. The three sub-sections identified are the following:

1. The suitability of the country's relief or topography for the development of all types of irrigation schemes: Normally, flat or undulating plains, allowing for flood drainage, are considered as potentially suitable;

2. The wide-spread presence of suitable irrigable soils on the right topography, and in areas served by a good network of rivers;

3. And the existence of a rainfall regime that has the potential of supplying all the water required for the development of all potentially irrigable soil resources.

However, an understanding of the physical potential on its own is not enough to explain the direction development has taken over the years: This understanding can only be achieved by analysing the socio-economic and political factors that have acted as major forces in the exploitation of the physical potential for the benefit of society. In the process of assessment, issues such as economic efficiency, equitable distribution of income, employment generations and land allocation, are discussed.

The chapter concludes by assessing the performance of the economy in recent years. Clearly, this information forms part of the picture of the country's resource base, and is indicative of the country's capacity to raise the required resources for investment in water and irrigation.

The Physical Resource Potential

Many countries, Egypt and Sudan among them, have come to take it for granted that irrigation agriculture is essential and its expansion imperative. This is particularly so where the potential for unaided rainfed agriculture is limited. Under the circumstances, the pursuit of irrigation agriculture has taken the form of massive investments in large scale reservoir development and large scale control of water for the achievement of higher crop yields over limited land surfaces.

In Zimbabwe the historical development pattern can be explained both in politico-economic terms and in physical deterministic terms. The variability of these attributes both in quantity and quality across space, makes the physical factors an important constraint, especially when the low capital formation in agriculture is taken into account. Since this variability in resource endowment could have far reaching implications on the spatial allocation of investment resources, it is essential that a brief outline of these factors is given.

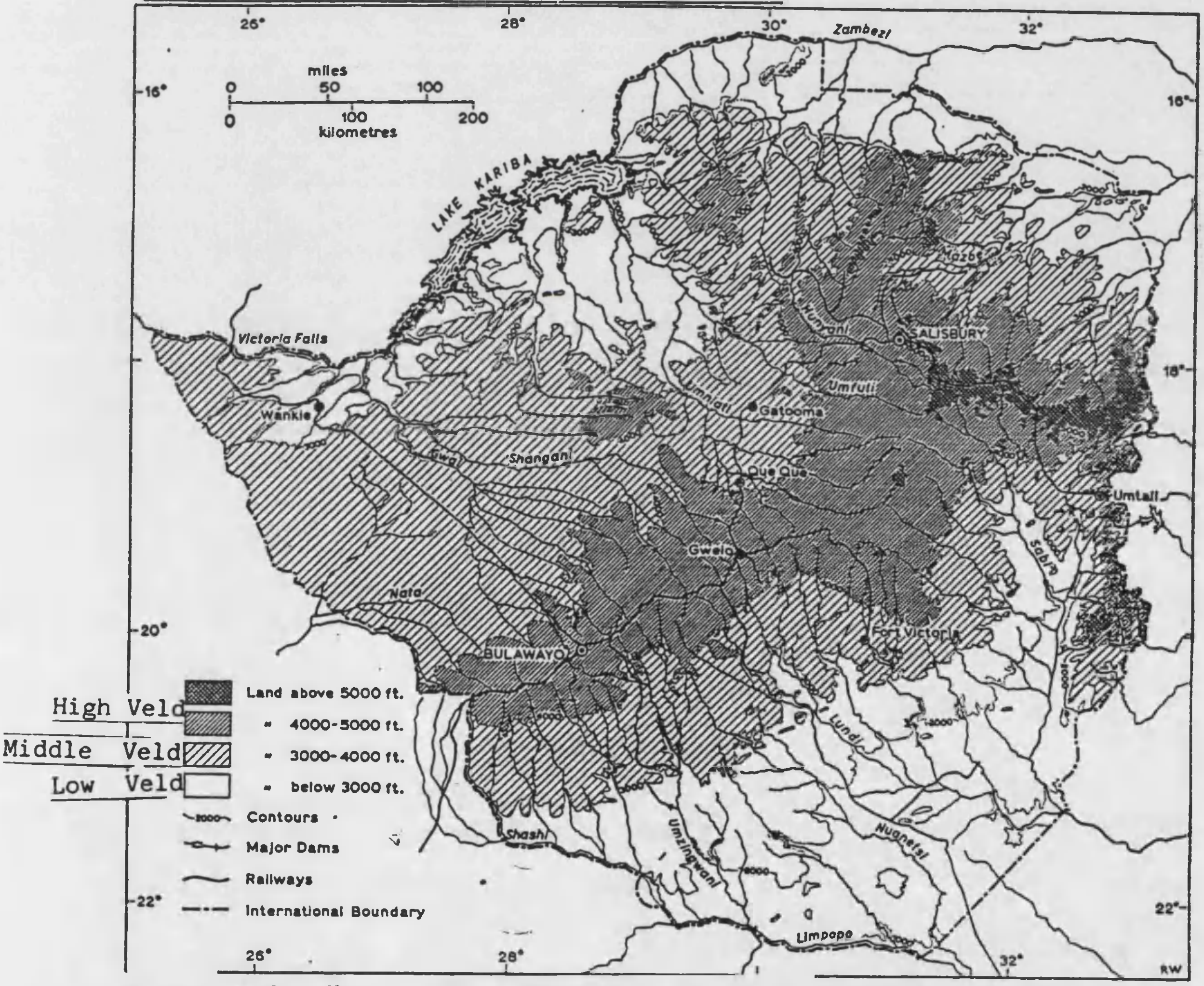
Perhaps the most dominant and decisive physical factor is the relief or topography of the country. It forms the fundamental base upon which all other variables operate, and most crucially, it shapes the dam sites and determines rainfall patterns and soil structures as well as, to some extent, human activity and settlement preferences.

Altitudinally, Zimbabwe can be divided into three broad physiographic regions as shown on Fig 3.1 (Kay[1] 1979), comprising the Highveld, the Middleveld and the Lowveld, each with different implications for both water and irrigation development. The Highveld (4,000 ft above sea level and over) consists of a narrow central land belt plateau stretching from the south-west of Bulawayo eastwards to the Mozambique border mountains of Nyanga and the Chimanimani ranges. The dominant feature of the veld is its general flatness and the fact that it forms the main watershed for rivers draining into both the Zambezi Basin in the north and the Limpopo Basin to the south. From an irrigation point of view, the resultant density and network of rivers has a positive effect on the potential development of bulk water storage reservoirs. On the Highveld itself there are a number of potential dam sites and a number of large dams for the supply of water to the towns and cities, have been constructed. The prevalent, high rainfall makes the construction of dams for irrigation purposes less urgent.

Skirting the Highveld on either side is the Middleveld (3,000 ft to 4,000 ft above sea level), a rugged and heavily dissected terrain whose southern slope is much sharper and abrupt than the gentler northern slope which forms a broad belt stretching towards the Victoria Falls on the Zambezi Valley. The escarpment zone between the Highveld and the Middleveld is both geologically, and in slope configuration terms, the most suitable, particularly on the southern slope, for the construction of medium and large scale dams because of the numerous gorges; but does not provide the right topography for irrigation land development due to the steepness of the slopes. This is clearly an excellent example where the potential for large scale water storage does not coincide in location terms with the right topography for irrigation development. This has direct implications for investment, where kilometres of expensive canals and pipes are required to carry water across

[1] For detailed description of the physical Geography of Zimbabwe reference is made to George Kay; "Rhodesia, a Human Geography, 1970".

Fig. 3.1 THE RELIEF MAP OF ZIMBABWE.



Source : G. Kay, 1970 , Rhodesia :A Human Geography . p.14

difficult terrain and mountain ranges to distant irrigable soils. In some cases this implies the installation of expensive pumping facilities. Examples of this situation already exist, whereby the Lake Kyle, the Bangala Dam and Lake McDougal are supplying water to the Triangle and Hippo Valley Irrigation schemes tens of kilometres away through a combination of the run-of- the-river and canals across the Lowveld.

The remainder of the country is the Lowveld (below 3,000 ft) which consists of two distinct segments as Fig 3.1 shows; a narrow belt of land running parallel to the Zambezi River in the north, and an extensive area of low lying undulating terrain in the south of the country. In purely relief terms, the Lowveld, because of its general flatness is the most suited area of the country for irrigation agriculture. The area is also served by a myriad of rivers that pass through this area from the Highveld on their way to the sea. However, not all parts of the Lowveld are well endowed either with rainfall or with fertile soils. Having the correct terrain suitable for irrigation is only part of the requirements for a successful venture in irrigation agriculture. The soils have to possess irrigable qualities.

Generally, Zimbabwe's soils can be divided into three main groups on the basis of their geological parent material, which naturally has implications for fertility. Firstly, the dominant sandy soils are derived from the wide spread omnipresent deposits of granite; these soils are acidic, and have a very low moisture retention capacity, are very infertile, and can only produce crops under heavy constant application of fertilizers, making crop production very expensive. They are therefore not suitable for irrigation. The sandy soils are, however, interspersed with small occurrences of the intrusive rock-derived loam and clay loamy soils, which like the sandy soils, are not strictly suitable for irrigation. This is largely because these soils have structural defects and occasional infertility depending on the topography and climate of the area. They are nevertheless much more suited than the sandy soils for rainfed agriculture; but can be developed for irrigation at very high cost. The long-term effect of using these soils for irrigation are as yet not fully known, although salinity and sodicity are suspected to occur in the long run. Most suitable for irrigation agriculture are the heavier paragneis and basaltic clay soils, which are characterised by a high clay content, good drainage, high levels of fertility and high moisture content. As shown on Fig 3.2[2], these soils occur as pockets in very few areas, but large blocks of them are concentrated in the southern Lowveld, between Tuli on the southwestern border with Botswana and the Mozambique border on the south east. Other much smaller pockets occur on the banks of the Mfuli River, in Dande and the Musengezi Rivers in the north.

The fact that these irrigable soils are so scarce and are partially concentrated in only one area of the country has had far reaching economic and political consequences, both in terms of the realization of a regionally balanced and equitable allocation of investment resources for irrigation. The nature of the rainfall regime in the area where these soils are found is so unsatisfactory that it has hindered their full use. Traditional land use in this area, has been extensive ranching. Only under irrigation can the soils be exploited for crop production.

The occurrence of important climatic variables of temperature and rainfall do not necessarily complement the location of potentially suitable relief and irrigable soils. A mean annual temperature map (Fig 3.3) shows that modest temperatures (below 20 degrees Celsius) are associated with the Highveld, while the highest temperatures (20 degrees Celsius to 30 degrees Celsius) are associated with the land below 3,000 ft above sea level, and this is largely the Lowveld and parts of the Middleveld. Mean annual rainfall distribution (Fig 3.4) shows a direct association of highest rainfall occurring in conjunction with the highest relief; and the lowest, with the lowest altitude. This means that generally rainfall intensity decreases from the north to the

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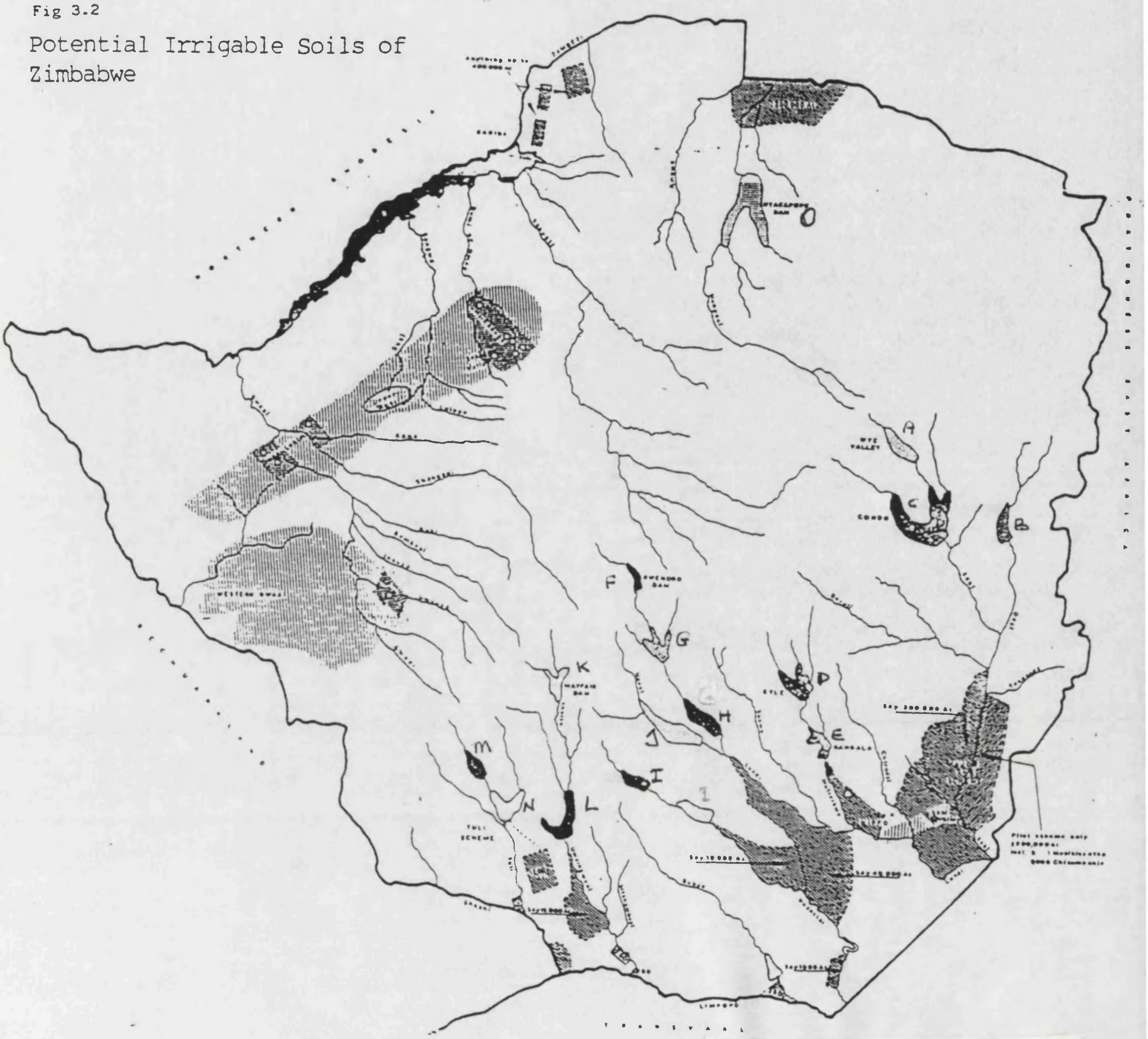
[2] A detailed geophysical analysis of the soils of Zimbabwe is in Phillips, "The Development of the Economic Resources of Southern Rhodesia", 1962.

Fig 3.2

Potential Irrigable Soils of Zimbabwe



REFERENCE

Existing Dams

Potential Irrigation Schemes

Artesian Boreholes

Known Artesian Areas

Possible Artesian Areas (partly Sub/Artesian)

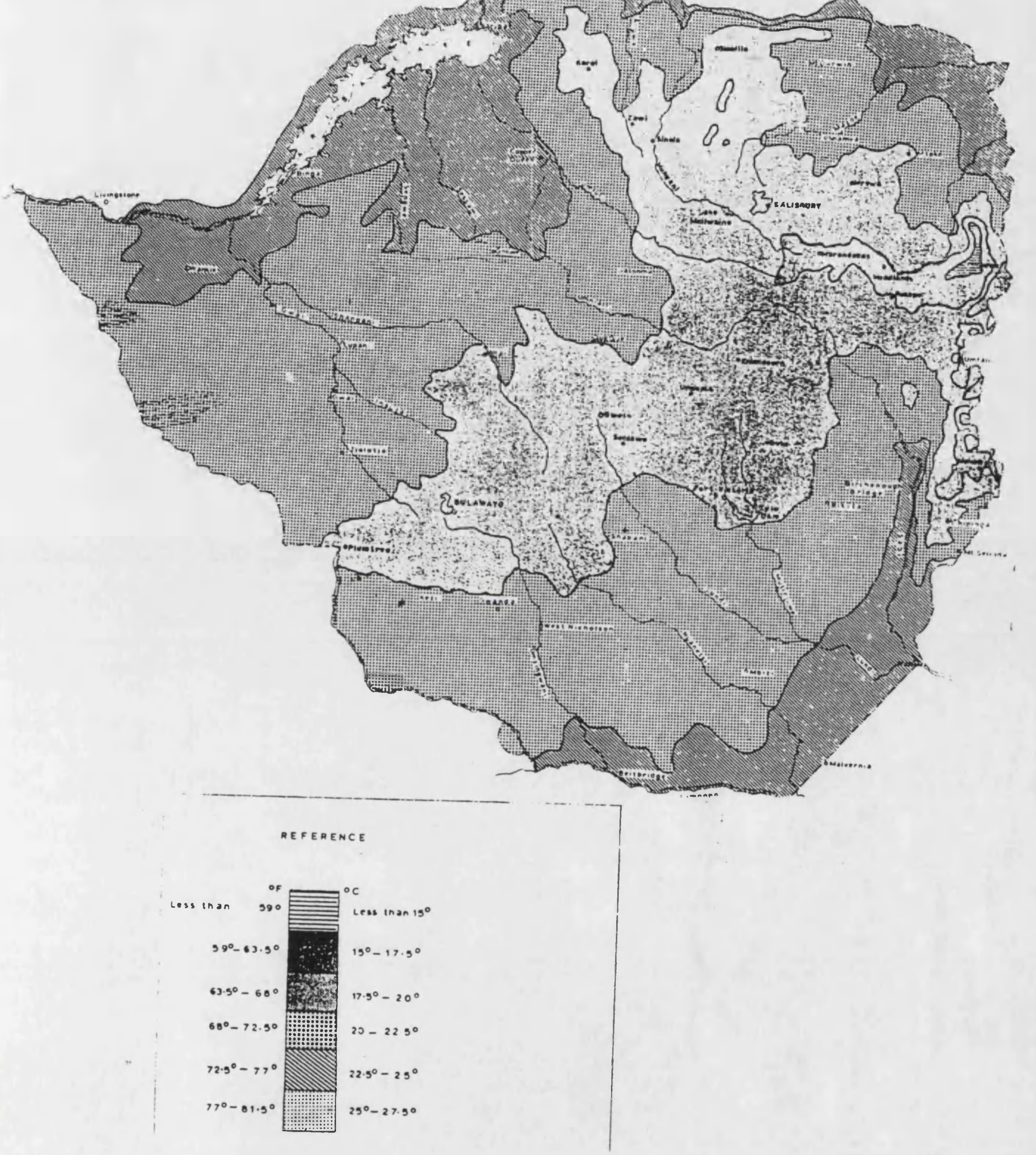
MAJOR DAMS
A. WYE
B. OSBORNE
C. CONDO DAM SITE
D. LAKE KYLE
E. BANGALA
F. GWENORO
G. TOKWE/SIYA
H. MANJIRENJI
I. MANYUCHI
J. ESQUELINGWE
K. MAYFAIR
L. SILALABUHWA
M. MAKWE
N. ANTELOPE
O. SILVERSTROOM

Source:Phillips et al ,1962

Fig 3.3

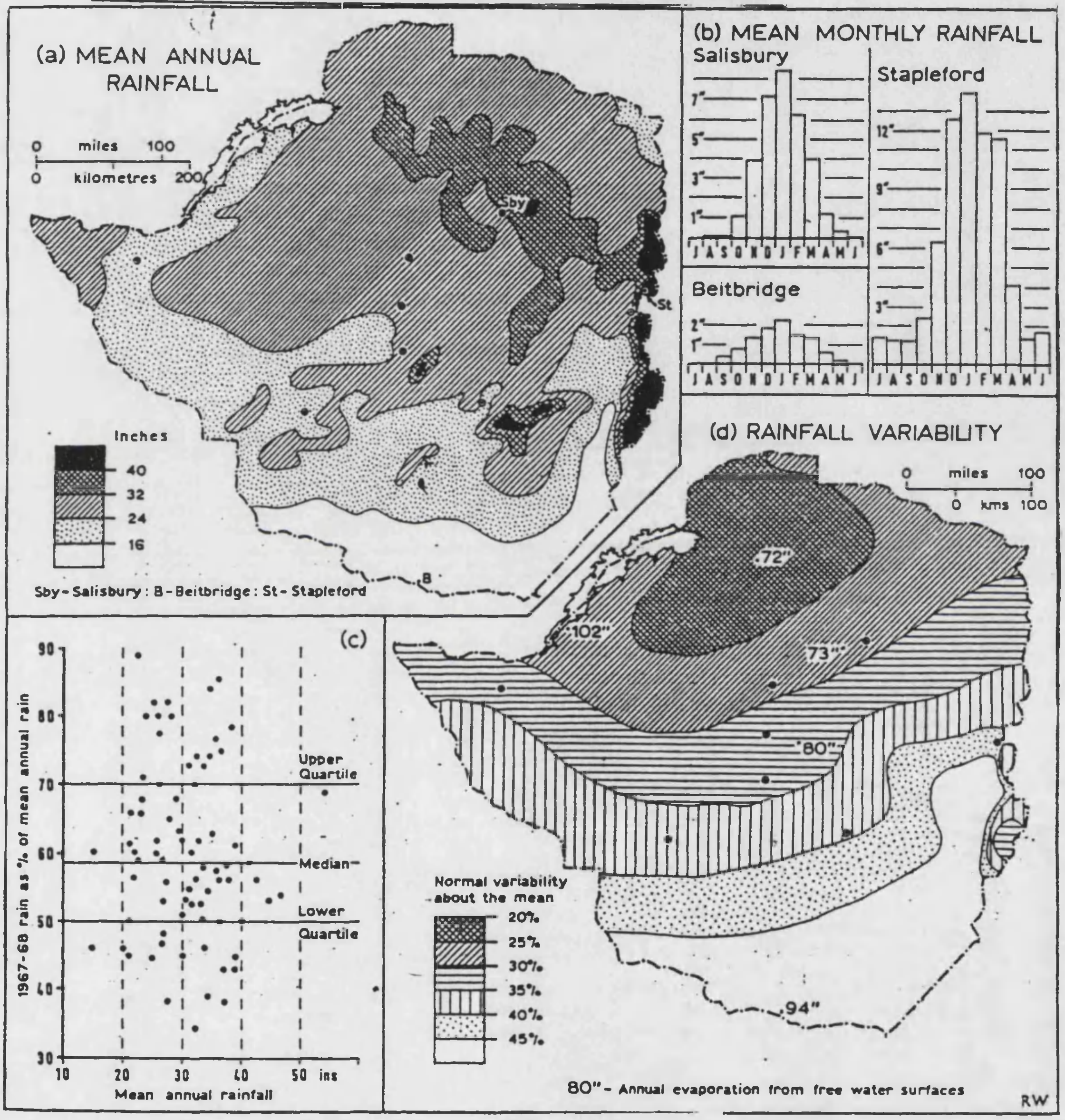
ANNUAL MEAN TEMPERATURE OF

ZIMBABWE



Source:Phillips et al ,1962

Fig. 3.4 RAINFALL VARIABILITY IN ZIMBABWE



Source : G. Kay, 1970 , Rhodesia :A Human Geography south, with the least rainfall (below 41 cm) falling in the southern part of the country, the area of good irrigable soils.

Although over two thirds of the country receive less than 76cm (30 inches) of rainfall as shown on Table 3.1 the coincidence of the highest temperatures and the lowest rainfall in the southern lowveld has far reaching implications for irrigation. Firstly, the low unreliable rainfall with a checkered occurrence record of one bad season for every three seasons, as compared to one bad in five good seasons, in the rest of the country, means that continuous rainfed crop production is nearly impossible. In most areas it can only be carried out under high risk conditions, or together with a greater reliance on livestock keeping. Secondly, the high temperatures are responsible for high evaporation and evapotranspiration rates, which further reduce both the surface waters and the water available for plant growth, hence the prevalence of drought-resistant vegetation in the area. This increases problems of keeping enough water for irrigation and of avoiding salinity.

Figure 3.5 and 3.6 show that, for both Chisumbanje and Middle Sabi, irrigation schemes in the Lowveld, when monthly evaporation rates are compared with monthly rainfall variations there is a disturbing relationship which shows that peak evaporation rates coincide with the peak rainfall period, which is also the hottest time of the year. It is also evident that for nearly every month, potential evaporation exceeds rainfall. This means that the Lowveld is a rainfall deficit area. The development of the irrigable soils would therefore depend on the intensity of the October-December thunderstorm rains on the Highveld. Although thunderstorm rainfall does not soak the ground, it is nevertheless intense enough to generate enough run-off that is then carried southward to the lowveld by the Sabi and Lundi Rivers and their tributaries. Since the rainfall is highly seasonal, coupled by high evaporation rates, plus the fact that of all the rainfall per season, only 6 percent is available as run-off (Kay 1970), it is imperative that

Fig. 3.5

MONTHLY EVAPORATION RATES: CHISUMBANJE/MIDDLE SABI, 1975/76 - 1977/78

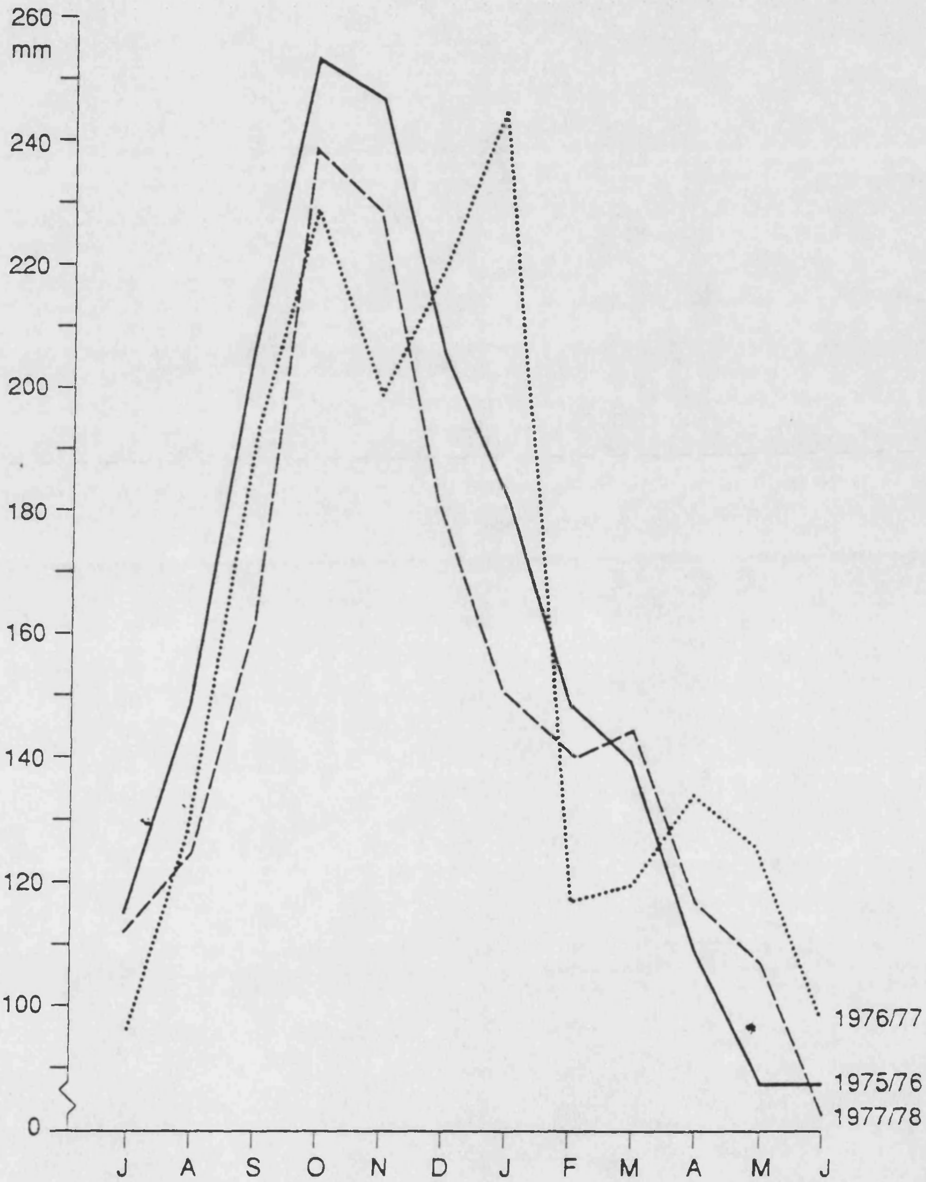
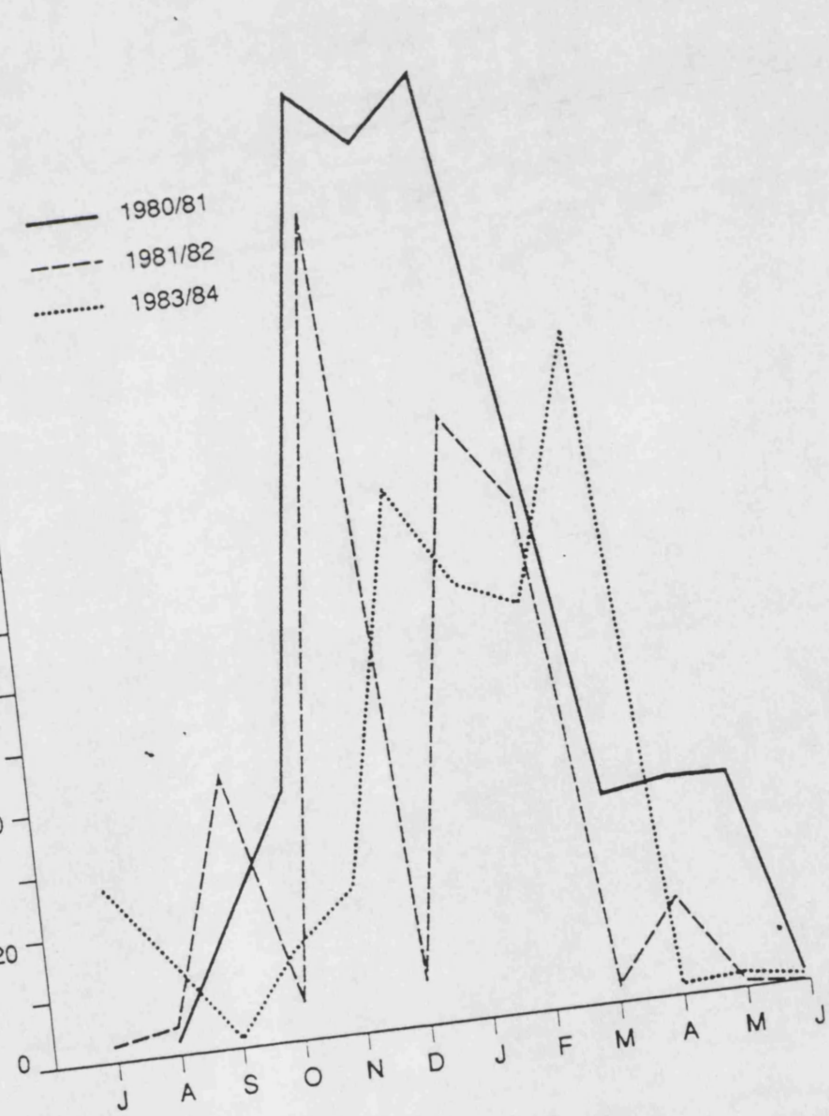


Fig. 3.6

MONTHLY RAINFALL CHANGES: CHISUMBANJE/MIDDLE SABI, 1980/81 - 1983/84



these large rivers are dammed, in order to conserve most of the water. Storage has got to be in such large capacities in order to offset water losses by evaporation. It is therefore clear that the available water resources are much more limited than the available irrigable soils, and the Government has taken the view that the only way this imbalance can be corrected is through large scale expansion of public investment in bulk water storage facilities.

TABLE 3.1

RAINFALL DISTRIBUTION IN ZIMBABWE

RAINFALL (CM)	PERCENTAGE OF ZIMBABWE
Over 91	5.1
81 - 91	12.5
71 - 81	19.8
61 - 71	31.6
51 - 61	17.6
41 - 51	8.3
Under- 41	5.1

Source: George Kay, Zimbabwe, a human Geography, 1970

TABLE 3.2

THE NATURAL REGIONS

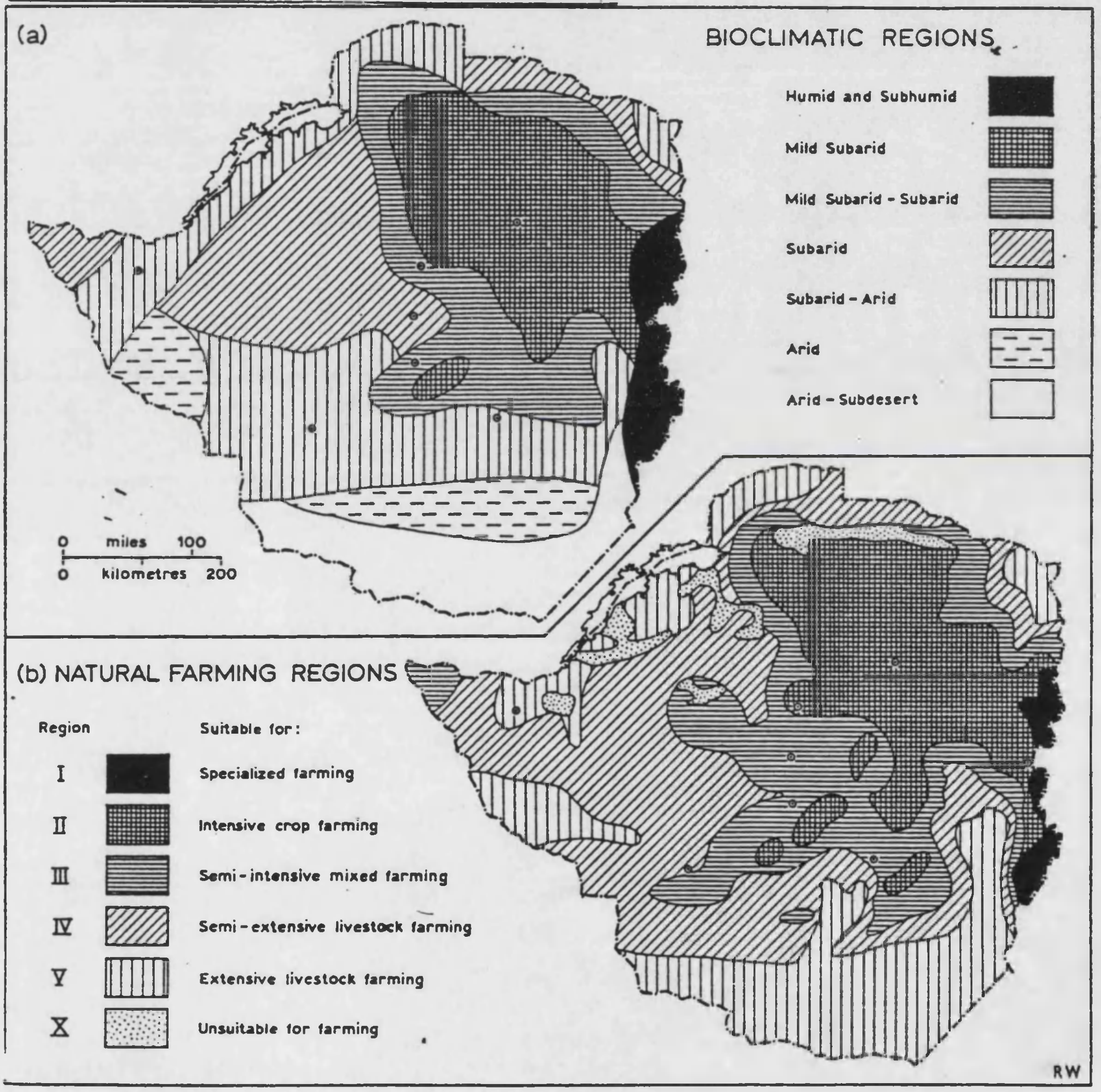
NATURAL REGION	CHARACTERISTICS
I	Covers 1.6 percent of the country, has effective rainfall, everywhere above 60 cm. The region is restricted to the Eastern Highlands and its agriculture affected by altitude, and limited land for cultivation. The region is therefore suitable for tea, coffee and deciduous fruits, vegetables and potatoes as well as plantations of wattle and soft wood trees.
II	Covers 18.7 percent of the country and has effective rainfall above 50 cm. Dry spells and midseason droughts are infrequent and rarely severe. The region is suitable for intensive crop farming with subsidiary livestock enterprise.
III	Covers 17.4 percent of the country. Rainfall is moderate and effective rainfall is between 41 cm and 51 cm. Midseason dry spells and droughts are common and often severe. This region is marginal for crops such as tobacco

	and maize but suitable for drought resistant crops. It is therefore suitable for semi-intensive farming based on mixed livestock and crops, where livestock is likely to be dominant.
IV	Makes up 33.0 percent of the country, and is the largest single region. Rainfall is between 35 cm and 45 cm. Seasonal droughts are severe, and midseason dry spells during the rainy season are common. Crop production is limited to drought resistant plants. The region is suitable for semi-extensive farming based on livestock ranching.
V	Covers 26.2 percent of the country. Rainfall is too low (effective rainfall everywhere is less than 41 cm (16") and too erratic for reliable production of even drought resistant crops. This region is naturally suitable for extensive livestock ranching only.
X	The last region, and covers 3.1 percent of the land and consists of excessively broken country, where steep slopes and skeletal soils preclude any form of farming (regardless of any climatic conditions). The areas included in this region are flood plains, swamps, mountainous areas etc, and areas of poor soils, which are physically unsuitable for farming.

Sources: Derived from both Kay (1970) and Phillips (1962).

The foregoing analysis has helped in the identification of the potential physical factors of production and their location in space. From the point of view of land use planning, it is necessary to combine these three physical factors in order to determine the country's agricultural potential. Phillips (1962) has developed a land use classification, dividing the country into six natural farming regions as shown on Fig 3.7 (a) and (b). The characteristics of these regions are detailed in Table 3.2. Region I, although very small, has the greatest natural agricultural potential. This area plus Region II and to a lesser extent Region III are suited to crop production; however, together they form only 38% of the country. By contrast 62% of the land area occurs in Regions IV and V (as well as a small percentage under Region X), which according to Phillips (1962) are only naturally suited to extensive livestock ranching.

Fig.3.7 NATURAL REGIONS OF ZIMBABWE.



Source : (a) Bioclimatic regions (after Phillips, 1962) and (b) Natural Farming Regions (after Vincent and Thomas, 1960).

This form of classification only considers natural conditions, and as such it excludes the potential which could be realized under land improvement like in the case of irrigation. If actual agricultural development (in the absence of any intervention) were to follow the pattern dictated by the physical potential, one would expect that the structure and scale of agriculture today would reflect the limiting effect of the physical factors. In efficient resource allocation terms , crop producers would tend to compete for limited land resources in Regions I, II and III while livestock farmers would be concentrating on regions IV and V. However the history of Zimbabwe's land development has been shaped by many other factor other than her physical attributes, such as the social, technological and political factors. It is therefore essential briefly to assess the role played by these factors and to highlight their implications for present policies and practice.

The Socio-Political and Economic Context

The history of public investment in water and irrigation agriculture, is in essence a socio-economic history of how, using sophisticated technology, Zimbabwe has sought firstly to influence higher crop yields through deliberate intervention in the works of nature, and secondly to use irrigation in the allocation, over time, of scarce land and other resources among its citizens. The main aim is to achieve equitable distribution of resources, in a country where over 70 percent of the population has always depended directly on the land for their subsistence. Clearly, the history of land distribution and the shift of political power between the blacks and whites is central to the understanding of policies that are affecting the structure and pattern of irrigation land use today. Without going into the details of land use history[3], the salient features must be recorded.

The occupation of what was to become Southern Rhodesia in

[3]Riddel (1978), Palmer (1972) and other contemporary writers present a detailed history of the land question in the context of the analysis of the history of Zimbabwe.

1890, was a result of the British South Africa Company (BSAC) mining ventures backed by the Colonial Office in London. Therefore, Company interests and those of thousands of other prospectors were paramount; overriding issues of equity or agricultural development. After the failure by the Company and the prospectors to find a 'Second Gold Rand' in Mashonaland, the Company, without jurisdiction, started offering land of the size of 2420 hectares to every white person who would settle as a farmer.

In the absence of a perfectly competitive land market to regulate the allocation of land between races, the Company used uneconomic factors such as racial bias and military superiority as the criteria for land allocation. As a result the first civil war (1894 to 1897) over the question of land led to the expropriation by the whites of all of Matebeleland except for two Native Reserves of Gwaai and Shangaani, within the philosophy of 'winner takes all'. By 1913, this form of land allocation had seen whites gaining 12 million hectares which included all the land above 3,000 ft above sea level and within 40 miles of the railway line. In natural regions terms, this is the area covered by Regions I, II and III as discussed above. With the passage of time, the replacement of the Company as sole administrator by the first all-white settler government in 1923, heralded the start of institutionalized racial policies in the legislative process; operating without the constraining influence of the Colonial Office in London.

Greater control by the white settlers of the national judiciary and the legislature resulted in the creation of an institutional framework strongly biased in favour of the emergent white nationalist class. Through a series of parliamentary acts, such as the 1930 Land Apportionment Act, the 1941 revision of the 1930 Act, the 1951 Land Husbandry Act, the 1963 Tribal Trust Land Act, and the 1969 Land Tenure Act, the state continued the removal of blacks from those lands whose natural physical qualities were regarded as good for European occupation. The physical qualities of land, soil and climate have thus played a central role in the actual expropriation and allocation of land between races as shown on Table 3.3.

TABLE 3.3

DISTRIBUTION OF LAND BY NATURAL REGIONS BY 1979

Natural Region	% of European Area	Ha. (Million)	% of African Area	Ha. (Million)
I	3		1	
II	27		8	
III	22		17	
IV	26		45	
V	22		29	
	100	18.2	100	18.3

When the population of whites (650.000) and blacks (6.5 million) in 1979 is considered, it is evident that, on average every white person had access to one hundred times as much land as every black person. The inequalities were exacerbated by the unequal natural productivity potentials of the land allocated to each racial group, and by the racial biases in public investment for infrastructure development. The great concentration of blacks on marginal land, produced many cycles of poverty, especially during the drought years when the land was least capable of supporting high human and animal populations. Given the poor land husbandry methods of the peasantry sector,arising from inadequate extension support and lack of government support, the implications of bad continuous cultivation of poor land were progressive soil erosion, and the progressive decline of land and labour productivity;leading to increased poverty.

Historically, this in-built trend of reduced labour productivity and worsening state of poverty and other factors ensured an expanding supply of cheap labour for the mining, the urban and the white agricultural areas. Thus, the racial land laws, coupled by such segregationist laws as the 1936 Native Registration Act, the Pass Laws, the 1931 Maize Control Act, the 1936 Job Reservation Act and the infamous 1921 Master and Servant Act, outlawed constitutionally any form of economic competition both in the productive sectors and in resource allocation between races. It was to take a 15 year civil war before it was possible to repeal the racial constitution.

This racially divided society provides the context within which the policies determining public investment in bulk water supply capacity and the subsequent development of irrigation agriculture emerged. The investment policies were also characterised by contradictions and inconsistencies arising in part from the administration's avowed intentions to maintain separate development between the races, and in part, from the need to appear to be championing the economic advancement of the black people.

For example, the first ever recorded African irrigation scheme developed by the Africans in 1908 with the help of missionaries at Mtambara in Manicaland, received the support of the Department of Native Affairs in Salisbury. Within this climate of government support acreage under irrigation rose from 33 acres in 1912 to 200 acres producing 400 bags (each 200 pound weight) of wheat by 1922. However, even on these early schemes, the number of peasants on each scheme was too large in relation to the irrigation acreage; each family received only 1/16th of an acre, which failed to meet the subsistence needs of most families.

The Department of Native Affairs was impressed by the high crop output achieved by the use of cheaply obtained inputs; water from the Sabi River was gravity-fed into the canals and no money was spent on storage capacity development. Of interest too to the government was the potential population carrying capacity of irrigation agriculture and the state saw in it, the ultimate answer to the poverty, overcrowding and landlessness, that resulted from the racial land allocation:

> "It is considered that a very great increase in irrigation works intended for settlement by natives should be planned for. There is no other way of settling agricultural communities at sufficient density for a large population to be absorbed in a limited area"
>
> Source: Southern Rhodesia, Report of the Director of Irrigation, Salisbury, 1949.

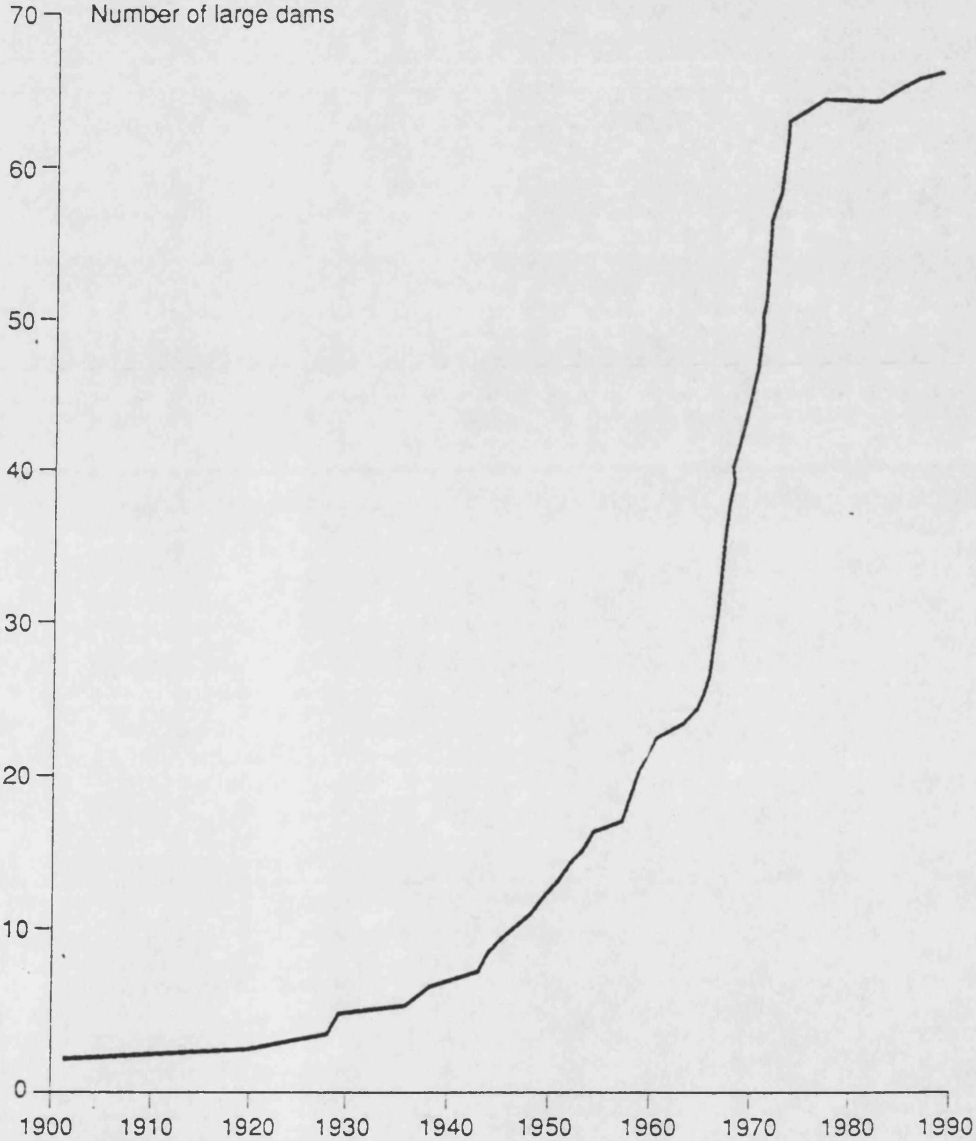
In line with this policy, the rate of forcible removal of blacks from designated white land increased (Roder 1965) and so did the rate of the development of the irrigation schemes designed for the peasants. The settlement of Africans on the Maranke schemes, in the Sabi Valley, for example, was carried out with full state financial and administrative support "......... in order to enable natives at present on private land and crown land farms in the Umtali District to be accommodated in Maranki Reserve" (Roder 1965). Six more schemes were developed for similar reasons in the Sabi Valley, and between 1936 and 1945 many were developed in other areas such as Tsholotsho and Beitbridge in Matebeleland. But the introduction in 1945 of a water charge of 10 shillings (fixed) per farmer per year, forced many peasants to shift from food crop production to cash crops.

In the early 1920's, the success of these schemes had depended not only on the continued flow of public subsidies to cover the construction costs of canals and land levelling; but on producers having access to urban markets. This position was to change after the Maize Control Act of 1931 which prevented producers from selling in urban markets. For the period up to and beyond 1945 the combination of such laws and water tariffs led to large scale abandonment of the schemes by many peasants.

White farmers' interest in irrigation agriculture emerged during the enactment of the Maize Control Act. The 1927 Water Act, by linking water rights to land rights, effectively terminated the efforts to develop irrigation agriculture amongst black peasant farmers who, because of the communal ownership system, had no individual rights to the land. They therefore could not individually or collectively apply for any right to water. In relation to commercial irrigation, public investment in water as shown by Fig 3.8 increased after 1927, and more so after the Second World War. Initially the abandonment of schemes by peasants did not reverse the policy preconception that irrigation was the only mechanism which would allow large numbers of people to subsist on a small area of land. The government remained undeterred, and from 1936 to 1946 it spent huge sums in developing schemes and offering them free to irrigators.

Fig. 3.8

Public Investment in Water Schemes - 1900 - 1980



Source: 'Rhodesian Dams' 1972; updated to 1987

No economic criteria were used to assess the viability of these schemes either measured from the macro viewpoint of rates of return on capital or from the micro considerations of whether the schemes would yield higher levels of subsistence to the peasants. This situation did not last long.

After the Second World War, public policy was influenced more by the attractiveness of large scale commercial schemes. Investment policy shifted from subsidizing peasant schemes towards the production of large scale water storage facilities, for large scale irrigation schemes. The Sabi-Limpopo Authority (now the Regional Water Authority) was formed in 1965 specifically to fully develop all the blocks of irrigable soils in the Lowveld for private investors. The policy shift towards large schemes was based on a number of assumptions and circumstances. For a start, the high demand for food and raw materials in war-torn Europe offered chances of a potentially secure market for such products as sugar, coffee, cotton and tea. At home the formation of the Federation of Rhodesia and Nyasaland (1953-1963) offered an extensive domestic market for the expected high yields. The Federation 's economic boom associated with Zambian copper exports created the excess capital resources needed for investment; and (given the strength of the economy and the attractive investment environment) policy makers were confident that many foreign investors would be attracted to invest in irrigation agriculture, and fully to utilize the developed water resources.

In order to attract both domestic and foreign investment capital, the state embarked on a policy of forward or upfront investment in bulk supply capacity. The dam construction rate increased rapidly as shown on the cumulative graph on Fig 3.8, almost all development occurring on European land; where it was safe from the problems of siltation. The rate of construction of large dams accelerated further between 1965 and the mid 1970's, partly because of the self-sufficiency based import substitution policies adopted in the wake of the Unilateral

Declaration of Independence (UDI) in 1965, and the imposition of comprehensive economic and trade sanctions by the whole world on Rhodesia. It is important to note that the factors influencing public investment in irrigation agriculture during this period, had very little to do with economic efficiency, or the need to achieve the optimal allocation of resources, but more to do with the survival of the UDI government. The result was that too many dams were built in the absence of any demand forecasting, and as such the investment was not directly linked to real economic demand for water, or to the cost of producing water.

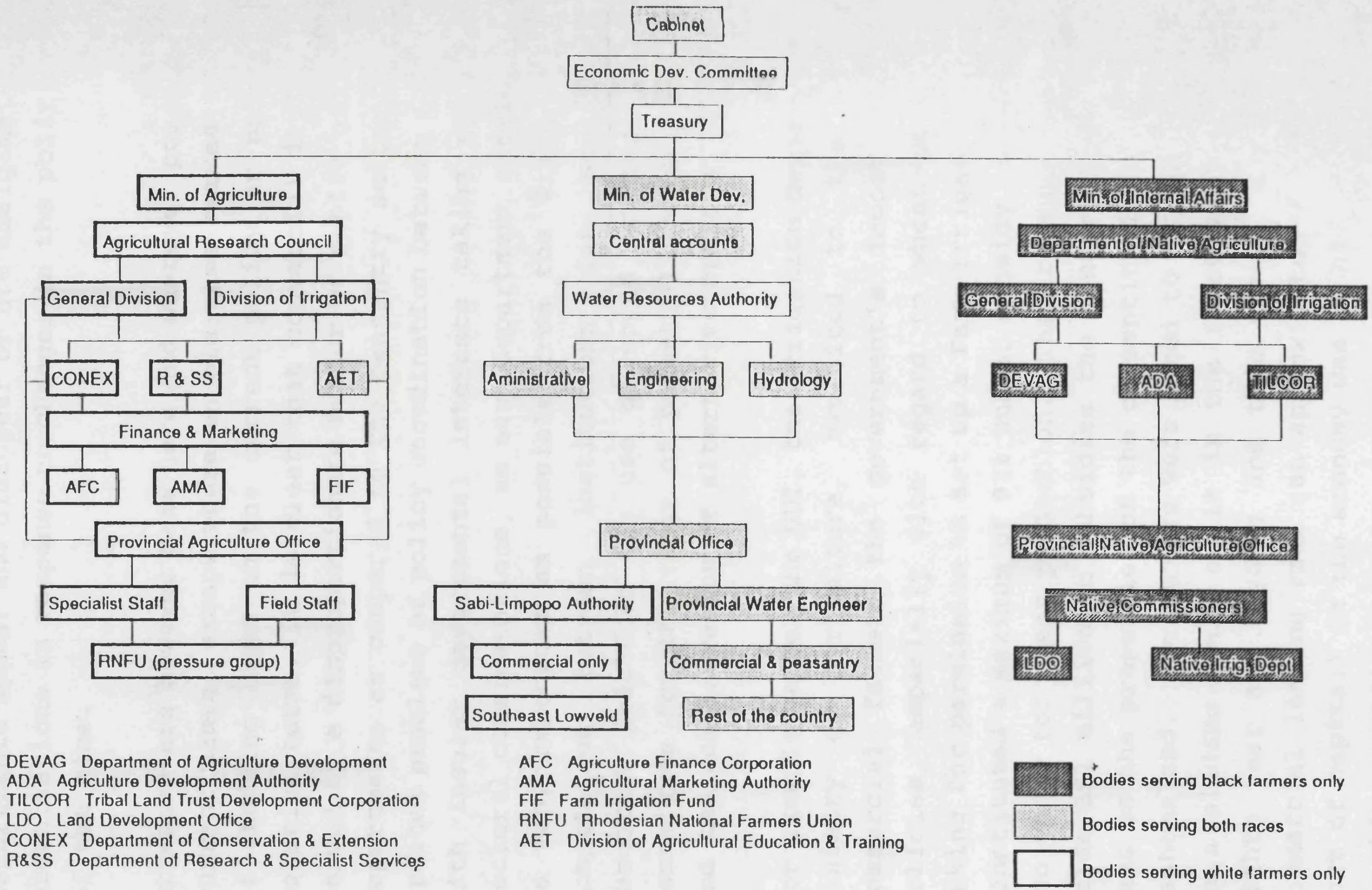
On the block of irrigation soils in the south eastern part of the Lowveld, only three multinational agribusinesses, the Anglo-American (Hippo Valley Estates), the Hullets Ltd (Triangle Sugar Estates) and a consortium of the above two companies (Mkwasine Estates) were attracted. These were, and still are the only recipients of all the water from 6 large dams (the Lake Kyle, Lake McDougall, Bangala Dam, Siya Dam, Esquelingwe Weir and Mushandike Dam). On the banks of the Sabi River, a small number of domestic private farmers has been attracted to the Middle Sabi schemes and to the Chisumbanje Estates. Elsewhere in the country, especially on the Highveld, many private domestic farmers were attracted into supplementary irrigation, after the government subsidized the construction of numerous small to medium size dams using the first Farm Irrigation Fund established in 1967. Huge volumes of water capacity have in the end served very few farmers. In a bid to induce greater farmer participation in irrigation, and greater use of the water, the state was forced to sell the water at less than the cost of producing it.

In the meantime, the Federation broke up, and with it went the perceived captive domestic market that was one of the inspiring factors behind the irrigation drive. The European market became saturated with the supply of the same commodities produced in Zimbabwe from other suppliers, and the result of this competition was the dramatic decline of all commodity prices; and except for occasional price windfalls, this market was no longer lucrative. The 15 years of sanctions sealed off any market that ever existed, except that of South Africa and those countries who conducted business in violation of the sanctions. Earlier enthusiasm that had given birth to commercial irrigation seemed temporarily stopped in its tracks.

However, the shift in government investment policy and practice towards the commercial sector had another perceived advantage in that the state no longer needed to support peasant schemes in order to solve problems of landlessness and unemployment. Rather, the large scale schemes were expected to offer employment opportunities that would absorb large numbers of the landless peasants. This was made more possible by the absence of any meaningful automation in the country's entire agriculture industry; making human labour resources the motive force of production. Therefore, future resource allocation to small scale schemes was to be justified on economic grounds, and in direct competition with all other sectors of the economy for scarce investment resources. Because of this shift towards efficiency in resource allocation, by 1979 only a handful of the small scale schemes were still operational.

Except for those small schemes drawing water form the perennial Sabi River, using the run-off-the river method, most other projects had failed; their viability being curtailed by many factors among which was the frequency with which the small multi purpose dams, (the predominant source of water for all purposes in the communal areas) dried up every dry season. This situation underscores the observation that historically, the distribution of effective irrigation capacity was and still is highly unequal between the races. The state firmly established a system of irrigation infrastructural provision which favoured the indigenous commercial and multi-national agribusiness interests, at the expense of the small scale peasantry irrigation sector. An institutional framework was put in place (Fig. 3.9) to buttress this racial divide.

Fig. 3.9
PUBLIC INSTITUTIONS AND ORGANISATIONS INVOLVED IN WATER DEVELOPMENT AND AGRICULTURE, 1961-1979



Source: Derived from field data

An assessment of the institutions and organisations can be very confusing because of the frequent changes in names, as departments appear and disappear or are amalgamated into new organisations in response to changes in the political set up of the time.

Attempts are however made here and wherever possible to use current names, except where an old name serves the purpose of shedding light on the current policy or practice. In relative terms, it is clear that commercial irrigation was served by a disproportionate number of public officials and departments as compared to the peasantry sector. This had created problems of policy coordination between departments, with insular departmental interests taking priority over sectoral considerations, as each department attempted to get as many resources as possible from the Treasury. Petty competition between institutions for scarce capital resources precluded the use of sound economic evaluation techniques for the range of potential investment projects and the consideration of alternative options.

For example, after the UDI, the irrigation department of the Ministry of Agriculture, exploited to the benefit of commercial farmers the government's import substitution policies, especially with regard to wheat-production, by asking for permission to set up a Farm Irrigation Fund, that constituted a maximum of 92% public subsidy to those farmers who opted for wheat production. The Treasury initially set aside Z$1 million to subsidize the construction of private dams on the properties of the consenting farmers, mostly in Mashonaland. The farmers were asked to pay an interest rate on a sliding scale of 1% in the first year to 8% by the eighth year and beyond; and this was at a time when the commercial lending rate (an approximate of the opportunity cost of capital) in the economy was as high as 10.5%. These practices reflected the department's preoccupation with self-legitimation, rather than the rational concern over the efficient allocation of scarce capital resources in the overall development of the country's agriculture.

Lack of coordination of development efforts between departments and between those organisations serving native interests and those serving white commercial interests had meant that neither economic efficiency nor equity had been served by the investment decision process. As a result, in economic terms, the marginal cost of producing water could not be related to the resultant marginal benefits, as should have been the case. Capital investment decisions were often taken without assessing the level of economic demand for water by farmers, or the extent to which existing capacity was efficiently utilized. Verbal pronouncements by farmers at the annual congresses of the Rhodesian Farmers Union (RFU) supported by both their parliamentary representatives and letters from the department of irrigation, and not the rational and well researched cost-benefit assessment of all competing investments, were often enough justification for the construction of new dams. Often, there was no evaluation of the extent to which subsequent private investment in irrigation agriculture and in distribution systems and other irrigation infrastructure would occur. Clearly, such private investment was crucial before the bulk supply capacity could be used to serve irrigation needs. Any use of public resources without reference to the above minimum requirements, could only represent irreversible misuse of scarce resources.

Until 1965, most of these schemes were not required to prove that they were economically viable, or that they provided higher levels of subsistence. In the case of the departments responsible for native affairs, freed from the need for economy by the wide use of public subsidies, the expansion of investment could only be curbed by limited Treasury allocations and not by the departments' conscious effort to ensure that limited resources were effectively used to produce greater subsistence benefits in a cost effective manner.

A number of factors were responsible for the uneconomic practices of most departments:

1. The emergence after 1965 of an "all out" irrigation policy in response to the import-substitution drive

post-UDI under which all potentially irrigable soils and dam sites were to be fully exploited, meant project development was no longer curtailed by the need to satisfy any choice criteria. In other words, the implicit assumption was made that the benefits from any, and all, irrigation projects inevitably exceeded the costs. Cost-benefit analysis(and any assessment method) was thus an irrelevance. This approach to development ignored the reality on the ground of real investment resource constraints, and the rising financial cost of constructing and maintaining the dams and irrigation networks. By 1980, nearly 90% of all the dams required major rehabilitation and/or maintenance work.

2. The investment policy did not consider the fact that irrigation projects do not only produce benefits, but also impose hidden costs. The implications of these were glossed over in the climate of over expansion and excess capacity development.

3. Engineers dominated all the policy making structures of the water industry. They sought solutions to complex crop production problems by resorting to the construction of water supply facilities as the only way to alleviate crop failure and to stop the occurrence of drought impacts. The engineers did not consider as part of their operational terms of reference the need to come up with alternative solutions outside the engineering mode. The engineers did not, for example, promote efficient water application technologies that could have had the effect of reducing water waste, and by implication, the need for new dams. The agronomists in the agriculture departments promoted low cost water delivery methods, such as the use of unlined in-field canals, and flood irrigation method, all of which had adverse water use implications.

4. The Ministry of Water had no economist posts, nor did it see the necessity of creating any. Where economists were employed, as in the Ministry of Agriculture, they were used to justify irrigation projects decided upon on

other criteria. Their job was to support the irrigation advocacy stance taken by Senior Ministry Officials and the political objectives, all of which had nothing to do with irrigation economics, but more to do with lobbying for more public subsidies on behalf of probably inefficient farmers.

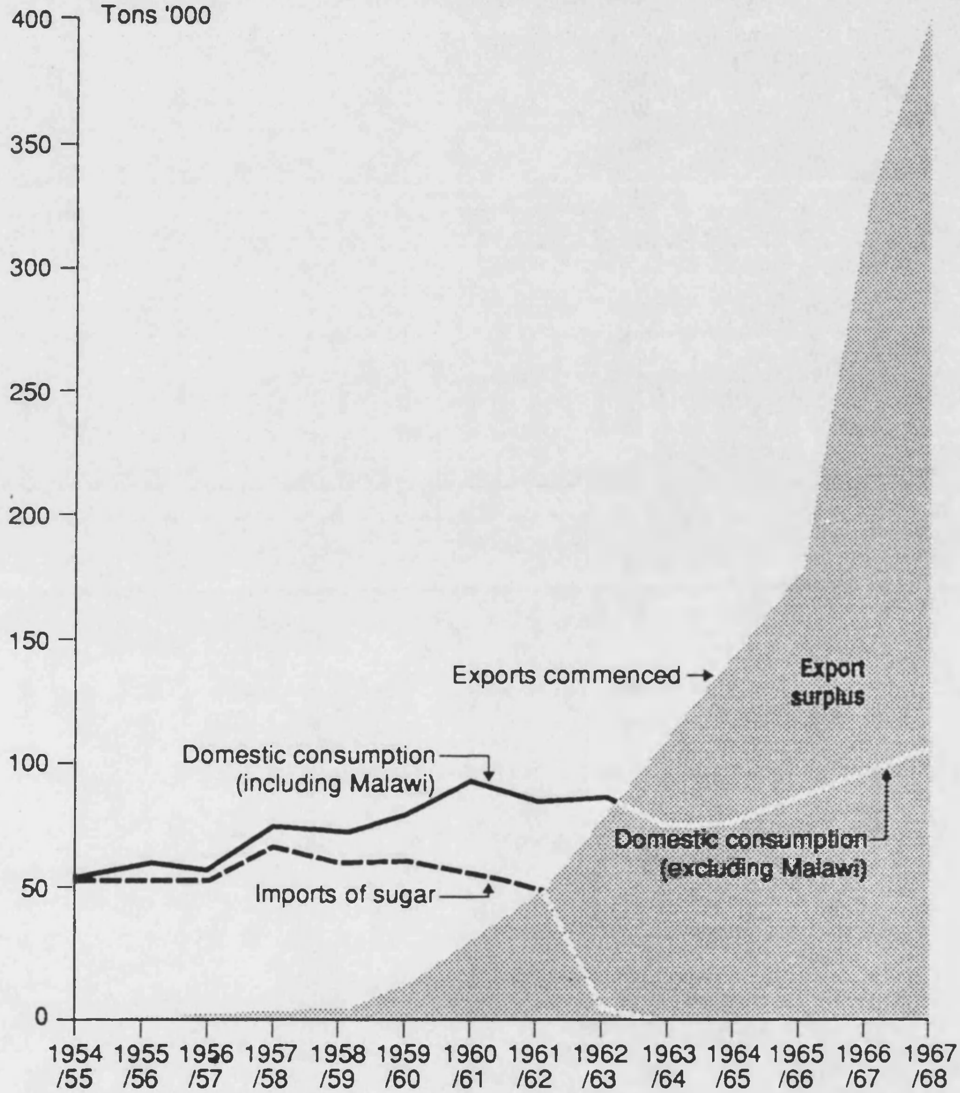
5. At the Cabinet level, most ministers and parliamentarians were farmers or represented farming constituencies. In 1970 for example, nearly 3/4 of the Rhodesian cabinet comprised farmers or people who had close links with the commercial farming community. The then Prime Minister (Mr Ian Smith) had an irrigation scheme at Hippo Valley Estates in the Lowveld. Thus, the Cabinet and Parliamentary irrigation committees were dominated by irrigation advocates, so paralleling the USA experience of the 1950s and 1960s as reported by Hirschleifer (1960), McKean (1958), and Haveman (1965), where political back scratching precluded the need to achieve economic efficiency in the allocation of investment resources. Davidson's (1969) work on Australia shows a similar trend. In Zimbabwe, officials were, as a result, unwilling to increase the price of water for irrigation despite the fact that irrigation claimed 2/3 of all the stored water, citing very generously the numerous benefits from irrigation as justification. The domestic water use and electricity Sectors were therefore burdened with the repayment of all costs arising from investments in water.

6. Public officials in most departments did not, for reasons to do with the preservation of their jobs, question, the politically determined allocation of resources, in terms of whether this was the most optimal in meeting the requirements of either allocative efficiency, or distributive equity.

The continued use of uneconomic investment policies were buttressed by the apparent success of irrigation in increasing the production of some crops. For example the country was changed from a net sugar importer to a net sugar exporter as shown on Fig 3.10, within a few years.

Fig. 3.10

THE GROWTH OF SUGAR PRODUCTION IN ZIMBABWE



Source: Fair, Optima 14(4) 1964

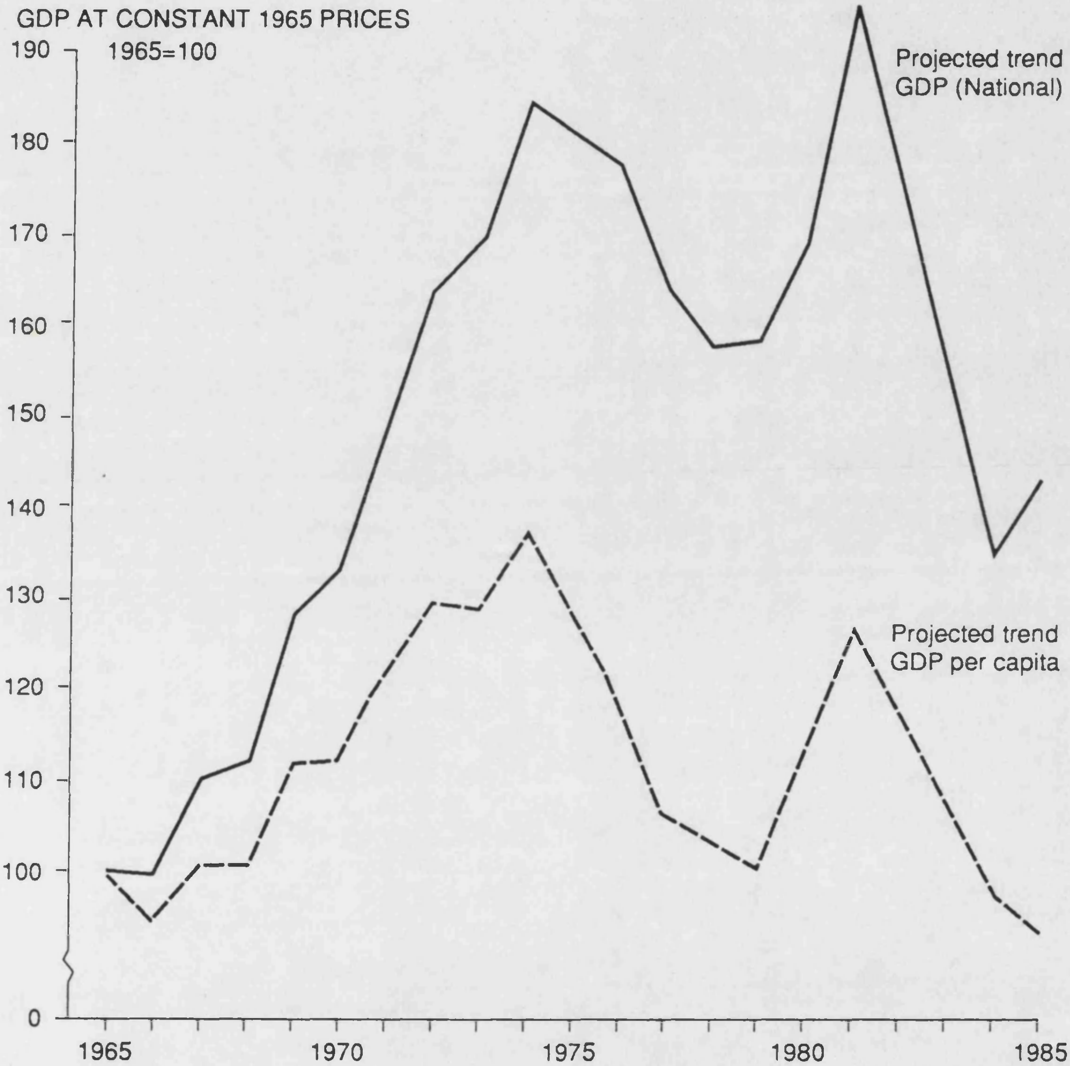
Similarly wheat output expanded significantly thus allowing for a dramatic reduction in imports such that by the early 1970s the country achieved self-sufficiency for a number of years. However, these benefits were only realised under conditions of public subsidy. Lack of public awareness and knowledge about what was happening in the irrigation sector meant that the tax payer could not complain about the potential and real misallocation of resources. In addition, the public was only too well aware of the effects of droughts to argue against official practice even if they were to have all the information.

The State of the Economy

Perhaps one of the most important factors (apart from political intervention) that has enabled the continued use of uneconomic investment policies, was the economy's ability to finance the expansion of irrigation programmes. As shown on Fig 3.8, the expansion in public investment in bulk supply capacity from 1965 on, and the introduction of the subsidy-based Farm Irrigation Fund, coincided with the period of high economic growth in real terms (Fig 3.11). Between 1965 and 1974 economic growth was on average 7 percent per year, far outstripping the 3.5 percent per year, population growth rate for the period (World Bank 1983). This meant that there was excess capital resources in the economy available for investment in the dams. The phenomenal growth was in fact due to the Government policies that stopped overseas remittance of dividend capital in favour of re-investment of shares and dividends locally, thus boosting economic development. In addition, per capita income at 1965 prices rose from Z$157.5 in 1965 to a peak of Z$ 223.3 in 1974, before dropping during the peak of the war, to Z $166.5 by 1979. The rise in incomes (be it for a smaller percentage of the population) meant that the state was able to raise more investment resources domestically, through taxation.

Public investment in water development declined progressively from 1970 to 1979, perhaps because of the intensity of the civil war. However economic factors also

Fig. 3.11



Source:Derived from field data

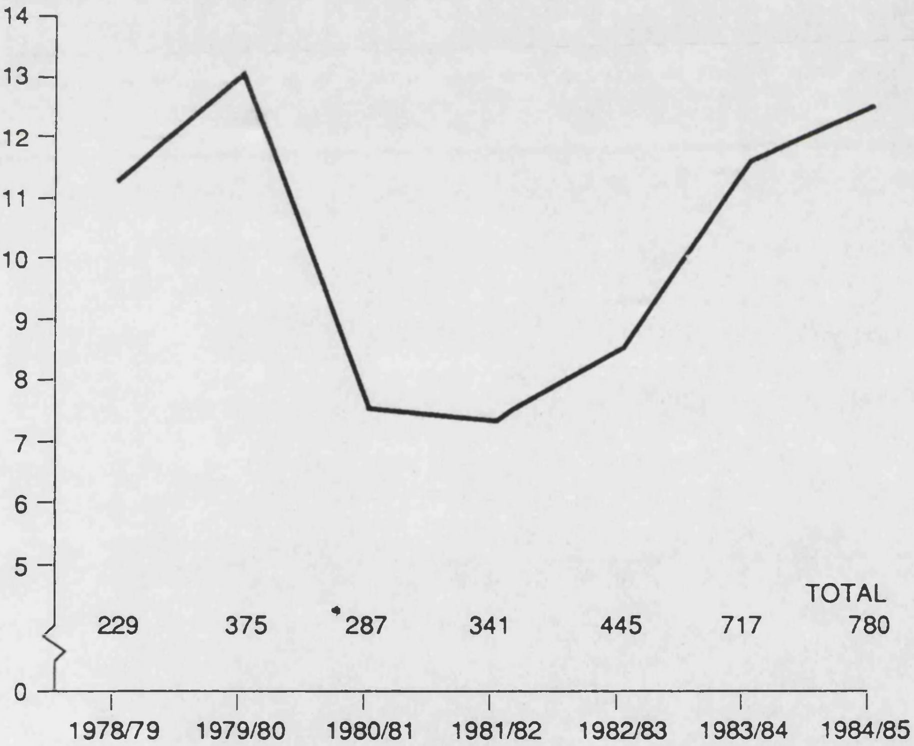
played a role through the combined effects of high oil prices and world economic recession, worsened by the operations of the sanctions. These forces set economic growth into decline. Public expenditure on water and irrigation projects thus, had to be curtailed.

An economic upturn, which occurred from 1979, produced a 1981 record economic growth rate of twelve and a quarter percent in real terms (four times higher than the population growth rate), and allowed the renewed rise in per capita incomes. A new government came into power in 1980, this recreated a favourable environment for renewed public expenditure with little regard for economy. It was at this time, that within the political context of correcting past racial investment policies, this time in favour of the peasants, that public subsidy-based investment in economically inviable small scale schemes was re-introduced. This was despite the fact that available evidence had shown that these types of schemes had failed to be self-supporting in the past. The new government had two evils it wanted to resolve quickly: the growing land squatting problem by the landless peasants, who had supported the war on the belief that the new government would nationalize all private land and give it to them; and the large numbers of returning residents, mostly former refugees, who wanted both employment and land. Small scale irrigation seemed the most suitable approach to addressing all these problems short of nationalising all the land. The rate of public investment in bulk capacity also picked up, and so too did general public expenditure, using funds generated mostly from donors at the 1981 Zimbabwean Conference for Reconstructional and Development (ZIMCORD) in Harare, set up for the specific purpose of mobilizing resources for economic rehabilitation.

The seeds were thus sown for the current account deficit to rise (see Fig 3.12) from Z $110 million in 1979 to Z $300 million by 1980, and to escalate to Z$ 780 million by the end of 1985. This uncontrolled pattern of public expenditure was bound to lead to economic bankruptcy, and by 1983, the country had to resort to the International Monetary Fund (IMF)'s standby facility, to support budget difficulties.

Fig. 3.12

CENTRAL GOVERNMENT BUDGET DEFICIT, AS % OF GDP



Source:Derived from field data

Government officials had embarked on high public expenditure generally, and on the expansion of irrigation in particular in the 1980/81 financial year, on the basis, and indeed the enthusiastic belief that the economy was to continue to grow annually until, at least the end of 1985, at the planned rate of 8 percent in real terms. It was also officially assumed that at that rate of growth the economy was going to be able to shoulder the burden of planned public expenditure generally, and in particular, that relating to water and irrigation development.

However, unlike the 1965-1974 period when positive economic growth lasted for nine years, this time economic growth, by 1982/83 had fallen to minus 2 percent, a fall of 14 percent from the 1980/81 peak level, and far below the planned target of 8 percent. The economic position remained poor in 1983/84, when the growth improved slightly to minus 1.1 percent, and overall sectoral performance deviated from the planned targets, by wide margins . As Table 3.4 shows, agriculture's target growth rate was 5 percent but the actual achievement was minus 9.8 percent, a deviation of 14.8 percent. Clearly, agriculture performed worse than other sectors of the economy.

The three year drought was blamed, among other reasons, for agriculture's depressed position. Gross earnings from individual food crops fell dramatically compared to the 1981 position. For example, maize earnings fell by 55.7 percent in just one year to reach only Z $74.8 million by 1982/83, wheat fell by 34.5 percent to Z $27 million, and groundnuts, soya beans and sorghum together fell by 47.9 percent to Z$12.3 million. These are mostly the food crops farmers grow on irrigation schemes as well as under rainfed conditions.

By contrast, the high value cash crops, most of them grown under irrigation, experienced positive growth in gross earnings. For example, tobacco's earnings rose by 18.6 percent to Z $184 million, cotton by 7.9 percent to Z $83 million and sugar by 8.1 percent to Z $81.8 million. But these positive growth rates for the export crops were not high enough to generate enough resources for the continued

TABLE 3.4

SECTORAL PERFORMANCE, 1982/1983

Sector	Planned Target %	Actual Performance %	Deviations %
agriculture	5	-9.8	14.8
mining	0	-1.6	1.6
manufacturing	11	-1.5	12.5
transport	9	-1.2	10.2

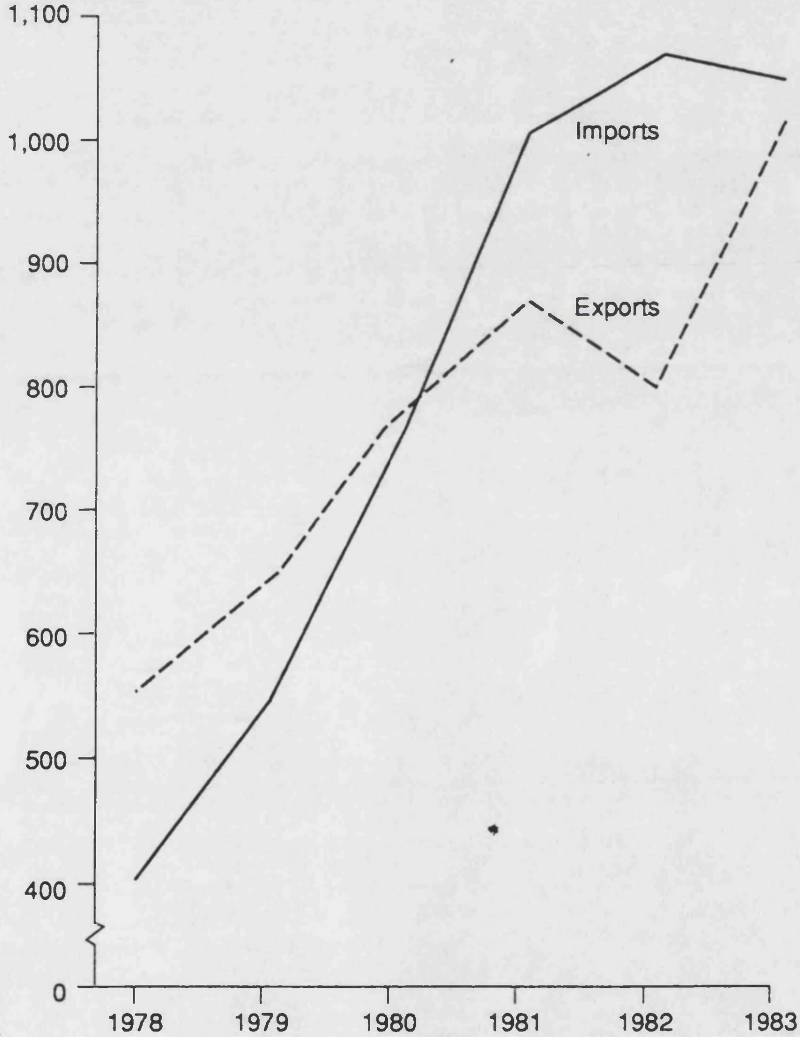
Source: Derived from the National Development Plan (Transitional) 1981-1984, The Government of Zimbabwe.

expansion of water and irrigation facilities. In part this was due to exogenous factors, particularly those of the depressed world market prices, but also of importance was the high national debt servicing ratio which took 36 percent of all foreign earnings annually, as well as the continued failure by the government to maintain a healthy balance between imports and exports as shown on Fig 3.13.

The generally negative performance of the economy meant that the state had to resort to raising revenue for investment through indirect taxation, because net real incomes had remained largely static at the 1981 level over the period 1981 to 1984 (Fig 3.14). The implications for continued public investment in bulk water supply capacity development and for the implementation of all the planned small scale irrigation schemes, is that public expenditure could not be funded solely from taxation-based resources. Thus the government sought to finance these planned investments from both domestic and foreign borrowings. Fig 3.15 shows the steep rise in borrowings for overall investment. It has not been possible, in the absence of data, to separate the share of the debt that is due to water and irrigation development. The size of the domestic debt has worrying implication not only for balance of payments and budget deficit management, but also for the availability of resources for investment to the productive sectors of the economy, namely industry and mining. The bunching of short-term loans over a period of four years following the ZIMCORD donor conference, has also come to mean that the resultant high debt servicing ratio swallows all net foreign exchange earnings.

Fig. 3.13

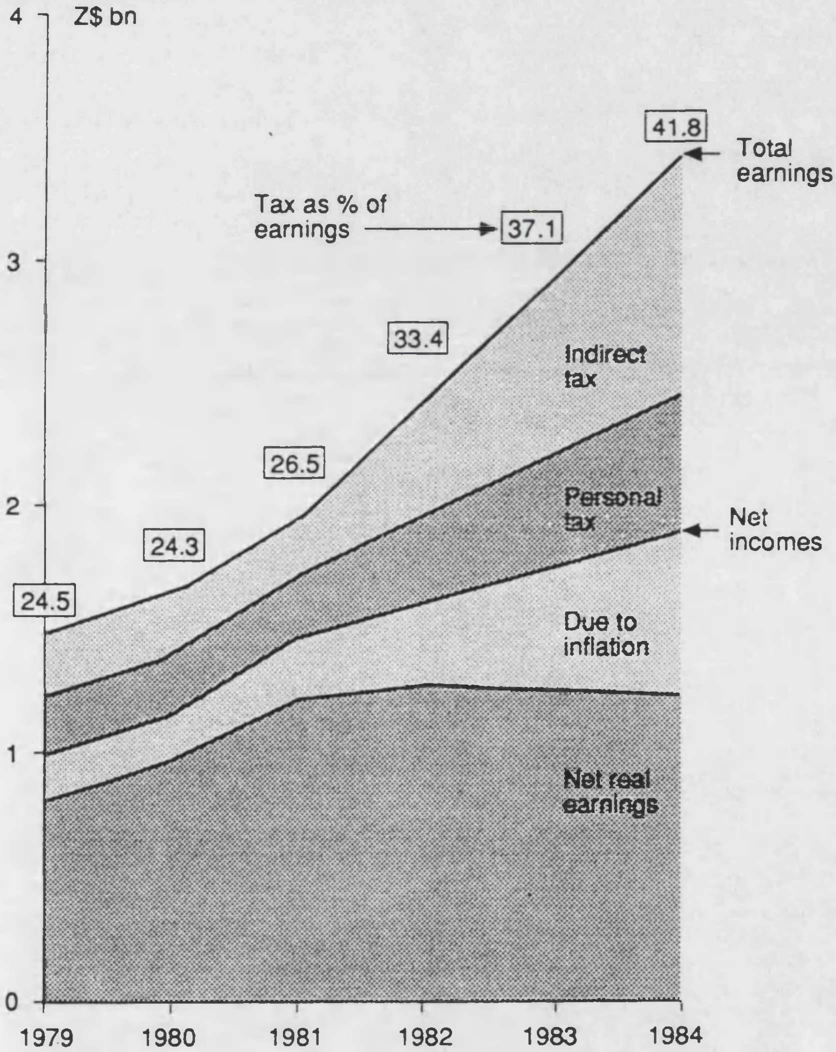
BALANCE OF PAYMENTS, $ million



Source: Monthly Supplement of the Digest of Statistics, Jan. 1985

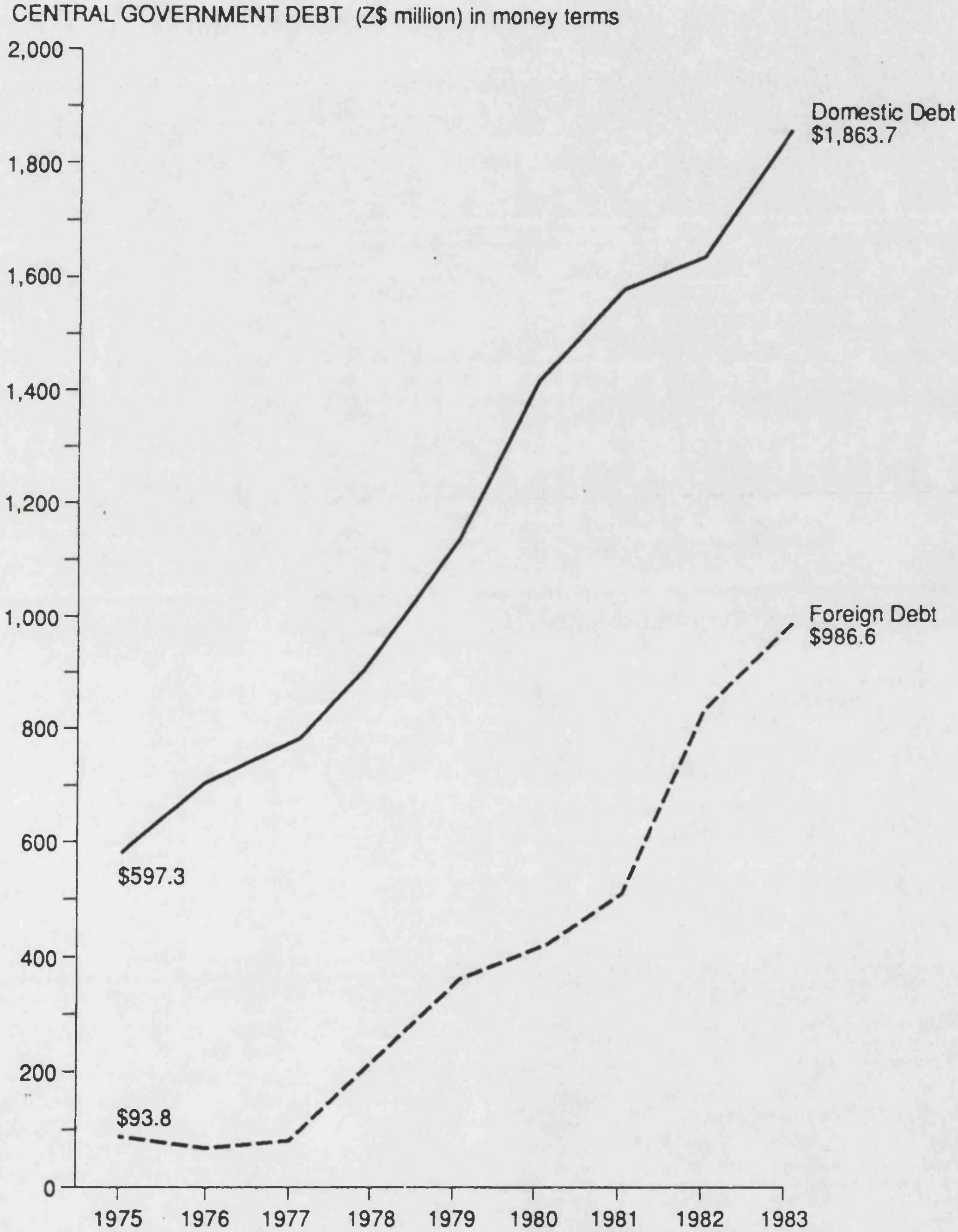
Fig. 3.14

EARNINGS AND THE TAX BURDEN



Source:Quarterly Economic and Statistical Review, 1984.

Fig. 3.15



Source: Quarterly Economic and Statistical Review, Vol 15, No. 1, March 1984

By 1986/87 the situation in the economy had not improved significantly.

It is against the above physical and socio-economic historical background that present investment policies and practices are assessed. In other words, given the foregoing, does irrigation represent the best, among other alternative investment strategies that maximize both growth and the equitable distribution of resources? Before any attempts can be made to answer these salient questions, it is imperative that, on the basis of available data, an attempt is made to assess the cost of developing the country's irrigation system.

CHAPTER FOUR

PUBLIC SECTOR INVESTMENT AND COMMERCIAL IRRIGATION COSTS

INTRODUCTION

As indicated in the preceding Chapter, it is officially taken as axiomatic that irrigation, in Zimbabwe, is necessary to raise agricultural productivity, and that the physical irrigation potential of the country should be fully developed. Further, it has become an accepted part of policy that the public should provide the initial, upfront investment in bulk water supply capacity. The assumption is that the scale of investment required to utilize all potential reservoir sites or river off-take points to their full capacity would be beyond the financial capabilities of individual private farmers. Moreover, the public provision of bulk supplies is seen as a means of encouraging the private sector to invest in the distributional networks and field systems required to realise the irrigation potential of the country. The orthodox approach to the role water plays in the internal development of a country's agriculture suggests that investment in its exploitation can act to spread growth and prosperity both across space and down to the poorest groups in society. The fact that this assertion is not based on any empirical evidence and cannot be substantiated by practice, has not deterred or taken anything away from this belief that has assumed a life of its own.

Historically, no Government in Zimbabwe has been content to let private interests entirely determine the development of a sector considered to be so vital to the functioning of all other sectors of the economy.

All the assumptions now so deeply embedded in the irrigation policy are questionable. In particular, there are many issues which need appraisal. First, is it correct to assume that all land which could benefit from irrigation should be developed for irrigation whatever the cost? Is the mere presence of water and irrigable soil in any place, enough justification for the development of irrigation agriculture?

A similar question applies to the attempt to develop all potentially suitable dam sites into water reservoirs. This basically raises the question of whether irrigation potential should actually be measured in purely physical or economic terms.

The economic approach has been to regard irrigation development primarily as an exercise in resource allocation (allocative efficiency criteria) the objective of which is to maximize the economic output from available resource inputs (Hirschleifer 1960). Decisions regarding the exploitation of the physical potential, at any time and point in space, should, thus, be made in the light of information on the economic, and social contributions of irrigation agriculture. Irrigation potential can therefore be measured in terms of the opportunity cost of the scarce investment resources and other factors of production.

A second, but clearly related issue is the question of whether irrigation agriculture is the most cost-effective method of raising agricultural productivity in the country. This issue clearly cannot be treated separately from two distributional questions; cost-effective for whom? (government, commercial farmers, peasants), and the question of who gains from any productivity increase? Such distributive questions were raised in early economic attempts to assess the viability of irrigation projects (McKean 1958 etc) and by more recent writers on LDC irrigation (Carruthers 1981, Clark 1970). But in the practice of irrigation, these policy issues have been neglected in most countries of the world, and Zimbabwe is no exception. In the Zimbabwean context, such current neglect maybe surprising given the political ideology and overt policy aims of the post 1980 government.

Third, the assumption that the public sector should provide the initial investment in bulk water capacity development and infrastructural support to the farmers, needs to be assessed and not simply taken for granted, especially in the light of costs involved. Particularly so, since a number of the largest schemes effectively are providing water for one or two multinational agribusinesses, whose international turnover from all concerns, arguably exceeds the entire GNP of Zimbabwe, and are therefore capable of meeting all the costs associated with irrigation unaided.

The need for the assessment becomes all the more urgent when it is considered that the greater part of government's additional financial outlay is in the form of subsidies to defray the effects of high input costs; producer price subsidies to motivate farmers to stay in irrigation and the free provision of supportive infrastructural facilities such as roads, railways and airports as well as an array of technical support services through effective field extension and the establishment and running of research stations, all at public cost. In addition the state has established a credit institution specifically for the farmers, the Agriculture Finance Corporation, and specifically for irrigation, a Farm Irrigation Fund which provides low-interest rate loans. The points at issue here are basically whether such producers would have provided their own supply of capital completely without state aid, or with only part of the costs covered by the state aid, and if not, whether the resultant losses in agricultural output would exceed the value of the saved capital resources.

Finally, two questions must be asked: first, whether the absence of water is the only constraining factor in irrigation agriculture, and whether its provision is the only essential prerequisite for irrigation. Second, the question must be addressed whether upfront water capacity development has encouraged (and has been the most efficient method of encouraging) the development of irrigation agriculture and the subsequent distribution of the benefits in the economy.

An economic assessment of the state's involvement in private commercial irrigation would require the evaluation of the stream of all costs including the subsidies incurred by the public sector, against the resultant benefit streams, with the benefits measured in terms of the public sector criteria. In the real world of poverty and under-development, especially in the LDCs, public sector criteria are characterised by the desire to achieve several, possibly incompatible objectives, at the same time. In Zimbabwe it is common for the state simultaneously to want private agricultural producers to operate in a manner consistent with efficiency, equity, etc plus a whole host of other economic and political objectives such as increasing national prestige, achieving regional and political stability and unity etc. The fact that some of these maybe recognized to conflict makes them no less desirable as objectives.

In fact a full analysis concerned with resource use optimization in the economy as a whole needs to consider the costs which must be incurred by both the public and private sectors, before the water has any effective use value. Such an evaluation is not an easy task, and is made more complex in Zimbabwe by the openness of the economy in trade terms. A considerable proportion of the industrial inputs are imported at very high foreign exchange cost, and in addition profits are remitted directly or transfer-priced to overseas shareholders and parent companies respectively. Because of the dominance of foreign agribusiness in the irrigation sector, the output from the sector yields benefits to overseas concerns. From the state's point of view private sector costs are only relevant when measured in terms of opportunity costs to the economy, by which is meant, the foregone value of returns on investment in other (more) productive enterprises within the economy. This involves, at least in theory, the assumption that resources spent on irrigation could have been spent profitably somewhere else within the economy. While this assumption may be valid for the indigenous private companies and individual farmers, it cannot be valid for foreign multinational agribusiness. As the multinationals would not re-invest the saved costs or profits within the local economy, the analysis of the efficient allocation of investment funds between the state and the private sector becomes that much more difficult to ascertain.

The range of public cost outlays is not limited solely to storage capacity development, but tends to permeate the entire irrigation agriculture production process as earlier indicated. Outright subsidies mean that the irrigation sector is shielded from market realities. The fragmented manner in which the plethora of public support measures are implemented, through the numerous institutions serving irrigation agriculture, hinders full automatic grasp of the scale and magnitude of state expenditure on the sector. It is therefore important that an attempt is made to try to group all state costs before any discussion of the benefits from this cost outlay.

<u>Public Cost Outlay</u>

Public Sector Investment (PSI) in commercial irrigation agriculture can be expressed as a function of a number of cost outlays, as shown below:

$$PSI = \frac{f(CO + OMR + CSP + ICS + CSM + FC + ISS + Ir)tn}{(I + r)tn}$$

Where:

Co - represents the initial capital cost outlay required for the construction of dams, canals, tunnels and a whole range of related fixed capital assess such as pumping stations and water gauging machinery, most of which have a substantial foreign exchange content.

OMR - represents all the annual operation and maintenance and replacement costs of the dams and reticulation systems to the edge of the field, as well as cost over-heads, such as the cost of the numerous water bailiffs, and in addition, the upgrading, repair and rehabilitation costs.

CSP - Represents the Commodity Support Price subsidies that the government pay as direct subsidy in order to influence the choice of crop and scale of output, annually. This cost outlay is associated with the crop pricing policies of the government, and manifests itself in the producer price, or the consumer price subsidy. CSP is associated with public policy objectives of either food self-sufficiency or reduction of food prices, on behalf of the poor section of society.

ICS - Represents the Input Cost Support measures aimed at reducing the cost of production by lowering the costs of inputs required by farmers, as a way of keeping the prices of the final product low, and is also aimed at increasing the incomes that farmers realise. This form of subsidy is closely related to the CSP above. The major inputs are fertilizers, machinery and seeds.

CSM - Represents the Credit Support Measures that the state sets up in order to make sure that farmers have access to cheap loans and other credit facilities. The Government's cost outlay here comprises the setting up of an exclusive farmers' credit institution such as the Agricultural Finance Corporation, and occasionally the writing off of the farmers' bad debts, as well as setting up of the Farm Irrigation Funds, as facilities for the expansion of irrigation at reduced cost to the farmers. These institutions can only operate under State guarantees against bankruptcy.

FC - Represents the feasibility study costs associated with public investment in capacity extension. Because they represent a substantial cost outlay and are not recovered from the farmers, there is a need to assess them as a cost in their own right, given that they have a high opportunity cost element.

ISS - Represents the numerous cost outlays for the Infrastructural Support Services that the state continues to finance in order to influence production systems, marketing, technology and the movement of goods and services. Among these services, Research, Extension and Transport have a great impact on irrigation agriculture.

IR - Represent the interest cost on all borrowings for irrigation agriculture. As most of the cost outlays are met from borrowed funds, borrowed either on the domestic or the external money markets, most of these funds attract high interest rates with long repayment periods. The state pays the interests.

(1+r) - Represents the discount factor for the assessment of the present values of the future cost outlays of the given costs streams.

tn - Refers to the time stream of each cost stream or variable for the given number of years.

<u>The Capital Cost Outlay</u>

The Colonial Government of Rhodesia constructed nearly all the large scale dams for the benefits of the private commercial irrigation sector (Chapter 3) alone. Surprisingly, the new Government's investment outline in the nation's irrigation agriculture (Table 4.1) for the period 1984/85 to 1986/87, shows that it too has accorded greater priority to the continued growth of the private domestic and foreign corporate agribusiness in the irrigation sector. While the Rhodesian Government could, on the basis of their policies, afford to channel a lot of resources towards commercial irrigation farmers, all of them white, the present Government, as per its pronounced policy of 'Growth with Equity' had to be seen to be aiding the peasantry sector. Certainly Table 4.1 does not show any departure with the past on the basis of the period covered by the figures.

TABLE 4.1

PROPOSED MEAN PUBLIC CAPITAL EXPENDITURE (1984/85 TO 1986/87)

	$'000	%
Peasant Schemes	9,994	23
State Farm Schemes	803	2
Private Commercial	32,786	75
	43,583	100

Source: derived from the World Bank working paper, 1984

The Colonial Government could also afford to construct many dams for the commercial irrigation farmers because the construction costs were low compared with the post 1980 costs. According to the data and information collected from both public and private institutions involved in irrigation agriculture, the costs of dam construction and irrigation works have increased considerably during the last decade, more so since 1980, when price inflation for irrigation works reached 1.5% to 2% per month. These findings are consistent with the findings of the World Bank's 1983 study of the agriculture sector. Using the Mwenje Dam Raising project, as an example (Table 4.2) it has been possible to show this price evolution.

TABLE 4.2

THE COST OF RAISING MWENJE DAM

	1970	1974	1980	1981
in $'000 (in money terms)	626	1,050	3,310	5,000
Index: real 1970 =	626	794	1,155	1,425

CONSTRUCTION MATERIALS' PRICE INCREASES

	1970	1974	1980	1981
Index =	100	266	319	519
Annual % increase	-	13	20	34

Source: Derived from the World Bank, Agriculture Study, 1983

Clearly, the phenomenal increase of the cost of the construction materials at real 1970 prices, has largely been responsible for the cost escalation of nearly all recent dams. This implies that the unit cost of producing a cubic meter of water has risen considerably since 1980, compared to the 1960 and 1970s. This is more evident when the unit cost of producing water before 1980 is compared with that for the post 1980 period for dams of a similar capacity as Table 4.3 shows.

For example, the unit cost of producing a cubic meter of water at total capacity of Tende Dam ($0.01939) is over 29 times higher, at 1976[1] prices than that at Lake Kyle ($0.000660). Likewise, for smaller capacity dams of broadly similar total capacity, there is some evidence of higher unit cost at new dams than at old dams. For example, the unit cost of producing one cubic meter of water at Bindura Dam ($0.09237) is 30% higher than at Turgwe/Siya Dam ($0.06404), at 1976 prices.

But the assessment of the unit cost of water using total dam capacity is always misleading, particularly so in drought prone Zimbabwe, without considering how much of the capacity is utilized at different times. Given the erratic nature of Zimbabwe's rainfall regime, all the huge dams like the Kyle, Tende, Mazwikadei, Bangala, Mukorsi, Manyuchi, to name a few (Table 4.3) will not fill up to capacity in less than five seasons.

If rainfall is consistently above average, these dams would fill to capacity in at least three seasons, and the smaller dams like Mwenje and Mkwasine, would require a full season and half to fill depending on the size of the catchment area. In addition, after every dry season or drought, the

[1] The calculation of the 'real value' capital costs at 1976 prices was based on inflation rates of 25% (1984), 18% (1983), 15% (1972), 12% (1981), 10% (1980), 9.5% (1979), 9% (1972), 8.5% (1971), 6% (1970), 7% (1969), 7.5% (1968), 6% (1967), 5% (1966), 8% (1965), 8% (1964), 7% (1963), 9% (1962), and 10% (1961). 1976 is chosen here as the last year for the construction of all old dams.

TABLE 4.3 : THE UNIT OF PRODUCING WATER: A COMPARISON OF OLD AND NEW DAMS

OLD DAMS

YEAR	DAM	TOTAL CAPACITY m^3	YIELD CAPACITY m^3	TOTAL COST $	COST/M^3 TOTAL COST $ (At 1976 Prices)	COST/M^3 TOTAL CAPACITY $/$m^3$ (At 1976 Prices)	COST/M^3 YIELD CAPACITY $/$m^3$ (At 1976 Prices)
1961	Kyle	1,378,100,000	247,000,000	2,950,180	9,089,946	0.000660	0.036802
1962	Bangala	126,600,000	100,000,000	4,641,594	14,301,441	0.112962	0.143010
1966	Manjirenji	274,400,000	103,000,000	3,806,488	8,210,886	0.029924	0.079718
1976	Turgwe/Siya	105,400,000	55,000,000	6,750,000	6,750,000	0.06404	0.122727
	TOTAL	1,884,500,000	505,000,000	18,148,262	38,352,273	0.0203512	0.0759445

NEW DAMS

YEAR	DAM	TOTAL CAPACITY m^3	YIELD CAPACITY m^3	TOTAL COST $	COST/M^3 TOTAL COST $ (At 1976 Prices)	COST/M^3 TOTAL CAPACITY $/$m^3$ (At 1976 Prices)	COST/M^3 YIELD CAPACITY $/$m^3$ (At 1976 Prices)
1984	Mazwikadei	360,000,000	100,000,000	44,720,000	13,875,620	0.0385433	0.1387562
Est.	Bindura	87,000,000	50,000,000	25,900,000	8,036,194	0.09237	0.1607238
	Tokwane	122,000,000	53,000,000	20,000,000	6,205,554	0.050865	0.117086
	Tende	1,200,000,000	168,000,000	75,000,000	23,270,827	0.019392	0.135168
	Mukorsi	1,727,000,000	348,000,000	75,000,000	23,270,827	0.013475	0.0668701
	Manyuchi	325,000,000	70,000,000	27,000,000	8,377,489	0.025777	0.1196785
	Mkwasine	24,000,000	15,000,000	12,000,000	3,816,416	0.159017	0.254428
	Mwenje	40,700,000	23,000,000	5,000,000	1,551,388	0.038118	0.674516
	Silverstroom	17,500,000	10,000,000	6,400,000	1,985,777	0.113473	0.198577
	TOTAL	3,903,200,000	837,000,000	291,020,000	90,390,101	0.023158	0.107993

Source: Derived from field data

dams take longer to fill up. Every year, for example, by September, all the nation's dams are usually less than 30 percent full, and lower in drought years.

Apart from the fact that dams rarely fill to full capacity in any one season, there is also the problem of high evaporation rates (Chapter 3). A high percentage of the dams' capacity is lost through evaporation. This is more critical in the Middleveld and Lowveld where most of the large irrigation schemes and dams are situated. In some years losses of up to seven meters per dam are experienced.

In the absence of any measures to reduce water loss due to evaporation,the actual economic water stored behind any dam is far less than the full capacity figures suggest. The water loss situation is not helped by losses during reticulation arising from seepage losses, pilfering and from the water that forms pools half way between the dam wall and the down stream farmer.

The Ministry of Energy and Water Resources and Development has also built into the dam capacity assessment, a certain percentage to cater for supply security risks. On the basis of the 'threat' to this supply security the Ministry, instituted water use management or outright water rationing measures in order to prolong the 'life' of the supply. All these measures and the factors discussed above have shown that there is need for caution in the assessment of the unit cost of producing water on the basis of full capacity figures. The fact that the capacities of all these dams are far larger than the real water stored in them, could be responsible for the evident high supply risk aversion of the Ministry responsible for water. Very often this is a response to the overstated demand that the farmers exert on the water supply system.

Evidence has shown that nearly all farmers display the propensity to overstate the quantities they require during their application for water rights. The difference between the water right quantities and what farmers actually use is substantial.

Clearly, in the assessment of the unit cost of producing water, there is, therefore, a need to consider the real economically useful yield, as this is what is actually traded or sold to the farmers. In Zimbabwe, this capacity is referred to as yield capacity. On the basis of yield capacity it is clear that the amount of useful water available is far less than that shown on Table 4.3. Of the 1,884,500,000 cubic centimeters of water of total capacity produced by old Dams' only 505,000,000 cubic meters, or 27% is useful yield capacity, less than a third of the total capacity. The situation is even worse in the case of 'New Dams', where useful yield capacity is about 20% of total capacity. This of course implies that the Government has to attempt to recover all the capital costs and supply costs from only a relatively small volume of water; thus markedly increasing the real unit cost/price of water. In practice, it is unlikely that Government will be able to recover all costs fully. On the basis of yield capacity, the unit cost of water for Lake Kyle for example, is 56 times greater than the unit cost calculated from total capacity figures. For the more costly 'New Dams' the use of yield capacity raises the average unit cost from $0.023158 to $0.107993, a rise of 79%, at 1976 prices.

A closer look at the individual dams will show that there are marked variations between dams. Clearly, all small dams (old and new) tend to show a sharp increase in the unit cost of water, when yield capacity is used. However, the small 'New Dams' such as Mwenje, Mkwasine and Silverstroom, show substantially higher unit cost figures. The yield capacity is thus used throughout the study instead of total capacity, because it is the yield capacity that is traded, and forms the basis for the recovery of costs, and the basis for the tariffs charged.

The generally high cost of new dams at 1976 prices, tends to support the hypothesis that as most easy-to reach first choice sites have already been developed, the development of new, geologically less attractive sites will increase construction costs. But there are several other factors involved. First, the policy of using too many foreign firms instead of the domestic construction firms, has not lowered costs. It would normally have been cheaper to use domestic construction firms, except for a number of factors. Discussions with local and foreign contractors indicate that local firms are unable to compete against foreign firms for a number of reasons including the fact that earth moving equipment and general construction equipment owned by local private contractors are over 15 years old and totally depreciated and most have a $1.00 value on the books of accounts. Replacement costs are very high and spares are difficult to get because of the problems of foreign exchange shortages, and when they are available, the addition of the 23% sales tax, makes the local retail price far too high. Against this background, the profit margins realised by the contractors are insignificant. It is only natural that local firms charge high costs. The combination of rising inflation, high customs duties (70% of purchase price) for all imported equipment and the deteriorating value of the Zimbabwean dollar against a basket of currencies of Zimbabwe's main foreign trading partners, has made it difficult for the contractors to recover all their costs from the contract fees.

The use of foreign contractors could have had the effect of reducing construction prices considerably if these were allowed to bring in their machinery, equipment and spares, without paying high customs duties. In the event that they are all required to pay duty, (for reasons of short-term revenue requirements), the contract price foreign contractors charge, therefore, differs from those charged by local contractors marginally. Clearly, if it were not for such considerations as the fact that donor funds are usually tied to the use of foreign contractors from the country giving the aid, it would not matter who does the dam construction work, on the basis of the cost.

Second, before independence, the Department of Water Resources and Development used to construct most dams in-house. In 1980, there was a massive exodus of almost all the highly skilled and experienced white engineers, most of whom emigrated to South Africa and other countries. Skilled construction manpower has been in short supply since. At present nearly 30% of the engineers in the Ministry are expatriates on short term contracts. At the end of 1985, of the Department's 70 established engineering posts only 40 were filled, and this situation has prevailed as far back as 1983. Given the low salary scales of Government, the Department is not only faced with the impossible task of attracting engineers to join it, but of preventing the few it has from leaving for the private sector where attractive employment conditions exist.

Third, the legislation, in 1980 of fixing the minimum wage level and the subsequent increases of this wage from $34 per month in 1980 to $158 per month by 1986 for all unskilled workers has affected badly many labour intensive industries. Most employers argue that since these minimum wages do not reflect the opportunity cost of labour, these wages represent an undue taxation of the employers. This has also been responsible for the increasing cost of constructing new dams. Given that the country is currently experiencing high unemployment rates, the high minimum wages has been blamed by many analysts for the low level of labour absorption in the economy.

While Table 4.3 shows very high construction costs for new dams both at 1984, and 1976 prices, these figures by no means tell the whole story, and they are only a fraction of Government's involvement in upfront water supply capacity provision on behalf of the private commercial irrigation farmers. For example, most of the dams will be connected by very long costly canals and reticulation systems, depending on location of the irrigable soils upstream, or downstream, away from the dam. For example, to the cost of Tokwane Dam of $20 million must be added $18 million for the 50 kms of the Tokwe/Lundi canal linking the dam to the Triangle and Hippo Valley irrigation schemes. To the cost of Manyuchi Dam of $27 million (1984 prices) must be added $62 million for the 100 kilometers of the Rutenga canal. Many new dams will need to be connected to the end user right to the field edge, and in a number of cases the canals will require the installation of costly pumping stations to boost the flow of water over long distances. This is largely because the new dam sites are increasingly remote and difficult terrain from the block of irrigable soils.

While the unit cost of producing water for different sizes of dams shows that large dams are less expensive than small dams, the central issue is not the amount of money spent but whether these cost figures are what the nation would consider a reasonable price to pay for water required for irrigation. In a nation where the policy on water development is based on supply risk aversion, the least cost supply or cost minimization strategy has not even been considered as an option. Availability of money and not the cost, would seem to be the central constraint. Up to now no potential dam site has been rejected because of the high cost of construction.

The over-emphasis on supply issues has lead to the neglect, both at the policy and practice level, of water demand management. Water requirements for irrigation are never seen as being caused partly by the farmer's wasteful water use practices. Solutions have therefore never been sought through the institution of water management practices. This omission is amazing for a drought prone country. The farmers are not given the full indication of what it costs to satisfy the demands they put on the water supply system. In fact, the recent blanket or 'postage-stamp' price of $12 per 1,000 cubic meters for all dams (new and old) in the country serves to give wrong signals to farmers, and may well promote demand for water, that will be difficult to satisfy without a significant effect on the economy.

A closer look at what the farmers themselves are prepared to pay for water is used here as a rough bench mark to show how many of the dams already built come close to the unit cost the farmers are willing to pay, if they are to remain profitable. The willingness-to-pay by farmers around the Mazwikadei Dam, as expressed in their letter to the Ministry for Agriculture, of $30 per 1,000 cubic meters is used in Table 4.4 as the reference price and a guide to what could have been charged. All the dams are therefore assumed to be supplying water to farmers whose willingness to pay is $30 per thousand cubic meters. The farmers drawing water from these dams are assumed to be wheat farmers whose profitability would suffer if the price of water rises beyond $30.00 per thousand cubic meters. When yield capacity is used for both Tables 4.4 and 4.3 at 1976 and 1984 prices respectively, it is clear that the government does not take into consideration the farmers' willingness to pay, when planning investments into water

TABLE 4.4

FARMERS' WILLINGNESS TO PAY COMPARED TO WATER PRODUCTION COST

Dam	Total Capacity $m^3 10^6$	Yield Capacity $m^3 10^6$	Total Cost $m^3 10^6$	Unit Cost Farmer's Preference $m^3 10^6$	Actual Unit Cost $m^3 10^6$
Mazwikadei	360	100	44,7	0.03	0.4472
Bindura	87	50	25,9	0.03	0.5180
Tokwane	122	53	20	0.03	0.3774
Tende	1200	168	75	0.03	0.4464
Mukorsi	1727	348	75	0.03	0.2155
Manyuchi	325	70	27	0.03	0.3857
Mkwasine	24	15	12	0.03	0.8000
Mwenje	40	23	50	0.03	0.2174
Silverstroom	17,5	10	6	0.03	0.6400
Total		837	291,02	0.03	0.3477

Source:Derived from field data

supply capacity extension. It is clear that none of the dams on Table 4.4 would qualify for consideration on that criterion. It follows therefore that since the government produces water at far higher cost than that the farmers are prepared to pay, the water produced must be sold below cost.

The scale of the loss arising from selling water below cost only becomes clear when the government's uniform water tariff of $12 per 1,000 cubic meters is compared with the unit cost of water on Table 4.4. Since the government's charge of $12 per 1,000 cubic meters is far lower than the farmers willingness to pay, the actual unit cost the losses to the state are in two forms; namely a loss in relation to the sale of water from the dams (for example, in the case of the Mazwikadei Dam the loss is up to $435 per 1,000 cubic meters of yield capacity); and since most dams are constructed using roughly 90% of loan money, the tariff set by government may well mean that for most dams the money spent on them will not be recovered in their life span through water sales. The state's argument for setting a uniform charge of $12 per 1,000 cubic meters, is the belief that since the $12 is higher than the charge for all old dams, these dams would compensate for the losses from the low water price from all new dams. The subsidy built into the price also means that because the needs for future replacement and capacity extension are not built into the price, the state will have to continue to find more money for all future investments into dams, including increased borrowings from commercial sources.

Foreign loans contracted by the government (Table 4.5) for the purposes of building dams, is usually of two types:

TABLE 4.5

FOREIGN INVESTMENT IN LARGE SCALE DAMS

	Foreign Donor	Loans $ million at 1984 prices	Interest Charges per Year %
Mazwikadei	Italy	44,72	10.85
Bindura	West Germany	25,9	9.00
Tokwane	Italy	20,0	6.00
Mukorsi	Yugoslavia	75,0	2.5
Mkwasine	Saudi Arabia	12,0	5.0
Chisumbanje	World Bank	10,4	9.5

Source: project Documents, 1984

The commercial loans, such as those from the World Bank, will always attract higher interest payments than those incurred through bilateral agreements, such as those from Yugoslavia and Saudi Arabia. Most bilateral loans have a low interest charge because part of the loan is transformed into a commodity Import Programme (CIP), a method of making available to Zimbabwe foreign exchange for the importation of donor-identified and supplied capital goods. However, many of the advantages of the low interest charge are lost because of the very short loan-repayment period and the tied nature of the imports. Obviously the short repayment period does not allow sufficient time for the dams and the schemes to begin to produce economic benefits and to repay the loans.

The repayment of both commercial and bilateral loans imposes high opportunity costs on the economy. Firstly, repayment cash flows have to be generated by other sectors of the economy, since irrigation agriculture requires too long a lead time before it can realize its financial and economic potential; more over in most cases viability is never realized. Secondly, public supply of irrigation water to farmers does not necessary lead to the success of irrigation agriculture. The presence of water alone is not enough to assure profitability. Certainly, the farmers' ability to meet other equally important costs such as the cost of irrigation machinery, fertilizers, insecticides, infield reticulation canals, labour and transport costs, have a direct effect on profitability. Thirdly, in 1984, a paper from the Commercial Farmers Union on irrigation, concluded that for established farmers, the highest cost of providing water without becoming bankrupt, was $5,000 per hectare, and for those entering into irrigation for the first time, up to $3,800 per hectare, a view supported by World Bank surveys. But when the hectares to be irrigated by the dams on Table 4.5 are added to the analysis, it is clear from Table 4.6 that supplying water to each hectare costs not less than $10,000. It is therefore clear that substantial amounts of extra subsidies are needed by the farmers.

TABLE 4.6

COST OF SUPPLYING WATER PER HECTARE

Dam	Capital cost $ Million	Hectares Served	Cost/Hectare $
Mazwikadei	44,7	3,000	14,906.67
Bindura	25,9	300	86,333.33
Tokwane	20,	1,575	12,698.41
Mukorsi	75,0	5,000	15,000.00
Mkwasine	12,0	700	17,142.86
Chisumbanje	10,4	400	26,000.00

Source: Project Documents 1984

The foregoing assessment has clearly shown that public cost outlays for the development of water represent, the permanent expropriation, of huge scarce financial resources into irrigation without a hope of ever recovering them fully, resources that have a very high opportunity cost as most of the money is borrowed at high interest rates. How far the government can pursue this line of investment into the future may well depend on the availability of viable alternative investment opportunities else-where in the economy.

The government's policy assumes that all private farmers and foreign agribusinesses involved in irrigation agriculture have neither the ability nor the capacity to shoulder alone all the costs associated with commercial irrigation. The flaw in this assumption is that while there maybe a number of individual farmers genuinely unable fully to pay the cost of irrigation, as shown by the costs above, it ignores the fact that the agribusinesses involved have other extensive profitable business concerns within the country and elsewhere and therefore have the capacity to meet the cost of irrigation. For example, the Anglo-American Corporation, apart from being one of the big sugar producing companies in Zimbabwe, is also involved in forestry and gold mining concerns in nearly every country in Southern Africa including the profitable gold mines of South Africa. Such a company has in principle the capacity and the capability to cross-subsidize its failing concerns from those that are doing well. Experience and practice elsewhere however shows that companies like Anglo American are unlikely to do so.

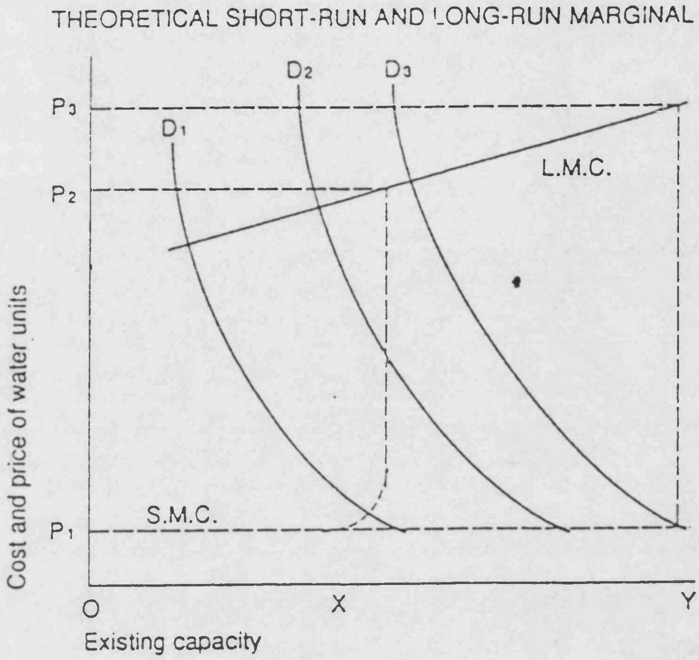
Supply Capacity and the Pricing Policy

Empirical evidence has shown that in many countries of the World, the charges made for irrigation water are well below the costs of producing it (Carruthers, 1981 and Davidson 1965). The experience of Zimbabwe is not different. The neo-classical argument is that if the price of water to the farmer exceeded the marginal cost of producing it, full economic utilization is likely to be prevented. Likewise, if the price charged was far less than the marginal cost of producing water, the misuse and misallocation of water would result as would a misallocation of resources in the economy as a whole.

It can be argued, at least in theory, that productive resources employed in producing new water supply capacity will be expended prematurely and non-optionally if supply extensions are provided when the costs involved exceed the value of the additional water to the farmers. By assuming that the price farmers are willing to pay for water is a true reflection of its value to them, premature investment can theoretically be avoided if water prices were based on the marginal supply costs.

FIG. 1

THEORETICAL SHORT-RUN AND LONG-RUN MARGINAL PRICES



Quantity of Water

Source: Rees, 1978 (Unpublished PHD thesis)

Where:

DI,D2,D3 = Demand Curves for water at different periods of time, say DI = year 7, D2 = year 10 and D3 = year 15. This movement outward over time is expected to be typical as farmers expand and become wealthier and are willing to take more water at all price levels.

S. M. C. = Short-run-marginal cost curve. This will be low and will not increase until the limits of existing capacity are approach ed when it will rise steeply becoming vertical at full capacity.

L. M. C. = Long-run-marginal cost curve, or the cost of providing additional supply capacity.

With reference to Fig. 1 above, it is theoretically possible to set the unit prices of water below the long run supply cost while existing capacity is under utilized. It is also advocated that as full capacity (O-X) is approached the price of the last water units taken by each farmer should be increased to cover the full cost of the next extension to capacity. This means that the unit price of water should be set at the long-run-marginal supply cost (p2) and should increase over time to reflect changes in the cost of developing additional water facilities.

When, for example, (O-Y) supply capacity was required the water price would need to be (P3) to cover the costs involved. Only when it is ascertained, that the farmers are willing to pay these long-run supply costs is capacity extension economically justifiable. Until then, the price rises would theoretically at least, control demands within available supplies.

Although this study does not specifically assess the demand for water by individual farmers it is clear that if existing needs can be served adequately from developed capacity, there would be no need to use price to control usage, and the price of the water, could theoretically remain between P1 and P2 for reasons of revenue generation. However when total demands are increasing over time, the continued use of short-run marginal cost prices would inflate the apparent need for investment in capacity. For example, given this price level farmers would demand O-Y units of water by year 15 (D3). This quantity can only be provided at a unit price P3, and if farmers had to pay this cost price, their demand and needs would in fact be met from existing capacity. In other words, it is possible by increasing prices to the level which reflects the costs of new capacity before investment actually takes place, to ensure that extra supplies are not provided prematurely, before farmers are prepared to pay the costs involved.

The savings that, at least in theory, could be generated by such judicious use of the price mechanism to postpone the need for additional investment could then be used in providing other goods more highly valued by the farmers, as well as by the economy as a whole. In Zimbabwe, prices of water have not been based on the above model, and have historically been very low in line with the need to recover low historical costs of capacity provision. No special reference is made to the obvious differences in costs between old and new dams, and the price would seem to be arbitrary. As already discussed above, while the price represents a reasonable rise in the price of water for old dams from an average price of $7.59 per 1,000 cubic meters to $12 per 1,000 cubic meters,it is however a gross under pricing of water from costly new schemes. For all new dams, the difference between the present official price of $12.00 per 1,000 cubic meters and what should have been the economic cost of water (Tables 4.3 and 4.4) is the public price subsidy to farmers as shown on Tables 4.7.

It is also clear that the level of subsidy is very high per $10^3 m^3$. When the Department of Water Resources Development's own tariffs based on historical accounting[2] are compared with the official price of $12 per 10^3 m^3, with the exception of Mukorsi Dam, the level of subsidy is equally high, over three times the original rate even considering the lowest level.

The water pricing policy has ignored the need for the mobilization of surplus capital required to meet both the requirements of repaying the capital and raising revenue to meet replacement and capacity extension. What has, and still continues to be ignored, is the need to produce, through water sales, greater revenue necessary to contribute towards debt servicing. The low water price would seem to confirm the findings of Davidson (1965), in Australia, and Hirschleifer (1960) in the USA, where like in Zimbabwe, the Government has refused to treat irrigation water like a normal economic good despite the high costs involved.

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[2]The formula used in the calculation of the historic cost tariffs is: Water tariff = annual repayment and operation and maintenance costs for 20 years + half % contract cost + $300,000 divided by 10% risk factor (yield capacity).

TABLE 4.7

PUBLIC WATER SUPPLY PRICE SUBSIDY TO FARMERS

Dam	Total Cost $ Million	Yield Capacity 10^3 m^3	Original cost of Water $/$10^3$ m^3
Mazwikadei	44.72	100	447.20
Bindura	25.9	50	518.00
Tokwane	20.0	53	377.40
Tende	75.0	168	446.40
Mukorsi	75.0	348	215.50
Manyuchi	27.0	70	385.70
Mkwasine	12.0	12	800.00
Mwenje	5.0	23	217.40
Silverstroom	6.4	10	640.00

Dam	Historic Cost Tariff $/$10^3$ m^3	Government Flat Rates $/$10^3$ m^3	Public Subsidy $/$10^3$ m^3
Mazwikadei	76.12	12.00	435.20
Bindura	81.11	12.00	506.00
Tokwane	49.06	12.00	365.40
Tende	37.50	12.00	434.40
Mukorsi	18.10	12.00	203.50
Manyuchi	44.79	12.00	373.70
Mkwasine	104.00	12.00	788.00
Mwenje	46.74	12.00	205.40
Silverstroom	97.20	12.00	628.00

Source:Derived from Assessment of field data

A precedent has long been set, buttressed against major changes by the restrictive rigid water righting system (Water Act, Chapter 41, 1976), which attached the right to water to property (land) in perpetuity. This has come to mean that there is no effective possibility of creating a water market, as the enshrined protective water rights have prevented the emergence of a price-led competitive water demand market. In fact, the system serves to prevent the entry into irrigation by new farmers.

However, in the real world optimizing water tariff in relation to cost of production is no guarantee that from an overall national view point marginal cost pricing is efficient. The prohibitive prices associated with the marginal cost pricing could, in effect, arrest development completely, as individuals are unable to raise the high initial capital.

Despite the distorting effects of subsidies, they are widely used in practice. While the Government of Zimbabwe has the legitimate right to use subsidies for specific policies, the seemingly indiscriminate wide-scale use throughout the cost structure is worrying. It is also questionable whether this practice necessarily achieves growth or equity.

The revenue-generation problem caused by the low price becomes all the more clear when problems of operation and maintenance are considered. As most of the dams discussed above are new, no real substantial operation and maintenance costs have been spent on them at this stage. The analysis is therefore on older systems like those under the Regional Water Authority.

Operation and Maintenance Cost Outlays

Recurrent operation and maintenance finance is the most scarce resource, and unlike investment capital, it cannot generally be obtained as aid or as cheap loans. Indeed, large capital projects can exacerbate the recurrent finance allocation problems in two ways: Because of limited financial resources engineers have been unable in most cases, to construct expensive, but technically sound dams which would have the effect of reducing future operation and maintenance costs to a minimum; the other problem arises from the use of very expensive technology which is beyond in-house capacity when it comes to repair and maintenance. Moreover, empirical evidence (Carruthers 1981) shows that, operation and maintenance, once starved of funds and equipment, become a low prestige area which has difficulty in attracting resources and retaining high calibre staff.

In Zimbabwe, like in most poor countries, the desire has been to develop high capital cost gravity supply systems which have low recurrent costs. This reflects the awareness of the difficulties involved in obtaining aid for recurrent costs. This effort has been frustrated by the need to instal pumping engines that have very high recurrent resource requirements, at the head of these canals , because of the long distance covered by reticulation canals. Therefore, while operation and maintenance costs are usually of minor importance to water capacity projects in the developed countries, they assume a much more significant role in poor countries.

Traditional cost-benefit analysis has treated capital as the most scarce resource (Maas et al 1962, Major 1977 and Little and Mirrlees, 1974), and has assumed that operation and maintenance costs are minor items of expenditure. While it remains true that investment capital is still a very scarce and a crucial factor constraining Less Developed Countries' (LDCs) development programmes, empirical evidence (Blackie 1984, Carruthers and Clark 1981) now shows that operation and maintenance costs are no longer insignificant items in the irrigation cost budget. In fact, the success and or failure of LDC irrigation programmes is clearly related to the availability of resources needed to operate and maintain schemes.

In Zimbabwe, the fact that in most cases operation and maintenance costs have not been fully met from the proceeds of water sales (because past water prices were far below even the recent flat rate of $12.00 per 1,000 cubic meters), has had far reaching implications. After subsidizing the capital cost the state has had to subsidize operation and maintenance costs, at very high cost.

Table 4.7 above, shows in column five the water tariff that would have been required by the Department of Water Resources Development, if cost recovered in historical accounting terms, was to be achieved, taking both capital costs and the operation and maintenance requirements into account. Clearly, diversion of scarce financial resources through payment of subsidies towards the operation and maintenance of dams and canals that otherwise would have met their own cost obligations, involves high opportunity costs. Although the government cannot normally borrow from abroad to offset the effects of operation and maintenance costs on the current account of the budget, its internal borrowings from domestic finance houses and banks for this purpose inevitably implies the withdrawal of much needed resources from other sectors of the economy.

During the 1960s and 1970s, it was rare for any analysis of capacity provision to include adequate depreciation allowances. Irrigation and water projects were costed in historic cost terms in order to meet short-term revenue requirements, and no surpluses were accumulated to replace capital facilities. Inevitably many of the early dams are now in need of costly overhaul, including dredging and measures designed to curb the increasing problem of siltation, replacement of pumps and canal relining. These unavoidable costs are increasing at a time when the 1982-1984 drought has instigated a capacity extension panic among the policy makers that has resulted in the hurried construction of the costly dams discussed above.
Thus operation and maintenance costs have been rising rapidly over the years. For example, in 1981/2 alone, the Regional Water Authority[3] spent over $3.6 million operating and maintaining its three river systems; the Mtilikwe, the Chiredzi and the Sabi. This amount represented 90 percent of the Authority's internally generated annual income of $4.8 million for 1981/82. In fact, in that year, the total revenue of $980,000 was collected from water sales in the Chiredzi system, but $1,494,000 was spent on operation and maintenance, so resulting in a deficit of $514,000. The Sabi River System realized an operating surplus of $476,000. The situation is unlikely to have improved significantly, even with the 1985 price increase to $12.00 per 1,000 cubic meters.

The level of deficits indicates that revenue generation through water sales is inadequate, and cannot even fully

[3] The Regional Water Authority is the sole authority charged by Government to develop the South-Eastern part of the country for private commercial irrigation, and is responsible for operating the five huge dams supplying water to the area, through the three river systems of Mtilikwe, Chiredzi and Sabi.

cover operation and maintenance costs, let alone allow some repayment of the initial capital investment. As a result the state has resorted periodically to boosting the financial position of the Regional Water Authority by granting it low interest long-term loans. For example, in 1981/82 the loan amounted to $20,712,672 (Table 4.8).

TABLE 4.8

REGIONAL WATER AUTHORITY'S CAPITAL STOCK, 1981/82

Source of Revenue	Amounts $	% of Total
Government long-term loan	20,712,672	72
Other loans	3,272,674	11
Authority's Revenue	4,775,914	17
TOTAL	28,716,260	100

Source: Regional Water Authority Project Documents, 1982

It is clear that the operations of the Authority are heavily subsidized by the state, as the Authority is most of the time operating a deficit account. As a parastatal, the Authority has to pay an interest rate of nine and half percent for loans from government, in line with other parastatals. This rate, though higher than the rate government is charged for some of the foreign aid that flows into the country, is nevertheless lower than the domestic commercial lending rate of 13.9% which government has to pay when it raises loans internally. Thus, the government, when passing on such loans to the Regional Water Authority, is providing a subsidy. As such subsidies have become a permanent phenomenon their long-term implications both for the national budget and the clearing of the budget deficit are worrying.

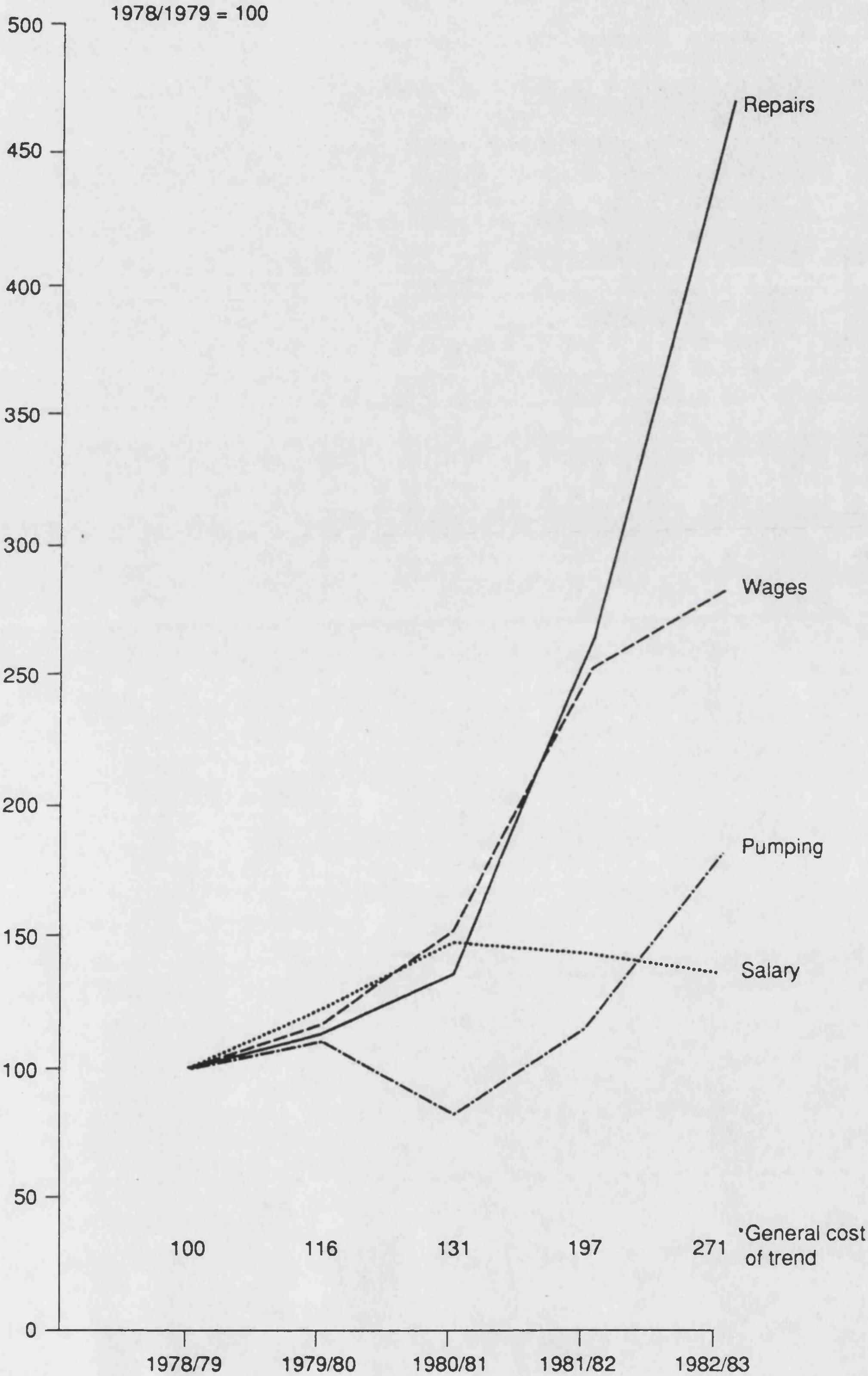
Fig II, III and IV show cost trends in the three water systems over the last ten years for the major variable items of expenditures such as pumping costs, salaries, wages for unskilled and repair workers. The figures employ indices which take 1974/75 costs as 100. An exception to this is the Sabi System which only started operating in 1978/79. For all the three systems, the trend was one of rapidly increasing operation and maintenance costs, although individual systems show some variation in the way each cost item has behaved overtime. For the Mtilikwe and Chiredzi systems, the combination of pumping and gravity-fed water reticulation systems plus the several tens of kilometers of lined canals mean that manpower is used intensively, so ensuring that, wages and salaries are the major cost items. By contrast, the river-based Sabi System incurs greater expenditure on the repair of the pumping stations, the canals and the night storage dams.

As the pumping engines are imported, their repair depends on the importation of both spare parts and costly technical services. As a result the repair-costs represent the highest cost variable. For all the Systems, figures for 1983/84 and 184/85 were not available. It is likely that the missing figures would confirm the above trend.

Overall, the increase in the cost of labour, especially unskilled labour is directly related to the introduction, in 1980, of the statutory minimum wage, a wage widely believed to be far higher than the opportunity cost of that labour. In 1983, the opportunity cost of unskilled labour, based on seasonal peasantry production was estimated to lie between $120 and $200 per year compared to the minimum wage of $780 per year. Pumping costs were obviously affected by the rise in oil prices, and if the current real term decline in oil import prices is maintained,it is expected that pumping costs for the oil-based pumping stations will decline from 1985. However, unfortunately electricity charges have risen by over 70% since 1980 partly because of the rise in the importation of Zambian electricity, and partly to recover the $780 million invested on the recently

Fig. II

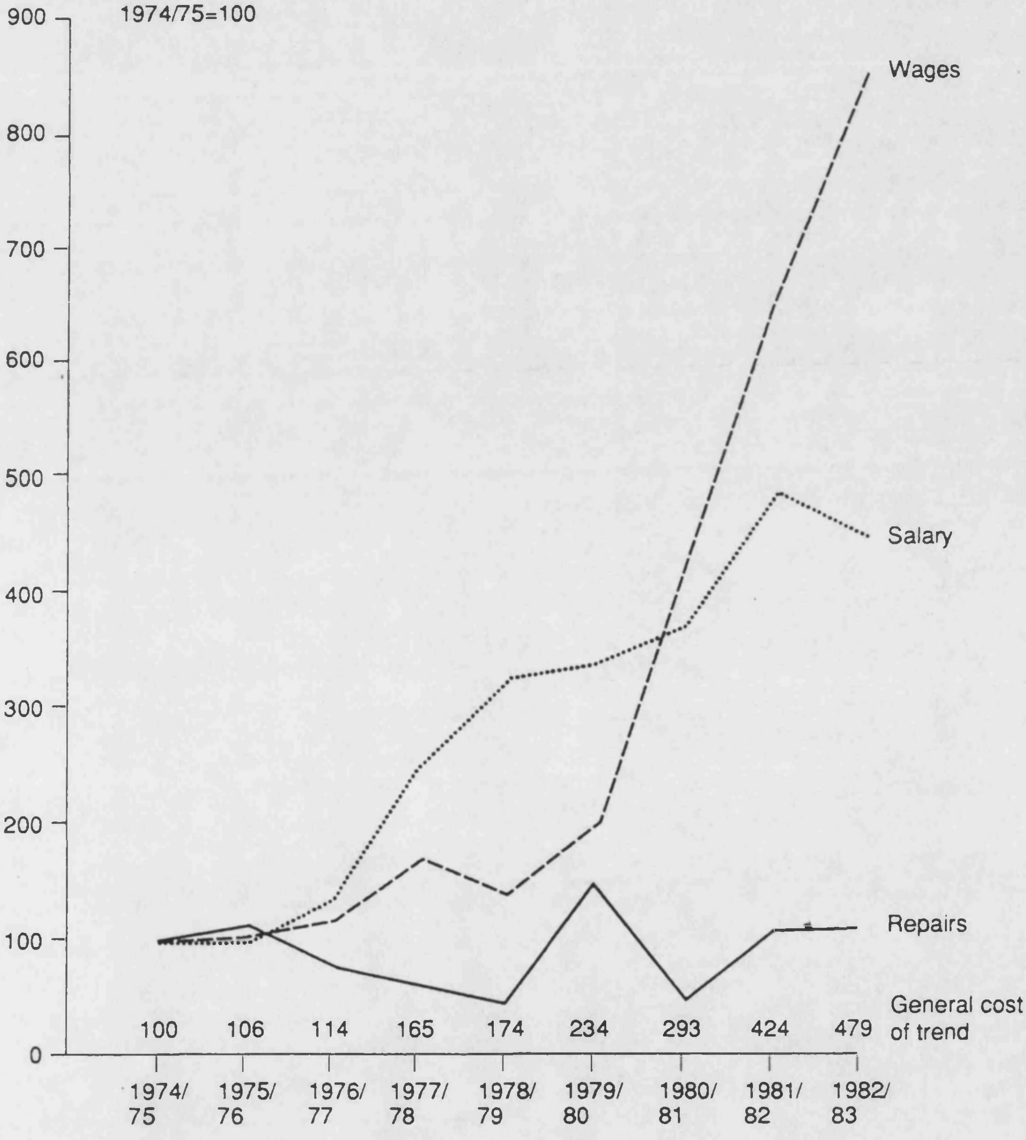
THE SABI (RIVER-BASED) SYSTEM: OPERATION AND MAINTENANCE COSTS



Source:Derived from Assessment of field data

Fig. III

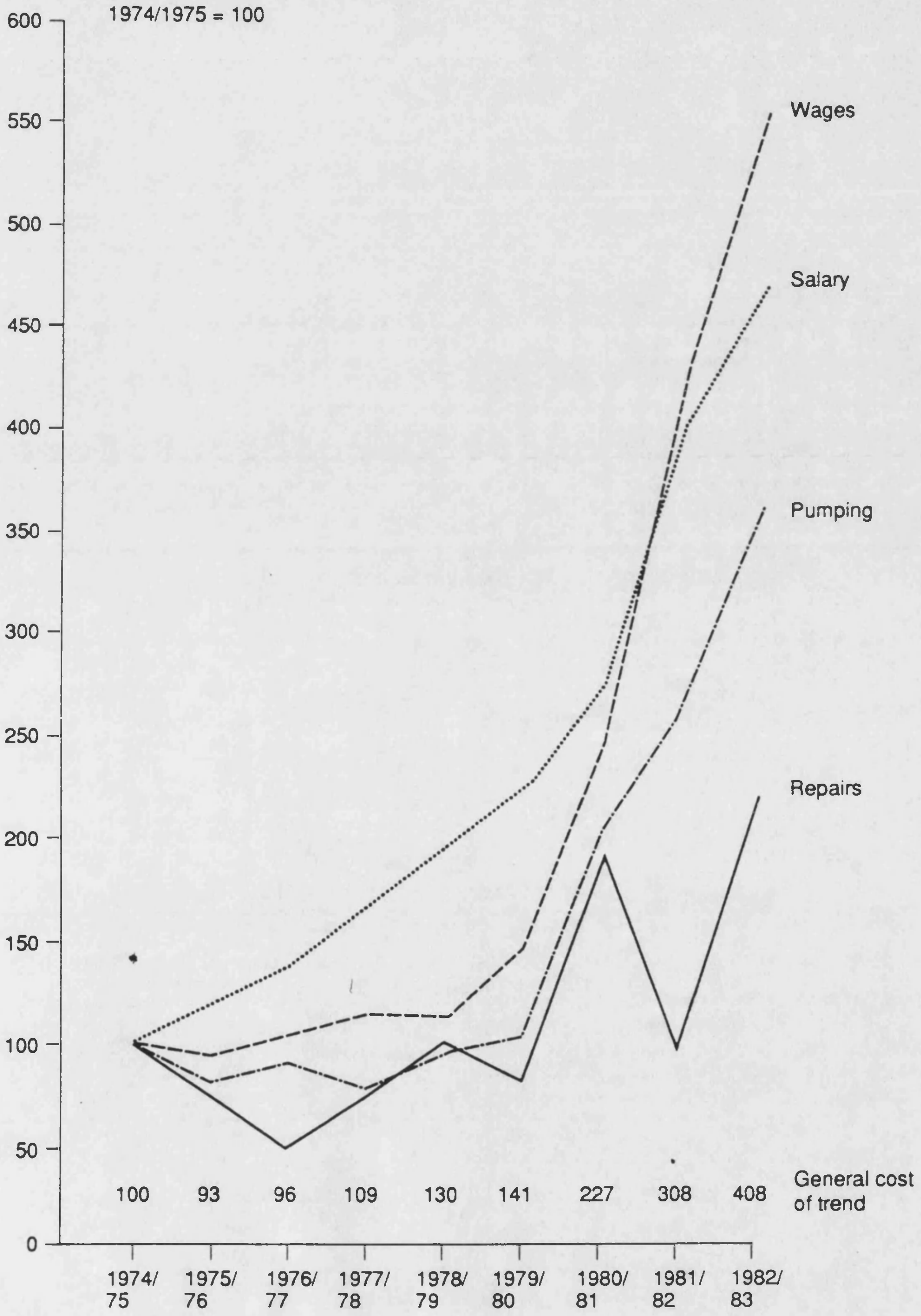
THE CHIREDZI (DAM AND GRAVITY-BASED) SYSTEM:
OPERATION AND MAINTENANCE COSTS



Source:Derived from Assessment of field data

Fig. IV

THE MTILIKWE (DAM & PUMPING-BASED) SYSTEM:
OPERATION AND MAINTENANCE COSTS



Source:Derived from Assessment of field data

opened second coal-fired Power Station at Hwange. These costs will continue to be high for the electricity driven pumping stations.

In addition to the cost outlays so far discussed the state also incurs substantial expenses on behalf of the commercial farmers in the area of credit and other inputs as well as the price incentives built into the producer prices.

Public Investment in Infrastructural Support Services

The state is indirectly incurring extra costs on behalf of irrigation through research, extension services and credit support facilities, marketing and transport services. Irrigation agriculture stands for a host of costs over and above the capital costs, which, if they are not in place, would render all the capital assets obsolete. The level of provision of these supportive services as a back-up package determines, to a large extent, the level of success of irrigation agriculture.

Clearly private and public benefit streams could not be expected to flow solely from the provision of dams. To be effective irrigation agriculture requires a whole range of additional support services, which can only be provided at a cost. The state has, over the years gradually accepted the responsibility for a considerable proportion of such costs. Inevitably, these increase the effective level of public subsidy to private irrigation agriculture. The point at issue is that although these costs, like all other costs, have been rising, at least in financial terms, there has been no attempt to recover these, wholly or in part, from the farmers themselves.

The cost of research has been increasing over the years. For example, it rose from $1.2 million in 1979/80 to $1.8 million by 1980/81 (World Bank 1983), this represents a real term rise of $384,000 or 32 percent. This trend of cost increase in real terms is believed to have continued beyond 1985, although there is no data at present at a sufficiently high level of disaggregation to support this contention.

However, it is known that enthusiasm for commercial irrigation has been re-kindled in association with the establishment of the Farm Irrigation Fund (FIF) and research into ethanol, palm oil and rice cultivation trials. The research costs quoted above do not include the salaries of research staff, some of which are expensive expatriate staff. If the salary cost variable were to be included, public cost outlay for research would increase substantially.

Part of the reason for the increasing cost of research has to do with the great number of research stations that have been set up, and the degree of specialization which each has sought to attain. As a result, separate research stations have been established for each of the major crops; examples of these include the Tobacco Research Board, the Cotton Research Institute, the Seed Maize Research Association and the Zimbabwe Sugar Association. Moreover, a number of stations have been developed which are specific to individual irrigation schemes; such as the Chiredzi Research Station, the Middle Sabi Station and one at Chisumbanje. Since government resources are scarce and are not specifically set aside for irrigation, their use to support research has to be measured against the opportunity cost of the resources in their alternative uses.

When it comes to extension services, there has been a marked demand for such services. This is largely because all commercial irrigators, commercial rainfed cultivators and the peasant farmers, require this service. Therefore, more resources are needed to train and equip extension services staff. As irrigation greatly increases land use intensity in addition to the high degree of crop specialization, more extension staff are required, than under rainfed agriculture, to serve the same acreage of land. For example, one extension officer is required for every five farmers using irrigation, as compared to one extension officer for 60 commercial rainfed area farmers, or one extension officer for 10,000 peasant farmers under dry land cultivation. The expenditure involved in service provision also includes transport costs, spare parts, staff housing, training and equipment.

The state is also involved in the provision of foreign exchange for the importation of crucial inputs such as fertilizers, tractors and other forms of machinery for which irrigation is a major user. These are then provided at a much lower price than the farmers would have to pay if they faced the open market individually. The state implements these price reduction measures by either exempting imported farm inputs from paying customs duties, or by instituting price control measures requiring that the prices of selected inputs would not rise above set price mark-ups. Although these supportive measures affect all farmers including the rainfed based farmers, irrigation benefits more than other crop producing sub-sectors of agriculture because of the much higher level of use or application of these inputs. Although no data is available for the determination of public capital outlay for this item of expenditure, it is however considered to be high.

In the area of credit facilities, apart from the irrigation-specific Farm Irrigation Fund, discussed below, the government has established the Agricultural Finance Corporation (AFC) specifically to lend money to farmers at reduced interest rates (8.7% per year, payable over 50 years, since 1981). This policy relieves farmers of the necessity to approach commercial banks for all their loan requirements, which would attract an interest rate of 13.9% per year. The AFC has often, on the advice of the government, written off the bad debts of many farmers, or allowed debt rescheduling for farmers who failed to meet their debt obligations following say a drought year, or when international prices are particularly low and are adversely affecting profitability.

Public subsidy expenditure also occurs in the form of the provision of transport facilities. Zimbabwe's agriculture generally suffers from transportation bottle necks, especially in the movement of large volumes of crops to both the domestic and foreign markets, and the movement of inputs (fertilizers, insecticides and machinery) to the farmers.

The problem is obviously accentuated by the fact that the country, being a land locked state, is connected to the ports by lengthy rail and road networks that pass through hostile territories, and thus are open to sabotage, as well as delivery delays of 6 months to a year. Within the country, of all the groups of farmers the private commercial irrigation farmers would seem to be by far the most favoured. For example, the Triangle-Hippo Valley irrigation complex is linked by rail to all major cities and has access to the Mozambican ports of Beira and Maputo, and to all South African ports either by rail or by all weather roads. Moreover, between Triangle and Chiredzi there is the Buffalo Range Airport, the third largest airport in the country, which was specifically developed to serve the irrigation area. In the same way, the Middle Sabi and Chisumbanje areas have reasonable accessibility, being linked both to Mutare and Harare as well as to Triangle by all weather roads, and with the recent expansion of the Chisumbanje irrigations schemes, the railway line is to be extended from Chiredzi to Chisumbanje.

Because the provision of these transport services was originally specific to irrigation agriculture, it is important that these public costs are included in the assessment of the overall public outlay for the commercial irrigation schemes.

The Farm Irrigation Fund

The costs to the government of providing water and other services to the private commercial farmers are compounded by the state's provision of low interest loans to these farmers, aimed at reducing their costs. For this purpose, the state has set up, under the Audit and Exchange Act, Section 30 of the Agricultural Finance Corporation Act, the Farm Irrigation Fund (FIF) (Chapter 168 of 1984). In pure cost-benefit terms, the provision of these cheap resources arising from the low interest charges on loans, is normally ignored in the assessment. The practice is to regard these cheap resources as mere transfers of income or purchasing power within the economy, and not a direct resource cost, ignoring the high opportunity cost of the resources in the economy.

However, in Zimbabwe, the above theoretical position does not apply with regards to irrigation. The use of the Fund involves real economic costs. As already mentioned above, most inputs into irrigation (tractors, combines, fertilizers and insecticides) are imported, and the payment for these inputs either by the government on behalf of the farmers, or directly by the farmers borrowing from FIF, in foreign currency, represents an economic cost in opportunity cost terms. Since the Fund is built up from both domestic and foreign borrowings, the repayment of these borrowings constitutes a real resource cost to the nation. At the national level, the cheap loans associated with FIF have a powerful impact on the distribution of wealth and income. As such, they have to be assessed, so that their impact to both the losers and beneficiaries is measured. More critical is the fact that they introduce inefficiency in the investment of scarce resources, distorting product prices and the farmers' demand for inputs, so resulting in a general misallocation of national resources.

The Farm Irrigation Fund was set up with the specific purpose of promoting commercial wheat production, although other crops produced in rotation with it also benefit. The problem besetting wheat production, arises from wheat output failing to keep pace with domestic demand. This has been viewed by Government as a physical issue created by the inadequacy of inputs and by the limited acreage under the crop. It was never regarded as a problem probably caused by the artificial rise in consumer demand stimulated by subsidized consumer prices, nor was it ever seen as a product of the employment of inferior production technology or the generally low per hectare-yields (4.5 tons/hectare) compared with yields in other countries like Britain (approximately 7 tons/hectares). Solutions were not therefore sought in these areas, but in the expansion of the acreage under cultivation, using the same old production approaches, resulting in the upsurge in the demand for water supply capacity needed to service these new areas.

The commercial Grain Growers Association, in a paper to the then Ministry of Agriculture, argued in defence of the need for the state to set up an interest rate subsidy, on the grounds that high interest rates of 13.9 percent were one of the main factors inhibiting private investment in irrigation agriculture, and in wheat production in particular. In response to this the Farm Irrigation Fund set up a 30% interest subsidy for the first ten years, with farmers being charged 9.75 percent per year only, and then reverting to the market rate of 13.97 percent thereafter. The aim to make the FIF into a revolving fund has so far not been successful. The expected inflow of foreign grants and softer loans have fallen short of expectations, and of the initially assessed strength of $96 million (1984 project documents), only $32 million (33%) was raised by the end of 1986, most of it from overseas loans with a short term repayment period or as suppliers credits. Already, some farmers have defaulted in their debt obligations following the poor rains and low yields of the 1985-1987 harvest, further depleting the resources of the Fund.

The value of the Fund has also depreciated considerably in line with the continued decline of the dollar against the international basket of currencies. For example, the value of the Zimbabwean dollar fell against the United States dollar and the British pound from US$0.91 and sterling 0.62 respectively in December 1983 to a low of US$0.58 and sterling 0.36 by January 1987, a fall of 36% and 42% respectively. The main contributory factor was the International Monetary Fund's request at the end of 1983 for a 40 percent devaluation of the Zimbabwean dollar, which was followed a year later by a further 40 percent devaluation associated with the 1985 Export Revolving Fund. During the same period domestic inflation increased in response to increased wage demands and price increases that followed the devaluations. The Fund's purchasing capacity in the domestic market has therefore deteriorated markedly within two years, and requires a lot more injection of resources to build it to its planned 1984 strength, and then to maintain the 1984 purchasing power. If extra resources are not found, it is possible that the 1984 planned 10,000 extra hectares or 50,000 tons of wheat per year required to meet self-sufficiency, would not be realized.

The Farm Irrigation Fund Subsidy and Wheat Self-Sufficiency

Three investment scenarios are developed below, using cost figures got from the Ministry of Agriculture and Lands (1984 prices) to illustrate the different choices open to a farmer borrowing from the Fund, and the implications of that choice, for the government's objective of wheat self-sufficiency in the next ten years. Table 4.9 figures are based on the assumption that 125 farmers will borrow from the Fund annually, that each farmer will develop 80 hectares.

TABLE 4.9

THE COST STRUCTURE OF THREE TYPES OF SCHEMES BORROWING FROM THE FUND

Variables	Total Hectares	Low Cost Scheme $	Average Cost Scheme $	High Cost Scheme $
Cost of Dam	80	80,000	150,000	220,000
Equipment		96,000	136,000	184,000
Engineering Fees		11,200	177,250	22,900
Electricity		3,100	5,600	8,000
Total		190,300	308,850	435,900
Cost per hectare:	$/Ha	2,379	3,861	5,436

Source:Ministry of Lands, Agriculture and Resettlement, 1984

On the basis of the figures on Table 4.9, if a farmer chose the scheme with the least cost per hectare, that choice would represent a preference for a low capitalized production process, that is, too small a dam, which is unlikely to last any dry season let alone a drought. This would mean that half the time the scheme would have to lie idle, and this would raise the costs to the farmer for the time he is out of production. This would be an uncompetitive choice, and if producer prices are not raised high enough, the farmer taking this choice would be unable to pay his debts, especially if there was a drought, assuming of course that the scheme is his only source of livelihood. For the government, if all the farmers were to go for this choice, the 10,000 hectares per year target would be more difficult to realize both in the short and long term, and the self-sufficiency objective would continue to recede.

However, while the choice of the average and high cost schemes would allow such an objective to be met, at the cost of $3,861 and $5,436 per hectare respectively production is likely to be unprofitable and therefore such schemes are unlikely to be undertaken even with the loan subsidies, and this outcome becomes all the more plausible when all other costs are added to the fixed costs on Table 4.9. Only a handful of farmers would be attracted, far less than the 125 expected by the government, and clearly the target hectarage per year could recede further. Thus, a catch 22 situation has arisen which strongly suggests that both the policy objective and the chosen means of achieving it need reappraisal.

An assessment of the likely profit margins that a farmer could expect from the three scenarios (Table 4.10), for the first ten years when he is receiving the loan subsidy, suggests that if he chose a low cost small scale option he would be very highly profitable at 30% interest rate subsidy. Returns on investment at 30% interest subsidy for a farmer who goes for a large scale high cost option are the lowest ($516) and it is likely that after tax deductions this farmer would be in debt; while the farmer who chose the average cost scheme option would realise returns that are half of those realised at the low cost option at the same level of subsidy.

A farmer who chooses the medium scale average cost scheme option would require the Fund to provide a 60 percent interest rate subsidy (below 5.65%) before he can become as profitable as he would be if he chose the low cost scheme option at no interest rate subsidy (13.9%). This outcome concurs with the Ministry of Agriculture and Lands' arguments for further interest rate reductions of over 50 to 60 percent if the Fund is to attract more investors.

TABLE 4.10

NET RETURNS (PRE-TAX) TO IRRIGATION PER YEAR

Interest Rates %	Low Cost Scheme $	Average Scheme $	High Cost Scheme $	Percent Interest Subsidy
13.9	27.382	7.583	-13.610	0
12.51	29.470	11.025	- 8.776	10
11.12	31.507	14.365	- 4.063	20
9.73	33.488	17.607	516	30
8.34	35.409	20.751	4.959	40
6.97	37.265	23.787	9.243	50
5.65	39.052	26.706	13.362	60

Source:Ministry of Lands, Agriculture and Resettlement, 1984

Only the farmers who already have the irrigation machinery and other inputs can be attracted to borrow money from the Fund to invest in average cost schemes while new entrants to irrigation agriculture facing higher initial capital costs would most probably go for low cost schemes; the option that is unlikely to fulfil the government's objective target of 50,000 tons of wheat per year.

According to the World Bank (1983) and the Ministry of Lands, Agriculture and Rural Settlement, private investment in irrigation is only worth while if the annual percentage net returns are above 9%. If the three scenarios or options are measured against this standard, only farmers borrowing from the Fund to invest in low cost schemes would be realising worthwhile returns (17.6 percent) at the set subsidy while those choosing average cost schemes would fall short of this expectation, and those choosing the high cost schemes would show very poor returns for all levels of interest rate subsidies shown on Table 4.11.

The foregoing cost analysis has shown that while low cost and small scale schemes maynot be able to achieve the target 10,000 hectares within a reasonable time scale, they would however be financially profitable at all interest rates including at the rate which approximates the real opportunity cost of capital in the economy, namely 13.9 percent. Clearly, it can be argued that some of these

TABLE 4.11

PERCENTAGE NET RETURN PER YEAR TO IRRIGATION

Interest Rates %	Low Cost Scheme %	average Scheme $	High Cost Scheme	Percent Interest Subsidy %
13.9	14.4	2.4	-3.1	0
12.51	15.5	3.6	-2.0	10
11.12	16.6	4.7	-0.9	20
9.73	17.6	6.7	-0.1	30
8.34	18.6	6.7	1.1	40
6.97	19.6	7.7	2.1	50
5.65	20.5	8.6	3.1	60

Source: Derived from the Ministry of Land, Agriculture and Rural Settlement's projects documents, 1984.

schemes could be developed profitably without the subsidies, the farmers could borrow from commercial banks without the need for the Fund. In this respect, it would appear that the need for the Fund is highly questionable. However, the profitability of the low cost schemes is predicated on attractive producer prices and public support in the development of attendant services.

Other factors will merit consideration in conjunction with the low cost small scale option. First the question of wheat self sufficiency has to be related to the excess demand for wheat products resulting from the existing consumer price subsidy. Second, the nation will have to face the fact that wheat self-sufficiency is becoming an increasingly expensive option. Since wheat, and wheat products do not represent the basic staple diet for the majority of the population, it may be necessary to consider access to wheat in terms of "ability-to-pay" than on "equity". There is a clear need to consider meeting part of the demand from imports as a policy option. The argument that home production saves valuable foreign exchange is of dubious relevance, since the funds to provide the inputs needed for irrigation production, are also imported. The net import savings are thus likely to be at best minimal and may well be negative. And third, it is perhaps more important now than ever, that the present wheat production system under existing technology be closely examined with the view to improving output before any new investment in expansion of hectarage or water supply facilities is allowed.

Because the state has continued to use subsidies to influence public demand for the crops produced as well as to influence levels of production, state capital outlays have continued to increase. The producer price subsidies, though equally applicable to rainfed agriculture, assume a much greater significance under irrigation.

Agricultural Producer Price Subsidies

Government intervention in agricultural pricing and marketing system in Zimbabwe has a long history, and has overtime steadily increased. At the beginning of 1980, the commitment to an open-ended subsidy policy for the agricultural sector, was partly justified by the argument for self-sufficiency, and by the need to earn more foreign currency from the export of large volumes of surplus products. It follows therefore that the producer prices set by government had to be high enough to provide an adequate incentive or return to producers so that self-sufficiency and export earnings are maintained. The fact that the case for higher producer prices often triggers higher selling prices for the crops produced is almost lost to the policy makers until they are required to pay more subsidies to cushion the consumers from the effects of these prices. In this section, attention is paid only to those crops produced under irrigation, and not the whole agricultural sector.

Irrigation agriculture involves the production, except for wheat and to a less extent maize, of low volume, high value cash crops such as cotton, coffee, tea and sugar-cane. Except for wheat and sugar-cane which are 100% irrigated crops, the rest have the greater part of their production under rainfed conditions; and the irrigated output is thus marginal to the total production. Generally, most crops produced in the country are sold through various publicly controlled and administered marketing boards, all of which come under the umbrella organisation of the Agricultural Marketing Authority (AMA).

Of the crops grown under irrigation, maize, wheat, soya beans, and coffee are sold through the Grain Marketing Board. Tea, tobacco and sugar-cane are not controlled crops and are therefore not subjected to state determined producer prices. The final products processed from these crops and sold in the domestic market are, however, affected by government price intervention in the retail sector. Bulk marketing of the uncontrolled crops is directly linked to the international commodity prices and is affected by their fluctuations. For the controlled crops, the producer price represents the minimum price the government can guarantee to pay to producers, and its announcement ahead of the planting season, is designed to reduce the price uncertainty faced by farmers, so enabling them to arrange their production in order to meet government output objectives. The producer prices that are finally announced are the result of bargaining between the producers and the government, taking into account the cost of production, forecast of internal demand and potential export earnings.

The central thesis is that whatever benefits may have accrued from commercial irrigation crop production, they have only been achieved at considerable costs to the state. This thesis is reinforced when the producer price system is analysed. For example, the bumper maize crop of 1980/81 was achieved only because of a 40 percent increase in the producer price over the 1979/80 level, (1979/80 price was $60.50 per ton, and 1980/81 price was $85.00 a ton), with a further 40 percent increase being allowed the following year to reach a price of $120.00 per ton by 1981/82. By the beginning of 1986 the producer price had risen to $180 per ton a rise of 200 percent on the 1979/80 price. In the case of wheat the producer price rose from a price of $115 per ton in 1979/80 to $300 per ton by 1986/87, an increase of 160 percent, or 27 percent per year. That of cotton rose a 100 percent in six years from 37.50 cents per kg in 1980 to 75 cents per kilogram by 1986/87. Clearly these prices were not a result of the market forces of supply and demand mechanism. The prices carry a large element of subsidy. This becomes clear when the retail selling prices for the crops are also assessed.

Whatever advantages the state had hoped for from the use of the subsidy, were lost, because of the existence of a food policy that places greater emphasis on maintaining low food prices mostly for the urban consumers. The result has been a sharp increase in required budgetary subsidy as shown on Table 4.12. The non-payment of subsidies in 1982/83 for maize meal and wheat flour indicate the effect of the drought, when domestic production was almost nil, and heavy imports of grain had to be resorted to. The little that was produced locally was kept in stock as a buffer. The rising wage rates, helped artificially to increase the food demand levels.

TABLE 4.12

BUDGETARY SUBSIDIES FOR VARIOUS AGRICULTURAL PRODUCTS ($000)

Year	Maize	Maize Meal Flour	Wheat	Wheat Flour	Soya Beans	Total
1970/80	4270	1400	925	3300	1379	11274
1980/81	9662	14430	N/D	6304	1919	32324
1981/82	6275	64800	N/D	8500	1001	80576
1982/83	14774	Nil	6224	Nil	1478	22476
1983/84	17864	400	8745	60	1563	28632

Source:Ministry of Finance,Economic Planning and Development, 1984

In the case of maize for example, while the producer price and the price for the millers have increased as Table 4.13 shows, the retail price has not. Thus the bulk of the subsidy required was directed to the millers. As a result of the high price incentive, the government has incurred a huge fiscal burden. Not only are losses sustained on domestic sales but, as maize output was higher than that required to meet domestic requirements, the government had to subsidize exports in competition with cheap US surplus maize, in order to get rid of the surplus produced. All these costs do not include the high storage cost of over $70 per ton. Storage costs of the surplus is running at $60 million per year; while transport costs have quadrupled since 1980 to $16 a ton (Africa Economic Development; July 1987).

TABLE 4.13

MAIZE: PRODUCTION, PRODUCER PRICE AND LOCAL SELLING PRICE

Year	Yield '000 Ton	Producer Price $ per ton	Local Selling Price (Millers) $ per ton	Retail Price (General Public) $ per ton
1979/80	1000	60.50	63.00	51
1980/81	1900	85.00	89.00	51
1981/82	1282	120.00	137.00	51
1982/83	576	140.00	150.00	70
1983/84	666	160.00	165.00	90
1984/85	500	180.00	200.00	100

Source:Ministry of Lands, Agriculture and Resettlement, 1984

In the case of wheat, in addition to the interest rate subsidy of the 1985 FIF, further support has been given through the producer price fixing policy, which has been dominated by the need to achieve self-sufficiency. While it is true that these public expenditures have in the past achieved self sufficiency, (Table 4.14), the subsidy costs of doing so now and in the future are increasing alarmingly. This is largely because of the rapid increase in the bread consuming urban population and because of the entry, in 1980, of a large number of these people into higher minimum wage income bracket; factors which serve to increase the demand of wheat and wheat products and thus make it harder to achieve self-sufficiency.

Volume of output has been affected more by the availability of water and changes in weather, (as in 1983/84 and 1984/85 drought years), than by the increase in producer prices or increases in the retail and selling prices. However, the high producer price has had some effect on volume of output, especially since the wet season of 1985/86, when the heavy rains provided the much needed water for irrigation

TABLE 4.14

WHEAT PRODUCER PRICES AND THE QUEST FOR SELF-SUFFICIENCY

Marketing Year	Volume (tons)	Producer Prices $/ton	Local Selling Price $/ton	Self-Sufficiency Level %
1975/76	121,083	110.00	ND	88.2
1976/77	141,433	121.00	ND	123.4
1977/78	164,540	123.00	ND	137.1
1978/79	207,999	110.00	ND	147.8
1979/80	158,940	115.00	134	93.8
1980/81	163,042	135.00	134	79.5
1981/82	200,912	165.00	157	89.3
1982/83	212,944	190.00	169	91.1
1983/84	124,250	220.00	239	54.6
1984/85	98,505	250.00	285	44.8
1985/86	205,484	285.00	323	83.0
1986/87	225,00	300.00	358	89.0

Note: ND = No data available

Source: Agriculture Marketing Authority 1987

purposes. Self-sufficiency has remained elusive despite increases in output, and in the producer price and the removal of some consumer subsidies on bread as from September 1984. The state has had to supplement local production through imports. In 1984/85 alone the state imported 104,184 tons of wheat, most of which was landed at an average cost of $296.93/ton compared with the cost of $285/ton local selling price to millers, and retail price of $200.00 per ton. Thus the differential between cost of imported wheat and the local wheat selling price to millers and the general retail price accounted for the deficit of $4.4 million suffered by the Grain Marketing Board.

Clearly, the fixing of high producer price and the removal of some consumer price subsidy has not saved the government from incurring high wheat import costs. In 1982 alone, millers received a subsidy of up to $6 million. Current trends in the wheat production sector tend to suggest that demand will continue to outstrip supply for sometime, and that self-sufficiency may be unattainable, until either the high level of demand caused mostly by the urban people, is curtailed by a steep increase in the local retail price, or until capacity extensions and or changes in production technology are introduced. It may well mean that all these measures would be unable to produce wheat self-sufficiency. The mix of domestic production and importation could be a permanent feature. The economics of such a mix will need to be examined by future research so as to determine the levels of the mix that are economically acceptable.

Soya beans and cotton have not been subsidized by the state to the same degree as maize and wheat. In the case of cotton and coffee the international market prices have largely dictated the prices paid to the farmers by the domestic marketing boards. For the uncontrolled crops such as sugar cane, tea and tobacco, the producer prices are the international commodity price; and the fortunes of the farmers involved in the production of these crops rise and fall in direct response to price fluctuations on the world market. Only coffee, of the crops under examination, realised trading surpluses (Table 4.15) for every year since 1979/80.

The total subsidy paid by government to cover the losses of the Agricultural Marketing Authority (A.M.A) have increased from year to year. For example, while the accumulated total subsidy paid to A.M.A. in 1979/80 was a mere $1,919,175, by the end of 1983/84, this figure had risen to $38,519,500, an increase of $36,600,325, a rise of 95% in five years or 19% per year. Most of A.M.A.'s losses are due to the differences between the high price the Authority pays to farmers for the crops delivered, and the low price it sells the crops to millers and retail outlets in addition to losses from exports and the high storage and handling costs. At the beginning of 1985, A.M.A.'s trading loss for commodities including irrigated crops, stood at $400 million, a fifth of which ($80 million) was estimated by the Ministry of Agriculture as due to losses associated with controlled irrigation crops, especially the huge importation of wheat following the 1981/82-1983/84 drought when the local wheat production was at its lowest, and other crops were experiencing depressed world market prices.

TABLE 4.15

SUBSIDIES PAID BY GOVERNMENT TO THE AGRICULTURE MARKETING AUTHORITY (AMA) ($)

Year		Wheat	Soya Bean	Coffee	Total to AMA
	a)	925,381	1,397,304	-	2,322,685
1979/80	b)	-	-	-	-
	c)	(+636,593)	1,919,175	(+1,690,194)	1,919,175
	a)	-	1,919,175	-	1,919,175
1980/81	b)	153,658	1,069,257	2,227,926	3,450,841
	c)	(+361,105)	1,069,257	(+130,402)	1,069,257
	a)	-	1,069,257	-	1,069,257
1981/82	b)	9,333,762	2,053,007	(+2,042,924)	11,386,769
	c)	8,932,972	2,121,872	(+2,188,027)	11,054,844
	a)	6,223,778	1,478,434	-	7,702,212
1982/83	b)	12,143,468	5,687,283	(+4,327,354)	17,830,751
	c)	15,549,961	6,496,347	(+4,444,368)	22,046,308
	a)	16,741	6,994	-	23,735
1983/84	b)	10,184,978	3,640,521	(+4,633,588)	13,825,499
	c)	27,602,410	10,917,090	(+4,810,995)	38,519,500

Note: a) = subsidy paid for deficits on previous trading year
b) = Annual Trading Loss (or Surplus)
c) = Accumulated sum paid by government after trading year

Source: Agriculture Marketing Authority, 1984

It was in 1985 that the price of sugar hit the bottom for a long time, selling in London at US$0.2 cents a pound, and recovery has been painfully slow, especially with the recent deterioration of both the US$ and the Z$, and Zimbabwe's loss of the USA sugar quota market. The implications of all these issues on the realisation of net benefits from all these cost outlays is the subject of the next chapter.

Public Cost Outlay to Irrigation and Rainfed Agriculture: A Comparison

The basis for comparing public cost outlay to irrigation and rainfed commercial agriculture, is limited to a few areas which include research and extension, the producer prices and loans. Because of this, it is felt that this analysis should not be buried in the main text of the Chapter, but treated separately, so that the unique nature of the different levels of public support to the two sectors is outlined clearly. The essence of the comparison is to attempt to show that a large part of the agriculture sector is receiving the least public sector assistance by way of subsidies, compared to the very small irrigation sector, on a per hectare basis. The picture that emerges is perhaps not entirely helpful in the absence of data on the level of benefits each section produces for the economy. This is done in the next Chapter.

Figures on Table 4.16 are based on 1984 prices. For the irrigation sector, most figures are derived from the foregoing text, while those for the commercial rainfed are based on a study of the Agriculture Sector Study by the World Bank. The assumptions behind the figures are explained in the notes under the table.

The State spends 20 times more money on commercial irrigation than on commercial rainfed crop agriculture. Expenditure on the rainfed sector is only 5 percent of the expenditure on irrigation. Where comparative costs are possible, like in the field of research, because of the high saturation of extension workers in the irrigation sector it has come to mean that the state spent twice on irrigation than on the rainfed sector; and 16 times in support of loans going to the water and irrigation sector than those going to the rainfed sector. Although the figures are only estimates, the obvious conclusions that can be drawn from them are that practically every cost item of the irrigation sector's cost configuration is supported by the government, and that irrigation agriculture is not possible without massive state help. This clearly raises the question as to whether irrigation agriculture can produce enough benefits to justify the appropriation of so much scarce resources.

TABLE 4.16

COST COMPARISON

IRRIGATION		RAINFED	
MAZWIKADEI DAM WATER		LOMAGUNDI (HIGH RAINFALL)	
Public Costs ($/hectare)		Public Costs ($/hectare)	
Crop: Wheat	TOTAL	Crop: Maize	TOTAL
1. Capital cost[a)]	8,944	N/A	N/A
2. Operation and Maintenance	100	N/A	N/A
3. Feasibility Studies	80	N/A	N/A
4. Service Provision[b)]	833	Research, Extension, Experiment	480
5. Farm Irrigation Fund subsidy[c)]	1,158	N/A	N/B
6. Producer Price Subsidy[d)]	248	Maize Producer Subsidy	270
7. Water Price Subsidy[e)]	4,350	N/A	N/A
8. Interest on Foreign loans	1,617	Loans connected with supply credits and imports of inputs	100
Total	17,330		850

Source:Derived from field data

Notes:

a) Capital cost calculations based on 60% of the $14,906.67 per hectare of the 3,000 ha to be irrigated by water from Mazwikadei Dam (Table 4.6)

b) Service costs based on the annual $5 million spent overall and on the ratio of extension workers to farmers. The figures are rough estimates.

c) Farm Irrigation Fund figure is based on 30% of the $3861, the cost of the average cost scheme approved by the Ministry of Lands, Agriculture and Rural Settlement.

d) The per ha wheat producer price subsidy is based on $55 per ton multiplied by 4.5 tons per ha, while those of maize are based on $45 per ton multiplied by 6 tons per ha.

e) The water price subsidy is based on the assumption that wheat will require 10,000 cubic meters of water per year, using figures on Table 4.7.

f) Interest on loans, is based on the 10.85% interest rate for the Italian loan used in building the Mazwikadei Dam divided by the 3,000 hectares to be irrigated.

CHAPTER FIVE

THE BENEFITS FROM COMMERCIAL IRRIGATION AGRICULTURE

INTRODUCTION

If the assessment of investment costs has been difficult, the assessment of the stream of benefits from irrigation is even more difficult. It is generally true that benefit estimation is subject to great uncertainty, not the least is determining the degree to which these benefits can directly be attributed to public investments in bulk water capacity development alone. Certainly, in a Zimbabwean context there are particular analytical problems. The analysis of benefits has to be undertaken from two distinct perspectives; the state and the private irrigator.

Clearly, if only the firm's own investment is considered, the cumulative private benefits accruing to the private investors may not necessarily fulfil the benefits expected by the state. This way the expected outcomes of public investment could well become an act of faith. The faith being that in the pursuit of profit maximization, the private investor would incidentally generate those public benefits. It would therefore be true to say that when public planners list the numerous benefits to be derived from bulk water supply developments, they neglect the fact that public influence over the outcomes is marginal and indirect. They have few mechanisms for controlling the pace and direction of private investment decisions, and have thus increasingly relied on expensive state subsidies, to cajole private investors to attempt to fulfil public objectives as well.

However, the pursuit of private benefits need not be antithetical to the creation of public benefits. And the relationship between the state and the private investors need not necessarily be confrontational, but complementary as the success of one side depends on the investment activities of the other side.

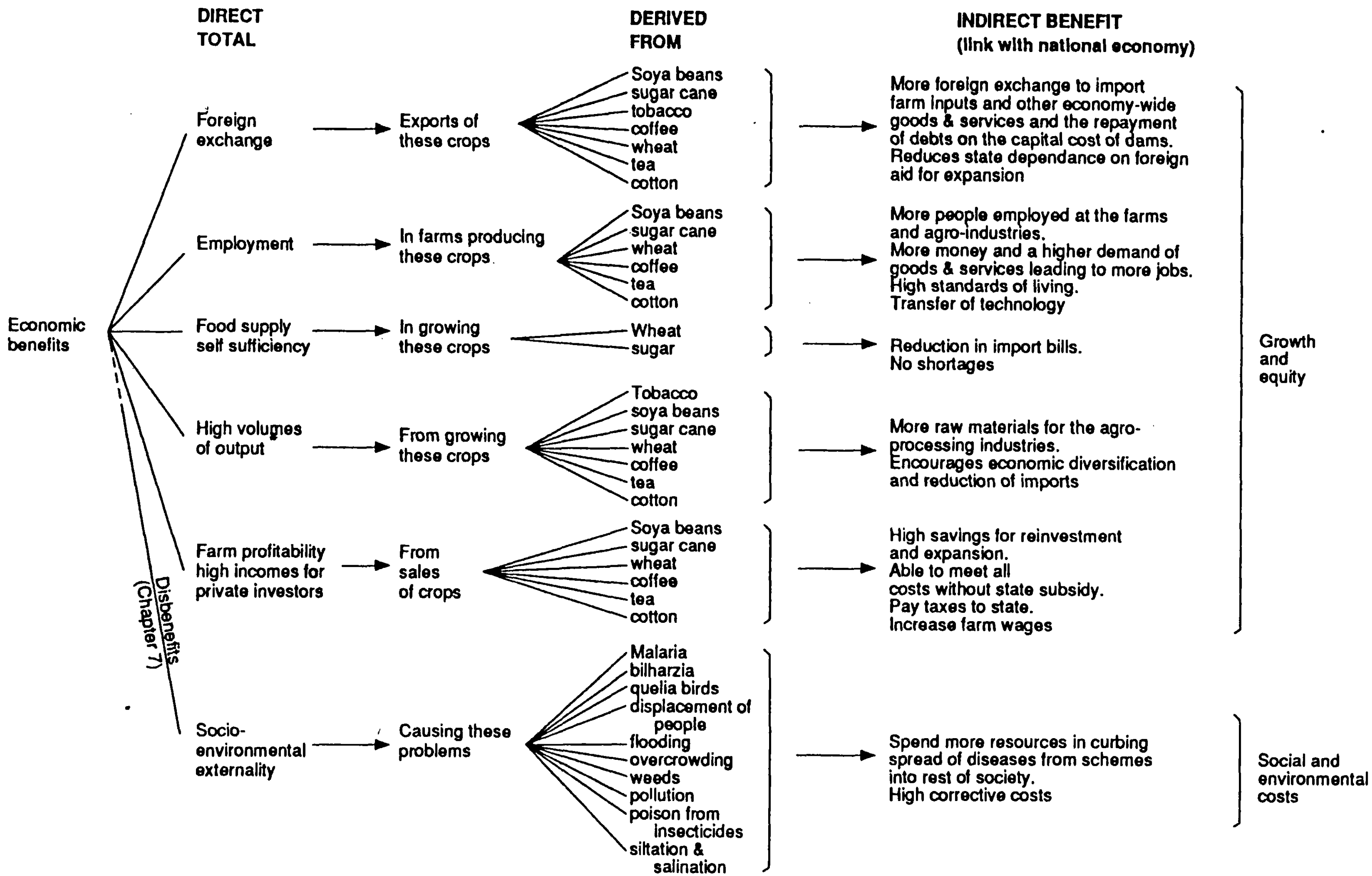
Fig. 5.1 represents the ideal or the expected benefits from commercial irrigation as perceived by the state planners. It is the possibility of achieving all these that lies behind the public policy preoccupation with investment in large water storages for irrigation purposes. As indicated on the diagram, an ideal irrigation situation has even the capacity to repay all the loans incurred in building the dams from the foreign exchange earned, with enough surplus resources for capacity expansion. The investors, in this ideal case, receive high prices for their crops and are able to save enough money not only to meet their recurrent cost obligations free of state subsidies, but are able to reinvest most of the profit as well as being able to increase the wages of the workers. The crop yields are expected to increase under irrigation, making it possible, to achieve food supply self-sufficiency as in the case of wheat and sugar. For the other crops, higher yields would mean a lot of raw materials for the agro-processing industry and other sectors of the economy in addition to exporting them.

Employment would be generated by the farms growing all these crops under irrigation. Some employment opportunities would be created by the processing industries. Workers would be expected to receive higher incomes. This would enable the workers to increase their demand for goods and services in the economy, and this in turn would give the necessary growth impetus to other sectors of the economy. The workers' standard of living would also improve.

This ideal situation is based on a number of assumptions, about a whole variety of socio-economic conditions, the majority of which are outside the control of both the government and the private investors. For example, in order to realise high inflows of foreign exchange, the international commodity market must buy all crops exported at very attractive prices; the prices of imported farm machinery, fertilizers and insecticides must be low so that the farmers can realise higher net returns; and the interest on foreign loans must be set at levels that will not allow huge outflows of the foreign earnings.

Fig. 5.1

BENEFITS DERIVED FROM COMMERCIAL IRRIGATION AGRICULTURE-THE IDEAL CASE



Source:Derived from Assessment of field data

The situation also presupposes high producer prices for these crops in the domestic market, and low price mark-ups for those inputs originating from within the domestic economy as well as low wages for the workers.

In the real world, where Zimbabwe is but a minor crop producer and a price taker on the world market, none of the assumptions can be fully satisfied.

Although the cumulative effect, under the ideal situation will lead to economic growth and the realisation of income equity, the real world situation is unlikely to produce the same result, as the discussion below shows.

The disbenefits are included in the diagram for completeness. They serve to indicate that even under theoretically optimal conditions, irrigation agriculture will produce benefits as well as disbenefits. However, these disbenefits are discussed in detail in Chapter 7, of this study.

<u>The Streams Of Benefits</u>

Zimbabwe's commercial irrigation agriculture is wholly based on cash crops for the export market, except for wheat and to a lesser extent sugar cane. But most of the high value export crops, namely cotton, coffee tea and tobacco are not only grown under irrigation conditions, but also under rainfed conditions, at varying degrees of crop intensity. For these crops it is therefore possible to carry out a rough comparison of yields under rainfed and those under irrigation conditions.

The yields of these crops under irrigation has got to be substantially higher than under rainfed conditions, for the high cost of growing them under irrigation to be economically justified. In the absence of data on what the farmer incurs in producing these crops, the comparisons can at best only be based on estimates. The per hectare cost figures of producing under irrigation and under rainfed conditions are derived from Table 4.16, where wheat costs represents the irrigated crop case, and maize the rainfed case. In this case a hectare of irrigated land would cost $17,330 to develop, while that under rainfed would cost $850 only. To these figures we can add the variable production costs borne by the farmers where they exist.

The High Yields

A comparison of yields between the rainfed and the irrigated components of such crops as tobacco, coffee, cotton, soya bean and maize, clearly shows that the irrigated component of the crop realises substantially higher returns than the rainfed one per hectare, for all the four years. For example Table 5.1 shows that increases due to irrigation returns for tobacco, rose from 303 kg per ha in 1981 to 575 kg by 1983. In each year the incremental yield due to irrigation was 17% above that from rainfed production, in 1981, 21% in 1982, 29% in 1983, and 16% in 1984. For coffee, the average increment was 26% for the three years assessed, and 67% for cotton over 4 years, 42% for soya bean and 47% for maize. These average percentage increases over the rainfed yields indicate that irrigation has been very beneficial, and indeed a superior system of producing the same crop. If the 'higher yields' objective was the only criterion to be considered, then irrigation would be fully justified.

Clearly, other questions, like the cost that had to be incurred to produce the extra yield, are very important. As Table 5.2 indicates, on the basis of the cost to the state of developing one hectare of irrigated and rainfed land, (Table 4.16), the incremental yield due to irrigation, is certainly achieved at substantially higher costs than under rainfed production conditions. For example producing the extra yield of tobacco under irrigation cost the state $45.00 per kg annually, resulting in a cost increase of $43 over rainfed agriculture for every kg produced. In the case of coffee the average cost of each extra kg produced under irrigation is even higher at $80, compared to $4, if that extra yield was produced under rainfed conditions.

TABLE 5.1

A COMPARISON OF YIELDS. RAINFED AND IRRIGATED AGRICULTURE. THE INCREMENTAL VALUE DUE TO IRRIGATION

CROP	UNIT	1981			1982			1983			1984			% of crop under	
		RAIN-FED	IRRI-GATED	INCREASE DUE TO IRRIGATION	RAIN-FED	IRRI-GATED	INCREASE DUE TO IRRIGATION	RAIN-FED	IRRI-GATED	INCREASE DUE TO IRRIGATION	RAIN-FED	IRRI-GATED	INCREASE DUE TO IRRIGATION	RAIN-FED	IRRI-GATED
TOBACCO Yield per ha	kg	1738	2041	303	1905	2313	408	1964	2539	575	2298	2657	359	90	10
COFFEE Yield per ha	kg	1202	1183	(-19)	1101	1242	141	904	1313	409	1210	1437	227	30	70
COTTON Yield per ha	kg	1777	2503	726	1671	2629	958	1478	2676	1198	1577	2967	1390	55	45
SOYA BEAN Yield per ha	kg	2075	2375	300	1630	2368	738	1225	1984	759	1491	2186	695	70	30
WHEAT Yield per ha	kg	-	5012	-	-	5140	-	ND	5140	-	-	4962	-	-	100
MAIZE Yield per ha	kg	5873	6949	1076	4098	6033	1935	2442	4343	1901	3326	4867	1541	92	8
SUGAR CANE Yield per ha	kg	-	103.9	-	-	113.7		-	104.1	-	-	104.7	-	-	100

SOURCE: Yield data from CSO, Crop Production on Large Scale Commercial Farms, 1984.

TABLE 5.2

THE COST OF THE EXTRA YIELD PER KG DUE TO IRRIGATION (USING FIGURES FROM TABLE 4.15) PER HECTARE ($)

CROP	UNIT	1981			1982			1983			1984			AVERAGE	
			COST PER KG $			COST PER KG $			COST PER KG $			COST PER KG $			
		EXTRA[1] YIELD	IRRI-[2] GATION	RAIN-[3] FED	EXTRA YIELD	IRRI- GATION	RAIN- FED	EXTRA YIELD	IRRI- GATION	RAIN- FED	EXTRA YIELD	IRRI- GATION	RAIN- FED	IRRI- GATION	RAIN- FED
Tobacco	kg	303	57.00	3.00	408	43.00	2.00	575	30.00	2.00	359	48.00	2.00	45.0	2.0
Coffee	kg	19	-	-	141	123.00	6.00	409	42.00	2.06	227	76.00	4.00	80.0	4.0
Cotton	kg	726	24.00	1.00	958	18.00	0.89	1198	15.00	0.70	1390	13.00	0.60	18.0	0.80
Soya Bean	kg	300	58.00	3.00	738	24.00	1.00	759	23.00	1.00	695	25.00	1.00	33.0	1.5
Maize	kg	1076	16.00	0.79	1935	9.00	0.44	1901	9.00	2.00	1541	11.00	0.55	11.0	0.95

NOTES

1 The Extra Yield is the incremental yield per ha due to the application of irrigation, from Table 5.1

2 Cost per kg irrigation, refers to the cost to the state of each extra kg of yield, given that it cost the state $17,330 to develop one irrigated hectare.

3 Cost per kg rainfed, refers to the cost to the state of each extra kg of yield, if that incremental yield was produced under rainfed conditions, given that state help to rainfed agriculture per hectare is $850.00.

At these costs, the benefits derived from higher yields under irrigation, diminish into insignificance. Continued production of these crops under irrigation would only be justified if the returns on the crops were substantially high enough to cover the production costs and give the producer some profit. For controlled crops and those sold through the national marketing boards, the producer prices paid for crops would need to be much higher than those discussed in Chapter Four, to make production under irrigation worthwhile.

The question must be asked, as to how farmers have managed to cope with such steep unit costs of production under irrigation. Clearly, no farmer would be producing these crops under irrigation if he was required to meet these costs from his pocket without state support. This means that, although these figures are real economic costs that ought to be computed into the cost of producing each crop; from the farmer's point of view these costs are external and do not directly affect the profitability of his operations. The farmer is more worried by the financial costs of producing the crop. On the basis of this partial allocation of costs, it has been possible for farmers to continue to produce under costly irrigation conditions. Ironically, the policy makers have also tended to promote this partial view of the relationship between the (extra yields) incremental yields under irrigation and the cost of achieving them.

Considerations of the economic costs of realising these extra yields would tend to nullify any benefit that could have been realized. If anything, producing these crops under irrigation, increases the costs to be incurred by the state in net terms. From the figures above, one is tempted to argue that more economic benefits would be realized if rainfed land area were expanded in order to produce that extra yield now realized under irrigation.

Food supply self sufficiency

Nearly the entire commercial irrigation sector of Zimbabwe is based on the growing of low volume high value export crops. The exceptions are the growth of wheat as an import substitution crop for the domestic market, and fifty percent of the sugar cane output which is destined for the local market. Tea, coffee and cotton play a minor role in the domestic food supply equation, except as beverages, especially in the case of tea and coffee for the urban population mostly. Cotton's contribution to the national food supply situation is through cattle feed and cooking oil; and that has been inadequate for over 6 years.

The focus on food supply self-sufficiency has, for years been directed at wheat production. Zimbabwe's wheat is totally produced in winter under irrigation. Thus yields are predicated directly on the availability of water, the decline in the number of farms producing wheat, and from high cost of farm inputs, as well as from dramatic declines in hectarage, due to farmers shifting to other crops in response to variations in producer prices. Table 5.3 shows that since 1982 there has been a sharp decline in the farms producing wheat, and on the hectarage put to wheat production. Although the yield per hectare has remained high at above 5 tons; the decline in hectarage under wheat seems to have been one of the main causes behind the drop in the total crop harvested from the peak of 191,857 tons in 1982, down to a mere 83,807 tons by 1984, a drop of over 56%.

Interviews with farmers seem to suggest that, although lack of water for irrigation during the three years of drought may have started, for many farmers in the High Veld, as the main reason for the decline on the hectarage under wheat, the high producer price of the easy-to-grow, maize may have been responsible for later losses of the hectarage. These farmers noted that, although the producer price of wheat was higher than that of maize, the higher input costs for wheat made it less profitable.

TABLE 5.3

WHEAT PRODUCTION: THE EFFECTS OF REDUCED HECTARAGE ON YIELD

	1980	1981	1982	1983	1984
Number of farms	424	504	485	304	271
Area planted (ha)	36,556	36,590	37,329	21,504	16,891
Crop harvested(ton)	154,593	183,380	191,857	110,988	83,807
Yield (ton/ha)	4,74	5,01	5,14	5,16	5,00

Source:Grain Marketing Board, Crop Estimates,1985.

While yields have continued to decline, demand for wheat products has continued to grow. Since 1980, wheat intake by the Grain Marketing Board (excluding stocks held back by farmers) has fallen short of domestic demand as Table 5.4 shows.

TABLE 5.4

WHEAT SUPPLY AND DEMAND SITUATION (tons)

Marketing Year	1980/81	1981/82	1982/83	1983/84	1984/85
Grain Marketing Board					
INTAKE	163,000	201,000	213,000	124,000	98,000
IMPORTS	3,000	17,000	31,000	55,000	104,000
LOCAL DEMAND	205,000	223,000	234,000	227,000	220,000
DEFICIT(surplus)	39,000	5,000	(10,000)	48,000	18,000

Source:Grain Marketing Board, Crop Estimates,1985.

The government has come to rely heavily on imports to assuage the shortages. In fact, reliance on imports has tended to grow with the decline in yield from 1980/81 to the 1984/85 marketing year, when imports were more than the grain supplied to the GMB by the farmers. Of the 104,000 tons imported that year 23,704 tons came in as grant aid, from Australia, Canada, the EEC, West Germany and Yugoslavia, and 30,603 tons as in-house barter with maize from Christian Care, Lutheran World Federation, World Food Programme and the Netherlands Government.

Attempts to achieve wheat supply-self sufficiency have been difficult according to Table 5.5.

TABLE 5.5

WHEAT SELF SUFFICIENCY

YEAR	DOMESTIC DEMAND	G.M.B. INTAKE	LEVEL OF SELF SUFFICIENCY
	(Ton)	(Ton)	%
1980/81	205,000	163,000	79
1981/82	223,000	201,000	90
1982/83	234,000	213,000	91
1983/84	227,000	124,000	55
1984/85	220,000	98,000	45

Source:Grain Marketing Board, Crop Estimates,1985.

The level of self-sufficiency may have risen from 1985 to 1986 as indicated in Table 4.14 above (Chapter 4). What is perhaps important to underline is the fact that this level of self-sufficiency is not a true assessment of the wheat supply situation in the country, since wheat is sold on allocation basis to millers. Without the strict allocation system local consumption (demand) would probably be higher than current levels, thereby decreasing the level of self-sufficiency considerably. So the demand figures on Table 5.5 reflect levels of allocation and not of demand.

Clearly the achievement of full national wheat supply sufficiency in the country will prove to be very expensive either in terms of costly extension of land under wheat as exemplified by the Mazwikadei Dam project (Chapter 4) or in terms of state subsidy outlays designed to cushion the urban consumers from the true economic cost of wheat products. Doubts must be cast on the rationality of pursuing a total supply self-sufficiency policy, especially when it is considered that the consumer price subsidy (which is unlikely to be removed) has allowed for the growth of uncurtailed demand for wheat products. Urban dietary habits have shifted away from the more traditional maize porridge for breakfast and 'sadza' (thick maize porridge) for lunch, in favour of bread and sandwiches respectively. The pursuit of a policy of domestic supply self-sufficiency must at the end of the day be subjected to the economic sensibility of doing so in relation to the changes in the price of wheat on the world market. The price for pursuing a domestic self-sufficiency policy must be carefully assessed (an area of future study) and justified rationally.

In the case of sugar, domestic supply self-sufficiency levels were achieved in the mid 1960s, and since then, the production of the crop has been directed more towards foreign exchange earnings objectives through the exports of large quantities of the output. Table 5.6 shows the share of the total output that have been destined for the domestic and for the export markets.

Domestic demand for sugar has been increasing since 1979/80, reducing the share destined for export, so that by 1984/85, the domestic share of output is nearly the same as that for export. The rapid increase in the domestic demand coincides with the increase in earnings following the introduction of the Statutory Minimum Wage in 1980. As a result, 1984/85 domestic demand is 77% that of 1979/80 output and 180% of 1979/80 demand figures. Certainly sugar production has kept ahead of demand in the domestic market.

TABLE 5.6

SUGAR PRODUCTION AND DISPOSAL (TONS)

YEAR		DISPOSAL (tons)			
	PRO-DUCTION (tons)	DOMESTIC market	% OF PRO-DUCTION	EXPORTS	% OF PRO-DUCTION
1979/80	272,50	116,000	43	156,200	57
1980/81	339,200	151,200	45	187,900	55
1981/82	369,900	171,400	46	198,500	54
1982/83	397,100	183,200	46	213,900	54
1983/84	410,700	206,500	50	203,000	50
1984/85	438,500	209,200	48	228,800	52

Source: Derived from Sugar Sales (Pvt) Ltd, London, UK.

Note: 1. Domestic market figures exclude the quantity of sugar used for ethanol production.

Unlike sugar and wheat, coffee sales in the domestic market have continued to decline since 1980/81 as Table 5.7 shows. It can be argued that the departure of large numbers of whites who constituted an effective domestic market for coffee between 1980 and 1982 is responsible for the drop in local sales by as much as 50 percent. While wheat relies 100 percent for its support from domestic sales, and for sugar 50 percent, coffee must rely on the world market price for 95% of its sales.

TABLE 5.7

DOMESTIC DEMAND FOR COFFEE

YEAR	LOCAL SALES (Tons)	AS PERCENTAGE OF TOTAL SALES
1980/81	530	10.8
1981/82	601	10.4
1982/83	341	5.4
1983/84	472	5.8
1984/85	487	5.1

Source:Grain Marketing Board, Crop Estimates,1985.

Given the vagaries of the world prices, the crop's total reliance on this market places it in a precarious position. Besides, while wheat and sugar have some nutritional value as foods, hence their production can be justified from the food supply self-sufficiency objective, coffee cannot be justified on this basis.

Tea's fortunes on the domestic market have followed those of coffee although volumes of sales have been much larger than those for coffee. Again, tea does not fit into the food supply self-sufficiency equation. It is so far very clear that the irrigated crops' contribution to the requirements for domestic foodstocks has been disappointingly marginal, and only for a small urban population. Perhaps through the offer of employment opportunities, commercial irrigation agriculture has contributed to the realisation of high incomes by the workers, the majority of whom are from the poor peasantry sector.

Employment Generation

The generation of employment opportunities has for a very long time been identified by successive governments of Zimbabwe as a major benefit to be derived from commercial irrigation. Such notions are particularly supported today in the climate of high unemployment and under employment of labour. Any analysis of the employment benefits of commercial irrigation has to identify the difference between employment benefits in terms of the absolute physical numbers of people that can be employed at the schemes, and the income distribution dimension of that employment. This separation in analysis, is made more necessary by the fact that policy makers and planners often focus undue attention on the physical aspects of employment at the expense of the earnings of labour. Labour, as an input to the crop production process, has an opportunity cost, so it is essential to establish whether its use in irrigation agriculture, is the efficient alternative form of employment, from the point of view of the whole economy. It is also important to assess the cost implications this has on the cost of irrigation. The Zimbabwean context also requires that any labour analysis should look at the role of permanent labour, covered by legal and statutory instruments of government, vis a vis the army of temporary labour whose constituent body remains undefined.

In pure physical numbers of workers employed in the commercial irrigation agriculture, the number of permanent workers is estimated at less than 50,000 of which nearly 17,000 are employed on the largest single continuous block of irrigated land of the Triangle-Hippo Valley-Mkwasine Schemes, constituting some 41,000 hectares of irrigated sugarcane. Tea alone employs some 10,000 workers, coffee, some 5,000 workers and cotton, nearly 10,000 and the remainder are employed on wheat farms and irrigated tobacco. The sugarcane schemes constituted the single largest employer of labour in Masvingo Province, and between 1981 and 1983, the schemes were providing one job opportunity for every 34 hectares developed.

When it is considered that all these workers are employed on only 136,000 hectares of land (2.7 workers per ha developed), as compared to only 10,000 workers over the same area of rainfed land, it is clear that, commercial irrigation has been able to employ far more people per unit area, than any other form of agricultural practice in the country because of low mechanisation and high dependence on human labour for all activities. However, statistical figures show that since 1980, the hectarage under irrigation has been declining, and with it, the decline in employment trends or opportunities.

While the employment growth in the whole economy has stagnated at 1% and -1% (Socio-economic Review 1980-1985), that in the commercial irrigation sector has remained static at zero growth rate over the period under review. From the agriculture sector as a whole's point of view, the physical permanent employment offered by irrigation is minor, at 18% of the total labour force employed in agriculture (an average of 270,000 workers nationwide).

Evidence clearly shows that employment impact of commercial irrigation is most felt in the neighbourhood of each scheme. The fact that the effect is location-specific implies that regions that lie far away from the schemes, or which have no resource base for the development of irrigation cannot benefit. Findings of a study done by Roder (1965) on the origin of workers on the schemes in Manicaland, concurs with this observation in the present study. The employment benefits are therefore not widespread, but are concentrated in Masvingo and Manicaland Provinces.

Nearly 90 percent of the total labour force at each scheme is unskilled, and can therefore easily be recruited from within the neighbourhood of the schemes. This is made possible by the fact that most of these schemes are labour intensive and require very little input of scarce skilled labour, which would be imported from regions further away from the schemes. The reason for this high dependence on unskilled labour is to do with the nature of the crops being produced.

Crops such as tobacco, cotton and tea, owe their competitive advantage on the international markets to the high quality products associated with hand picking during harvesting. While large numbers of people are required during the planting of these crops, these numbers swell much more during harvest periods when large numbers of seasonal temporary labour are recruited to help in the hand harvesting of the crops. Normally irrigated tobacco would employ one worker to half a hectare compared to one for 2 hectare under rainfed cropping or one to five hectares for rainfed maize, but at the peak of harvesting time the number of workers per hectare can increase to as much as 5 per hectare on irrigation farms, depending on how profitable this would be. Cotton and tea employ even higher numbers of temporary (seasonal) labour as they are especially vulnerable to improper handling and require that both the fibre quality of cotton, or the leaf-quality of tea be of paramount consideration. In the case of tea, the mountainous topography precludes the use of machinery, and makes human labour the first and only harvesting method of choice. Seasonal labour is not costly, and depending on the scale of famine, drought, unemployment, etc, in the neighbourhood, most workers are prepared to take substantially lower wages than permanent workers. In addition seasonal labour is not protected by the legal statutes of the Statutory Minimum Wage, so making it easier for the employers and workers alike to come to some reasonable wage agreement, far lower than the government's stipulated level.

Although sugarcane does not depend for its quality on hand harvesting, most operations are labour intensive. This is largely because it is still considered economic to use human labour than costly machinery, even at the current level of wages. Only wheat has introduced, on a large scale, combine harvesters and tractors. The mechanisation option for all crops grown under irrigation, and indeed for the whole agricultural industry has become less and less attractive because of the shortage of foreign currency needed to import all the machinery, particularly during the period under review. As indicated earlier, it has also been difficult to import spare parts for the maintenance of the current stock of aging machinery.

The increase in the cost of tractors for example from $30,000 in 1984 to $60,000 by 1987 has made it uneconomic to place too high a reliance on machinery. The foreign exchange allocation system, with typically a one year delay in the assessment of applications and approval of allocation, be it for new machinery or spares, has affected planning at the farm level. This situation has all the hall marks of being permanent for the foreseeable future. It is clear that Zimbabwe is facing difficulties in setting up a limited mechanisation programme let alone a full blown mechanisation of the whole production process. The domestic bottlenecks have got to be seen against a background of poor world commodity prices which have been on a downward trend since 1982/83; and the high levels of unemployment in the economy, especially of the unskilled labour.

Although human labour seems the only means of production of choice for irrigation, it is important to assess the economic cost of this choice. The cost of creating one job under irrigation 1981/82 was estimated at $4,000 as compared to $200 under rainfed conditions. By 1984, this rose to over $6,000 per job under irrigation compared to less than $400 per job in the rainfed sector. Available information suggests that at this cost, job creation cost was only second to industry and mining. It is therefore possible that the ceiling for the expansion of employment benefits in irrigation may have long been reached. It is true that new schemes are experiencing these high costs much more than the older schemes constructed when costs were very low.

Economic analysis would require that any incremental job opportunity to be created be justified on the marginal incremental benefits it would bring to the investor. Given that the crops grown are export reliant and are in turn affected by poor world commodity prices, the prospect of any extra labour bringing more benefits to the investor are slim.

However, the social benefits of irrigation, in project appraisal, are not often discussed in macro terms as above. A micro-analysis of the real wage earned by the worker, on which he makes a living, is usually the basis for the calculation of the aggregate benefits to workers from the employment. The wage earned by the worker can be taken to represent the workers's value for working under irrigation. However, this is not always true, especially in an economy where wage levels are fixed by an Act of Parliament. In an ideal competitive economy, the wage labour earns should approximate the opportunity cost of that labour. However this requirement would mean that the wage earned by irrigation workers, in a situation of high unemployment and underemployment of labour, would be close to zero, the opportunity cost of that labour. On this basis, irrigation workers' standard of living would be the same as those under subsistence rainfed agriculture, and that is less than $400 per year.

In 1980, the enactment of the Statutory Minimum Wage (Statutory Minimum Wage Act 1st July 1980), saw the rise of wages for farm workers from $20 in 1980 to $75 per month by 1985, a rise of 275% over 5 years, or an annual increase of 55%. These have been huge real increases in income even taking inflation into account, compared to the $30 per month realised by the subsistent farmer (CSO, 1985). Assessed on their own, these wages do not reveal the disparity between farm workers' wages and those received by other workers in other sectors. As Table 5.8 shows, the agricultural worker's wage is at the bottom of the income table, for the less skilled grades.

Even if it is assumed that the $75 is added to the average $30 per month produced by the rest of the family under subsistence rainfed agriculture, the total income realised is not substantial.

TABLE 5.8

MINIMUM WAGE - LOW INCOME GRADES - A COMPARISON

Sector	Monthly Wage ($)
Musicians (urban)	166.75
Musicians (rural)	143.75
Commercial Fish Worker	147.20
Town Council General Worker	143.75
District Council Hand	78.00
Skilled District Council Hand	143.75
Miner	143.75
Unskilled Welfare Worker	85.00
Agricultural Industrial Workers	143.75
Domestic Worker	75.00
House Keeper	77.00
Baby Minder	79.00
Agricultural Farm Worker	75.00

Source: Zimbabwe, The Herald, July 1st, 1985, page 3.

But the size of the wage does not carry the actual real value which the receiver enjoys from it. There is therefore the need to break down the wage received into what it can purchase. This way it will be possible to compare what the wage can purchase and the Poverty Datum Line (PDL), a level of income above or below which a given size of family can be said to be adequately subsisting . The PDL is a realistic measure of the quality of a wage because it is based on real costs incurred in the pursuit of subsistence, and therefore changes from year to year in line with changes in prices of goods and services in the economy. It is therefore a reflection of the wage that is required, or to be paid to the workers if they are to realize the minimum requirements of subsistence regardless of that labour's opportunity cost, in line with the objectives of equity.

On the basis of a PDL of $128 per month calculated by the Riddell Commission on Incomes in 1980, the minimum wage of irrigation workers remains in the bracket of 'poverty' incomes; for it does not accord the worker, the minimum requirements for subsistence. Apparently this situation affects over 6 categories of workers and is not specific to irrigation agriculture. The key question therefore is not how far above or below the PDL the wage is, but whether it is better than nothing. Clearly, the wage, though low, represents nearly three times what the workers would realise if they did not join irrigation agriculture employment.

However, public wage fixing reduces excessive income differentials in society and can form the basis in future for addressing the equity problem. The policy dilemma is that, while the wage level is clearly very low from the worker's view point, pushing the wage further up, under present conditions of high unemployment would fuel the rate of unemployment. Public wage fixing denies the worker the right to price himself/herself into a job at his/her own perceived opportunity cost. On the other hand a wage policy whose horizon is the realisation of a subsistent income would encourage private investors to go into irrigation on the false assumption that wages would remain for ever subsistent. This would cause adjustment problems should wages increase drastically in future. The policy solution has been to grant workers wage increases in small doses, so as to ameliorate the effects of the sharp wage rise on the export crop and on profitability. As this has often led to price increases of goods and services within the retail sectors, wage increases have had no beneficial real effect on the workers' purchasing power.

It is equally very important to assess the benefits that accrue to the individual investors, as far as data will allow.

The Profitability of Commercial Irrigation

The motive force behind the development and indeed expansion of commercial irrigation is the private investor. To attract the private investor, irrigation agriculture has to be seen to be profitable.

It is however clear that despite the state's provision of considerable public aid, the private irrigator still has to bear significant development costs, which clearly affect the private profitability of irrigation ventures. These costs comprise, depending on the type of crop grown, labour, tractor operating costs, fertilizer and lime, seeds, herbicides, insecticides aerial spraying costs, irrigation costs, combine hire, transport, bags, packaging, storage, insurance, levy costs and other sundry costs such as income tax payment, interest payment on loans and building costs.

The cash requirements to meet all these costs can exert a lot of pressure on the resources of the investor. Most investors therefore rely heavily on borrowing from banks and the Farm Irrigation Fund in order to be able to carry out any investment. Clearly, their ability to repay the loans and be able to continue in irrigation agriculture ultimately depends on the crop prices that are in operation.

Table 5.9 shows for a selected number of crops, that the size of the profit margin realised by the private investor depends on the size of the gross income realised in relation to the total variable costs incurred. For the venture to be profitable, the gross income must be higher than the total variable costs. In the examples given, it is clear that the gross profit for each crop has been fluctuating over the 9 years reviewed. Wheat, cotton and soya beans realised peak profit margins around 1983, 1984 and 1985, while maize's peak profitability period was 1980/81 when it realised \$330.45 per hectare. A comparison of all the four crops' profitability on a per hectare basis, suggests that wheat cultivation has been the most profitable venture realising the highest gross margin of \$475.85 per hectare in the 1984/85 seasons.

In order to assess the real returns to the investor it is necessary to assess the returns for every dollar invested. On the basis of this criterion, only maize has realised the returns per invested dollar of up to \$2.01. All other crops have experienced more or less uniform returns fluctuating between \$1 and \$1.6 for every dollar invested. For all crops, the margin of profitability declines towards 1987.

TABLE 5.9 RETURNS TO PRIVATE INVESTORS

CROP	YEARS							
WHEAT	1980	1981	1982	1983	1984	1985	1986	1987
Total Variable Cost	438.64	507.83	591.81	696.17	785.79	947.01	1159.74	1223.25
Gross Income	663.55	811.00	934.10	1081.30	1246.75	1422.86	1497.75	1497.75
Gross Margin	224.91	308.17	342.29	385.13	460.96	475.85	338.01	274.50
Returns/$ T V C	1.51	1.60	1.58	1.55	1.59	1.50	1.20	1.22
T V C + 1/2 + 10% of G I	724.32	842.83	981.13	1152.39	1303.37	1562.81	1889.39	1984.65
Index of Return/$ T V C	100.00	105.96	104.64	102.65	105.30	99.34	85.43	80.79
SOYA BEANS	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Total Variable Cost (T V C)	277.52	315.13	361.62	401.47	457.59	539.60	653.55	716.64
Gross Income (G I)	368.00	391.00	460.00	598.00	660.10	736.00	782.00	782.00
Gross Margin (G M)	90.48	75.87	98.38	196.43	202.51	196.40	128.45	65.36
Returns/$ T V C	1.33	1.24	1.27	1.49	1.44	1.36	1.20	1.09
T V C + 1/2 + 10% of G I	453.08	511.80	588.43	662.16	752.40	883.00	1058.53	1153.16
Index of Return/$ T V C	100.00	93.23	95.49	112.03	108.27	102.26	90.23	81.95
COTTON	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Total Variable Cost	396.83	440.05	519.48	569.35	675.37	820.72	996.92	1138.21
Gross Income	590.04	621.23	822.69	813.78	907.34	1062.61	1191.55	1191.55
Gross Margin	192.21	181.18	303.21	244.43	231.97	241.89	194.63	1.05
Return/$ T V C	1.49	1.41	1.58	1.43	1.34	1.29	1.20	1.05
T V C + 1/2 + 10% of G I	654.25	722.20	861.49	935.42	1103.79	1337.34	1614.54	1826.47
Index of Return/$ T V C	100.001	94.63	106.04	95.97	89.93	86.58	80.54	70.47
MAIZE	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Total Variable Cost	267.58	328.71	416.50	470.30	521.99	651.03	799.91	882.74
Gross Income	466.93	659.16	659.16	659.16	781.41	1002.15	999.88	999.88
Gross Margin	199.35	330.45	242.66	188.86	259.42	351.12	199.97	117.14
Return/$ T V C	1.75	2.01	1.58	1.40	1.50	1.54	1.25	1.13
T V C + 1/2 + 10% of G I	488.06	558.99	690.67	711.37	861.13	1076.77	1299.85	1424.10
Index of Return/$ T V C	100.00	1114.86	90.29	80.00	85.71	88.00	71.43	64.57

Source:Derived from Assessment of field data

Clearly, the total variable costs and the gross income or the gross margin aggregate figures are all affected by many other negative factors in the economy such as inflation. It has therefore been necessary to index all the figures on returns per dollar using 1979/80 as the base year. Using real term figures, it is clear that irrigated commercial maize has not been profitable since 1981, and the profit margin has declined by as much as 40% of 1979/80 figures.

Cotton has experienced similar declines in profit margins, with the lowest level in the 1986/87 season when profit margins were 30% below the 1979/80 levels. On the contrary, wheat has been very profitable since 1979/80, and experienced minor declines of less than 20% from 1985. In the absence of figures on other cash crops such as tea, coffee and sugar, it is clear that wheat has been a more profitable crop than the other crops.

What is perhaps of great concern to the cashflow position of the investors is that they are required to meet a much higher cost outlay per hectare, in financial terms, in 1987 than was the case in 1979/80.

In the case of irrigated maize for example where the outlay was, in 1979/80, at $267.58 per hectare, in 1986/87, it was $882.74, an increase of 230% against a fall in profit of 35% for the same period while the cost outlay for wheat rose by 179% over the same period. This implies that it is much more costly financially to engage in irrigation in 1987 than it was in 1979/80. This conclusion has very serious implications for the expansion of commercial irrigation in Zimbabwe. Clearly, while profit margins have actually fallen in real terms, investors are having to put more financial resources into irrigation. This has a tendency of barring the entrance of new farmers into commercial irrigation.

Discussions with investors have revealed that all is not well in the irrigation sector. Farmers have blamed low profit margins on a host of factors ranging from the input price escalation to the low international commodity prices.

In addition to these, is the ever present problem of the delivery of necessary inputs such as farm machinery, fertilizers, insecticides and fuel, not arriving at the farm in quantities and at the times that are opportune from the farmers' point of view. The fact that the availability of these essential inputs cannot be guaranteed has affected optimal planning at the farm level resulting in a lot of hesitation on the part of the farmers to exploit to the fullest, the crop production opportunities in order to realise much higher profit margins.

The recurrence of droughts and the resultant water shortages have also eaten into the profitability of irrigation. The peak of any drought has often ushered in temporary water use control measures, that in farming terms, have come to mean the curtailment or the 'shrinkage' of the hectarage under irrigation, and by implication, causing a drop in output and profitability.

Since the irrigation sector is cash crop and export dependent, crops such as cotton, coffee, tobacco, tea and sugar are going to continue to rely for their profitability on the vagaries of the international commodity prices. Since the 1982/83 price peak, the world agricultural commodity prices have experienced sharp declines, resulting in the erosion of profits and the viability of most of the irrigation plantations in Zimbabwe. The position of irrigation farmers is made worse by the fact that, because of the fixed physical structures of irrigation, and the plantation nature of the production system, the farmers are not able to shift from these crops to other crops easily, or without incurring huge financial losses. The improvement, since mid 1986 of commodity prices on the world market and the rise in demand, has been a source of encouragement. It is, however often difficult to tell whether the upturn in prices reflects a long or a short term trend.

One indicator of the low profitability of irrigation agriculture is perhaps the high level of indebtedness and in some cases, outright insolvency, among the farmers. Although up-to-date statistical figures are not available, the Chavunduka Commission (1982) indicated that by 1982, many commercial farmers (irrigation and rainfed) were unable to repay the loans borrowed from the Agricultural Finance Corporation (AFC), let alone service the interests. The occasional 'writing-off' of farmers' bad debts by government has enabled most farmers to remain on the land.

The same Commission showed that in 1982, only 1,547 farmers were able to pay tax out of 4,975 commercial farmers, despite the existence of a very generous tax regime for the farmers. Although 'payment of tax' as a measure of profitability is rendered weak by the high degree of tax avoidance and evasion the fact is not lost that nearly two thirds of the country's commercial farmers experienced 'serious' financial problems.

Foreign Exchange Earnings

Perhaps the most important benefit that can be realised from cash crop irrigated agriculture is the level of foreign exchange the sale of crops overseas can bring. It follows therefore that the higher the level of foreign exchange resources realised by the irrigation sector the greater the chances that the sector would be able to get most of the essential inputs, as well as service or repay all the loans borrowed for dam construction.

From a national point of view, the generation of foreign exchange by irrigation agriculture is important in terms of meeting nationwide obligations that need foreign exchange. The Zimbabwean economy has been experiencing serious foreign exchange constraints, which have resulted in the curtailment of the imports of intermediate goods and essential raw materials and services, needed by the whole economy but more so by the industrial sector. The state has tended therefore to support any investment that has the potential to generate foreign exchange; and commercial irrigation is one such investment.

For example, tobacco, cotton, sugar, maize, coffee and tea earned the country $222 million in 1979 and $257 million in

1980. However, real gains can only be evaluated in 'net' foreign exchange terms. The size of the 'net' for Zimbabwe is affected by a number of factors. In production terms Zimbabwe is a small producer of all the export crops and as such has limited influence on the prevailing international commodity prices. As a 'price taker' as opposed to a price determinor, Zimbabwe's gross earnings are entirely at the mercy of the big producer countries and the stock holding policies of the buying countries. Zimbabwe has a very high foreign debt servicing ratio of 36 percent per year (as of 1986) which tends to take a very large share of the gross foreign exchange earned.

Although there are no figures, it is believed that the transportation of these export crops takes a sizeable share of the gross earnings.

In order to assess the gross foreign exchange earned by irrigation, the gross volume of export for all crops (including the rainfed component) has been assumed to contain all the output from irrigation. The percentage volume due to irrigation has been calculated using the representative portion of output that is due to irrigation. The gross value earned has then been divided by the gross volume and the result multiplied by the volume due to irrigation. The error in the calculation is negligible. The end product of this calculation is Table 5.10. The figures produced are only valid insofar as the basic assumption, that all produce from irrigation is included in the volume exported, can be accepted. This is considered a fair assumption, given that sales in the domestic market of the produce (except for maize and sugar) is relatively insignificant. In the absence of data on foreign exchange earned specifically by the irrigation sector, this is the only possible approach to approximate foreign exchange earnings by irrigation.

According to Table 5.10, it is clear that gross foreign exchange earned was largely from tobacco, cotton and coffee by volume and value of export. Maize, a low value, high bulk commodity has consistently yielded poor foreign

TABLE 5.10

GROSS FOREIGN EXCHANGE EARNINGS FROM IRRIGATION CROP EXPORTS ONLY (1979 - 1983)

CROP	1979		1980		1981		1982		1983		PRINCIPAL DESTINATIONS OF EXPORTS
	MASS '000t	VALUE $M	MASS '000t	VALUE $M	MASS '000t	VALUE $M	MASS '000t	VALUE $M	MASS '000t	VALUE $M	
Tobacco	6	8	9	12	13	22	9	19	9	23	Holland China W.Germany
Cotton Lint	22.05	21	24	26	24	27	21	23	22	33	Italy W.Germany Japan SA
Sugar (Raw and Refined)	245	21	166	47	172	55	220	52	202	52	USA EEC Botswana
Maize	17.52	1.4	5	1	19	3	28	3.2	40	3.3	Zaire Zambia SA Ethiopia
Coffee	2.8	7.7	2.1	5	4	7	5	11	5	13	SA Switzerland W.Germany
Tea	4.4	4	3.3	3.3	3.3	3.3	4	3	4.4	6	UK South Africa Eire EEC
TOTAL	297.77	63.1	209.4	94.3	235.3	117.3	287	111.2	282.4	130.3	
% Share due to Irrigation		35%		39%		31%		31%		31%	

Source: Figures on this Table have been derived from figures in the Monthly Supplement to the Digest of Statistics, January 1985 exchange returns, and so has sugar. A comparison with other crops would show that one train load of cotton can earn as much foreign exchange as eight train loads of maize, and one train load of tobacco can earn the same as about 15 train loads of maize.

Although earnings by tobacco are clearly substantial per volume of sales, tobacco prices on the international market, have remained volatile. This has had the consequence of affecting the stability of the tobacco industry as a whole and indirectly of the economy that is heavily dependent on it. World market cotton prices have also been depressed for some years, but the high quality of the Zimbabwean fibre has always attracted premium prices. Coffee prices have been boosted by the country's joining of the International Coffee Agreement, which has given Zimbabwe an assured fixed quota market annually of 65,000 bags (60kg size). The world coffee prices also received a boost due to the short-to-medium term effects of the Brazilian drought, which has created a higher demand for coffee, allowing small producers to benefit as from 1984. In addition, Zimbabwe's quota is set to increase by 10% annually until it reaches 400,000 bags. Without this quota, the country would find it almost impossible to export its coffee competitively; even on the spot market.

Sugar, the main irrigation export crop, has suffered exceptionally wide price fluctuations on the world market. This has mostly been due to the unfair competition from the subsidized beet sugar within the EEC countries, and the production of the corn-based sugar in the USA market.

The London Daily nominal prices, as shown on Table 5.11 show that there has been a steady decline in the price of sugar since 1980. The price fell from Sterling Pounds 291.52 per ton in 1980 to Sterling Pounds 70.00 per ton by July 1985; a fall of 76% of the 1980 price. Demand for sugar in the OECD countries and in the USA also suffered from the health-awareness campaigns and from competition with the industries producing sugar-free artificial sweeteners.

TABLE 5.11

LONDON DAILY PRICE OF SUGAR, 1980-1985

(ANNUAL AVERAGE PER TON)

YEAR	PRICE (STERLING) (LONDON)	DOMESTIC PRICES (STERLING EQUIVALENT) (ZIMBABWE)
1980	291.52	191
1981	202.21	182
1982	118.92	112
1983	140.04	145
1984	103.56	93
1985 July	70.00	45

Source: C. Czarnikow Ltd (1985) Personal Communications
'Domestic Prices' are calculated from field data.

The Zimbabwean Sugar Industry owed its survival to the sugar quota market, especially between 1982 and 1985. Joining the International Sugar Agreement has enabled the country to sell 260,000 tons; approximately the total current annual export. In addition to this quota, the Lome Convention allows Zimbabwe to sell 25,000 tons of cane sugar annually into the UK market. The quota market affords the country much higher prices than the prices realised on the world market or the spot market.

Within the southern African regional market, while exports to South Africa are affected by political considerations, Botswana buys 30,000 tons under contract, and in recent years barter trade with Mozambique has allowed Zimbabwe to export sugar in exchange for fish and cashewnuts.

The fortunes for the tea industry have equally been depressed. The high domestic production costs have eaten into the industry's productivity, at a time when domestic consumption was falling, and the government refusing to support the industry. On the world market, the carry-over stock of 55,300 tons in 1983 ensured that the price of tea was kept low. The situation improved slightly in the 1984/85 period when India, a major tea producer reduced its exports in order to satisfy the domestic market.

The poor world market prices for the crops discussed above, have partly been responsible for the country's acute foreign exchange shortage.

Net Foreign Exchange Earned

The net or surplus foreign exchange earned by irrigation, after subtracting all foreign exchange used for the importation of irrigation inputs, represents the true benefit of irrigation agriculture to the whole economy. The following formula has been employed in calculating the 'net' foreign exchange earned:

$$N^f = \leq Fg - (\leq (\leq 1^r c + 1f + 1m + 1o))^{t\,(1+r)}$$

where

N^f	= Net Foreign Exchange Earned
$\leq Fg$	= Gross Foreign Exchange Earned
$1^r c$	= Imported capital and interest charges on the capital
1f	= The cost of Imported Fertilizers
1m	= The cost of imported machinery
1o	= The cost covering all other inputs e.g. spare parts, fuel, insecticides and expertise
1+r	= The discount factor over time

Figures on Table 5.12 are used in the calculation of 'net' figures. The tabulated figures are all estimates arrived at very roughly, first, by calculating the percentage of the general gross import bill, that is due to irrigation. After estimating the dollar equivalent of irrigation's share, due consideration is taken of the fact that commercial irrigation sector is double cropping and therefore uses twice as many inputs as any other cropping system in the country. In the case of imported capital, the estimation takes into account the fact that, on current evidence, most dams constructed, have been constructed using 4/5 foreign capital and 1/5 government resources.

TABLE 5.12

USE OF FOREIGN EXCHANGE RESOURCES BY THE COMMERCIAL IRRIGATION SECTOR (1978 / 1983) ($'000)

YEAR	IMPORTED AGRICULTURAL MACHINERY (GENERAL)	IMPORTED MACHINERY IRRIGATION (40%SHARE)	INSECTICIDE IMPORTS (GENERAL)	INSECTICIDE IMPORTS IRRIGATION (50%SHARE)	FERTILIZER IMPORTS (GENERAL)	FERTILIZER IMPORTS IRRIGATION (45%SHARE)	FUEL IMPORTS IN THE ECONOMY (GENERAL)	FUEL IMPORTS FOR IRRIGATION SECTOR (30%SHARE)	FOREIGN CAPITAL AND INTEREST CHARGES FOR DAM CONSTRUCTION	TOTAL
1978	5 859	2 344	12 045	6 023	14 747	6 636	5 827	1 748	28 667	45 418
1979	8 818	3 272	13 158	6 579	23 939	10 773	8 441	2 532	29 000	52 156
1980	17 355	6 942	15 894	7 947	29 578	13 310	9 435	2 831	58 600	89 630
1981	18 685	7 474	18 486	9 243	45 000	20 250	15 916	4 774	68 000	109 742
1982	18 108	7 243	18 064	9 032	48 000	21 600	12 025	3 608	62 000	103 474
1983	28 036	11 214	12 391	6 196	19 374	8 880	11 109	3 333	74 100	103 723

NOTES

1 All figures for irrigation above are based on rough estimates of the share of use of foreign exchange by irrigation

2 The higher figures for the capital cost borrowed for dams reflects the rise in interest charges, and the progressively worsening position of the Zimbabwean Dollar against major currencies.

3. The foreign exchange expenditure items, are the major ones, and do not include many minor ones such as the cost of wheat inputs, imports of bags, electricity, expatriate labour etc. Foreign remittances of profit is one major item of foreign currency expenditure that is not included above because of lack of data.

Source: Derived from Assessment of field data

Using the equation $N^f = \sum Fg - (\sum (1^r c + 1f + 1m + 1o)^{t(1+r)}$ the calculation of N^f, can be arrived at for all the years involved by first calculating the $\sum$ Fg side of the equation using information on Table 5.10. Data for the right side of the equation, (the summation of what is in brackets) is derived from Table 5.12, which are then subtracted for all the years from $\sum$ Fg. The result of this calculation is Table 5.13. The lo element of the streams of 'other imports' has not been calculated because of the absence of basic data that would have made estimation possible.

On the basis of the above calculations it would appear that commercial irrigation is a net foreign exchange earner. Clearly, this conclusion has been reached at using very crude statistical figures and the omission of very important items of imports that use a lot of foreign currency. It can be argued therefore that the inclusion of these could have the effect of reducing significantly the margin of net foreign exchange returns, and in some cases it would be possible to record negative returns. If the 'net' returns on Table 5.13 were calculated in real 1979 prices, the net returns over the five years would be much less. Although this is not done here, the reason why that outcome is possible is mostly to do with the fall of the value of the Zimbabwean dollar by almost 80% of the 1980 value, the increase in the rate of inflation and the presence of other uneconomic factors in the economy, that have the effect of affecting the relative values of commodities.

TABLE 5.13

NET FOREIGN EXCHANGE EARNING - COMMERCIAL IRRIGATION ($'000)

YEAR	GROSS FOREIGN EXCHANGE EARNED	TOTAL USE OF FOREIGN EXCHANGE	NET FOREX SURPLUS/ DEFICIT(-)
1979	63,100	52,156	10,944
1980	94,300	89,630	4,670
1981	117,300	109,742	7 558
1982	111,200	103,474	7,726
1983	130,300	103,723	26,577

Source:Derived from Assessment of field data

Internal Linkages with the Domestic Economy and the Fostering of rural Development

In cost benefit analysis terms, and with reference to Fig. 5.1, the linkage effects of public and private investment in commercial irrigation represent the projects' impact beyond those immediate to the schemes. An analysis of the linkage effects inevitably introduces a high degree of subjectivity in the analysis, because of the nature of the streams of benefits that result. As it is often impracticable to quantify these effects, the adoption of a descriptive analysis in this study is considered sufficient.

Since sugar cane, tea, coffee, cotton and tobacco are largely exported in raw form, the country therefore not only loses the value added due to processing but also the opportunity of setting up agro-based industries and the jobs that could result from some form of beneficiation. These benefits are realized 'off-shore' in the importing countries. Also lost are the benefits associated with product diversification, as well as the preclusion of the emergence of a crop processing technology in the long term.

Although this study has not analysed this problem fully, preliminary investigations have shown that it is possible that commercial irrigation has exacerbated poverty and income differentials by attracting able-bodied men to work on the schemes. This has led to the reduction in domestic food production among the peasants concerned, which cannot adequately be compensated by the low minimum wages. Since the workers and their families cannot rely totally on the wage paid, the decline in food production has resulted in widespread poverty among the workers, and malnutrition among their children. Certainly further research work is called for, to verify these assertions.

At the farm level, the creation of surplus savings for re-investment has clearly been made more difficult by the low rates of individual profitability and the high rates of indebtedness among the farmers. Expansion of the sector, clearly has to continue to rely heavily on the continued flow of state subsidies, as has been the case so far. The relatively reasonable profit margins realised by the few large agribusinesses such as the Anglo American are eaten into by the need to remit some of the profit in the form of dividends to external shareholders as a matter of corporate obligation. This clearly means that the reinvestment capacity of irrigation must remain highly proscribed. The dependence by the sector as a whole, on costly imported inputs, has not been helpful.

Only to a limited extent has irrigation encouraged the emergence of manufacturing industries producing sprinkler equipment, small tools, pipes and ploughs. While this is certainly a positive development, the benefit from it is reduced by the fact that the inputs produced have a very high import content. Besides, considerations of economies of scale in terms of marketing, and with respect to capital and available skills, would require the growth of the sector to more than double its present size, before an economic manufacturing base can be developed to service it.

The realization of regional benefits arising from the location of most of these schemes in the dry and remote parts of the south-eastern Lowveld, has been precluded by the fact that these schemes have largely remained isolated "islands" of growth in vast areas of relative backwardness. From a regional economic development planning point of view, the "enclave development" nature of the schemes, means that they form neither a part of the overall regional development strategy nor do they exhibit any sensitivity to neighbourhood problems. For example, while the peasantry sector surrounding the Triangle and Hippo Valley schemes was seriously hit by the 1982-1984 droughts and famine, the two schemes continued to produce cash crops, and no attempt was made to put a few hectares of irrigated land aside for food production.

From the degree of intensity of use of both capital and technology, the schemes have clearly had little or no direct link with the activities of the neighbourhood environment. The resulting absence of technology transfer to the communal areas means that future expansion of private irrigation along current lines will clearly continue to reproduce these negative relations. In the absence of a coherent and conscious effort by both the government and the private investor, to change the current status, there is no basis for optimism that irrigation agriculture could produce 'trickle-down' effects into the whole economy other than those discussed above.

CHAPTER 6

PUBLIC INVESTMENT IN SMALL SCALE IRRIGATION AGRICULTURE

INTRODUCTION

In the previous Chapter, an attempt has been made to assess the extent to which both public and private sector investment in bulk water supply capacity and commercial irrigation agriculture have fulfilled the policy objective of output maximization or economic growth. In the peasant sector, however, the Government's objectives are different, namely to influence the distribution of income, to reduce regional growth disparities, and generally to raise the standard of living of the peasants. The aim is to achieve these objectives through massive investments in small scale irrigation agriculture.

An attempt is made in this Chapter to demonstrate that small scale irrigation agriculture has failed to act as an appropriate vehicle for achieving the desired benefits associated with the Government's equity objectives. It is further argued that where public sector investment in small scale irrigation schemes has achieved some of the set objectives, this has only been done at very high cost involving massive subsidies, and at the expense of other potentially more rewarding investments elsewhere in the economy. The extent to which the full exploitation of the present dryland agriculture can be seen as a viable alternative to irrigation agriculture is then examined and further study work recommended.

In Zimbabwe, particularly since 1980, the justification for all forms of public intervention in the peasantry sector has been based on the political requirement to redress those developmental imbalances associated with the racial policies of past regimes (Chapter 3). Of crucial importance, public intervention has had to address the relationship between limited land resources and rapid population growth. The need to intervene, on behalf of the peasants has got to be seen in the context of the relative lack of industrial growth, and the absence of alternative employment opportunities in the economy, and the inevitable pressure on the rural resource base. A pressure no doubt, greatly exacerbated by the past racialist land policies and the inability of the present government to undo them. Above all, this intervention has been seen as a practical attempt by the government to solve problems of hunger, poverty and deprivation, in the communal areas.

Being seen to be addressing the issue of distributive equity became the key preoccupation of politicians. The aim was to ensure that the benefits from growth were equitably distributed in such a way that the pace of growth would not be stifled. In reality, this has meant that the modern agricultural sector has remained largely untouched and the equity considerations have been confined to the policies developed for the peasant sector. In the long term, the aim is to upgrade rural peasantry incomes and to reduce income disparities between that sector and the modern sector of the economy. There was thus little attempt to redistribute incomes directly; the assumption was made that policy initiatives could promote faster rates of real income growth in the peasant sector. Thus in time it was hoped that differential growth rates would achieve the redistributive objectives of the government. The small scale irrigation strategy was conceived within this view.

The seeds of failure were inherent within this approach to reducing income disparities. As a strategy, it could only achieve the equity objectives over a considerable period of time. Moreover, the perceived need to maintain growth in the 'market' economy meant that in reality a high proportion of available investment resources had to be allocated to the market sector. Perhaps the most damning aspect of this strategy was the fact that it did not question nor did it seek to change the historically established patterns of wealth. If anything, by seeking to redress inequalities solely through intervention in the peasant sector, the strategy fossilized the inequalities that existed prior to 1980.

On a wider contextual level, the Government of Zimbabwe's direct intervention in small scale irrigation schemes can be seen as a reaction to the observed deficiencies of the economic growth efficiency model. It has largely come to be realised in development economics literature that neither the equity with which benefits from production in the modern economy are allocated between people over space and time, nor the spatial allocation of any associated growth and associated developments are matters of concern in the efficiency model. But these closely related issues are rarely matters of indifference to the 'socialist' government, which is concerned both with the proportion of income, employment and the general rise in the standard of living accruing to the peasantry sector and other low paid groups.

Theoretically, any discussion of distributive equity is plagued by the very different definitions which have been employed within the development economics literature (Rees 1985). Some analysts would argue that equity means equality with equal shares for all, while to others it means allocating shares according to need. Further, there are those who regard it as equitable to give the greatest share to those who have made the greatest contribution, giving more rewards to the industrious, those willing to take risks and those with greater skills or knowledge. A further group of 'market' oriented economists argues that it is equitable to allocate shares according to people's willingness to pay for them; that is, following Young (1980) 'to each according to the contribution of resources in his possession'. This put simply means that those possessing large initial resource endowments will receive proportionately large shares of the productive system's output. In the developing countries, very few people would openly argue that a system was equitable if it served to make the rich still richer, especially when it is considered that in most cases resource endowments for the rich few, are a result of historic legacy.

In Zimbabwe and in most Third World countries, the variant of equity that is dominant, at least at the policy formulation level, is that which seeks to give rewards "to each according to need". There is also the problem of balancing "growth" versus "consumption" objectives, lack of investment versus the high propensity to consume of poor groups. This notion of rewarding members of the society on the basis of some set standard of what constitutes 'need' has been buttressed by the proliferation of the 'Basic Needs' literature in current development discussions. The synopsis of the argument behind this notion of equity, is that society must, as a matter of right, make sure that everyone of its members has received the three 'basics', namely: adequate shelter, food and adequate access to health and education facilities before any development can be said to have taken place. In fact some have gone as far as recognizing the fulfillment of this notion of equity as the prerequisite requirement for any 'just' society. It follows therefore that greater expenditure on health and education is often seen as fulfilling this notion of equity. It is, however, clear that the proponents of this form of equity have not been able to come up with any low cost mechanisms for its achievement. Existing mechanisms such as the social security systems set up in some developed countries, would impose a tremendous burden on the LDCs' economies. Indeed it would be impossible to operate in poor countries where, those in "need" are in the majority (above 70% of the population); where the revenue generation base is small and overtaxed, and where overall development is heavily dependent on foreign aid.

All the above equity concepts are concerned with outcomes; with who gets what from a productive system. However, over the past couple of years, the thinking in Zimbabwe has shifted in favour of an alternative notion which stresses the process involved rather than the end-results. The idea being emphasized is that there should be equality of opportunity or equality of access to opportunities and of participation in the development process. The notion clearly does not address the question of prior availability of 'opportunities', especially when it is recognized that in most Third World countries, 'opportunities' in whatever form are non existent and cannot be taken as given.

Notwithstanding this fact, it is true in many respects that the growth with equity policy is regarded by the Government of Zimbabwe as one which achieves equity by allowing, for example, the peasants to participate in income generating projects like the small scale irrigation schemes. What the policy makers often forget in the pursuit of this form of equity is that the 'peasants' are not necessarily a homogenous class of people with 'equalized' material base and needs.

Ideally the projects in which peasants participate should be so viable that the beneficiary peasants do not require further government handouts or subsidies. In the same vein, it is theoretically supportable for the government to incur the 'one-off' expenditure essential for the creation of economic 'take-off' conditions. The fact that actual experience has failed to live up to the desired outcomes, as enunciated in the 'Growth with Equity' policy strategy, is the subject of discussion in this chapter. It must be pointed out that the process of experimenting with this notion of equity is not a costless exercise.

The use of such vastly different equity concepts in part reflects genuine ideological differences between analysts and helps to explain the highly polarized debate over what should constitute the most equitable social system. The arguments over equity are further complicated by the fact that it is by no means unusual for the governments and individual citizens to appeal simultaneously to quite different notions of equity when it is in their interest to do so (Rees 1985). While the Government of Zimbabwe accepts the notion of equity based on the active participation of the peasants in the process of their development, the peasants frequently view this notion as highly inequitable since the process of their development does not in anyway challenge the historical basis of the existing inequality, nor does the government have any plans, or tangible programmes for rectifying the unequal distribution of the resource base itself. The failure of many equity-oriented and public supported schemes can be traced to this issue of unequal resource base which makes public subsidies almost inevitable.

Following Rees (1985) it is highly possible that equity considerations can be used as a means of legitimizing decisions made on quite different grounds, or to justify demands and actions that are in reality motivated by self interest or political considerations that have nothing to do with equity. If there is so much disagreement as to what constitutes 'equity' at the theoretical level, the attempt to move beyond the rhetoric, and try to implement the various notions of equity has been bedeviled by numerous problems, some of them, arising from the definition problems.

Equity and Public Investment in Small Scale Irrigation Agriculture

There is a lot of validity in the allegation that public sector investment in small scale irrigation agriculture, mostly through the use of subsidies, is a form of a 'bribe' designed to persuade the landless peasants and those living on the overcrowded communal lands to desist from agitating for an 'equitable' redistribution of land.

The civil war that culminated with political independence in 1980 was fought under the banner of 'more land for the peasants'; and the socialist principles and policies of the ruling party made that outcome all the more plausible. Restoration of 'stolen lands' to their 'rightful' owners was then regarded as the highest form of 'equity'. It was only natural therefore that most peasants expected and believed that they were to repossess all the land that was under private commercial agriculture.

This did not happen. Instead, the pragmatic policies of the 'new' government shifted away from the original plan of massive land handouts, to a more controlled and limited land resettlement programme. Under this programme, returning refugees from neighbouring states were given first resettlement preference, and then peasants from a few highly overcrowded communal areas. The 1979 Lancaster House

Accords and the resultant Independence Constitution, had made the acquisition of land by the Government both very expensive and restricted. Naturally, only a small number of peasants could be resettled. Even the planned resettlement figure for 1983 was only 20,723 families out of a government target of 162,000 families (The Three Year Transitional Development Plan, 1981); that is only 8 percent of the planned three year target as Table 6.1 shows. However a World Bank review at the end of 1983 indicated that even

TABLE 6.1

EQUITY THROUGH LAND REDISTRIBUTION NUMBER OF FAMILIES SETTLED

THREE YEAR TARGET 1980/81 - 1982/83	YEAR 1 ACTUAL 1980/81	YEAR 2 ACTUAL 1981/82	YEAR 3 (ESTIMATE) 1982/83
162,000	480	7,497	20,723

Source: Derived from the 'World Bank, Agricultural Sector Study, 1983'.

this low figure was not achieved and only 18,000 families had actually been settled. If availability of land proved difficult, the cost of resettlement was excessive. For example $60 million of British aid was spent in resettling only 18,000 refugee families ($3,400 per family, 1982 prices). An estimation by the World Bank in 1983, showed that to settle a further 144,000 families, a total of $640 million was required. It became clear that the economy could not finance such a program:

> "......... funding only the set up costs of a program of this scale entirely from domestic resources would consume funds equivalent to more than 70% of total government revenue over the years........ and would require resources amounting to eight and half times total government development expenditure......... and these figures make no allowance for added recurrent costs".
>
> (The World Bank, Agriculture Sector Study 1983).

A further factor that contributed to the abandonment of land redistribution as a strategy for achieving equity, was the belief among politicians that large scale land redistribution could threaten the country's agricultural viability, and in turn the economy. This was an open acknowledgement that the commercial agricultural sub-sector was the backbone of this agriculturally based economy.

Thus the post-independence surge of illegal squatting on commercial lands, resulted in the arrest of the squatters. But, politically this reaction could only be a temporary measure; it was vital that alternative strategies were worked out. Small scale irrigation schemes seemed to offer such a solution. In other words, what could not be solved by the extensive redistribution of land, was to be solved by the intensive settlement of peasants on small irrigated plots scattered throughout the communal areas, on small pockets of irrigable soils. However the key question that has not been answered is whether irrigation is the correct or appropriate vehicle for delivering distributive equity.

Why Irrigation?

The question that has to be asked is why the government decided to rely on investments in irrigation agriculture as the vehicle for the achievement of equity. Irrigation agriculture, as a system of crop production, at least in its ideal form, possesses many attractive qualities compared to any other form of cropping system:

1. It allows for very high yields to be obtained from a small piece of land;

2. Land use is intensive and agriculture can be carried out throughout the year;

3. Crop diversification is made more possible in areas where one crop per growing season is the norm;

4. It has a very high potential population carrying capacity;

5. The incomes of participating farmers are potentially

high;

6. Because of the year round cultivation possibilities, full time and seasonal employment opportunities are expected to be good;

7. Irrigation allows climatically marginal areas with good soils to be brought under cultivation and crop production.

However, this attractiveness of irrigation agriculture belies many practical problems which makes it less suitable as an appropriate mechanism for the achievement of equity, as this Chapter seeks to demonstrate.

For the Zimbabwean Government, it is irrigation agriculture in its 'ideal' rather than actual form that seems to have had the greatest influence on the policy process. Despite glaring evidence of the failure of the irrigation-based Green Revolution (Amin 1979) to afford 'equity' there has been no dampening of the government's enthusiasm for irrigation. To the politicians, irrigation seems to offer answers to two policy problems at once. That is, it addresses problems of income redistribution through development; and it seems to offer solutions, albeit in the short term, to the explosive problem of landlessness without the need to remove any more land from the commercial sector. In the process, the politicians earn their legitimacy, and their names can be associated with the commissioning of a number of dam construction works or the clearance of land and canal building. They are thus, prepared to invest in small scale irrigation agriculture on the basis of an idealized notion of what it can achieve.

However, the findings of this study show that 'the reality' deviates from the 'ideal' by a very wide margin for a number of reasons. If investment in small scale irrigation agriculture is to become the vehicle for achieving distributive equity, the question has to be asked as to whether it is the most cost effective crop husbandry system for achieving the policy objectives of equity.

<u>The Investment Cost Subsidies</u>

The Government has sought to implement its distributive equity objectives through massive use of subsidies on the development of the irrigation schemes. Unlike the commercial irrigation sector, where some, albeit inadequate, attempts have been made to recover the historic capital costs, no such attempt is made in the case of small scale schemes. All capital costs relating to dam construction, canal construction, pumping stations and infield development, are paid for in full by the State.

The State has devised an accounting procedure which allows it to carry out all investments on dams in rural areas without the need for consideration for economy. Under the 'normal development vote' all investments of a general nature including conservation works, territorial canal construction and so forth are carried out in the communal areas at no cost to the recipients. The policy makers therefore end up justifying and regarding as the <u>only</u> public subsidy, the 75% subsidies paid for the actual water used by the farmers, with the farmers paying only 25%. This false accounting procedure has enabled the State to treat the overall subsidy as insignificant.

Before 1980, the government could afford to write off the capital costs because on average the small-size dams (capacity >5 million cubic metres) used to cost $50,000 to construct. Today the capital cost of the dams of the same size is much higher, both in real and nominal terms as Table 6.2 shows.

Clearly, it will not always be possible in future to justify the dismissal of these costs as 'obligatory normal' development expenses, and to allow for non-repayment. The fact that these cost figures exclude subsequent expenditure on infield works, land preparation and clearance and, where applicable the cost of pumping stations, enables the schemes to continue to be presented as 'low cost'. This approach also allows the Department of Agriculture and Extension Services to press for further investments in irrigation;

TABLE 6.2

CAPITAL COST CHANGES FOR SMALL DAMS

DAM	1980/81 ESTIMATES	ACTUAL MONEY PAID IN 1984/85	1984/85 COST AT 1980/81 PRICES
	$'000	$'000	$'000
Nyanyadzi Nenhowe	422	8,500	5,780
Mondi Mataga	3 750	7,900	5,372
Silverstroom	4,000	16,400	11,152
Tshovane	310	5,500	3,740
Mlezu	285	1,025	697
Shangani-Nkayi	3 650	12,200	8,296

each time making sure that the mobilization of resources for all categories of capital costs are presented singly in a fragmented manner. Thus the overall cost implications for each scheme are always lost to the decision makers. Besides the presence of a dam has always been used successfully to establish a prima facie case for subsequent investment in canals, infield works and pumping stations.

TABLE 6.3

CAPITAL COST ESCALATION RATIO

YEAR (SELECTED)	1970	1978	1979	1980	1981	1982	1983	1984	1985
Index	100	267	319	385	519	758	1190	1992	3347
Annual % Increase		13	20	21	34	46	57	68	112

Source:Ministry of Lands, Agriculture and Resettlement, 1984

According to Table 6.3, while the government continues to operate the partial cost accounting system that has the effect of misdirecting scarce investment resource towards inviable projects, the construction costs have continued to rise many fold since 1970. Given the inflationary trends in the economy and the current poor growth prospects, these costs will continue to rise, and if this open-ended subsidy policy continues, (which is likely), the distortions arising from this could have very severe effects on other sectors of the economy.

In addition to meeting the full cost of constructing the dams, the state bears the total cost of reticulating the water through expensive lined canals to the field edge. In 1984 Agritex had estimated this cost as falling between $1500 and $2500 per hectare, depending on the design of the scheme. However, evidence from the field supported by the World Bank findings (World Bank Study 1983) casts doubts on such figures, and gives alternative costings of $10,000 per hectare for gravity fed schemes and over $15,000 for those schemes involving long distance supply transmission canals and requiring booster pumping, as is the case at the Middle Sabi and Mtambara.

In addition, the state is also responsible for the operation and maintenance costs of each and every scheme. However, the peasants are expected to pay a token fee towards meeting this cost element (Table 6.4) although the State still meets 75% of the cost. The share of the cost paid by the peasants was fixed arbitrarily.

The charges reflect the government's desire to leave as much income as possible in the hands of the farmers, and have little to do with the need to make sure that the schemes are self financing. In 1983 alone the State spent $11,500,000 on operation and maintenance of all the schemes. For gravity-fed systems (the least cost schemes) this came to just over $500 per ha inclusive of a few supportive services. For the schemes served by kilometres of canals fed by booster pumps the cost outlay was over $800 per ha. In sand abstraction schemes, where all water has to be pumped from deep wells in the river beds, the running cost was over $900 per ha, at 1983 prices. Why did the State not ask the farmers to meet at least the full cost of operating and maintaining the schemes?

TABLE 6.4

THE (20 - 25%) OPERATION AND MAINTENANCE CHARGE MET BY FARMERS. ($/HA).

	DOUBLE CROPPING	SUMMER CROP	WINTER CROP
(a)	145	90	55
(b)	72	45	30
(c)	30	30	30

Note:

The above levels of charges apply as follows:-

(a) Where the water supply to the scheme is assured
(b) Where sporadic water shortages are experienced
(c) On sand abstraction schemes: summer only or winter only schemes.

The answer lies partly in the understanding of government's desire to make the schemes work, at any cost, and partly in the not-so-high incomes realised by the peasants.

According to Agritex's own estimates, for example, most irrigators were only earning annually between $1 200 and $1500 per hectare gross, even with the subsidies. If operation and maintenance charges were to be levied on the basis of the amount of water used, the average rate charge would be $600 per ha per year, assuming a water requirement of 12,000 cubic metres/ha/year. This would leave the farmer with between $600 and $800 per hectare per year, before deductions for ploughing costs and other small services and the cost of seeds. On the basis of these figures, the net income per family is so small that in order to avoid the erosion of the income received by each family, the government has had to subsidize the running costs upwards of 75%.

If the peasants on the schemes receive all the above state subsidies, how much subsidy outlay is received by the peasants practicing rainfed agriculture, the alternative to irrigation? Very little. A comparison of subsidy provision to peasants on the schemes and those practicing dryland farming shows that very few resources are allocated to subsistence rainfed agriculture, as shown on Table 6.5.

TABLE 6.5

PUBLIC SUBSIDY OUTLAYS, A COMPARISON BETWEEN IRRIGATION AND RAINFED PEASANT AGRICULTURE

ACTIVITY	IRRIGATION (%)	RAINFED (%)
1. Dam Construction	100	60
2. Canal Construction	100	Nil
3. Land Clearance	100	Nil
4. Pumping Station	100	Nil
5. Infield Development	100	Nil
6. Extension Services	65	35
7. Other Supportive Services	100	Nil
8. Running Costs	75	Nil
9. Input Costs	60	20

Source:Derived from Assessment of field data

According to Stoneman (1978), in 1978 the government was subsidizing dryland peasants at between $0.60 and $1 per family. Since then the real term level of subsidization has not changed. Rainfed agriculture is under supported, and remains under capitalized a feature which definitely prevents the potential of this sector from being realised. Because of the large number of families involved in dryland agriculture as compared to irrigation, the total state subsidy to dryland farming could constitute a huge outlay of resources, and this could be the reason for lack of support.

Clearly, in terms of investment, no equitable share of resources has taken place, on a per hectare or family basis and by implication, public investment in irrigation serves to widen the income gap among the peasantry class. Equality of opportunity or of access to opportunities for all peasants, does not seem to exist; and is surely not being promoted by irrigation agriculture.

Although statistical data are not available it is common knowledge in Zimbabwe, as observed during field work, that the beneficiaries of the irrigation subsidies are often the Village Development Committee Leaders, or district councilors. An extension officer interviewed, argued that it was often necessary to have community leaders on all schemes as they were more amenable to government policies, and that these leaders would persuade other peasants into the schemes, by example. The belief seems to have gained ground in government circles, that the success and/or failure of any government sponsored project will depend on the enthusiastic support or lack of it, of community leaders and prominent people in the villages. The fact that the proliferation of obviously well-to-do people in schemes designed to promote equity, could hinder the realization of the objective, as the well-to-do become even wealthier, becomes secondary. The 'success' of the project for field officers in terms of visible activities is more important than the fulfillment of the policy objectives.

At the schemes themselves, the appearances of wealth and betterment arising from these subsidies has on the one hand increased jealousies between the peasants on the schemes and those on dryland agriculture. On the other hand, the fact that the peasants on the schemes have continued to hold on to their dryland crop and grazing rights in defiance of government laws and regulations, has increased land rights tensions among the peasants, with the dryland peasants voicing their concern at what they rightly see as 'double' gains by the peasants on the schemes. The open ended use of subsidy in irrigation has denied the cliental peasants the opportunity to fully appreciate the true costs associated with irrigation agriculture. This fact alone removes the element of participation by peasants as purported by the 'Growth with Equity' strategy in resource mobilization for the development process, and creates an internal dependency syndrome with the peasants entirely dependent on the state. All irrigation farmers entering new expensive schemes have come to expect the same package of subsidies, and cannot accept future policy deviations by the government from the precedence that has been set.

From the interviews conducted with both the peasants and government officials during field work, it became evident that small scale irrigation schemes as operated in Zimbabwe are very costly compared to rainfed agriculture, and tend to worsen rural income inequality and to exacerbate regional development imbalances. For example Table 6.6 shows that in terms of state investment, more development has taken place in Manicaland and Matebeleland South; then Masvingo and Midlands. The three provinces of Mashonaland are not important in terms of small scale irrigation development because Mashonaland has very high rainfall and is the area most covered by private commercial farms (Chapter 3). Although there are a lot of schemes both gazetted and developed for dry Matebeleland South than for Masvingo and Midlands provinces respectively, most of Matebeleland South, Midlands and Masvingo schemes are either abandoned totally every drought year, or are only occupied during the rain season when the dams have some water. Only Manicaland has benefited significantly from State intervention in irrigation agriculture.

TABLE 6.6

DISTRIBUTION OF IRRIGATION OPPORTUNITIES BY PROVINCES

PROVINCE	AREA IN HA.		PROPOSED EXPANSION (HA)	NO OF PLOT HOLDERS	AVERAGE ALLOCATION PER FAMILY (HA)
	GAZETTED	DEV.			
Manicaland	9,458	2,189	1,300	2,149	1.02
Matebeleland(S)	3,625	1,161	NIL	1,173	0.99
Mashonaland(W)	NIL	5	NIL	16	0.30
+Mashonaland Central	300	48	NIL	60	0.8
Mashonaland East	NIL	NIL	NIL	NIL	NIL
Matebeleland North	622	79	7	220	0.36
Masvingo	1,005	418	185	1,062	0.39
Midlands	3,136	369	100	1,205	0.31
TOTAL	18,146	4,269	1,592	5,885	0.73

Note: + Abandoned schemes.

Source:Ministry of Lands, Agriculture and Resettlement, 1984

It has the highest number of all-season hectares so far developed, and proposed for expansion. While the average hectare allocated - per family for the whole country is 0,73 hectares Manicaland alone has an allocation of over 1 hectare per family. Five out of eight provinces have allocations below 0.73 ha. Recently, concerns have been expressed in parliament over the fact that Masvingo Province has more irrigation dams than any other province, and some MPs have openly campaigned that no new dams should be built in Masvingo until other provinces have had reasonable water supply.

Why has the state chosen to pursue a regionally unbalanced investment strategy in irrigation? Government officials interviewed during the field work explained Manicaland's apparent favoured position from this perspective: Since Manicaland Province is highly mountainous and has most of the country's forest reserves, the land area available for peasantry agriculture is very small including the steep mountain slopes and river banks, and this has made Manicaland's major rivers like the Sabi River the most silted in the country. It was inevitable therefore that after 1980 Manicaland experienced the first wave of illegal squatting on commercial farms by thousands of land hungry peasants. In 1982 for example over 15,000 families illegally squatted on both commercial and forestry land and had to be forcibly evicted.

While illegal squatting has been Manicaland Province peasants' reaction to problems associated with unequal distribution of land, the use of irrigation to redress this was, to say the least, not appropriate. Hindsight shows that despite massive investments in irrigation, illegal squatting has not gone away, and has, if anything, tended to grow since 1980 at an alarming rate. As recent as 1986 the Ministry responsible for agriculture has been fighting to curb the spread of the squatting 'disease' through the use of force. Today, the only factor restraining squatting is not the irrigation schemes but an array of draconian laws of eviction and prosecution, which in themselves are a clear admission by the government that it has failed to find a solution.

The high costs involved in irrigation coupled with the large and rising number of landless peasant families, have made it inevitable that objectives of viability and income equity had to be sacrificed in the bid to find them land. Hence the allocation of land on the basis of the national average of 0.73 ha per family nationwide, has no basis in viability and/or in distributive equity. Perhaps the greatest irony of the irrigation strategy is that it has not only failed to achieve income equity, and equity of opportunities among all peasants, but that by failing to achieve physical land redistribution goals (as only few families could be settled (5885 by 1985) (Table 6.6), the strategy has created a new long-term problem. The high concentration of families (3 families per hectare) on the irrigation schemes, not only means an erosion of the income as family size increases, but also sets in train the need for another round of costly resettlement of the residual population. It is unlikely that there will be more land for redistribution in future.

It can therefore be argued that the policy objective of releasing land pressure by settling large numbers of families on irrigation schemes is contradictory to the pursuit of equity. Clearly the policies governing irrigation agriculture development show all the hallmarks of a 'reactive' policy strategy that manifests itself in the now-all-too-familiar 'crisis planning' that typifies many Third World planning exercises. The policy strategy is not a well thought out investment framework imbued with the capacity to 'direct' investment in irrigation so as to achieve maximum equity and the self-perpetuation of this. For example, while responding to the symptoms of the squatter problem, the investment programmes are not designed to realise both short and long term objectives. Interviews with peasants show that today two in five of the peasants settled on each scheme abandon it every year.

One single event that has had a great contribution to the pursuit of irrigation agriculture is the 'one-in-five-years' drought event. The upsurge in the construction of so many small dams (Table 6.2) as upstream investments by government has been a reaction to the drought event as well as to other factors. The dam construction solution has meant that the search for alternative solutions to beat famine and starvation in drought prone areas has largely been abandoned. The fact that most of these dams cannot store water enough to last one dry season, is often overlooked, and where cognisance is taken of this fact, it often serves as the reason for constructing even more small dams, in the belief that a 'saturated' provision increases the volume of water available for irrigation. In the meantime the belief has gained ground at the policy making level that irrigation offers unquestionable, solutions to present and future famine problems, as evident in the setting up of the Farm Irrigation Fund in (1985), as a vehicle for focusing attention on irrigation.

Past failures of the small scale irrigation policy have been blamed on the unacceptable racist leadership of the past rather than on the inherent weaknesses of the strategy and the apparent policy contradictions. If anything, the belief has been established that under the government of their choice, the peasants would turn 'failure into success'. While this may be true in certain circumstances, this simplistic notion has led policy makers to ignore such important factors as costs, marketing problems, and timely input availability, which invariably have a more direct effect on success or failure than political motivation.

Large quantities of human and capital resources continue to be poured into the 'irrigation void'. It clearly is relevant to ask who the real beneficiaries of this investment are? In order to answer this question it is necessary to examine the interests of various pressure groups in irrigation agriculture and the extent to which their own interests and preoccupations have been translated into the resultant irrigation investment policy of today.

<u>Interest Groups in Small Scale Irrigation Agriculture</u>

A look at the supportive structures for small scale irrigation schemes in Zimbabwe, will show that there is a large number of interest groups involved, each with different affinities and approaches to the schemes. These groups, outlined in Fig. 6.1 promote irrigation for both selfish and altruistic reasons that are consistent with their view of what constitutes the needs of the peasants. The intensity with which each of these interest groups support the irrigation sector materially and policywise, is far different to that accorded to rainfed agriculture.

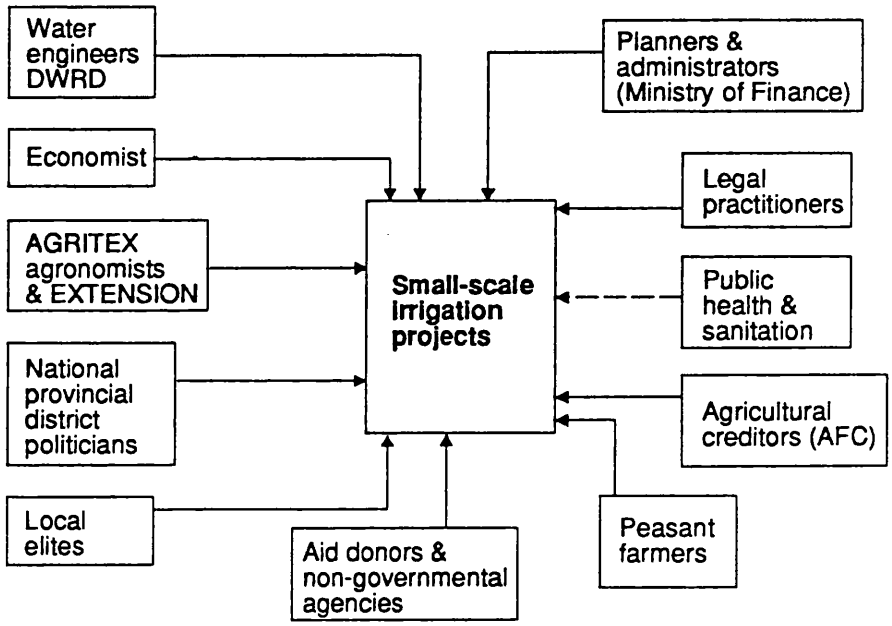
<u>The Agronomists and Agricultural Policy Makers</u>

The agronomists and agricultural extension officers from the Department of Agriculture Extension Services, support and promote public investment in small scale schemes more from the 'desert-shall-bloom' logic, than from what is possible within the limitations of resources. For example, interviewed agronomists expressed their strong belief that the solution to future food (crop) production problems in climatically marginal Natural Regions 4 and 5 (where incidentally most peasants live (Chapter 3)) can only be solved by massive irrigation intervention. Rainfed peasant agriculture is rejected wholesale (except in relation to livestock agriculture), as a meaningful alternative. Its role in crop agriculture is seen as a transition while the state is still engaged in upstream massive investments in numerous small dams needed for the implementation of a full scale peasantry agricultural transformation towards irrigation crop agriculture. The fact that the unreliability of rainfall in the same regions could mean that in some years irrigation dams might not fill, and thus affect the continuity of irrigation agriculture, is often ignored. Even recent events during the 1982-1984 drought, when virtually all the small irrigation dams were dry, have failed to influence attitudes.

Ignored too is the cost involved in changing most of the rainfed agricultural land into irrigation flatlands connected by networks of canals.

Fig. 6.1

THE INTEREST GROUPS IN SMALL-SCALE IRRIGATION



AFC Agricultural Finance Corporation
AGRITEX Department of Agricultural & Extension Services
DWRD Department of Water Resources Development

Source:Derived from Assessment of field data

While technologically that transformation is not impossible, it is doubtful whether resources needed to effect this, are available given the state of the economy (Chapter 3). It is even doubtful whether any attempt to achieve this irrigation transformation can be justified by the benefits that are expected to flow from this policy strategy. Clearly, the agriculturalists' preoccupation with output maximization often restricts their ability to see more broadly the issues involved. They seem to be unable to encompass not only the opportunity cost of the investment resources, but also the social consequences of what they are promoting, and of the uneven access to irrigation facilities.

What often makes the attainment of equity all the more difficult is the fact that agronomists tend to promote the growing of such crops as sugarcane (SE Lowveld) and rice (Tsholotsho in Matebeleland) which have high-water requirements and low tolerance for moisture stress. Plant breeding research aimed at producing drought-resistant rainfed crops is receiving less attention within the policy framework supporting irrigation advocacy, according to the Agritex officials interviewed. While the choice of irrigated crops is bad enough, the marketing of these crops often present major problems given the peripheral location of most of these schemes in relation to major markets. For nearly 70% of these schemes, the market is not less than 100 kilometres from the scheme, and often the greater part of the journey is through hazardous seasonal roads; resulting in costly delays and the deterioration of the product.

The cash basis of most of the crops grown under irrigation, means that ultimately irrigation agriculture does not address the objectives of food self-sufficiency within each locality, unlike rainfed agriculture which is totally subsistence oriented. The production of cash crops under irrigation involves the need for credit, and farmers are urged to borrow up to $600 per growing season from the Farm Irrigation Fund to pay for high water bills ($145.00) (Table 6.4) and for other inputs.

The Agricultural Finance Corporation which administers the Farm Irrigation Fund, in addition to providing credit facilities to farmers of every category, confirmed that of the peasant farmers indebted to the Corporation over 90 percent of them were those on the irrigation schemes. In fact the stringent rules governing the use of the Fund and the use of the stop order system (an arrangement that allows the bank direct access to the client's account for purpose of recovering debt, over a specified period of time), has had a negative effect. The great majority of the peasants on the schemes are now afraid to borrow from the Fund. Indeed in 1986 and 1987 not a single irrigator took out loans and the government has been involved in a major exercise to reformulate the rules and to try to interest the farmers in using the facility again. The peasants argue that the burden arising from interest payments on past debts has forced their operations to focus on debt repayment than on meaningful development. Indebtedness had created a dependency syndrome that was too difficult for farmers to break.

In the meantime, the politicians in collaboration with the agriculturalists, have decided to adopt a risk aversion strategy, by saturating the schemes with specialist personnel. This saturation is not directly linked to the extent to which the crop yields help to achieve equity. For example, the following is a typical manning level at the schemes:

1. A resident irrigation officer	)	
2. An irrigation assistant	)	This provision is
3. A foreman	)	for every 200
4. A handyman	)	irrigation farmers,
5. A water bailiff	)	compared to nothing
6. A fence ranger	)	for rainfed farmers.
7. A snail ranger	)	
8. A field orderly	)	

9. One agricultural extension worker for every 50 irrigation farmers compared to one for 1 000 rainfed peasant farmers.
10. One agricultural extension supervisor for every 300

farmers on the schemes compared to one per district for rainfed agriculture.

11. One community developer for every 600 irrigation farmers as compared to one per district for rainfed agriculture.
12. One cooperative assistant for every 600 irrigation farmers compared to two per district for rainfed agriculture.

This high level of bureaucratization of the production process, inevitably leads to most of the needed investment resources being diverted to cater for the needs of the bureaucracy itself, and very little going into actual production. According to field evidence the following costs are being incurred on behalf of the civil servants on the schemes: Three grades of staff houses are required per scheme.

(a) For field orderlies, a three bedroom house costing $24,000 each (1985 prices)
(b) For the irrigation assistants, extension supervisors, extension workers and cooperative assistants, a three bed-room house each costing $28 000 (1985 prices).
(c) For the irrigation officer, a house costing $35,000 (1985 prices) to be built, and for 76 schemes this comes to $2.7 million.
(d) Teachers' houses at $18 000 each for a minimum of seven teachers at every school at each scheme.

When other infrastructural services, such as roads, clinics, telephones, schools and tractors are added to the above, it is clear that very little money actually reaches the farmers. It must be added, however, that the farmer has no choice in the provision of the listed support services. The provision is a government-determined package and is implemented as a matter of course. The marginalization of the farmer in the decision making process is further worsened by the plethora of what sometimes appear to be draconian by-laws governing the farmer's choice of crops, fertilizers and other inputs, determining when a farmer can plant as well as his tenurial security, to name a few (Appendices 2 to 6). Clearly, the objective of achieving equity through the development process has become unattainable, in the light of many policy contradictions, on the one hand, and on the other, a nightmare for the peasants.

While relatively reasonable incomes at the schemes can be assured where there are markets and continuing high levels of subsidy like at the Nyanyadzi Scheme (Manicaland), the same support and saturation of technocratic help is not extended to the numerous rainfed agriculture farmers.

To the extent that this negates the very policy objective of achieving distributive equity the irrigation strategy as operated in Zimbabwe, has proven unsuitable.

The Engineering Bias

A further group with a strong interest in continued irrigation is the engineering profession. Zimbabwe has a very large number of private engineering and construction firms, and within Government there is the Department of Water Resources Development which is totally dominated by engineers. In addition, since 1980 many foreign civil engineering companies have come to work in the country. While the private and foreign construction companies thrive very well in the existing environment favouring the expansion of the irrigation sector generally, it is the Department of Water Resources Development that has had the greatest impact on the expansion as well as on the problems associated with small scale irrigation agriculture. The institutional arrangement is such that the Department of Water Resources is only responsible for the provision of dams and water to farmers up to the field edge, and the control and use of that water lies with the Department of Agriculture and Extension Services (Agritex).

Freed from the need for economy, the Department of Water Resources has pushed for capacity extension in terms of the provision of more water in response to increased acreage under irrigation, regardless of the costs involved. The fragmented institutional arrangement has created conditions whereby the search for alternative investment directions that could better achieve equity at lower costs, has been rendered almost impossible. The employment legitimacy of the water engineers lies in their being seen to be constructing many dams and water supply points, and there is no pressure upon them to adopt design options that reflect capital scarcity.

Nearly all the ten small to medium dams (6 of which are on Table 6.2) visited during field work had 'defective' designs either from the point of maximising the collection of water, or from the point of reducing both construction and recurrent costs. Since 1983, most of these dams, for example Mwenje, Tshovane and Mataga have been undergoing costly uprating and dredging works.

Clearly, the investment climate is one where the belief has gained acceptance that since a unit of water is needed to save plant life, it is axiomatic that every potential supply must be stored for plant needs, especially in drier areas. In the process of trying to 'capture' every drop of water in every stream, for irrigation purposes, the result has been an increase in the dams planned and those under construction. For example since 1982 over forty small to medium dams have been planned annually although only about fifteen per year have been tabled for financing.

On the other hand the irrigation department within Agritex, equally freed from the need for economy, has called for the uncontrolled expansion of investment into irrigation agriculture. In 1983 alone, at the peak of the three-year drought, Japan, West Germany, China, Italy and a number of UN agencies were involved in extensive feasibility studies aimed at the promotion of small scale irrigation schemes. West Germany's involvement in Masvingo Province, for example, has been responsible for the construction of the "Gutai Irrigation Cooperative Gardens" in Gutu District, which policy makers consider as a fine example of equity-based investment efforts. In the Midlands Province and South of Manicaland, various versions of the 'Gutai' concept are being tried with Japanese and Chinese assistance.

Questions of scheme viability, self-sustainability of schemes, and the search for alternatives, have not been allowed on the planning agenda. A very senior Agritex official summed up the mood within the department, during the setting up of the Farm Irrigation Fund in 1984 when he said,

> "It must be accepted, in the assessment of projects applying for loans from the Farm Irrigation Fund that while most commercial schemes can be assessed in terms of economic viability... The situation regarding small holder schemes is different. Most of these schemes are not economically viable and rely on government grant aid".
>
> (Deputy Director of Agritex 1985)

Investment in more schemes is a fait accompli, sanctioned by overwhelming political support. The governors of Midlands, Matebeleland South and Masvingo Provinces saw the future of agricultural expansion in their respective constituencies, as lying in "the unmitigated expansion of irrigation agriculture with the support of government".

The efficacy of the schemes in delivering distributive equity is assumed but not proven. The collusion between the engineering and agronomic technocrats and the politicians means that for the foreseeable future the pressure to construct more schemes will override rationality in the allocation of scarce resources. At the same time, every dam or scheme constructed takes the peasant agriculture sector further from the equity objective.

The Political Imperative

Politics colours the whole investment spectrum in Zimbabwe, and by tradition, Zimbabwean politicians of every colour or ideological persuasion have historically expressed similar sentiments when it comes to irrigation agriculture. In the case of small scale schemes, the overwhelming urge to turn the dry semi-desert-scrubland into green grain fields seems to be irresistible, and this is further enhanced by the absence of alternative solutions to the high population growth rate of 3.2% per year, amongst the highest in the world.

As indicated by Carruthers (1983) irrigation is a rapid and dramatic form of public investment that a politician can promote, in that schemes can be planned and executed within a short period of time. Dams are named after him, canal opening or well pumping can be filmed or photographed. Promotion of irrigation has benefited many politicians, and given the smallness of most schemes (average size 50 hectares), it has been possible to complete many schemes within the politician's five-year term of office.

In Zimbabwe the pursuit of irrigation has had the added effect of bringing remote areas of the Zambezi and Limpopo Valleys, for the first time, under the effective jurisdictional control of the State. Prior to the introduction of irrigation in the Zambezi Valley, the Tonga Tribe lived virtually outside the effective political and administrative control of the State. The introduction of irrigation has resulted in an influx of non-Tongas moving into the region following the opening up of roads, clinics and schools, as well as district administration offices.

A report by Agritex officials indicated that the Tongas were not too happy about this second invasion of their 'land'. The first time the State moved into their 'land' during the construction of Kariba Dam (Chapter 7) resulted in many Tongas losing their land and being moved away without compensation. To the Tongas the State's attitude of trying to 'civilize' them through the introduction of irrigation amounts to unwelcome patronage. Naturally the Tongas of the Zambezi Valley and the Vendas of the Limpopo Valley will lose more of their land to the 'new comers' who have come from other parts of the country, and have better skills and a positive attitude to irrigation and are better able to benefit from irrigation agriculture than the Tongas.

Donor Support

Perhaps the greatest support for the irrigation strategy has come from the numerous donors, who have financed and continue to support this strategy, for varying reasons. With the exception of the World Bank which insists on some cost-benefit analysis of every project proposal, and carries out its own studies, most bilateral donors tend to take an attitude supportive of government approaches. Overall the donors are more interested in the implementation of the projects then in the debate on 'equity' issues which they rightly believe are within the purview of the Zimbabwean Government. But the fact that they invest in non-viable publicly subsidized schemes, amounts to a substantial involvement in the nation's debate on equity through investment. The reason why most of the donors do not follow the World Bank model, is to do more with the political nature of the aid being given. For most, the selling of technology, the achievement of solidarity and friendship must take precedence over project effectiveness. The giving of grants by donors to finance these schemes has inadvertently promoted a wrong notion among policy makers that these schemes are being developed at no cost to Zimbabwe, while the donors have remained ever anxious that the government should pick up all the resultant recurrent budgets, if the schemes are to remain everlasting symbols of friendship and solidarity.

Planning and Administrative Controls

Irrigation is a technology- intensive system of crop production which makes it imperative that both the producers and the production process are controlled (see Appendices 2 to 6). For example the new seeds require adherence to a definite irrigation and husbandry regime which can only be achieved, in the case of the peasants, through discipline imposed by the various civil servants working at the schemes, as discussed above. Control through the regimentation of the production process has been tried before without success (Roder 1965). The bye-laws in Appendices VI.2 to VI.6 show clearly that the relationship between the farmer and the technocrats is governed by the threats of eviction and loss of tenure, and not necessarily by the motivation (on the side of the farmer) to excel in order to achieve higher incomes.

Health inputs are conspicuous by their absence (Chapter 7). In the South Eastern Lowveld, plans to curb the spread of water-based diseases have entered the planning framework by default and not by design.

Part of the reasons for the omission of health matters is related to the domination of the whole irrigation strategy by engineers, politicians, and agronomists and to the lack of an economic perspective. Water economists are needed to fight the growing trend towards 'water fundamentalism'. Evidence in Zimbabwe and elsewhere in the world has shown that water is no longer a gift from God, but a very costly commodity whose production must consume large scarce resources that have high opportunity costs. In deciding to invest in small scale irrigation, an economist, if given prominence in the planning process would seek to understand to what extent such investments would be financially viable or produce the objectives of government, and at what cost. Further the economist would analyse the comparative costs and benefits of a range of alternative strategies, given the amount of resources lost this way, without ever fulfilling the set objectives.

The Farmer

As Fig. 6.1 shows, of all the parties to the irrigation project, the farmer is perhaps the only one who must live with the success and/or failure of the schemes. It is however unfortunate that he/she is overwhelmed numerically by the technocrats who claim to be operating on his/her behalf. The farmer is therefore, and in terms of decision making, marginalized. His general low level of education does not facilitate effective communication with the technocrats, most of whom have a paternalistic view of the farmer's role and a poor regard for the possible value of farmer participation in the planning process. The evident overmanning of technocrats at the schemes is a confirmation of this position. The farmer's interest is assumed to be better defined and protected by the technocrats, and the benefits accruing to him are those determined by the controlling technocrats. The planning horizon of the technocrats is determined by the five-year political cycle of the ministers, and as such does not take into consideration the long-term interest of the farmer. For example, all farmers who fail to produce crops at the expected output levels within the first five years of settlement are threatened with eviction. The short-term view is evident in the allocation of land to peasants, where each receives less than a hectare of irrigated farm land. Clearly, the long term welfare of the farmer and his expanding family, and the implied real decrease in income, would appear not to be the central concern of the planners.

With so many interest groups having a 'finger in the irrigation pie' and the enactment of so many bye-laws, it is inevitable that the irrigation strategy has become a classic "too many cooks spoil the broth" situation.

The full impact of all these interventions by the interested parties has been to confuse the farmer, and not to help him make his own choices, in the light of resources available to him. His rainfed counterpart, although equally marginalized has a much greater decision making freedom on farm organization and production and is not swamped by technocrats to the above degree.

<u>The Benefits</u>

Because of the multiple nature of government objectives, an assessment of the benefits of the irrigation strategy is very difficult. It is made even more difficult by the fact that most of the expected outcomes are unquantifiable, and as such the impact is not readily apparent, while the long-term nature of others makes it premature to assess them within a period of five years.

For example, the high capacity of the schemes to carry large numbers of people per unit piece of land would seem, in the short term to fulfil the requirements for settling most of the landless peasants on these schemes, and thereby reduce land pressure on the overcrowded communal lands. Unfortunately the value of this benefit is limited by the fact that the population is growing at 3.2 percent per year, and in the absence of any alternatives to irrigation, this will make it necessary for another round of resettlement in the very near future on a much reduced land resource as earlier discussed. It will be remembered that part of the reason for the adoption of the irrigation strategy was to avoid having to pull land out of commercial production for resettlement purposes.

Whether the benefit of reducing land pressure is worthy of the amount of subsidy that goes into irrigation is another question; especially when it is considered that high levels of current investment outlays cannot preclude the future necessity for land redistribution. So far, the beneficiaries have been "small in number terms" and all the effort towards irrigation has not been able to stem, substantially, the tide of squatting.

It cannot concretely be said that the areas where most peasants on the schemes came from, have experienced the benefit of more land. Most peasants on the schemes interviewed indicated that they continued to hold on to their communal cropping and grazing rights on the dryland areas.

The major benefit of any irrigation system must at the end of the day, be measured in terms of the crop yield realised by the participating farmers, as this forms a basis for higher incomes. Table 6.7, for example, shows that for the maize crop, yields per hectare are higher under irrigation than under rainfed agriculture by up to 30%, and that gross incomes are three times higher under irrigation than under rainfed agriculture.

TABLE 6.7

A COMPARISON OF CROP OUTPUT AND INCOMES, PER HECTARE

IRRIGATION SECTOR				RAINFED SECTOR			
YIELD (200lb) BAGS	GROSS INCOME $	PROD. COST $	(LOSS) OR NET PROFIT $	YIELD (200lb) BAGS	GROSS INCOME $	PROD. COST $	NET PROFIT $
60 *	900	439	469	20	300	30	270
100**	1 500	[4 425]	1 500 (2 925)	40	600	40	560

Note: * Denotes figures without subsidy
** Denotes figures that contain public subsidy
[ ] Paid fully by the Government

Source:Derived from Assessment of field data

If marketing problems could be overcome, the high yields could be a basis for much higher incomes. In fact yield figures have often been used by government officials, in isolation of the cost considerations, to justify the need to expand small scale peasantry irrigation. Clearly, in aggregate terms, output figures represent real benefits on the 'without project' situation namely, the rainfed situation.

On the basis of Table 6.7 it is clear that the net profit margin for irrigation agriculture, without public subsidies is low. However when all public subsidies are computed into the figures for both sectors, irrigation losses make rainfed agriculture an attractive option, except for the fact that it is the state that bears most of the losses of irrigation agriculture and not the farmer. Clearly, only under heavy state subsidy can irrigation, in yield terms, be an effective substitute for rainfed agriculture.

What Table 6.7 does not tell us is that for rainfed agriculture to produce the same number of bags produced under irrigation per hectare, one and half to two hectares will be required. Land is an expensive finite resource, which does not stretch in order to accommodate the ever increasing demand for land. When the rate of growth of the population is also taken into account, it is clear that land redistribution alone cannot be seen as a long term permanent policy for addressing issues of equity. This factor alone, makes the rainfed option and its demand for more land, a less attractive solution in the long run. Both the rainfed and the irrigation options do not preclude the need for yet another land redistribution exercise.

In income terms, the irrigation option rewards the farmers, albeit under subsidy, with much higher incomes per hectare than the state-supported rainfed option. However, it is important to note that both the rainfed and the irrigation incomes remain within the subsistence level and their differences, a mere reflection of the degree of subsistence. This is a classic catch 22 situation, whereby each strategy selected to address the equity problem seems not to solve the fundamental problem: the irrigation option is very costly, and does not have room for containing the expanding population; the low cost rainfed option demands more land than is available, and likewise it requires that the State resettle excess population elsewhere.

Within the peasantry sector, the irrigation option has served to widen the income gap between those on the schemes and those outside the schemes. This is despite the fact that incomes obtained from irrigation under state subsidy, cannot form the basis for the advancement of peasants into higher production relations and the chances for much higher incomes. It is also clear that the irrigation incomes do not in anyway reduce the wide gap between the peasants as a whole and the commercial agricultural sector.

When these incomes are compared with the income of the domestic worker, the lowest paid category of work in Zimbabwe (the domestic worker realises a net of $1 140 per year, 1985 salaries) the peasant both on the irrigation scheme and on rainfed agriculture receive similar income. This partly explains the reason behind the influx of some peasants into cities looking for jobs that do not require skills, such as domestic work, baby sitting, gardening and all ranges of manual jobs, as opposed to working on the land.

What is the alternative?

Clearly, the small scale irrigation option is very limited. It is too costly and requires a continuous input of state subsidies to keep the schemes producing, at the expense of alternative investment opportunities. The number of people benefiting is far too small for the amount of resources spent. The opportunity cost of the scarce resources lost to a non viable investment option are considerable.

The rainfed option is equally unsatisfactory. This option's capacity to afford peasants higher incomes and hence greater equity, is limited by the fact that, in order for the peasants to realise the same output as those got under irrigation, nearly twice as much land, under existing technology is required.

It is tempting, looking into the future to suggest that part of the answer could be the development and the greater use of a technology that would make dryland agriculture produce much higher yields on limited land sizes, using very little water. This technology would obviate the need for costly resettlement programmes, and certainly reduce the need for subsidized irrigation agriculture. That type of technology is arguably within the country's grasp. Verification of this possibility calls for further research work. Caution is however called for. Solutions to the problems of inequitable distribution of income cannot be purely technical. Another alternative deserving study is regional food transfers involving food crops from wetlands and animal products from dry areas. This option holds promise for the future, if issues of transport, and political commitment can be tackled to ensure that effective distribution of both cereals and animal products can reach the needy at prices they can afford, without disruption. More research must be carried out on this option, before implementation is recommended.

The present study cannot answer a number of questions until there has been research and/or answers to a number of problem areas. For example, the pursuit of equity using whatever developmental strategy is bound to fail until there are successful family planning and population control measures in operation. Planning for a fast increasing population like the Zimbabwean one renders every effort made ineffective over time, and the resources used, wasted. Future research must seek to find answers to the ever rising urban and national unemployment problems, and also address the problems of finding alternative employment opportunities away from agriculture. Research would also be required to assess the viability of a "land-for-all" policy strategy, which currently has been responsible for huge resources being ploughed into both irrigation and the resettlement programmes. There are no easy answers.

The study clearly recognizes, however, that the requirement of the present settlement policy with its initial emphasis on the need to provide for subsistence, is not only the root cause of much of the over population on irrigation schemes. That same policy is also responsible for the faulty approach to development elsewhere on the dryland, where the focus is on ways of conditioning dryland areas to provide for increasing population densities regardless of the quality of the land and its natural carrying capacity.

The inability of the irrigation schemes to increase income distribution, arises from the fact that policy formulation takes its point of departure from what is officially perceived as constituting the requirements of peasants. The 'us and them' syndrome that emerges has dominated project assessment at the planning stage, and is responsible for the public error of regarding small scale irrigation agriculture as the suitable vehicle for the conveyancing of equity. The study certainly raises more questions than answers. In the end, solutions to the plight of the peasants must be sought within the context of the survival and/or progress of the national economy as a whole.

CHAPTER SEVEN

THE SOCIAL AND ENVIRONMENTAL EFFECTS OF PUBLIC INVESTMENT IN WATER AND IRRIGATION DEVELOPMENT

INTRODUCTION

In the preceding chapters it has been shown that the search for economic efficiency (as defined by the Pareto Criterion) from public and private investment in commercial irrigation agriculture is often an illusory goal. Moreover, irrigation has become a very costly investment strategy. Equally illusory are the policy goals designed to realize equitable distribution of benefits from public investment in irrigation for small scale peasantry agriculture. This outcome makes irrigation agriculture one of the most uneconomic agricultural systems in the country, the continued operation of which can only be traced to the wide range of vested interests and the public subsidies involved.

Clearly these outcomes have been based only on the analysis of quantifiable and monetized streams of costs and benefits. It is a universally accepted fact that investments in water and irrigation agriculture will always confer upon the benefiting (and losing) communities externality effects of a social and environmental nature. The fact that these effects are residual in relation to the quantifiable effects, means that, they are not the objective outcome of the deliberate policy intervention, but the inevitable unplanned consequences of the investment process. The scale and nature of the impact of negative spill-over effects from irrigation projects can vary markedly, depending not only on the physical characteristics of the areas involved, but also on dam design and management practices.

It is normal for people of any nation to expect that the activities of their governments should support life and promote the sustainability of life's supportive system, like the natural resources. In this respect the aim of an investment policy has clearly to take into consideration, measures to eradicate or reduce the scale of the social and environmental effects associated with each irrigation project to levels considered 'acceptable' to society. Clearly, problems regarding the definition of "acceptable" and questions of who should determine this subjective level of suffering are central to the whole environmental planning debate. The complexity of the problems involved emerges more clearly when it is considered that those who make decisions about investment, and these are mostly the urban-based public officials, do not reside in the same affected environment as those who are affected by the side effects of these decisions, mostly the peasants and farm workers. Public officials' sensitivity to these effects are therefore diminished by both spatial distance from, and the lack of first hand experience of any of the effects.

At the project design stage, there is no legislation or policy directive requiring public officials to even discuss these effects. The practice has been characterised by the need to maximize output regardless of the effects (socially and environmentally) this process may produce. In fact, the view that the resultant effects were the inevitable 'tax' to be paid for advancement has become ingrained in the thinking of the decision makers. Admittedly, any investment in a production system that interacts with the complex human and biological systems, must require difficult trade offs to be made. But lumping together of all effects as "necessary" 'tax' to be borne by society, no longer involves any trade offs at all. The resulting 'no decision' situation is in fact a policy decision that have little regard for anything other than output maximization.

The search for solutions to social and environmental effects is further complicated by the fact that as yet unknown side-effects cannot be included in any computation. Many potentially important externality effects from irrigation development have not yet become apparent in Zimbabwe, although their presence in other countries provides a strong prima facie case for their inclusion in project appraisals. Moreover even those externalities which have become evident are only now being analysed and crudely costed. Scientific predictive knowledge in this field is still in its infancy. Thus, unless the planning for, and the prediction of, social and environmental effects precedes actual construction of water and irrigation works by five to ten years, several of the adverse effects are bound to occur when there is little preparedness among Zimbabwean planners.

In the meantime, in the absence of any substantive information on the spatial scale of these externality effects, there is a need to attempt (qualitatively and where possible quantitatively) to assess the structure of the effects and to draw out the implications they have for public investment in irrigation agriculture. The discussion takes into consideration the fact that these effects often extend much further than the planning area itself. Such an analytical task is difficult, and made worse by the dominant role of engineers in the water and irrigation industry and their natural propensity to construct. This may mean that the solution to the increasing social and environmental effects will not feature greatly at the design stage, without fundamental changes to the current practice.

In fact, the approach in government is based on correcting the effects after they have become manifest, instead of adopting an "effects avoidance" strategy. Clearly, such ex-post corrections will normally be more difficult and costly to execute than properly designed ex-ante amelioration measures. The only exception to the lack of ex-ante analysis is the recently set up Mushandike Dam Monitoring Unit (1984/1985). The setting up of the unit is in part due to this study which raised a number of important questions during the field work. The critical lack of data was also exposed. Subsequent discussions with Blair Centre researchers triggered interest that culminated in the establishment of the Mushandike Dam Monitoring Unit. Prior to this, Blair Centre's activities were only directed towards the clinical study of pathogens and to the evaluation of experimental preventative measures. The Mushandike Unit, when fully operational will be unique in that it will be the only experiment in the country designed to study the effects of including externality awareness at the design stage and the use of design techniques to reduce such effects as bilharzia and malaria. Beyond this, the

Unit will hopefully attempt to quantify, as far as possible, the health related effects both in monetary values and in pathological terms. In addition, it plans to monitor the usual ex-post corrective measures. It will take many years before useful conclusions can be available from this experiment, for wider applications.

Although it will not be feasible for this study to consider all the known possible spill-over costs and benefits of public investment in water and irrigation agriculture, the frequency, magnitude and nature of these effects warrant some consideration of the most important of them. They are included in this study with the full realization that there are inherent quantification problems which cannot be solved here. Such analytical problems which are well documented (Carruthers 1975, Blackie 1984) cannot, however, justify the neglect in current literature and development efforts of externalities which are distributed unevenly and unequally over the physical and the social space, so affecting the relative real benefits from developing the schemes. It is hoped that this exercise will sensitize the decision makers to move towards the need to include social and environmental effects in the planning of these schemes and towards the need to reduce or eradicate these effects, where they are already manifest.

<u>The Socio-Economic and Environmental Effects</u>

The focus of this discussion on the socio-economic and environmental effects of water and irrigation development is not whether irrigation schemes should have been built at all, but rather to outline the externalities which have arisen or will potentially do so, and to consider what practical steps could have been taken at the initiation of the schemes to prevent or keep the deleterious effects to the minimum.

Internationally, a lot of practical ex-post studies in the Third World carried out mostly under the auspices of international organizations such as the World Bank and the United Nations (Biswas 1978), have made it possible to draw up an inventory of some of the common externality effects especially those related to water borne diseases (Feacham 1977, White et alia 1972). The practical importance of such studies have unfortunately come too late for those countries where the effects had become epidemic; and for those entering into irrigation agriculture, the lessons and the prescriptions contained in the studies have either been viewed as too restrictive to the investment process, or like in Zimbabwe, considered as the inevitable cost of advancement.

First Order Environmental Effects

First order effects are the more direct and immediate products of water development projects, while the second and third order effects occur at a much later time scale (the difference between the two being more a function of time than intensity of occurrence), and are often but not always a consequence of the first order effects. Table 7.1 does not contain all the effects of water and irrigation investment in Zimbabwe, but only those observed during field work.

There are many outstanding social and environmental effects that are known throughout the world, but not quantified in Zimbabwe. For example the effects of the building of large scale dams in Egypt (Aswan), Ghana (Volta), Nigeria (Kainji), USA (Hoover) and many other countries, have been relatively well documented. The social costs of the displacement of people, and the types of diseases induced by water bodies have at least been crudely enumerated. Moreover, other problems such as salinity and water logging are also identified in the literature; as illustrated by Davidson (1965) on the Australian experience. While it is true that rich countries like the USA and Australia have been unable to avoid the social and environmental effects of large water impoundments, they are however better able to meet the high cost of the needed corrective measures than the poor Third World countries like Zimbabwe.

TABLE 7.1

THE SOCIO-ECONOMIC AND ENVIRONMENTAL EFFECTS OF IRRIGATION DEVELOPMENT

ORDER	ENVIRONMENTAL	ECONOMIC	SOCIAL
1st Order	1. Dam siltation	1. Rise in Public Debt	1. Spread of water related diseases
(Direct)	2. Evaporation water loss	2. Rise in budgetary subsidy	2. Disruption of communities due to removal and resettlement
	3. Land loss to inundation	3. Increased loss of foreign exchange due to imports of inputs	3. Loss of production and continuity
	4. Progressive soil salinity and sterility	4. Increased dependence on foreign banks	4. Can cause tribal conflicts in resettlement area
	5. Disruption of communication and other facilities due to inundation	5. High compensation costs	5. Can increase income inequality between the scheme and dry land farms
		6. High of cost of removal and resettlement of displaced people	
		7. Loss of production and productive land	
		8. High cost of correcting disease effects	
2nd Order (less Direct)	1. Creation of a new micro-climate and diseases	1. High import cost of insecticide fertilizers and machinery	1. Over crowding at schemes and inversion by second stage diseases, due to insanitary conditions

	2. Induce earthquakes around dams	2. Increase in cost of disease corrective measurers	2. Division of families
	3. Sedimentation and poor scenic view	3. Widen regional income disparity	3. Increase in jealousies between irrigation and rainfed farmers
	4. Over irrigation affecting soil structure	4. High cost of rerouting (Dam) disrupted services	4. Growing more of cash crops and less food crops leading to continuation of famine
	5. Introduction of weeds	5. Possible net losses in the production process, and problems of mono-culture	5. Continued increase in income gap
			6. Spread of water borne diseases beyond the schemes
3rd Order (long term)	1. Reduced life of dams due to siltation	1. Long term budgetary subsidy losses and commitment to imports	1. Increase in over crowding and abandonment of schemes; and the need for more new schemes
	2. Costly dredging and weed control	2. More dams to replace those silted	2. Long term increase in clinics and hospital provision
	3. Abandoned due to salinization and water logging	3. Budgetary commitment to correcting expanded costly water borne disease infested area	3. Disease can become chronic or fatal. Loss of life.
	4. Irreversible changes in land value, and loss of scenic value	4. Long term distortion of the economy and regional income distribution	4. Income inequality fossilized

5. Possible earth quakes and loss of life	5. Bad long term dependence on external cash crop markets and high risks	5. Poisoning of human and animal life by molluscicides and weed killers
		6. Ground and surface water polluted by fertilizer chemicals from the schemes

Source: Derived from field data

Table 7.1, a product of field work experience in Zimbabwe, attempts to categorize the effects into three broad but related areas of: environmental; economic; and social effects. The effects are further grouped into first order effects down to the third order effects on a scale of diminishing direct impact. The divisions are arbitrary and drawn for the convenience of analysis. Attempts have been made to highlight, be it qualitatively, some of the effects, so as to bring forward their individual contribution to the overall impact on the costs and benefits of water and irrigation developments.

Following Adams and Adams (1986), the construction of a dam involves a deliberate human intervention into the natural physical state of a river. Environmental direct effects occur in two areas; up stream of the dam in the form of a permanent reservoir, and down stream where the presence of the dam transforms the existing pattern of high and low flows both between seasons and between years. Effects are primarily on the physical system of the rivers (discharge, sediment load, geomorphology etc) but there are also complex webs of other effects on biological systems and socio-economic effects as shown on Table 7.1.

Zimbabwe experiences a very high degree of soil erosion (because of the wide spread occurrence of fragile sandy soils and erratic rainfall system (chapter 3)), which inevitably raises fundamental questions about river silt load and dam siltation. The questions are central or ought to be central, to the decision making process regarding investment in dams and irrigation agriculture. The value of a dam to irrigation agriculture must depend on the dam's ability to store and to provide water continuously, and at little supply (failure) risk, for many years (time horizon of 50 years is the standard minimum). The longer the period the dam can be utilized to realize the discounted net returns (lower capital costs), per unit of supply, the higher its value to irrigation agriculture. The single most critical threat to the long term capacity of a dam is the problem of siltation. Clearly, the higher the rates of siltation, the less likely it is that the dam will be useful for 50 years.

The overcrowded catchments of the Sabi River and its tributaries, and those of most smaller rivers rising within the country's Communal Areas in Natural Regions 4 and 5 (see chapter 3), yield large quantities of soil deposits into those rivers. In the case of the Sabi River, the high level of soil erosion in the mountainous catchment area of the Eastern Highlands, has prevented the construction, since 1947, of the proposed Condo and Chitowe Dams. Recent estimates from the Department of Water Resources Development and from an on-going study by the British team of experts, put sand deposits in the middle and lower reaches of the Sabi River (sites of both Condo and Chitowe Dams respectively) at an average depth of 5 metres. The same estimates argue that if the two dams were built, they could silt up in a space of 5 to 10 years.

Since each dam is estimated, at 1984 prices, to cost $1.5 billion, the resulting loss from siltation would be astronomical, especially since it would happen before the dams have been able to repay the capital cost. The government is, for political reasons, however determined to go ahead with the construction of these two dams, so as to cater for the expansion of irrigation at both Chisumbanje (an addition of 28,000 ha to the present 400 ha) and Middle Sabi (an increase of 4 000 ha) irrigation schemes. Since this level of expansion is not feasible, using the current costly river pumping methods, the government is committed to the construction of one or both of the dams in the immediate future.

In line with this commitment, a team of British scientists have been asked to carry out a detailed study of the siltation problem of the river Sabi and to recommend to the government the possible solutions to the problem. Manicaland Province is the most densely populated province, and the smallest in size, and yet a large percentage of the province is covered by mountain ranges stretching into Mozambique. Land area for cultivation is scarce and limited to river valleys and slopes of mountains. A pessimistic and yet realistic scenario whereby the British study would recommend the removal of large numbers of people and livestock from the catchment area in order to remove the causes of the high incidence of soil erosion, would run into a political mine field. Such a removal would not be voluntary and would involve a considerable reduction of the population of Manicaland province. It is only possible to resettle these removed people outside Manicaland itself. It is obvious that Manicaland people and politicians will resist such an obviously sensible and clearly the only long term practical solution to the siltation problem. A historical precedent against such a solution has already been set. When the Tangwena Tribesmen refused to leave the upper reaches of the Sabi River in the Gaeresi Area, between 1969 and 1974, a serious case arose that raised both domestic and international criticism against the government of the day which had ordered their forcible removal. The present government is certainly unlikely to repeat this.

Away from the silt-laden Sabi River example, historical factors (discussed in Chapter 3) have been responsible for the low silt load that has so far entered major irrigation dams such as Lake Kyle, Lake MacDougall, Bangala Dam, Lake MacIlwaine, Siya Dam and Ruti Dam, to name a few. The very early forcible removal of African peasant farmers after 1890, and more so in accordance with the terms of the 1930 Land Apportionment Act, from the Highveld (the source and watershed of most rivers) as it became European Land, reduced the density of occupation and intensity of cultivation in the catchment zone. It is not clear, at the time of writing, the extent to which current resettlement programmes will in future alter this historical, albeit, ironic benefit, regarding the absence of silt in the above named dams. Experience shows that, in a trade-off between curbing soil erosion and providing more land for food production through resettlement, the latter is always chosen. This is particularly the case since, the central questions of who benefits and equity are given a much greater weighting today than was the case in both the 1890s and 1930s.

While the 1930 land legislation laws have largely benefited large-scale irrigation dams and municipal water supply systems, the situation regarding small size dams in communal areas is less attractive. Most of these multi-purpose small dams have local water catchment ares, often constituting the over cultivated and overgrazed treeless hillsides. The result has clearly been a sharp increase in the rate of siltation. The average life for the majority of these dams is under ten years. In any case, most of these dams offer only one season irrigation water, and the majority of them are empty or nearly so before the end of every dry season. The siltation problem further reduces their usefulness, and clearly raises questions of the correctness of an investment policy that seeks to expand the rate of these dams, in the absence of any erosion control measures. It is also clear that solutions to this problem cannot be found within the current preoccupation with capacity extension, as this tends to increase the problem both in terms of lost opportunities, and in terms of the higher cost of correcting the problem.

There is no data on the cost of dredging of dams in Zimbabwe generally, although observations would suggest that several millions of dollars are spent per year. If the cost of uprating the dam instead of dredging, is anything to go by, the dredging exercise is very costly. The engineers have often reacted to the silt problem in two ways: constructing new dams; or increasing the height of the wall of an old dam, instead of dredging. For example, the cost of increasing the Mwenje Dam wall, by some extra six feet in 1984/85 came to just under $5 million, a figure that was twice the original cost of constructing the dam. By all indications, this is far too high a cost per extra foot of wall height, especially when it is considered that the extra capacity created would be lost later to siltation within a few years. Moreover there is clearly a limit to this costly uprating exercise. Very often peasants have been organised within the context of the "Food For Work Programme" to dredge dried up small dams for portions of food. The fact that the opportunity cost of this labour is often considered by officials, as nearly zero, has lulled policy-makers into believing that siltation can be solved at very little cost to government. But as more of the suitable dam sites are fast developed and silted up, the time is not far off when expensive dredging cannot be avoided as a solution. Recent appeals by the government leadership that the whole population of the country should engage in tree planting, especially over the catchment areas, and the fact that a National Tree Planting Day has been set aside, are steps in the right direction. A lot more needs to be done beyond these clearly ex-post, often expensive measures.

Another significant direct environmental effect observed, apart from the siltation problem, is water loss due to evaporation. Evaporation, a function of wind velocity, water surface area and temperature, affects more the effective capacity of a dam while evapotranspiration necessary for plant growth, affects water application rates. Zimbabwe's climatic conditions, especially in the drier areas where most irrigation schemes are concentrated, tend to exacerbate these two processes. In the irrigation fields of the South-Eastern Lowveld for example, the combination of high temperatures during the nine summer months (Chiredzi/Triangle an average of 32°C) and the mild three winter months (21°C average), and the fast flowing South Easterly winds that descend from the Eastern Highland, mean that evaporation water losses on the expansive water surfaces of the large irrigation dams in the area, is upward of seven metres per dam per year on average. This means, in volume terms, a loss of nearly a third of the total installed capacity of each dam.

At the small to medium size dams in natural regions IV and V (Chapter 3) where similar conditions obtain, the water loss represents on average two fifth of the effective capacity. This is part of the reason why most of these small dams are empty during every dry season, at a time when their waters are most needed for small scale irrigation agriculture. The planners and decision makers have again reacted to the water loss by seepage, siltation or evaporation, in typical fashion; namely the construction of extra dams. Clearly this capacity extension has only added more volumes of water that are subject to evaporation, and the real benefit of constructing these dams has, in each case, been reduced.

Apart from the engineering solution of additional capacity, attempts to reduce evaporation have sought to use chemical molluscicides. The application of chemicals, most of them imported from overseas, has so far proved to be of limited value and prohibitively expensive. As a result most efforts in this direction have proved futile and have thus remained experimental. One of the reasons for the low application of evaporation control techniques is the very low cost of water to the final consumer, which has clearly acted as a disincentive for the application, by individual farmers, of chemical molluscicides.

At the field level the very low water price coupled with evapotranspiration losses have induced over application of water, and by so doing has raised the possibilities of water logging occurring on most farms. The farmers have typically reacted to their ignorance of the true evapotranspiration requirements of the crops, by applying more water than the normal levels required for plant growth in the belief that every drop is essential in countering water losses. The dominantly used and inexpensive flood irrigation method makes the application easy and the setting-in of the water logging and salinity problems become a mere question of time. The total quantity of water lost due to over application and more so due to evapotranspiration cannot be known without further investment in costly technology designed to measure the loss. In addition, extra people would have to be employed to advice farmers on how to control water applications and on water release time schedules. The search for such a technology would have to be economically justified while experiments tried elsewhere have proved unsuccessful. At present, there doesn't seem to be any technical way of reducing water loss by evapotranspiration arising from over application other than through night irrigation, whose efficacy has not either been studied or verified. Besides, night application is unpopular because of the lighting problems and the dangers of real over flooding, and is not convenient for the workers.

In the case of seepage losses, incurred mostly during storage and transmission, the solutions are known. The large scale irrigation schemes experience very little water loss due to seepage because water transmission is through lined canals, right to the edge of the field, and in most farms like the Hippo Valley and Triangle Estates, this includes the infield transmission canals. Unfortunately most canals carrying water to small-scale schemes are unlined and water losses are estimated to be very considerable. The cost of lining is prohibitively high.

No attempts have been made in Zimbabwe to calculate the real economic value of the vast amounts of water lost by either of the ways discussed above and no attempt is made to do so in this study. More research work is needed in this area before any concrete proposals for water-loss-reduction can be considered for implementation.

While water loss is indeed an important consideration, the economic implications of over-application can be very serious. Apart from serious water logging problems, over application can cause the more serious problem of soil salinity or soil sterility. All soils contain salts in varying degrees of concentration as a result of the geo-chemical weathering processes. If salt levels in the soil become too high, especially closer to the surface, the land becomes toxic to plant life, and needs vast amounts of clean water to flush the salts through the soil. Ground water provides the main reserve and source of salts circulating in the soil profile. It is therefore agriculturally important that the water table beneath potentially saline soils is kept as low as possible. This is both a technical and a planning prerequisite in such countries as the Soviet Union, where salinity problems are common in the semi-arid regions. In Zimbabwe, over-application of irrigation water especially at the small scales schemes, tends to lead to a rise in the water table, concentrating salts in the upper zones of the soils. This salt interferes with the plant's ability to absorb oxygen and moisture, and the land could become effectively dead.

While Zimbabwe's short history of commercial irrigation has been relatively untroubled by salinization problems, evidence of small quantities of sodic elements have been identified at the laboratory level in some soils associated with irrigation agriculture (Blackie 1984). All indications show that most soils of the country have relatively low salt concentration except for the Kalahari Sandstones of Matebeleland North Province and the drier Southern Lowveld. Over irrigation and waterlogging has been reported at several schemes, especially at the small scale schemes. The increase in the number of these schemes, almost all practicing poor irrigation methods, also increases the likelihood of widespread salinization in the long-term. The fact that most of these schemes practice flooding irrigation methods, makes that eventuality probable, in the absence of any counter measures, or any degree of awareness of this danger by the farmers.

The use of the flooding irrigation techniques, for example, involves difficulties in determining with any confidence the quantities of water which are applied. By comparison, sprinkler techniques are much easier to control but are much more expensive. Officials at Triangle and Hippo Valley Estates and those from the Regional Water Authority indicated that the dangers of waterlogging increased during the rainy season, because of the high incidence of rainfall soon after heavy irrigation water application. In the Matebeleland South Province, around Gwanda and Beitbridge closer to the Botswana border, a number of small scale schemes were abandoned in the past partly because the waterlogging had badly affected the fertility of the sandy-loam soils. Unfortunately these dangers have not acted as a sufficient warning to the farmer, and have not deterred the planners from establishing more schemes without proper drainage systems.

Fullstone (Blackie 1984) reported cases where saline waters used in irrigation, especially borehole water, have produced conditions of sodicity within ten years. The fact that the incidence of salinity and sodicity is still very low has led to the perceived apathy among Zimbabwean farmers and decision makers about issues relating to the construction of drainage canals, or the adoption of attitudes that would prevent the eventual arrival of salinity problems. Given that most of Zimbabwe's soils are shallow, the long-term implication must be that once the salinity process starts at the base of the soil, it would prove difficult to remove.

Examples of the dangers of salinity in other countries serve as a timely reminder of the magnitude of the problem and its impact.

For example, at one time, Pakistan was losing 24,280 ha, of fertile cropland every year as a result of salinity, and nearly 10 percent of Peruvian agricultural area was sterile due to salinization by 1977 (Widstrand, 1978). Although there is no information on soil type and the duration of irrigation for the two examples, in order to compare with the conditions in Zimbabwe, it is nevertheless possible that these conditions and effects could occur in the country in the long-term.

The cost of removing salt water from the soil once salinity conditions have occurred, is forbidding. For example, in the USA, Californian irrigation farmers have for a number of years now, been battling with the salt problem. Large tracts of land are abandoned because the cost of removing salt from the land is both prohibitive and wasteful of scarce resources, especially in water deficit areas. Construction of canals to carry away saline waters is expensive, and there is also the need for the not readily available clean water to flush out the salts. According to Pringle (1981), the cost of the canal proposed to carry salty water from Californian's Valleys back to the sea would be at US$ 1.2 billion (1981 estimates). There is clearly every incentive for Zimbabwe to take precautionary measures now, designed to prevent salinity from ever starting on any significant scale. This, naturally, must include a much higher price of water and higher prices for crops produced if farmers are ever to adopt water—use efficiency technologies.

Public investment policy is generally interested in the size of land the water from the dam will bring into production. All efforts, and indeed the technical exercise of benefit calculation regard the land under irrigated crops as a benefit and an indication of achievement. Politicians often put greater weight on the area of the land rather than the resultant yield. However, little consideration is given to the equally valuable land, that must be lost in the flood zone of the numerous dams built and those to be built. Clearly, land losses resulting from inundation have been ignored by policy makers, as representing real cost. This loss is of a significant nature and cannot continue to be ignored, especially in the light of the number of large and small dams that have been planned for the next few years. For example, it is believed that the construction of the Aswan High Dam in Egypt led to the loss of nearly as much land as was brought into cultivation by irrigation. The Aswan Dam example is illustrative of the likely outcome of the present strategy of constructing numerous dams in Zimbabwe depending on site differences.

The only time when this issue enters the planning process is when issues of compensation are raised. For example, the proposed Chitowe Dam on the Sabi River will result in a lake covering over 15 square kilometres of land. Inundated in the flood zone will be the present Chitowe Small Scale Irrigation Scheme, and all its infrastructure. The monetary value of the Chitowe Scheme has not been calculated, but it is a reasonable estimate that, including the irreversible loss of crop output from the scheme, the value could well exceed ten million dollars. What is often not made clear in the trade-off is the fact that bringing the new land into production would involve the provision of costly infrastructural services.

In the case of Mazwikadei Dam, the 3 000 ha to be brought under irrigation is far smaller than the 12,000 ha that will be lost in the flood zone. A lot of infrastructure such as roads and bridges are going to be lost. The rerouting of telephone and electrical lines as well as the 30 km road detour will cost a lot of money. At 1984 estimates, the cost of laying telephone wires was $25 per 500m while that of road surfacing was put at $400 per km. To these costs must be added $120,000 total compensation claims by farmers (based on the $10,000 per ha cost of land in 1984).

What the planning process has not considered at all is the need to search for alternatives to irrigation, alternatives that could result in less dams being constructed, and less land being lost to inundation.

Second and Third Order Environmental Effects

The construction of large water bodies, has in the long term, the effect of changing a purely terrestrial system into an aquatic system. The changes mean that the local micro-climate takes on a different character, that is often not fully understood or whose long-term effects are not obvious at the planning stage. For example, the Kariba Lake has induced an equatorial climate in a typical tropical environment, with the consequent introduction of life forms hither to unknown in the area. Veterinary officials would in fact argue that the recurrence of tsetse flies in the area is largely due to changes in the climate induced by the lake. Lake Kyle has similar effects although on a reduced scale. However, not all of these effects are necessarily detrimental. Very little research has been carried out about the effect of the Lake Kariba or Lake Kyle.

The University of Zimbabwe has recently opened a study Unit on the Kariba Dam, and since the work of the Unit is at a very early stage it was not possible to get an informed view from the Unit.

Still a lot of the effects of large water impoundments are yet to come to the surface. For example, on the 18th of July 1986 (The Zimbabwe Herald, 20th July 1986) tremors from an earthquake around the Kariba was felt in Karoi and Harare over 200 km away. The quake had a magnitude of 5.1 on the Reichter Scale, and scientists argued that it was associated with the refilling of the lake after 4 years of drought and very low water level. If the Kariba Dam were to break as a result of these now frequent tremors, the consequences down stream could be catastrophic. The worst scenario would be the consequent bursting downstream of the Kabora Basa Dam in Mozambique and the destruction of land, infrastructure, and more importantly, the loss of human life.

Although the other dams in the country have not yet experienced any tremors, the Kariba has shown that the possibility cannot be ruled out, especially for those dams that are to be built along fault lines, like Chitowe and Condo Dams in the Eastern Highlands.

One effect that is very much a subject of public debate in the country is the arrival of foreign weeds on most dams. The weeds, eichornia and pistia, are believed to be of South American origin (The Zimbabwe Herald, 6\4\86).

The weeds have the following effects:

a. The weeds spread over the water surface forming a thick carpet which prevents oxygen (air) and sunshine from reaching other aquatic life below. This affects fish production and fish food;

b. The water surrounding the weeds is affected by the rotting leaves, turning into brackish water, unsuitable for human consumption;

c. More important for irrigation, the weeds are sucked into the water pumping machinery and pipes carrying water from dams. The process of removal is both time consuming and difficult. The life of the pumping stations and the pipes is reduced by this constant blockage; and

d. They make access to water for irrigation very difficult apart from increasing the cost of maintaining affected canals.

For example, the weeds have seriously affected Lake McIlwaine, Darwendale Dam, and Hallam Dam, dams that supply water to the city of Harare and surrounding commercial irrigation farms. According to the Zimbabwe Herald report of the 15th May 1986, the cost of spraying chemicals (glyphosate) on the weeds using a plane was put at $178.50 per hectare. Initially, the government had allocated $100,000 for this operation in April 1986 and by June 1986 a further $110,000 had to be made available as the initial allocation proved inadequate for the fight against the weeds. A helicopter and a light plane were initially hired for the work. When the use of the plane and the helicopter proved costly and unsuccessful, the army using cranes and other weed-cutters, moved in, and still the weed proved intractable. The weed continued to grow along river courses. By June 1986, only 756 tons of the weeds had been removed after nearly six months of continuous operations (The Zimbabwe Herald June 1986). The on-set of winter in June 1986 meant that the weeds became dormant, and the physical operations of removing them had to be suspended until October 1986 when the weeds were expected to start growing again with the on-set of the rainy season. This has become the pattern of operations annually. At the start of every season, the weeds will have spread into new areas as well as covering with the same original intensity, the areas previously cleared.

The likelihood of this menace affecting all large dams of the country cannot be ruled out. If that were to happen, the cost of attempting to remove the weeds would continue to rise. Clearly the fact that has to be faced sooner than later is that the weed can no longer be eradicated, and this will put into question the rationale for costly and yet futile attempts at eradication. The benefits to be derived from temporary amelioration, will need to be assessed soon before more resources are "thrown" at the problem, and alternative methods sought.

In the frantic fight against the weed, the government has lost sight of the long-term effects of the chemicals being used, both on other more useful aquatic life and on human life. It is obvious that the application of the chemicals has not been preceded by any research into the side effects. The nature of the crisis management that has resulted in this case is likely to be applied elsewhere should the weeds spread to other dams not yet affected. The example above is indicative of what happens when no precautionary measures are taken as part of an investment strategy. Such essential ex-ante measures do not enter the planning process at the time investment decisions are taken. This is largely because the irrigation advocacy environment within which policy decisions are made, does not allow environmental concerns to be introduced (Chapter 6).

Apart from the weed problem, the introduction of new crops into areas where they were never grown before, and the year round cultivation system at most large irrigation schemes has introduced pests hitherto unknown, or has made the known pests multiply many fold. For example, the introduction of cotton at irrigation schemes in the south-eastern lowveld, has led to the year-round increase in cotton attacking pests. The government has been forced to take draconian measures in order to control the pests from becoming an epidemic. It is now a criminal offence for any farmer who fails to plough down or cut all the old crop remains after harvest, by the stipulated dates, and the fines are heavy. In some cases a farmer who fails to harvest his cotton at the stipulated time, risks having his crop destroyed without any compensation. It is unfortunate that no study has yet been done to determine the obvious significant costs of importing insecticides not only for cotton but other crops, or for the hiring of the planes used in the control measures.

Likewise, the growing of winter wheat in the same area has been hit by the sudden increase in the population of quelia birds; described by the Zimbabwe Herald as "... the feathered scourge of Africa" (The Zimbabwe Herald, 8th May 1986, p6.). According to the Department of National Parks and Wild Life, the birds destroyed at least $5 million worth of cereals in 1985 alone. One farmer was quoted as having lost $15,000 worth of grain before the control team moved in (Zimbabwe Herald, 8th May 1986). In 1985 alone the estimated 500 million birds destroyed 11,000 tones of wheat.

Eradication of the birds has proved both difficult and very costly. The bird is known to fly up to 30 km from roots to feeding grounds, and unlike the locusts, its flight cannot be detected by radar. The use of queletox poison (FAO recommended) costs $1 ,000 a barrel (1985 prices). For the two months of May to July in 1985, the department spent $150,000, and during that period, spraying killed over 150 million birds. When South Africa, to the south, complained about these birds, it became clear that a regional approach was called for in trying to combat the birds. The problem is however hardly controlled by the kill rate that was being registered in 1985, and yet the cost of importing insecticides has continued to rise.

Most of these out bursts of pests are taking place at the schemes in the absence of any natural biological control systems. If the extra costs required to eradicate these pests are taken into consideration, irrigation agriculture, already marginally profitable, would become even less attractive, because these extra costs reduce the benefits from irrigation agriculture. There is therefore a need that these costs are considered during the ex-ante appraisal of the investment projects. Anticipatory measures, based on historical data, should be included in the planning system, so that, for those crops susceptible to pest problems, the calculation of their profitability would take into consideration the extra costs for pest eradication and crop losses.

Social Effects

Apart from causing a number of environmental externalities investment in water and irrigation agriculture can cause many social costs many of which may be unquantifiable (see Table 7.1) but are nevertheless real. The negative effects on social systems include , for example, the deliberate removal of people from the flood plain and areas adjacent to the dams. Evacuations and subsequent resettlements have caused the breakdown of communities, disoriented the society's patterns of production and the traditional life support system, and lowered morale. The removal of the Tongas from the shores of the Zambezi River at the time of the construction of the Kariba Dam in 1960, was carried out in accordance with the 1930 Act; without the necessary sociological and psychological preparations, and with a lack of compensation. Rubin and Warren (1968), in their study of the Tongas, showed that these tribesmen were resettled in less hospitable areas, and were forced to start completely afresh to develop an entirely different socio-economic system employing completely different production relations. The Tonga's social hierarchy structures were completely destroyed, and they had to realign allegiance to not always hospitable tribes. Moreover, the feeding centres that were set up by officials, and the makeshift camps where they crowded, became disease transmission centres. Within the first two years of resettlement, over 10 percent of them died.

Elsewhere in the country, the experience of the Tongas, was repeated over and over through the removal of peasants when their land became "European Land" and in order to make way for commercial schemes. Very few peasants so displaced were allowed to settle on the schemes developed. The current pragmatic policies of government towards land redistribution could perhaps imply that while there will be more prior consultations and pre-planning before evacuations are carried out, the end result will probably not differ materially from pre-independence strategies. If the recent case of Chief Seke's Dema Tribe is anything to go by, traumas and the pains will not be very different from those suffered by the Tongas. The Dema people (100 families) are to be evacuated from the flood plain of a proposed dam 50 km south-east of Harare, and to be settled in the Beatrice District over 80 km south-west of Harare. The peasants are refusing to move stating as reason for their refusal the following:

> "some of the farmers argued that they could not leave the area because their ancestors' graves were in the area ....
> and these needed yearly rituals on the sites...."
> (The Zimbabwe Herald, 21st July 1986).

Since the government is determined to go ahead with the construction of the dam, the peasants' wishes will not come to much. Already there were arguments as to the level of compensation that has to be paid for the destroyed huts. While the fixing of value of the huts will cause a lot of disagreements, the peasants' lack of title deeds over the land to be inundated means no compensation is being paid for the lost land. Again the government will have to make arbitrary offers that may well not match the values of the properties to be lost, and the pain of being up-rooted from a familiar environment.

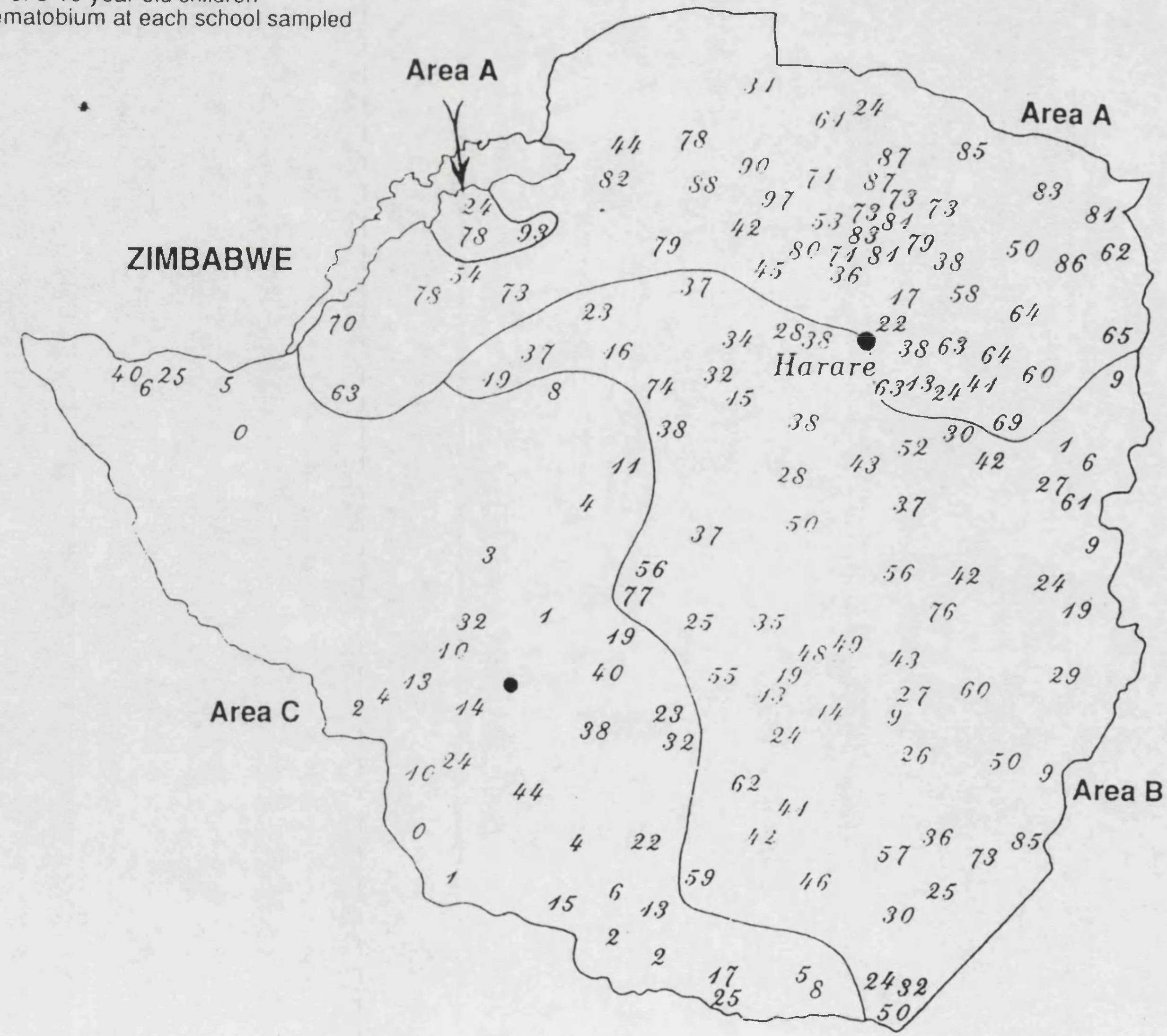
The Spread of Diseases

Probably, the worst and certainly the most obvious and immediate direct externality effect associated with investment in water and irrigation agriculture is the spread of malaria and bilharzia, both within the schemes themselves and among surrounding communities. The phenomena is equally apparent on both commercial and small-scale schemes. Although these two diseases were known in the country long before the advent of irrigation projects, the expansion of such developments has undoubtedly been a major contributor to their spatial spread and their greatly increased incidence. They have now reached epidemic proportions particularly around the schemes themselves. Moreover the high population mobility and interaction has meant that these diseases have began to spread further afield into areas hitherto unaffected (see Fig I and II). Prior to the introduction of dams, the vectors that pass malaria (anopheles mosquitoes) and bilharzia (fresh water snails which carry S Haematobium and S Mansoni) were kept in check by the prevailing seasonality of the climate. During the short rainy season, the vectors proliferated, but during the following long dry season (nine months) and during intermitted periods of drought, most of these died. In this way acceptable, manageable vector population levels were maintained naturally. But the construction of large static water bodies, and the accompanying development of permanently cultivated fields, had made it possible for the vectors to continue to multiply throughout the year, in the absence of any natural control measures. Inevitably the incidence of infection has likewise increased, and the problems have been exacerbated since irrigation has made it possible to concentrate large numbers of people around each scheme. This has tended, particularly in the case of bilharzia, further to increase the number of potential disease carriers moving with the infection into areas away from the schemes. Gilmary, Riddell, and Sanders in 1979 (Chandiwana 1983) found that, apart from malaria and bilharzia, other secondary contagious diseases, such as diarrhoea, typhoid, dysentery, trachoma and scabies (no doubt aided by the ever present unsanitary conditions), were an ever present menace and a cause of many deaths at the irrigation schemes.

While bilharzia causes debilitating effects and creates a favorable environment for secondary infection, it does not directly kill human beings. However, this is not true of malaria which probably accounts for the highest proportions of deaths of children at the schemes, the other major cause of increased mortality rates being a host of secondary diseases to which weakened individuals become prey. No statistical figures are available, but the level of infant mortality is known to be higher than the national average of 20 percent per thousand per year. If other external factors such as the poor sanitary conditions and

Fig. I

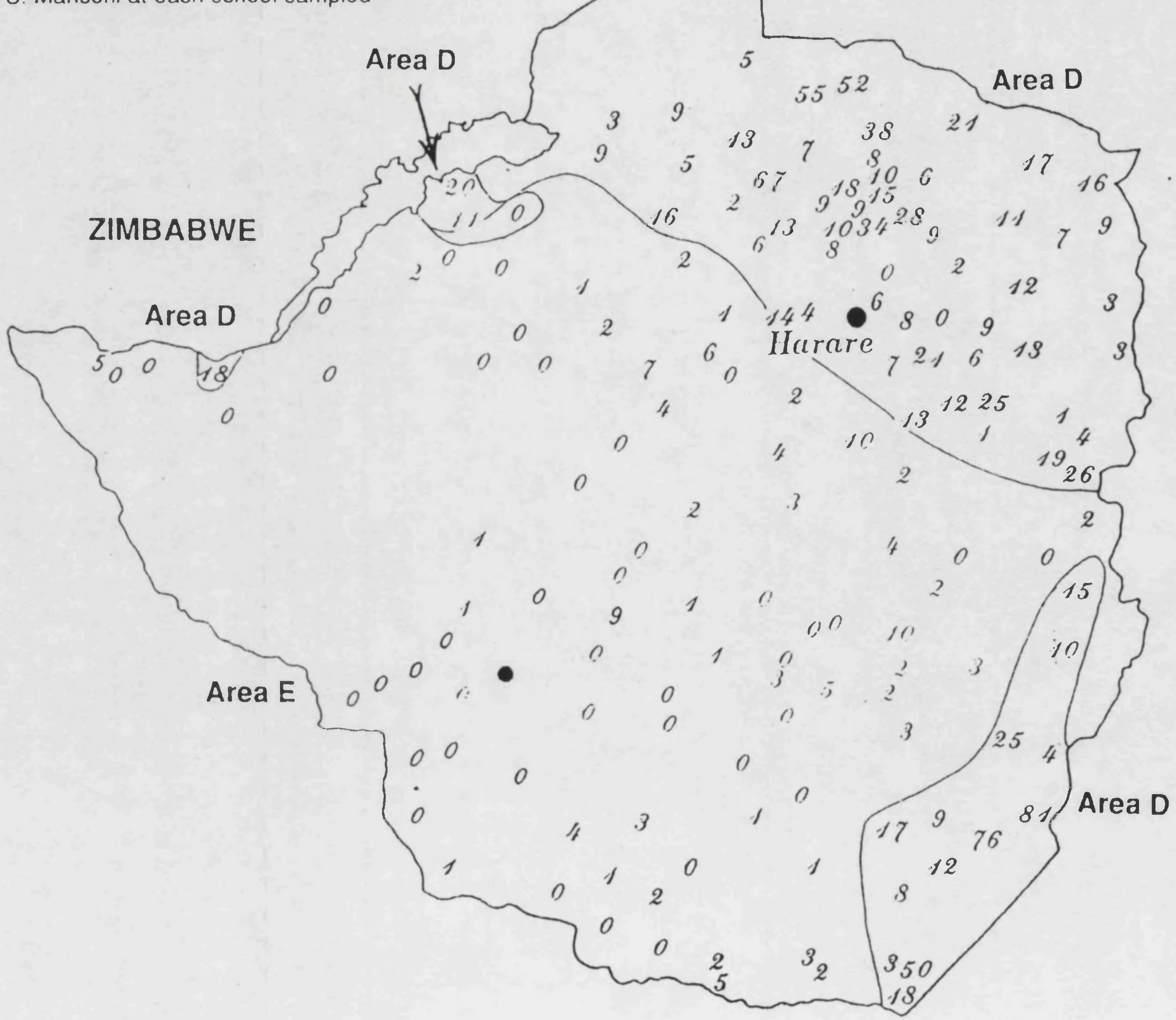
Percentage of 8-10 year old children
with S. Haematobium at each school sampled



Source:Ministry of Health, Government of Zimbabwe, 1984.

Fig. II

Percentage of 8-10 year old children
with S. Mansoni at each school sampled



Source:Ministry of Health, Government of Zimbabwe 1984.

malnutrition, all prevalent at most irrigation schemes, are taken into account, cumulative health problems are considerable.

The spatial dispersion of bilharzia as shown on Fig I and Fig II, indicates that while S Haematobium has become a nationwide disease, its spread is less in the low rainfall areas of Matebeleland, but the incidence increases markedly as we move towards the wetter east and north-east. However, S Mansoni displays different spatial preference. Concentrations around Harare and the south eastern part of the country are clearly associated with large scale commercial irrigation agriculture. Nearly two-thirds of the country is yet free of S Mansoni, and again Matebeleland experiences the least effect because of the absence of perennial surface waters and large scale irrigation.

Since infection transmission can only be effected through contact with water, the correlationship between availability of water (as rainfall or in dams) and the incidence of infection is well established. The greater use of flood irrigation now, more than in the past in Zimbabwe, increases the opportunities for body contact with contaminated water. On small scale schemes, the absence of lined canals and the presence of abundant weed growth means that the snail population has a suitable habitat within which to multiply and so carry on the infection chain. Permanent water availability removes the natural checks on the increase of vector populations which dry seasons and droughts provide. As long as irrigation agriculture development continues to expand along presently planned lines, especially given that little or no preventative measures are included at the design stage, bilharzia and malaria will continue to flourish. In the case of bilharzia, the fact that it does not kill makes it easy for public officials to ignore it. Moreover, adult victims rarely report the disease because its symptoms, such as urinating with blood, etc. affect intimate and taboo parts of the human body. Thus the spread of the disease continues unabated.

Data on the spatial spread of malaria is difficult to obtain. Table 7.2 and Fig III, based on the Malaria Blood Slide Submissions of 1982/83 give some indications of the potential regional pattern of infection. However, the data is suspect and is by no means comprehensive. It is used here as indicative of spread only, but cannot be taken to reflect the absolute relationships.

TABLE 7.2

REGIONAL MALARIA INCIDENCE, 1982/83 (BASED ON MALARIA BLOOD SLIDE SUBMISSION TO HOSPITALS)

PROVINCE	NO. EXAMINED	NO POSITIVE	PERCENT POSITIVE
Masvingo	3 504	1 571	45
Midlands	1 896	174	9
Manicaland	1 245	218	18
Mashonaland	5 862	1 012	17
Matebeleland	3 738	1 601	43

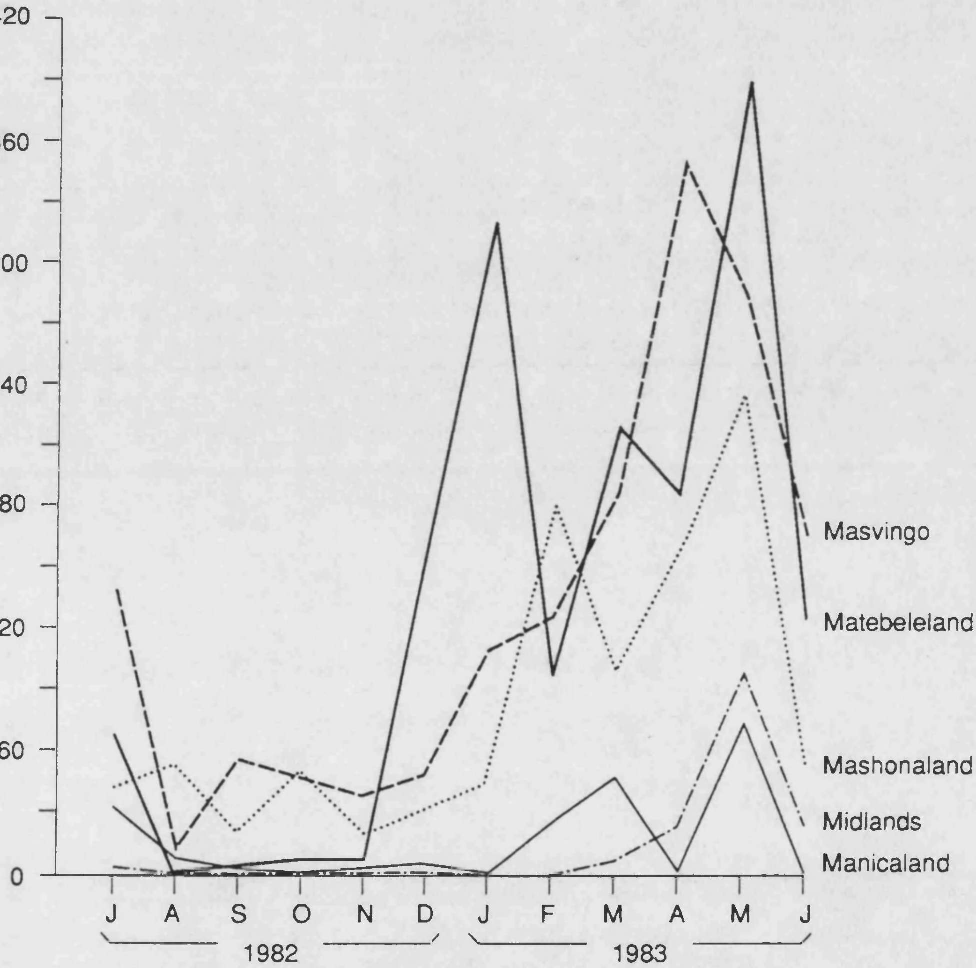
Source:Ministry of Health, Government of Zimbabwe, 1984.

There is need for caution in the interpretation of the above data. The sample size examined from region to region was not uniform and not always statistically significant.

The relatively low incidence in Mashonaland and Manicaland can be explained by the altitude and generally low temperatures in winter; such conditions do not favour the multiplication of mosquitoes. However, the situation in Masvingo with the highest apparent incidence of malaria infection, is a clear indication of the importance of the combination of high temperatures and the presence of expansive water bodies, especially around Chiredzi and Triangle. In Matebeleland, despite the absence of major irrigation schemes, the presence of the Zambezi Valley and its high temperatures is responsible for the abnormally high incidence, in a province that is naturally too dry to be a suitable habitat for mosquitoes. Clearly, the high level of positive samples in Masvingo is in all probability a good reflection of the impact of the numerous large dams and large scale irrigation schemes, on the spread of malaria.

Fig. III

MONTHLY REGIONAL INCIDENCE OF MALARIA
BASED ON MALARIA BLOOD SLIDE SUBMISSIONS, JULY1982-JUNE 1983



Source:Derived from Assessment of field data

The Socio-Economic Cost of Malaria and Bilharzia

Comprehensive data on the socio-economic costs of malaria and bilharzia is not available in Zimbabwe, their impact can only be inferred from overseas experience, supplemented by field analysis and limited information available in the country. Data on economic costs assembled by the World Health Organisation (WHO) for many countries have largely been general in nature. The quoted financial figures often refer to the costs incurred in attempts to eradicate either malaria and or bilharzia, in addition to costs associated with research. While the recorded financial costs are generally very high, and for those countries concerned, represent a major diversion of scarce resources from other beneficial uses, they represent however, only a fraction of the overall economic cost which these diseases impose on the affected economies.

A full analysis of the economic cost of malaria is made more complex by the fact that malaria occurs in combination with secondary infections; many of these are promoted by factors which have little to do with irrigation per se, but stem from the more general problems of low rural incomes and poor living conditions. Thus, malnutrition and pneumonia are very common features in all peasant families. When these combine with malaria the result can be fatal. It is clear that the cost of medicine needed for curing malaria has clearly to be added to the cost of curing the accompanying secondary diseases, but this raises problems of separating those costs relating to malaria alone and those to secondary forms of infection. Import bills can be valuable source of cost data relating to the cost of importing medicines, preventative drugs and insecticides. Unfortunately, there has been no deliberate effort in Zimbabwe to separate, these bills. Likewise, pesticides import data can only yield a very partial insight, since they include pesticides which are used to control other pests including animal and crop pests. Any effort to separate malaria related data from these bills would produce results that at best are only rough estimates.

Unrecorded estimates by the Ministry of Health officials put the cost of importing malaria drugs upwards of $500,000 per year, the greater part of this in foreign currency, while that spent on importing insecticides plus the cost of controlling mosquitoes is put at above $2 million annually. These figures do not however indicate, in the case of the drugs, how much of the imported medicine per year is actually used, and how much stays on the shelves of shops for years. Besides, the import bill figures reflect only what has been bought, which in turn is a reflection of the foreign currency allocation procedures, and not of demand, and certainly not a reflection of the cost to be paid to reduce or eradicate malaria. Clearly import data alone cannot be used as an indicator of the cost of the disease.

Any attempt to assess the full costs (which is not made here because of lack of data) should involve the production of monetary estimates of the increased need for medicare in the absence of import controls, including the provision of clinics and hospitals, increased staff numbers, the cost of training malaria specialists, and the cost of malaria related research. However, such data would still be unable to determine the full damage in human terms. No monetary value can adequately measure the worth of lost lives, or the declining quality of life which the disease imposes on the sufferer. The victim's willingness to pay a higher price than that paid by the state, in order to get rid of the threat of death and suffering, is likewise a poor measure since it is proscribed by the victim's inability to pay. This means medical receipts of individual medical purchases cannot be used as the price the individual is prepared to pay to get rid of malaria. The fact that medication for the poor receives public subsidies further complicates both the data collection process and the analysis. Inevitably, it becomes a public sector choice as to whether disease reduction is worth the investment involved.

Hypothetically, it could be argued from the view point of the economy as a whole, that the cost of death from malaria for an irrigation worker is the lost value of his labour to the economy minus the savings in compensation. However, such opportunity cost calculations apart from raising ethical questions, have little meaning given the high level of unemployment in the country and thus the low real value of labour. Moreover, malaria affects even the unemployed and children, which renders the analysis still less meaningful. In such circumstances, it is quite possible for malaria to yield net apparent economic benefits to the economy, since each death reduces the consumption of goods, services and government grants. In the same vein, the statutory minimum wage for irrigation workers of $95 per month (1985/86) can be regarded as being more than adequate compensation to the workers, given their near zero opportunity cost. But this mechanistic approach to the problem is so devoid of empathy that it has no chance of ever being considered as part of the planners' approach to project appraisal, least of all in a socialist society.

Unlike malaria, bilharzia has been studied at length at the Blair Research Station in Harare, at the De Beers and at Chiredzi Research Stations. A great deal of research work by Evans, Shift, Clarke, Barnish, Makura and Chandiwana (Chandiwana 1984) has centered on the experimental use of chemical molluscicides and other control measures. The studies have not yet moved away from the medical bias to the assessment of the economic implications of bilharzia. As was the case for malaria, no cost data has been compiled on bilharzia, nor has a register been kept, of the additional medical and research costs which bilharzia has imposed on the economy. The spread of the disease throughout the country (Fig I and II) means that nearly every clinic and hospital has to spend a certain amount of time and money on bilharzia. In fact, bilharzia has long stopped being purely an irrigation related disease, and is now a nation-wide menace. The high cost of collecting data on costs nation-wide is a major constraint, especially in the absence of a tradition or a conscious effect to collect data, and so is the lack of trained personnel to do such a job. As such, the study examines a few research works and foreign experiences as indications of the seriousness of the disease and its economic impact.

For example, the Blair Research Station's Research Unit at Mushandike Dam and irrigation schemes is trying to answer some of the problems raised here. Such experiments are naturally long term and very expensive. For example, a nine year experiment on the control of bilharzia at Triangle and Hippo Valley irrigation schemes cost US$696,000 or US$249 per km2 covered, in 1979/80.

Table 7.3 is an example of the costs of some of these studies. To these figures must be added the cost of actually implementing the result and outcomes of these studies nation wide, plus the cost of medication just as in the case of malaria. The problems here are similar to those discussed under malaria.

TABLE 7.3

COST OF EXPERIMENTATION

TIME PERIOD	RESEARCHER	ANNUAL COST (US$)	TOTAL COST	UP TO YEAR
10 Years	Evans	800,000	8 Million	1983
10 Years	Shift/Clarke	54,800	540,000	1973
9 Years	Shift/Clarke	696,000	6.3 Million	1979/80

Source:Ministry of Health, Government of Zimbabwe, 1984.

Unfortunately no other cost data is available in the country. Officials running the private Chiredzi Hospital, the only hospital in the country that has more than ninety percent of its patients as irrigation workers, refused to answer questions relating to cost of medication, cost of importation of drugs, and the provision of clinical data relating to frequency of infection among the workers. Two visits to the hospital failed to produce any results and all questionnaires were returned unfilled.

Studies carried out on the economic cost of bilharzia in other countries are considered below. For example, Farroq (In Obeng 1978) has analysed the loss of labour productivity and the costs of bilharzia control. He puts the economic cost of bilharzia at several millions of US dollars. His methodology is to turn the cost of control into the economic loss due to bilharzia. However, the weakness of this methodology which argues that bilharzia weakens the body and thereby reduces work effort and output, and by implication productivity, lies in the blanket assumption that all such physical weakness can be attributed to bilharzia. Ignored by Faroq and other researchers who share the same views are important factors that have been observed at most schemes in Zimbabwe, and naturally elsewhere. These include sheer laziness, loss of stamina arising from previous work conditions, poor living conditions at most labour camps, illnesses and malnutrition. Moreover the efficiency effect of bilharzia is not uniform among all workers; the effect varies with the duration of exposure to infection plus individual immunity responses. Clinical evidence suggest that the disease displays a symptomatic severity gradient ranging from mild, moderate to very severe. The implication of the gradient is that the efficiency effects of bilharzia are likely to vary according to differences in physiology.

Following Prescott (1979), the use of macro estimates of economic loss is rejected here. The aggregate figures produced have not stood the test of micro analysis. For example, by assuming that Egypt would save US$650 million if it eradicated bilharzia, macro analysis has assumed a costless eradication process. Micro analytical work by Prescott (1979), Weisbrood (1973/74) and many others, did not find significant results to support the much publicized hypothesis that bilharzia affects labour productivity and by implication profitability. Admittedly, all these studies did not look at the relationship between the worm load in each person and labour productivity, and the ease with which secondary effects can affect a bilharzia carrying person.

In Zimbabwe, attempts at assembling aggregate figures of the economic cost of bilharzia must include the cost of molluscicides and other related costs. This inevitably is a partial picture, and to this must be added such unquantifiable elements as the debilitating effects which leave suffers prey to secondary diseases. Taken together all these cost elements are a sufficiently high figure to deserve much greater attention by decision makers at project designing stage.

The eradication of both malaria and bilharzia has not yet become a conscious national policy, and the rate at which irrigation schemes are being built can only negate the adoption of such a policy. This implies therefore that national effort must be directed either towards the reduction in the expansion of investment in new schemes, or the inclusion at the project design stage of measures aimed at curbing both malaria and bilharzia. The later approach would obviate costly future expenditure on ex-post control measures.

However, it is ironic that the government has chosen, more by default than conscious design, to employ ex-post corrective measures in dealing with this problem. The focus has always been on the application of insecticides and pesticides; this has not only triggered resistance in mosquitoes, but also caused potentially harmful side effects to human beings. For example, women in the Sebungwe Valley have recently been found to have DDT in their breast milk, three years after DDT was sprayed in the area (The Zimbabwean Herald, July 1986).

TABLE 7.4

CASES OF MOSQUITO RESISTANCE TO INSECTICIDES IN THE WORLD BY 1980 (PRECIPITATED BY INDIRECT SELECTION PRESSURE, BY AGRICULTURAL INSECTICIDES)

SPECIES	COUNTRY	CROP	INSECTICIDE RESISTANCE
1. Anopheles Acconitus	Java	Various crops and rice	Dieldrin, DDT
2. A.Albimanus	El Salvador Nicaragua	Cotton* and	Parathion and Malathion Fenitroth-ion Propoxur, Carbaryl
	Mexico, Guatemala Honduras Nicaragua	Cotton*	DDT and Dieldrin

3. A.Culcifacaes	India (Haryana)		Malathion
4. A.Gambiae	Ivory Coast, Ghana, Nigeria Mali, Togo, Sudan, Burkina Faso, Senegal	Coffee, Cacao Groundnuts Cotton*, Cotton*, Various crops	Dieldrin Dieldrin DDT DDT
5. A.Melas	Zaire	Bananas	DDT
6. A.Pharaoensis	Egypt, Sudan	Cotton* Other crops	Dieldrin DDT
7. A.Quandri-maculatus	USA Mexico	Cotton* Cotton*	Dieldrin D D T , Dieldrin
8. Sacharovi	Greece, Turkey	Cotton* Rice	D D T , Dieldrin
9. A.Ainensis	China	Rice	Ocando, Op
10. A.Maculi-pennis	Romania,	All crops	Dieldrin
11. A.Melanoonsu -balpinus	Turkey	All crops	Dieldrin
12. A.Rufipes	Mali	Cotton*	Dieldrin
13. Aedes Aegypt	Tahiti	Coconut	Dieldrin
14. Aedes Nigromaculis	USA	Various crops	DDT, Dieldrin OP
15. Culexpipiens Fatigans	USA	Various crops	OP

Source: Bull, D, A Growing Problem, Pesticides and the Third World, Oxfam, Page 34, 1982

Table 7.4 shows a global picture of the cases of mosquitoes' resistance to some of the most powerful insecticides. An F.A.O. report (Ceres 1980) quotes that, the anopheles mosquito is resistant to over eight major insecticides. While greater application of chemicals has met with greater mosquito adaptability, the resultant failures have spurred manufacturing companies to search for even much more powerful chemicals. The search for a super killing drug has led to the production of biocides which are known or suspected carcinogens and mutagens, whose long-term continued use introduce a new dimension to problems related to dealing with environmental effects of irrigation agriculture.

The cost implication for Zimbabwe's cash crop based irrigation strategy are obvious. For example, the replacement of DDT with a more powerful malathion increases the farmers' costs by as much as seven times, while the use of the carbonate propoxur increases the cost by up to 27 times (Bull 1982). Only very rich farmers (not found in Zimbabwe) and multinational agribusinesses can afford to switch to these more expensive types of drugs. Clearly any ex-post measures that the country might choose to adopt are full of difficulties and very expensive. Indeed, even clinical treatment at hospitals like Chiredzi have to be regarded as palliative, because of the high rate of second and successive infection. The drain from the exchequer must clearly increase with the increase in the number of dams and irrigation schemes developed each year.

In conclusion it is clear that the amount of work carried out to identify and ameliorate the social and environmental externalities arising from irrigation is disproportionately small when viewed against the scale of the current and potential problems. The appreciation of potential problems has been slight, and the commitment by decision makers to their appraisal or monitoring has been minimal. Irrigation agriculture in Zimbabwe stands today as a classic example of socially and environmentally blind development. In suggesting lessons to be learned, the temptation is to call for the inclusion in the planning process of a sound environmental impact procedure (Environmental Impact Assessment (EIA) as employed in most developed countries. In many ways, however, the EIA is an inadequate straw to clutch at in the search for more environmentally and socially sensitive approaches to irrigation development.

Certainly there is a lot of logic in the use of the EIA framework, primarily because it is the only currently acceptable way of putting social and environmental issues onto the project planning agenda at all. Dams and irrigation projects are planned by engineers and demanded by politicians. None of these have any interest in the environment other than as something to be used for the benefit of people, and the EIA can bring particular issues to their attention which would otherwise certainly be ignored or remain unperceived. In particular there is a need for substantially greater investment in the collection of social and environmental data, with a stronger focus on longer time scales. This should not only involve detailed pre-project investigations and the preparations of social and environmental impact statements, but should also contain specific provision for continuous monitoring and for follow-up studies in the form of social and environmental audits.

These recommendations are made here with the full realisation that the prerequisite to their adoption is the missing political willingness and commitment to such a procedure, even if it should come to mean less dams and less irrigation schemes. In the absence of this, social and environmental provisions will simply be grafted onto an existing project appraisal system as an after thought, occupying a very peripheral position, as is the case at present, to the decision making process.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATION

INTRODUCTION

In this study an attempt has been made to evaluate the past and present public policies for the development of irrigated agriculture and to assess the consequences of implementation practice. Both public policies for the production of bulk water supply capacity, and the subsequent investment in irrigation infrastructure, by both state agencies and private producers have been assessed. Throughout, the performance of the state in producing water, and that of the irrigation sector (commercial and peasantry) has been analysed in terms of economic efficiency and equity.

Conceptually, the framework of cost-benefit analysis was adopted, but clearly this had to be adapted to deal not only with the particular socio-economic and political context within which Zimbabwean investment policy must operate, but also with considerable data defects. Theoretically, cost-benefit analysis would require that both the public and the private sector investments in water and irrigation projects must generate net benefits. However, as was discussed in Chapters 2 and 5, in most countries, and certainly in Zimbabwe, the question of who obtains these net benefits is a relevant consideration.

The rationale behind the adopted theoretical framework is based on the fact that the investment of scarce resources into irrigation and water projects represents a cost to society in lost opportunity terms. Therefore it is very important that both the investment capital and the resultant fixed capital assets are used optimally. Given that 'optimality' is a difficult concept to define and still more difficult to achieve, the baseline requirement must be that the chosen projects at least produce benefits which exceed the discounted total investment and running costs. While this is a requirement crucial for all forms of investment in any less developed country where capital is a scarce factor of production, it becomes particularly pertinent in the water case since the developed capital facilities are use-specific; the capital therefore becomes locked in and cannot be employed to produce other goods more highly valued by the farmers and consumers.

The advantages and disadvantages of the adoption of the cost-benefit framework, particularly for the commercial irrigation sector, were discussed fully in Chapter 2, and need not be repeated here. In the case of the peasantry sector, the use of the cost-effective analysis method was to find out if the chosen projects had achieved the set policy objectives of equity at least cost. While the full cost-benefit analysis or cost-effective analysis for any of the projects involved, was not carried out, the use of the macro-analytical approach is to ensure a consistency of analysis, and as comprehensive an assessment as is feasible given data defects. The normal procedure of assessing each project individually and then drawing generalizations from the results of all the projects was not followed here because of the paucity (indeed in some areas the complete absence of) important items of data.

The results of a study of this type must inevitably be somewhat speculative. However, what evidence there is clearly points to a number of issues which must be addressed if the efficiency, efficacy and equity of investment in irrigation and agricultural productivity are to be improved. The analysis of the economic and investment policy issues was carried out against the background of an economy that is experiencing sector-wide declines both in the short and long term. The negative economic growth rates are the key factors constraining the generation of resources needed for investment in water and irrigation agriculture. This factor puts a premium on, and increases the opportunity cost of any investment resources that are generated.

It must therefore be considered, at least in theory, that the scarce investment resources would be directed towards those water and irrigation projects where they would realise optimum benefits. However, in the real world, scarcity of investment resources has not often been associated with the need to realise 'optimality' largely because of political considerations. As the discussion in Chapters 5 and 6 shows, the allocation of scarce investment resources has often defied economic rationality, certainly it has defied optimality as defined by welfare economics. The allocations are inevitably sub-optimal in Pareto terms, especially since allocation is based on a less rigid criteria. The results from this form of allocation are even more dubious as the benefits and the costs are undiscounted. The result has been the development of uneconomic projects, and the premature development of bulk capacity water supply facilities, ahead of any economic demand.

Apart from the above negative economic background, the study also had to be conducted against the backdrop of a society that is in a process of recovering from the effects of the structural dislocation caused by the 15 years civil war, a society that is still experiencing wide ranging imbalances, which are a carryover from the past. These imbalances have resulted in extremely uneven distribution of income, and spatial inequalities, particularly between the people of European and African origins, reflecting a correspondingly skewed distribution of the means of production and uneven access to development opportunities in the past. But inequality in terms of access to high quality land shows that a few private domestic farmers and external agribusiness concerns, have had a greater control over most of the best agricultural land (Chapter 3). Over 40 percent of the over 700,000 peasant farming families are experiencing landlessness and general poverty.

The central point at issue is whether investment in irrigation agriculture is <u>the</u> best way for the country to fulfil its dual objectives of economic growth and equity.

The existence of three separate sectors (the commercial, the peasantry, and the water development sector), all responding to, and indeed controlled by, different policy objectives, have complicated the appraisal and made it more difficult to produce one generalised set of conclusions, valid for all times and for all forms of irrigation.

Public Investment in Water

It has been shown in the study that public investment in raw bulk water supply was not based on any economic efficiency criteria, that could, at least in theory, bring about the optimal allocation of investment resources between competing water projects. Theoretically, allocation efficiency, in determining the level of investment in water projects, requires that public development agencies employ efficiency pricing systems, in the allocation of resources. Although application of efficiency in practice will always be difficult given the problems of definition and implementation, any attempt to relate water production costs to the prices charged for this water, would constitute a great improvement for a country that is experiencing investment capital constraints, and is financing most of the investment from borrowed resources.

At present, in the absence of any irrigation water demand forecasting, public investment in new bulk water storage facilities is not directly liked to any expressed economic demand for water by farmers. There has been no research in the country, to establish the actual relationship, for all existing storage facilities, between storage capacity and water use-efficiency at the farm level. This information is very important in indicating the maximum number of farmers that could be served from existing facilities, before any new dams were constructed. Investment in additional supply facilities would then reflect incremental demand for water, which in turn would reflect the extra benefits to be realised by the farmers using the additional water resources, sold at a price reflecting the cost of producing the water.

The findings of the study show that existing investment policy has tended to lead to the premature development of capacity, in the sense that the problems of crop failure and/or famine or droughts, have come to be seen as problems of the absence of dams with enough water capacity for irrigation purposes. Solutions to problems of landlessness, regional backwardness and rural poverty and deprivation, have also come to be sought through the development of irrigation agriculture. Investment requirements are determined administratively on the physical potential criteria, rather than on the basis of attempting to optimise the returns on the capital invested. Less attention was paid to maximizing output of agricultural returns using existing water storage facilities. It has been shown that this bias towards premature over-provision is due to a number of factors:-

First, in the past additional supply facilities were developed easily and cheaply, for very few farmers, thus lessening the need for economy in investment. It may well have cost more to ensure that available supplies were used to best advantage than it did to provide new dams. Such a situation no longer exists. In the tropical developing countries of Africa which have marked dry and wet seasons, and whose agriculture partly depends on irrigation, water is in the transition from being a virtually free good to becoming an expensive manufactured product, the competition for which is increasingly intense. In Zimbabwe this is evident from the high amount of capital resources on the national budget, that are increasingly directed towards water production.

Second, water provision for irrigation agriculture has always been dominated by pro-irrigation public bodies with a vested interest in maintaining the construction of large dams and output from irrigation, such as the Ministry of Energy and Water Resources and Development, the Ministry of Lands and Agriculture, and the Regional Water Authority. The position taken by these public agencies is reminiscent of the activities and operations of the Corps of Engineers in the United States of America up to the mid 1960s (MacKean 1958, Hirschleifer et al 1960, and Maas 1962). Moreover, the executive agencies, (the Regional Water Authority, the District Development fund and the Department of Water

Development), are freed from the need to make profit and from the financial constraints that inhibit the operations of other sectors in the economy.

There has, therefore, been even less pressure to provide storage facilities using cost-minimizing techniques. The position has been made worse by the absence in these agencies of an analytical framework within which to evaluate and prioritise investment options. At the base of this problem is the organizations' lack of professional capability to carry out efficient investment functions, and to formulate policy and institutional alternatives. The agencies have so far failed to take into account a wide range of conflicting economic and social objectives, that call for appropriate balancing and explicit evaluation of trade-offs. Instead, in an attempt to guard against unexpectedly rapid increases in future water requirements and cyclical droughts, they have normally allowed capacity construction to take place well ahead of expressed demand by farmers. In the establishment of these supply safety margins, no attempt has been made to relate the high cost of investment against expected benefits.

Third, the prior appropriation water right system (Water Act, 1976) enshrines the rights of riparian farmers to existing water supplies in perpetuity, and at low historic prices. No reference is made to the farmers' water-use efficiency or to the equitable and efficient allocation of the available water between increasingly competitive agricultural demands. This permanently fossilizes old, possibly inefficient, uses, and therefore new demands can only be met through the development of further storage facilities, but these new consumers are provided with supplies at similarly low prices. This way, a self perpetuating cycle has been established and possibilities of challenging the water right system, without alienating the farmers, are politically slim, given the fact that farmers acting together are a powerful political 'constituent'.

Fourth, most of the public water development agencies are run by engineers, trained to construct dams rather than to ensure that the need for more dams is minimized. The dominance by the engineers of the advisory and policy formulation functions has led to the observed over emphasis on capacity extension, as a solution to water supply bottle-necks, and to the neglect of efficient water use measures designed to reduce the need for new facilities. To date the engineers have failed to perceive that non-construction measures exist which could increase the effective use of water in existing storage facilities, and thus allow a balance to be achieved between demands and available supplies. Technical and financial assistance from overseas has tended to reinforce the existing preoccupation with the 'monument syndrome', largely because donor agencies, like the host government perceive mutually beneficial political capital in the construction of dams. Foreign debt burdens arising from investment in dams, have often been passed on to other sectors of the economy.

The absence of an efficient project selection criterion means that decisions that are made and the projects that are chosen are largely based on non-economic criteria. As a result, a number of non-economic features can be observed:-

1) The choice of capacity extension schemes almost always falls on those that yield economies of scale. The implied advantage is however, always lost because of the fact that the resultant water resources are not always used efficiently, because the water pricing system does not promote efficiency. Discounted cash flow techniques and other optimising techniques are not used at all. This is largely because engineers are not trained in them. Where donor agencies offer these services, their efficacy is undermined by the fact that no dam construction project has ever been rejected on the basis of failing to pass the efficiency test. All water projects, good or bad, end up being developed.

2) As the rate of inflation has been rising rapidly,

engineers have often argued with the Treasury, for the need to build as many planned dams as soon as possible, since building them in future would cost more. They ignore, or fail to see, the fact that inflation is irrelevant to the argument, and the fact that the very high number of these projects all planned in a single fiscal year is inflationary.

3) In the absence of demand forecasting the apparent need for new facilities is determined by crude extrapolation methods; by pressure from farmers; or simply by the need to be seen to be doing something.

4) The 'once and for all times' price setting system reflected the need to generate sufficient revenue to cover costs as measured in accounting terms. Price levels were not adjusted for inflation nor were they set to reflect the scarcity of water or the high cost of producing it. Demand control through the price mechanism has not been considered as the Ministry of Energy and Water Resources and Development's function. The preoccupation has tended to be with the lowering of prices of water and attracting greater use of water. This is largely because, despite the high per unit cost of production, water has been treated in social service terms. For some reason, water officials exhibited a high degree of hesitation to annoy farmers through high (but essential) water charges, although there was little evidence to suggest that the farmers would resist such charges. This implies that vital data on the individual farmer's ability to pay and/or willingness to pay has not been collected, nor is there any plan to use such information in the formulation of future water pricing policies.

Investment in repairs of leakages, particularly for the peasantry sector where water is in fact supplied through unlined canals, is far less than that directed to capacity extension. While it may be appreciated that canal lining may be expensive, a clear cut cost relationship between the cost of lining and the economic value of the water lost by not lining, needs to be established and used when the 'to construct or not to construct' decisions are being taken. This procedure is not followed at present.

At the farm, farmers have not been dissuaded from the water flooding irrigation technique (60% of commercial irrigation schemes and over 95% of peasant schemes) which allows for over application and greater water losses. This is despite the fact that officials are aware of the alternative water-use efficient sprinkler system, which although expensive to install can reduce drastically water wastage.

The sprinkler system has the added advantage of delaying the likelihood of leaching and water-logged conditions setting in, helping to prevent the future occurrence of soil salinization, which in future would cost much more to correct as shown by the California example (Pringle, 1982). There is however, little private incentive for water economy, where water prices have not necessitated the development of technologies to increase water use efficiency at the farm level, nor have the farmers been imbued with a water management consciousness. In the case of small scale farmers, the fact that water is provided almost free, means that the incentive for conservation must be zero, while that for over use and/or application is unconstrained. The result is the false perception, by all farmers engaged in irrigation, that water is plentiful, a perception which reinforces the tendency for demand to be artificially escalated.

The neglect of investment cost minimization and water use management techniques can partly be explained by the high level of institutional fragmentation (Chapter 3 and 4). In the absence of common operational guide-lines, the Regional Water Authority has pursued its own policy to develop the Sabi-Lundi Valleys for commercial irrigation, with little or no coordination with the Ministry of Energy and Water's investment strategy. The independence of the Authority from Central Government control has meant that the Authority often promoted the advancement of its own parochial interests, with little regard to whether its investment fitted or complemented other sectoral development efforts in the region. If anything, the Authority has tended to set up congenially beneficial operational procedures between itself and the cliental farmers, that could not be duplicated elsewhere in the economy.

At the national level, the Ministry of Energy and Water's activities were normally defined solely in terms of providing dams, the subsequent responsibility for water end-uses lay with the Ministry of Lands and Agriculture, and the Department of Rural Development. Since these departments were more agronomically inclined, the responsibility for instituting water use management practices became no one's responsibility.

Among the water officials, it is, for example assumed, in the absence of any research evidence, that the introduction of any management techniques would be widely unpopular and resisted by farmers, and that if the introduction of such mechanisms were price-led, there would be a public outcry by farmers and politicians from farming constituencies.

Recommendations on water pricing

Most of the recommendations made below will largely remain an act of faith, until there is real political commitment to reviewing the existing investment policies and practices affecting water and irrigation.

It is recommended that, if investment efficiency is to be realised, the current costly duplication of administrative structures should be ended. This can either be done by creating a single body (the Water and Irrigation Development Authority) that combines water and irrigation development responsibilities. The body would be autonomous or semi-autonomous with the operational requirement that it makes profit from water sales, and that it finances all the expansion of additional water facilities and irrigation agriculture from its own savings. An exception to the commercial criteria could be made where demonstrable political considerations of equity would demand that cheap or zero priced supplies are provided for peasant farmers, however in this case some physical controls would be needed to ensure that water misuse did not occur.

Any policy that is leaning towards charging economic prices for the water, would not only increase revenue levels, but, in the process, the policy would inevitably induce water use management awareness among farmers. This in turn would induce more efficient use of existing facilities and thus would lower the demand or delay the construction of new facilities. The proposed body would also have the incentive to employ all technical methods such as demand forecasting models, and extrapolation methods in its effort to achieve efficiency. The present system where revenue returns are not realised by the water bodies, but by Treasury, would be abandoned. Technological efficiency may therefore be able to increase yield in existing dams and in the process curb the need for capacity extension.

But these economic advantages would also have costs. Inevitably there would be some shrinkage of the area under irrigation, and this will in turn result in some income and job losses.

In determining prices to be charged to the farmers, the bottom line should always be the need to ensure that schemes developed do not collapse for lack of resources.

Under these conditions, the possibility of drawing up a social contract between the state and the peasant farmers, could arise, whereby the state would direct most of the donor grant aid resources towards covering most of the capital costs, and the farmers paying fully for the operation and maintenance costs in perpetuity.

In the case of the commercial irrigation sector, the low water prices have allowed the growth of unconstrained demand for water. Farmers have therefore often been able to procure more water under the water right system, than they actually need. In Mashonaland, the prevalence of small private dams (Chapter 3), has come to mean that in good rainfall years, less water is taken by farmers from the large dams than they are entitled to under their 'right' agreement. But since under the current water pricing policy farmers are only required to pay for what they actually use and not for what they are entitled to take, large quantities of water are thus sub-optimally allocated, and revenue is lost to the state. A revised pricing system based on economic prices, should induce farmers to relinquish rights to some of their entitlement to bring 'right' levels close to actual use. In this way it would be possible to reallocate the released waters to new farmers, and thus obviate the need for investing in new costly dams. The growth of a water market should be encouraged and its operational mechanisms assessed, by future research work.

While the great majority of farmers have now shifted towards low cost, but wasteful flood irrigation, a revised price structure should induce farmers to invest more into those spray or drip irrigation technologies that would cut down wasteful water use. In the long term, these proposals would remove the necessity for water rationing during drought years as more water would have been conserved by careful use. For example, during the 1982-84 drought, the low water price allowed over use and wastage of water to continue, such that by mid 1983, most irrigation schemes had to be closed or were forced to operate at half capacity. These measures, while they effectively dealt with the severe problems encountered at the peak of the drought, were however not part of a conscious demand management policy. The need for control has always arisen by default as a manifestation of crisis management and as a result of the lack of a permanent overall water management policy. This problem, far from being restricted to irrigation, is also prevalent in the urban domestic and industrial water supply system, where temporary water restrictions in dry months are followed by the absence of any in wet months; therefore leading to constant supply bottle-necks.

The pursuit of efficiency must mean the need for the revision of the present irrigation agriculture policy. But change is not a costless process, so the cost-benefit analysis of the proposed change needs to be examined and assessed.

Investment in Small Scale Peasant Schemes

Public policy on the development of small scale irrigation sector schemes was shown to be subsidy based; most costs are not recovered from the beneficiaries, and the state pays over 80 percent of the operation and maintenance costs at every scheme. The historical reasons for the establishment of these schemes, namely the accommodation of the displaced and landless peasants, was discussed in Chapter 3. Present day enthusiasm for small-scale irrigation is ironically based on similar reasons despite changes in the political situation. Economic considerations have often appeared as an after-thought or by default and only when it was discovered that the schemes were becoming an unbearable financial liability to the Treasury.

Chapter 6 has discussed the practice and implications of the subsidy-based policy. It was also shown that state subsidy went beyond capital outlays to embrace the ever increasing service costs. The open-ended subsidy-based investment policy must assume that small scale irrigation represents the optimal method of tackling gross inequality in income, poverty and landlessness all of which affect the peasants. In other words, the existing rainfed peasantry agriculture is considered by policy makers as the undesirable state from which peasant farmers must be moved, and the irrigation subsector, as the future ideal.

This conclusion is determined by the fact that, in dollar terms per hectare, government is spending on small scale schemes an average of approximately $5,000 per year (1983/84 prices), whereas it spends less than $2 (1983/84 prices) per ha per year on rainfed farmers: a ratio of 2,500 to 1 in favour of irrigation agriculture. In purely financial comparative terms therefore, the policy has set a prima facie case for irrigation agriculture development, at the expense of rainfed agriculture.

Chapter 6 has also shown that the officials of the Department of Rural Development, freed from the necessity for economy in investment, have gone ahead and developed, in a period of five years, nearly 80 small scale schemes, almost all of which are uneconomic. The officials make no pretence about the fact that most of their schemes are uneconomic, and incapable of sustaining themselves in perpetuity.

Indeed the argument at public meetings was that these schemes should not be judged on the basis of their economic viability but on equity grounds. The thinking was that, the heavy subsidy input would enable these schemes, in total, to deliver income equity to the beneficiaries. It has become clear that the achievement of equity and its sustenance through these schemes would continue to require the payment of more subsidies from the state.

In addition irrigation uses large numbers of expert labour per scheme compared to the peasant farmers on rainfed lands. The level of state subsidy, already high, will continue to increase, largely because of the spiral rise in the rate of inflation and the high interest rates and debt service ratio on borrowed capital. In the absence of these subsidies, small scale irrigation produces the same or even less benefits when compared with rainfed agriculture, and that in numerical terms, the number of families benefiting from irrigation subsidies are far fewer than those outside the schemes.

It is axiomatic that any large scale capital investment must involve intertemporal (or intergenerational) choices, choices between consumption and savings, or alternative investment directions, overtime. By choosing to use subsidies in the development of small scale irrigation and water schemes, the government has implicitly chosen to allow consumption to take precedence over saving in the short-run and inevitably this reduces the level of resources available for other investments. On the other hand, the present pattern of investment is sure to leave a legacy of uneconomic and inefficient projects for the future generations, a legacy in whose making they will have had no say. This is more likely to happen with irrigation agriculture development where the physical transformation of the land is semi-permanent rendering the land unusable for any other purpose without costly corrections. It is clear, therefore that given the foregoing assessment, the present policy rejection of allocative efficiency as an investment criterion can only lead to future bankruptcy of the schemes and heavy cost burdens for the state.

The study has shown that subsidy-based investments tend to be tied to time tables reflecting the political cycles of the politicians involved. This political exploitation of the process of development is not unique to Zimbabwe. Reference has been made to similar cases in the USA.

Typical of political expediency, the government ignored two warnings that were available to it, against such a policy. Historical evidence within Zimbabwe (Roder 1965) showed that the strategy had failed before. Farmers were often very unwilling to accept any future changes to the privileges subsidies conferred. This is likely to happen again, especially if the proposed final takeover of schemes' management by the peasants is to be accompanied by the removal of state subsidies. Already, of the 76 schemes in 1984, only 54 were reported to be operative while 22 of them (nearly 30%) were out of action at the beginning of 1986 due to a combination of technical and managerial problems. Where the schemes were out of operation either due to prevailing technical difficulties or future abandonment, the capital resources invested in them was inevitably lost.

While withdrawal of subsidies will be politically unpopular, even vote-losing, it may in reality, be the only way to save the economy from a long term heavy liability. The Treasury has already shown its unwillingness, indeed, its inability to continue to finance uneconomic projects.

With respect to the failure of small scale irrigation schemes to alleviate land hunger (Chapter 6) and consequently rural poverty, there is a need to explore alternatives to irrigation. It is recommended here that the government should investigate the possibility of instituting as part of the land reform policy, a land sharing policy requiring that commercial farmers lease a certain percentage of their land to peasants (on both rainfed and irrigation farms). Evidence of this strategy can be seen in the limited programme of ARDA's core-periphery model where by ARDA provides technical assistance to adjacent resettlement schemes. This recommendation would fulfil positively, two government development objectives. This would enable current landless peasants from overcrowded communal lands to utilize the existing unused capacity (Stoneman, 1978) on most commercial farms, and thus allow those remaining in the communal areas to be able currently to adjust their land use practices so as to realise high economic returns from their investments.

A 'land-for-all' policy is suicidal and can not be fulfilled by any government. Instead, the policy should seek to make land available to those who can use it efficiently. For this to happen, it is recommended that a land-tax should be put in place, given the failure of the land market to release land, so as to force farmers to sell excess and under-utilized land to those who can use it. The use of a Land-tax will ensure that land would not be held purely for speculative purposes only. There is a need for further study before it can be implemented, and the study should also examine why the land market has failed to release land to higher value uses. The inevitable future need for land for resettlement would largely be eliminated this way. Away from the land issue the government would need to improve all other sectors of the economy, so that the unemployed or the excess out of the land are absorbed by other sectors of the economy.

The costs involved in implementing such a policy would be minimal compared to current irrigation costs. In line with this policy recommendation, commercial agriculture would not be affected negatively, but complement the efforts of the peasantry sector.

Other Subsidies

Traditionally, and historically, Zimbabwe's agricultural sector, particularly the commercial sector, has enjoyed a very high level of infrastructural service provision at government expense. The present government has not altered this nature of service provision, and if anything, incremental policy changes have tended to strengthen this level of provision. Chapter 6 has shown that a whole range of supportive services must accompany the development of each small scale scheme. The level of provision is far higher than that found in the rest of the economy especially the rainfed sector. It would therefore appear, that on the basis of publicly supported developments, there is gross inequality of service provision between peasants on the schemes and those on rainfed agriculture. The fact that this differential is a result of deliberate public policy, implies that the subsidy-based irrigation policy, far from 'equalizing' rural incomes, has the opposite effect.

The range of subsidized infrastructural services for the commercial sector were discussed in Chapter 5. The main weakness behind the policy, was that the farmers (peasant and commercial) who could have been able and most probably willing to pay for most of the services they receive, were not made to do so.

The study recommends that all commercial irrigation farmers must be required to pay for all the services they receive. In the case of peasant farmers, their ability to pay must be assessed in relation to the income they receive, such that, farmers earning higher incomes meet fully all costs accruing to them. The state would only continue to help those who are in real need of help, and at that, only for a short time until they are able to meet their own costs. The current open subsidy policy on inputs and services cannot be allowed to continue as it fails to take account of changes in the incomes of farmers and their ability to pay.

Of course the public pro-irrigation technocrats whose employment security and promotion prospects are enhanced by the push for more dams and irrigation schemes, will resist any changes that may appear to threaten their vested interests. But a long-term analysis would show that their interests are best served by seeking economy, and efficiency in investment.

<u>The Benefits from Commercial Irrigation Agriculture</u>

Theoretically, commercial irrigation agriculture should lead to a number of economic benefits; first, it is expected to enable the country to earn substantial foreign currency from the exports of the crops grown. Second, the production under irrigation of crops that would otherwise not grow in the country saves foreign currency losses from the importation of these crops (import substitution benefit). Third, irrigation agriculture is associated with the increase of employment opportunities, and offers year-round employment. Fourth, in its relationship with other sectors of the economy, irrigation is expected to provide a sounder (than rainfed agriculture) raw material base for the agro-industries in the local economy (high linkage advantage). Above all, as discussed in Chapter 5, irrigation agriculture is expected to increase crop output beyond those obtained under rainfed conditions, and to enhance regional development as well as acting as a stop-gap against famine caused by droughts. Theoretically therefore, commercial irrigation agriculture must enable the economy to expand, and in the process must improve the wealth and welfare of the farmers and workers greatly.

In many respects, the study has shown that this ideal picture (theoretical) has been responsible for attracting many investors and government into commercial irrigation agriculture, in the belief that the ideal was achievable. Besides, the use of cost-benefit analysis (where they are used) in aiding investment decision-making, often assumes that the ideal economic situation would prevail. While the real investment experience in the field of commercial irrigation from both the United States of America (Pringle, 1982) and Australia (Davidson, 1969) would suggest much wider divergences and deviations from the theoretically optimal or ideal, governments from the rest of the world including the two countries above have not relented in the pursuit of the ideal and often elusive, benefits. However, recent changes in pricing policies have seen the introduction of tradeable water permits and increased unit abstraction charges in the rich nations. Future studies should examine these changes in relation to possible application in Zimbabwe.

This study on the Zimbabwean attempt, has shown that a whole host of factors have prevented the 'full' realization of the ideal set of benefits. Before providing a summary of some of the factors identified in Chapter 5, it is important to note that, in the absence of some very important items of data, the assessment took a macro-view of the industry, and in the process lost the advantages of a micro-analysis. The missing project specific micro-data includes data on private production cost outlays and on net income earnings per farm or agribusiness. Farmers were unwilling to cooperate in providing the required data. Their suspicion and uncooperative attitude became evident when they knew the researcher was a government employee; possibly for reasons of taxation.

In the absence of micro-data the study concentrated on a macro analysis of the whole commercial irrigation sector, in order to produce generalizations that reflected the benefits realised by the whole sector. Identified benefits showed that while crop output was higher under irrigation, for those crops that were grown both under irrigation and rainfed conditions like tea, coffee, tobacco and cotton, the marginal increases due to irrigation appeared not to be substantial.

Future research will need to focus on improvements in production technology, and in seed culture, under rainfed conditions, in order to assess whether, in theory at least, the small difference due to irrigation could be realised under improved rainfed agriculture. It is possible that the use of irrigation for very marginal increments in output levels may have precluded the future use of agrotechnological innovations in the rainfed agricultural sector.

In future, before expanding irrigation agriculture for crops that do well under rainfed conditions, technical solutions should be sought first that will enable the achievement of the same benefits under rainfed conditions. This way, the full potential of less costly rainfed agriculture could be realised, leaving irrigation to high water demanding crops such as wheat, rice and sugar cane. The choice between a technological solution to crop production, and irrigation, has got to be based on the comparative economic benefits that could be realised in pursuing each investment path.

The dominant multinational agribusinesses have the capacity to develop such technologies. The aim should be to develop seeds or crop species that, under rainfed conditions, would use less water, ripen over a shorter period, and achieve higher yields. Zimbabwean researchers have in the past produced a maize crop variety (R200) that has a short growing season and high yielding advantages. The new maize is doing well in drier areas where the rainfall season is very short.

Although it was not possible to show the actual individual profitability of the farmers and of the large scale schemes, the general information available from agricultural statistics (Chapter 5) shows high levels of commercial farmers' indebtedness (Chavunduka 1982). Stoneman (1981) concurs with these findings when he argues that only 5 percent of all the commercial farmers were able to pay tax, and that these are mostly multinational companies, who are at the same time responsible for the production of 60 percent of the entire commercial crop. On the basis of this information, it has been speculated in this study that only very few commercial irrigators were profitable most of the time. But since the greater part of commercial irrigation agriculture is directed towards the export market, profitability is predicated on the attractiveness of the world market prices and on their stability over time.

Part of the explanation for the assumed low levels of profitability and even bankruptcy was explained by the fact that commercial irrigation agriculture was dominated by high value cash export crops for which high international prices could not be assured from year to year. The most affected crops are sugar, tea and coffee. While sugar could rely on revenue from domestic and regional sales to cover running costs, its export record has been very poor since 1980. The low domestic demand for both tea and coffee (because of a poor domestic market) and a poor export market has meant that producers have had to be subsidized by the state in order to continue in production. The situation is made worse by the fact that Zimbabwe is a small producer and a price-taker for all the crops it exports.

The study has argued that the farmers have continued to produce these crops largely because the government has allowed producers generous tax concessions, and has often written off bad debts of most farmers to the Agricultural Finance Corporation and other finance houses. In the USA, similar measures were instituted to encourage farmers to remain on the land, as part of the frontier policy (McKean, 1958). In addition a number of inputs such as fertilizers, water and insecticides are sold to farmers at subsidized prices. An array of supportive services such as research, extension and transport, developed at the state's expense have enabled to reduce the full cost impact of the factor costs on every farmer's resources.

The study has also argued that the government has been seeking guaranteed quota marketing agreements and futures markets whose price levels are much higher and guaranteed than those on the spot market. However, the conditions listed above are temporary in nature. The government has been looking at the economics of producing all inputs within Zimbabwe to save on foreign exchange losses. However such a solution will still need to address the foreign exchange requirements for the production of these inputs, as well as the economic size of such industries to the size of the home market, and the possibility of selling surplus in the regional markets of both the Preferential Trade Area (PTA) and the Southern African Development Coordination Conference (SADCC).

There is also a need to move away from crops that have little or no domestic demand in favour of those that can produce raw materials for local industries and can provide food to meet domestic requirements. A raw materials export-led irrigation strategy can only be a recipe for doom, especially when crops produced at high cost in Zimbabwe compete on the world market with those cheaply produced from the major producing countries. There will be a need for substantial beneficiation in order to increase the value added realised by Zimbabwe from growing these crops. However substantial cuts have to be incurred up front establishing these beneficiating industries, and this will require a lot of foreign currency that the country has not got. The case for tobacco has to be viewed with respect to the growing international anti-smoking campaigns, which although insignificant at the moment, could in future produce the devastating effects similar to those that have hit the asbestos mining industry.

Despite the negative implications of an export-led irrigation agriculture, at present, to try and move away from it would raise problems of what else to export to obtain foreign exchange, especially when the minerals industry is equally suffering from price recession, and the livestock industry is beset by the continuous outbreak of the foot and mouth disease. Cash crops have traditionally been the backbone of the country's economy, and only recently has manufacturing featured and performed better than agriculture in the share of the national growth domestic product (Chapter 3). For these reasons, the state is unlikely to move away from supporting the export-led irrigation agriculture strategy; even if it is proven (see Chapter 5) that the commercial irrigation industry remains a high risk investment area. Recent positive trends in the horticulture industry point to profitable alternatives which need replication on a wider scale.

Many producers live in hope that international prices for these crops would improve again. For example, the 1985 tea sales reduction by India pushed up the price of tea on the world market. Such intermittent price windfalls do not provide the basis for a stable price policy or for a long-term investment strategy. The prospects for crop price rise on the international market, in the long term, remain bleak.

From a foreign exchange point of view, the study showed (using crude statistical data), that the purchasing power provided by agricultural exports rarely kept pace with the price of agricultural machinery imported from abroad. As a result, the increasing volume of cash crops sales has not been able to improve the country's declining foreign exchange reserves. The country has increasingly come to rely on expensive foreign loans and commodity import programmes in order to be able to procure the required agricultural machinery. The consequences of this situation is that ever larger quantities of agricultural products must be exported in order to import a constant quantity of farm inputs.

Even a good price year brings problems, for it encourages investors to increase the output of a crop, although there is no guarantee that the price will be sustained; and there is every chance that the price will fall if all exporting countries increased their production.

The study has identified that, besides the importation of farm inputs, a significant part of the foreign exchange earned by the export of these crops is remitted out of the country. This is largely because irrigation cash crop production is in the hands of a few multinationals such as Hullets and Tate and Lyle for sugar, Nestle for coffee, Brooke Bond for tea, Cargill for cotton, and B.A.T. for tobacco. In Zimbabwe, these corporations control all the production, distribution, processing and marketing. It has been argued by Hines (1983) that while companies experience losses at the production level, therefore the demand for tax concessions and for state subsidies, the profits are recouped overseas from distribution, marketing and processing. Re-investment in the country of location does not often happen on a scale that could form the basis for the expansion of the industry. There are therefore real net outflows being experienced by the economy, which constitute a significant loss. The exception is in the case of cotton production where the greater part of the crop is used for the local production of clothes and fabric for export to the neighbouring countries.

Sugar production has been carried out with the aim of providing a greater linkage within the local economy through the final processing of domestic sugar (50 percent of output) requirements; and through the production of ethanol for blending with petrol, in order to reduce oil imports. The problem with ethanol production is that it tends to demand more land to be removed from food production for sugar; the cost of developing new land and irrigation facilities is very high. For example, the proposed ethanol plant at Chisumbanje would require the use of over 35,000 hectares at a cost of nearly one billion dollars at 1984 prices. At present the international cost of crude oil is between US $10-15 per barrel (1985 prices) and the trend is for a downward price structure for some time to come. The real production cost of alcohol was estimated at between US $64 and US $75 a barrel (Hines, 1983), a cost that is about 6 to 7 times the cost of importing crude oil today. In the case of Zimbabwe, the benefit of producing ethanol is limited by the fact that only 20 percent of the blended petrol is ethanol. Apart from the few private car owners who use petrol, the country's transport network, the rail system and the industries as well as the farming industry use diesel oil. Ethanol is therefore not directly relevant in the productive sectors of the economy which consume over 85 percent of the nation's fuel energy.

With regard to employment benefits from commercial irrigation, the results of the study as analysed in Chapter 5 are not totally encouraging. Historically, commercial irrigation in Zimbabwe is based on a labour intensive production system with a very low level of capital formation. Even the types of crops chosen: cotton, tobacco, tea and sugar cane, reflected the human labour preference as the means of production. Although capitalization of the production system was possible, from very early on, in cost terms, it was found that it was cheaper to use human labour than automization of the production system. This was largely because there was a very large unskilled labour force of landless or displaced peasants following the 1930 Land Apportionment Act (Chapter 3). The wage levels of the farm workers were also very low, reflecting what was regarded as the opportunity cost of that labour. It may be uneconomic, in cost-benefit cost terms at least, for farmers to automize the production system. But over the 50 years of commercial irrigation, employment benefits have not increased much, and less so during the period under review because, among other factors, the increase in the wage levels.

Commercial irrigation has now come to rely heavily on the seasonal and/or temporary contract labour, because, unlike the permanent labour, contract labour was not covered by the statutory instruments of the Minimum Wage Act of 1980. This shift from permanent labour has been made all the more easy by the existence of thousands of refugees from Mozambique, who are forced by their plight to accept wage levels far lower than those acceptable to Zimbabwean workers.

From the point of view of local workers, the statutory wage increases, although real and beneficial, in opportunity cost terms did not represent the basis for the economic advancement of the workers. If the criterion of 'effective income' was used, that is, income that enables an average family of 6 to subsist, as measured by the poverty datum line, the wage levels remained below the national poverty datum line of low income people. This means that the incomes remained thoroughly subsistent, with little or no scope for savings. The level of the wages reflected the policy preoccupation with the satisfaction of the procurement of the means of subsistence, than with the movement of workers beyond subsistence. The continued deterioration of the Zimbabwean dollar in terms of purchasing power in the local market, has not helped in strengthening the workers' purchasing power. The farm workers are therefore not part of the effective market for goods and services produced in the economy.

It is obvious that the study has raised more questions than answers. It must be accepted that not all the problems identified can be solved easily. It would not be easy therefore to recommend any solutions for the way forward as any such recommendation could be too simplistic, in the absence of a more thorough study of several important areas, which are identified in a subsequent section of the chapter.

The Benefits to Small-scale Producers: The Equity Question

The benefits of public investment in water and small scale schemes were shown to be very difficult to grasp in equity terms. The small scale sector required a wide range of public assistance beyond the mere provision of water and, as such, whatever benefits have been associated with peasantry sector irrigation, could not certainly be attributed to the provision of water alone. The fact that this assistance took the form of open-ended public subsidies raises questions regarding the continuation of an investment policy based on subsidies in the long term. The value of the benefits in net terms has been found to be limited, and only possible under conditions of subsidies, implying that these schemes were unable to financially sustain themselves, both in the short and long term without state subsidies. This conclusion raises the question as to whether the real aim of establishing these schemes had anything to do with the provision of income equity. This question becomes more poignant when it is realized that, the schemes have if anything widened the income gap between those farmers receiving subsidized incomes on the schemes, and the unaided rainfed based farmers.

Chapter 6 has shown that from the government's point of view, the greatest benefit was seen as the greatest number of families who could be settled on a small piece of land. Irrigation has the capacity to absorb a family per 0.73 hectare, and this means effectively two families per hectare. In this respect, irrigation was seen to provide the answer to the political questions of land scarcity, overcrowding in communal lands, illegal squatting on private land and the question of famine. Although irrigation schemes could help reduce population pressure in communal lands, the pursuit of this objective through irrigation was shown to be of limited advantage given that the population was growing at a rapid rate of 3.2 percent per year (one of the highest in the world) far higher than the rate of growth of the economy. Besides, the fact that there is no urban and industrial alternative employment opportunities means that the government will have to face the question of land-population pressure again in the long run.

In fact, the pursuit of the objective of land pressure release through irrigation had led to the allocation of uneconomic land sizes to families, and in the process, sacrificed the basis for an economic allocation. As a result, the small plot sizes per family failed to reflect any serious intention by the state to try and upgrade the livelihood of the farmers and their families, for all times. Although the incomes farmers received were high compared to those received by farmers practicing rainfed agriculture, the fact that these incomes were only as high as they were because of the massive injection of public subsidies, was no cause for comfort. The inevitable removal of these subsidies in future would certainly be followed by large scale abandonment and collapse of most schemes and loss of income.

But while subsidies last, the farmers on irrigation schemes must feel privileged compared to those practicing rainfed agriculture. Since not all peasants would be chosen to enter irrigation, in equity terms, the choice of those who enter must raise the question of the fairness of the choice criteria. Inevitably the losers would be unhappy, firstly because they are denied access to high income, and secondly, because state support to irrigation must mean a reduction of investment resources directed to rainfed agriculture. It could be possible in future that communities that once lived in harmony, could experience some hostilities towards each other as a result of the unfair distribution of wealth arising from these irrigation schemes. Even at this early stage, the study could identify areas of friction, mostly around the practice by irrigation farmers, of holding onto the grazing rights in the rainfed sector, in addition to the jealousies over the services provided to all the irrigation schemes.

The question of who benefits, given the numerous number of eligible applicants raised difficult political decisions. The study provides no answers for these questions. If consideration was made of the high cost of investment per hectare (Chapter 6), one would wonder whether equity could not be best achieved perhaps by the improvement of the low cost rainfed agriculture, which had a much wider coverage. It was already pointed out in Chapters 5 and 6 that the full potential of rainfed agriculture had not been fully exploited. The area of technological inputs that could help increase yields still needed to be studied fully. Amin (1976) and others have however cautioned against putting greater faith in technological improvements following the failure of the Green Revolution to provide benefits to all farmers. Socio-economic factors not addressed by this study will have to be tackled ahead of any introduction of technological innovations.

Questions of equity in terms of land and income allocation could not be fully answered by the data available to the study. Even if the data were adequate, it is doubtful whether that allocative equity could be achieved without sacrificing the existing high crop output from the commercial agricultural sector. Given the rapid increase in rural population, any 'ideal' equitable distribution of land today would have very limited rewards in future; especially when it is considered that land is a fixed asset. The alternative must be sought in the improvement and expansion of other sectors of the economy such as the manufacturing sector. Both rainfed and small scale irrigation agriculture should form part of a complementing development strategy. Irrigation should be resorted to, only where its benefits outweigh the costs, and developed in such a way that it fits in with other developments around the schemes, in a coordinated manner.

The Social and Environmental Effects

Apart from discussing the problems associated with monetary costs and benefits, the study has also attempted to show, on the basis of limited data, that irrigation agriculture has exacerbated, and in some cases introduced negative social and environmental effects. It was shown in Chapter 7 that prominent among these were the introduction of mosquitoes and malaria into areas hitherto unaffected. With respect to the prevalence of bilharzia, irrigation agriculture had made it possible, in the absence of natural biological control mechanisms, for the snail population to multiply throughout the year. The greater use of flood irrigation with its high rate of water-human body contact, had increased the level of infection among irrigation workers.

The high degree of population movement away from the schemes, had helped to spread the disease into rainfed agriculture, especially in the absence of properly regulated sanitation systems. The increase in disease incidence had in turn been responsible for the high public expenditure on building clinics and hospitals as well as on the importation or production of curative drugs, that would not have occurred otherwise. Although there was no data on the actual cost of drugs, Ministry of Health officials believed that it was very significant. The fact that both malaria and bilharzia apart from attacking the human body, acted as body-resistance weakening agents, thus allowing the invasion of the body by other equally dangerous illnesses, did not help in the attempt to quantify the effects.

The investment policy had not in the past (and at present) taken into account these effects as part of the real cost of implementing an irrigation agricultural strategy for development. The reasons for ignoring such effects in cost calculations was identified as partly to do with the predominance of engineers and the total absence of economists, social scientists and medical professionals in the make-up of the policy makers. The engineers had tended to be guided by the desire to produce superior structural designs with little or no regard to whether these structures aided or reduced the incidence of water borne diseases. Besides, it was often thought that it was not the responsibility of engineers to worry about the environmental and social effects, as these issues were considered to be the Ministry of Health's sole concern. The politicians worsened the situation by regarding these externality costs as the necessary price to be paid for agricultural advancement. Investment planning for irrigation therefore was not sensitive to the possible occurrence of these externalities. These views and many others have provided an excuse for not doing anything.

Insensitivity to these adverse externalities can also be attributed to the fact that the policy makers were far removed from the site where these effects occurred, and therefore could not develop a realistic appreciation of the gravity of these effects. The workers, on the other hand, bore the brunt of these effects, but had no input into the decisions that determined public investment in water and irrigation. The absence of consultation by policy makers of irrigation workers on these important issues could be interpreted as a sign of a callous disregard of the workers' welfare.

The fact that these first order disease effects could not at least in theory be quantified, could not excuse policy makers from not attempting to minimize their effects at the field level. It was unforgivable that drainage on small scale schemes was inadequate or absent resulting in the development of dangerous bilharzia habitats.

Second order effects like the high cost of building hospitals and clinics as well as the purchase of curative drugs had not stopped investment in irrigation. The building of clinics had been viewed as part of a normal nationwide programme of providing health facilities, and not as a specific response to an abnormally high incidence of bilharzia or malaria around irrigation schemes. The costs involved were not directly attributed to the presence of irrigation schemes; therefore in the absence of this important link, public investment in water and irrigation continued to be carried out with little or no reflection of the impact of the dangerous side effects.

Problems of siltation, on the other hand, had continued to worsen. With regards to waterlogging there was evidence that most small scale schemes with poor drainage were prone to waterlogging, and that the presence of irrigation officers at every scheme had reduced the incidence from becoming widespread.

All these factors did not in any way excuse official neglect of the social and environmental effects associated with irrigation agriculture. The winners or beneficiaries were not prepared to compensate the losers, and the conferring of these real costs on the losers must become a policy concern in future. This is largely because the planned increase in investment in water and irrigation, largely within the same provinces of Masvingo, Matebeleland, Manicaland and Mashonaland will continue to worsen both regional income disparities and increase the social and environmental costs on the losers.

The study recommends that an attempt should be made by agencies responsible for project implementation to collect data on external costs and as far as is possible, that project choice should use not only economic criteria, but criteria aimed at reducing these external effects and their impact; and that project design should incorporate efforts to reduce environmental effects.

With regard to the social effects, the study recommends that the establishment of the proposed single Water and Irrigation Authority (WIA) discussed earlier in this chapter, should go a long way to reducing social effects. The Authority should be required to incorporate social and environmental factors in addition to the economic and financial factors when choosing projects. A project should, in future be expected to fulfil social and environmental objectives apart from the usual economic objectives.

The land distribution issue is closely linked to income equity and has got to be addressed by politicians, instead of pushing it to the technical departments who are ill equipped to handle this matter.

This requirement is not always resorted to because of existing policy inertia towards change and the dominant controlling effect of the policy process by those benefiting from the present uneconomic investment relations. However, the hope is that the worsening economic situation in the country coupled with heavy public indebtedness to foreign banks and the poor balance of payments position could, in the long run, force upon government the necessity for economy in all sectors.

Future Research Needs

An alternative investment strategy that will take into account both the requirements for economy and high productivity and high incomes, is difficult to visualize let alone implement in the absence of adequate planning data. Cases have been noted in this study, where analysis of the investment structure could not be made due to lack of information. These include the inability to carry out a project by project cost-benefit analysis; the absence of data on the current relationship between the level of water supply, and the use of water; the absence of private commercial irrigation cost outlay data; and lack of data on the extent to which current water capacity is underutilized, as well as the absence of quantified information on the benefits accruing to the peasants, or quantified data on the cost of water borne diseases. Research into these aspects and a concerted effort at data collection must of necessity be conducted within the water and irrigation industries themselves.

Research work must not be just theoretical, it must require the active cooperation, and participation of the water and irrigation industries themselves. For example official research into the effect of high water prices cannot contribute anything to the farmers' responses, or to water demand forecasting, unless the Ministry responsible for water removes the existing subsidy on the price of water. The same would also apply to studies on wheat self-sufficiency in a climate of consumer price subsidy. Nor can the effect of subsidy removal be assessed until attempts have been made to study income levels, and abilities to pay by the farmers, and how these vary. Similarly, evaluations on the effect of cutting down on investment in bulk water capacity extension must involve the cooperation of engineers.

Because the practice of water development and irrigation agriculture cannot take place without the support of or without affecting other sectors, the implied interdependency means that in order to fully understand the problems of water and irrigation agriculture, a lot more research into the related sectors (not discussed fully here) has to be carried out. A number of areas for further research effort in which economists and other professions, can jointly contribute is discussed below. The list is by no means exhaustive:

1. <u>The Land Tenure Issues and Rural Incomes</u>

   Public investment in water and the subsequent investment in irrigation agriculture, are all deliberate manipulations of nature in order to increase crop yields or wealth, derived from agriculture. This intervention or manipulation presupposes that natural rainfall has become an inadequate basis for agriculture development.

   Yet there is no information or data necessary for the mapping out of regions with excessive population pressure and those with less. There is therefore an urgent need for research to determine the existing areas of high and low population pressure. Such research would help government policy makers with information pertaining: to regional crop specialization; to the carrying capacity of different soils and also provide leads as to the best or optimal land allocation system.

This way it would be possible to avoid the current wasteful and expensive attempts through both irrigation and the land resettlement (Chapter 3), all of which clearly cannot provide the needed safety-valve for the communal areas. Given that there are definite limits to the extent to which irrigation can substantially relieve land pressure, research work in this direction would definitely appear to be paramount. It is hoped that, such research would be able to define the scale and relevance of not only irrigation agriculture, but also of rainfed agriculture and other tenurial systems, within a coordinated and complementing agricultural reform.

Since there is insufficient land for distribution to everyone without causing economic disruption, and since the indigenous system is frequently unable to provide the family with tenurial security it provided during the period of land abundance when population was small, this means that emphasis must shift from land opportunities to employment opportunities. The more land is carved up into very small parcels, under small scale irrigation the greater the likelihood of diminishing productivity.

Whatever short-term benefits are realised, the high rural population growth rate alone would surely offset these current efforts within a few years. Efforts to reduce the population growth rate at the national level, must be put in place. There is therefore an urgent need for research to seek long-term solutions in the identification of alternative permanent non-farm based employment opportunities in the rural economy. Such research should consider the possibility of setting up food processing industries, repair metal workshops, fish farming, poultry, etc. The research should provide insight as to how such small scale concerns could become viable, and the scale of public assistance that may be needed. This direction could hold much more promise than the present overcrowded irrigation schemes.

2. Analysis of Water Use Efficiency in Agriculture

The understanding of the variables determining water consumption at the farm level is crucial if water demand projections are to be made at all. This information is also crucial in indicating regions or areas where capacity extension would be needed. There is therefore need for research to be carried out in order to determine the quantity of water that is used per hectare per different crop per given type of soil and per region, as well as estimates of moisture retention capacities of different soils. This information would be helpful in assessing the true economic quantity of extra water needed, and could help farmers and policy makers in identifying aspects of water management that could be introduced to cut off water waste. As a spin off of this research, it should be possible, on the basis of the information available on crop-water requirement, to suggest further research areas where technological intervention can help produce crop varieties that either ripen early, or use less water per growing season. This could lead to less and less dependence on costly irrigation and water schemes, and lead to the promotion of crops that are largely dependent on the available rainfall.

Of more immediate urgency, is the need for research on the likely implications of the growing tendency by all types of farmers, of using flooding irrigation methods. If this information is not provided soon the consequences (salinization and leaching as well as waterlogging) could be irreversible, and where the attempt to reverse these are carried out, the cost could be forbidding. The Californian irrigation agriculture problems (Pringle 1982) have shown just how difficult it is to correct such mistakes.

Research is also required on the variations in water use within and between sectors, including the domestic and the industrial sectors. In this way it would be possible to calculate the opportunity cost of using expensive water for irrigation agriculture at current prices.

3. <u>Organizational Issues</u>

Public implementing agencies are presently fragmented and uncoordinated in their efforts. This study has already recommended the setting up of a single autonomous body responsible for both water and irrigation development. There is therefore a need for research that will enable the policy makers to establish the efficacy and efficiency of such a body in delivering the intended benefits of irrigation development.

Of immediate concern is the need for research on the possible effects of removing the public managerial support from small scale irrigation farmers, as a prelude to the setting up of the proposed single authority.

The urgency for this piece of research arises from the fact that the state is already beginning to feel the financial effects of over-manning the schemes. The farmers are likely to be asked to bear the total burden of managing the schemes, at a time when they may be ill-prepared. Although such research may be theoretical initially, it may hold key answers to what would actually happen if the state was not involved at all. Such answers could prove useful for planners and policy makers, who may be interested in the future direction, development and the management of the water and irrigation industry.

4. <u>An Evaluation of the Political and Legal Constraints</u>

The study has indicated that politics is, at the end of the day, the most crucial stumbling block to the achievement of economic efficiency in investment in both the water and irrigation industries. Political expediency is responsible for the subsidization of the inviable schemes, because of the short term benefits such subsidies could provide. Politicians are much more inclined to use subsidies as a way of overcoming perceived obstacles for the sake of political capital, which incidentally is often associated with benefits that accrue in the short term. Sound investment strategies that lead to a much more secure long term future are ignored.

As such, there is a need to carry out a study that will help identify those legal, political and other non-economic factors constraining operational and investment efficiency. Such work would look at the possibility of evolving an investment strategy that would minimize undue political interference, but remaining politically acceptable. The results of such research may well remain theoretical, if there is no political willingness to accept change. Such research must be seen to be strengthening the role of politicians in development, and not substituting it; but should outline clearly the various paths open to them and the implications of choosing alternative directions.

The existing prior appropriation water law has been noted for fossilizing inequitable and most probably inefficient water rights. Until a study is carried out with the aim of assessing the legal system's unfairness, and its limiting effect on new entrants to irrigation farming, it would be difficult to propose new policy measures that ensure efficient use of water from each existing storage facility. This research, if carried out, could form the basis for the revision of the water right system, and as an offshoot of the study, provide information regarding the potential volumes of water to be saved by such revision. One possible effect of such information is that it could delay the need to construct new dams by several years or decades, and also open, for the first time, possibilities of a water market, or privatisation of water supplies.

5. Food Self-Sufficiency and Cash Crops

Zimbabwe's commercial irrigation agriculture was shown in Chapter 4 and 5 to be export cash crop based and therefore to be directly linked more to the international market than to the local economy.

The country produces its staple crop, maize, under rainfed conditions, and in good years, can achieve food self sufficiency. The country has an erratic rainfall regime, and droughts can occur once or twice per decade, apart from the fact that there are certain provinces that experience permanent rainfall deficits. The past three years of drought (1982-1984) have shown that, contrary to official assertions, irrigation agriculture did not help at all in the fight against famine and in reducing regional food deficits. If anything the agribusiness corporations involved continued to put all their land to the full production of the usual export cash crops.

In the light of this, there is need for research to determine the effects of putting the whole or the greater part of irrigation agriculture to food production in rainfall deficit areas, permanently or mostly during droughts. Wheat production is mostly for domestic consumption; but local yields have fallen behind demand, and the state has been forced to operate a wasteful twin policy of subsidizing wheat production (Farm Irrigation Fund, 1985) and of subsidizing the consumer. A study is needed to look at the best way of achieving wheat self-sufficiency, without expanding the land under irrigation, by examining an incentive package that would force producers to remove some land from cash crop production to wheat production. This way the state would be able to be advised on the options available for achieving high wheat yields without the need for new costly capital investment in water capacity extension or expansion of land under irrigation. The cost-benefit analysis of such a study will also have to show the opportunity cost of the shift in the farming system; so as to justify the use of the land for wheat production. The research may well find that the wheat so produced may be still too expensive, necessitating the continued use of consumer subsidies. In this regard the study should look at the likely technological innovative changes that could help to produce a wheat variety whose yield per hectare could be much higher than the present 4.5 ton per ha, as well as the possibilities of realising self sufficiency if the yield were to reach 6 ton per ha (closer to 7 ton per ha in Europe) on the same land under wheat now.

6. Regional Food Transfers

As indicated in Chapter One, one area of possible future research is in the area of national/regional food transfer. As a concept, this implies the movement of cereal grains from surplus (specialising in grain production) to deficit areas (specialising in other equally important agricultural products such as livestock or fish, etc). The resultant trade between and among areas or regions producing different products suited to their climatic conditions, could remove the need for every peasant to produce both livestock and cereal products, sometimes in unsuitable climatic conditions.

Already SADCC has set up in Zimbabwe, a Regional Early Warning System served by a network of National Systems, providing the ten member states of SADCC with information on the status of supply and demand for cereals. A Study is also under way to set up a Regional Food Reserve Project on the basis of establishing storage facilities in all countries and facilitation mechanisms for regional trade in grains (food transfers).

Future research should examine the extent to which both the Early Warning and Food Reserve projects could be made to be effective in terms of delivering food to households and the effect on the participation of peasants and the extent to which these programmes can also address equity considerations, and thereby reduce the need for irrigation. It will also be important to extend the analysis to the possible movement of other food products (e.g. animal products) other than cereals within the food transfers equation.

7. The Externality Effects

The total absence of data on the role of external effects on investment must be corrected by research work which aims at linking the quantifiable costs and the social and environmental costs as criteria for project assessment. The findings of such a study would alert policy makers and the public to the impact of the externality effects both in money and in social terms, and this way help to increase the need to curb or control these effects. The country can no longer continue to treat these as the price to be paid for advancement. The setting up of the Mushandike Pilot Study arising from this study can only be a step in the right direction. Recent discussions with officials from Blair Research Centre (Harare) revealed that work was under way fully to document quantitatively the monetary effects of these externalities, (especially the diseases), within the limitations of methodology.

As a final note it is however perhaps regrettable that in Zimbabwe interest in water and irrigation development has largely remained advocative and agronomic in nature, lacking the essential critical appraisal insights necessary for economic efficiency in investment. Even the existing agronomic information has not been coordinated and published for public use. Widespread sharing of information has not taken place, in particular between the researchers, and those government officers who should use such information. As a result individual research efforts are likely to duplicate some of the work already done, although this might be a mute point. Ideally, efforts should not be spared in the development of common research methodologies, and the development of project appraisal methods to be used by all government officials and researchers. This proposal is important when it is considered that Zimbabwe is experiencing resource bottlenecks.

The success and indeed the coming into being of all the proposed research areas, will depend to a large extent on the creation of research units within or associated with the executive agencies of government. These research units will have the responsibility of reviewing and linking current practice, in the field of government investment, to improvements resulting from research. Results from private research interests should find their way to public agencies.

APPENDIX (1)

SMALL-SCALE IRRIGATION SCHEMES IN ZIMBABWE

IRRIGATION SCHEMES	COMMUNAL AREA	AREA, HA GAZETTED	DEVELOPED	PROP. EXPAN.	NO. OF PLOT HOLDERS
MANICALAND PROVINCE					
Deure	Sabi	318	263	(150)	312
Murambinda	Sabi	60	35	-	27
Mutema	Mutema	520	283	-	338
Tawona	Mutema	320	149	(50)	213
Chibuwe	Kuskavanhu	770	326	-	257
Nyamaropa	Nyamaropa	770	406	(500)	314
Nyanyadzi	Muusha	2 980	423	(500)	424
Chakowa	Mutambara	1 100	84	-	109
Mutambara*	Mutambara*	400	135	-	123
Maranke*	Maranke	1 620	40	-	-
Nyachowa*	Zimunya	200	45	-	32
Bondi	Sabi	-	-	(600)	-
Sub Total		9 458	2 189	(1300)	2 149
MATEBELELAND SOUTH					
Bili	Machuchuta	40	21	-	(35)
Jalunganga	Maramani	121	45	-	(75)
Kwalu	Siyoka	120	46	-	(75)
Shashi	Maramani	1 210	128	-	70
Tongwe*	Mtetengwe	40	27	-	30
Duncal	Umzingwane	38	15	-	18
Mzinyatini*	Mzinyatini	53	32	-	40
Silalabhwa	Insuza	1 000	350	-	135
Konkoni	Shashi	100	36	-	(60)
Makwe	Makwe	-	202	-	240
Masholomoshe	Matshotshe	400	40	-	50
Ruster's Gorge	Shashi	70	27	-	(45)
Sibasa	Dibilishaba	125	60	-	(100)
Sukwe	Dibilishaba	30	22	-	(28)
Mbebeswana	Semukwe	8	6	-	16
Mambale	Mambale	28	14	-	(23)
Maitengwe	Maitengwe	60	20	-	(33)
Chikwara-kwara	Chipise	182	60	-	(100)
Sub Total		3 625	1 161	-	1 173

MASHONALAND WEST					
Gache	Gache	-	5	-	16
MASHONALAND CENTRAL					
Gutsa+	Gutsa	200	36	-	-
Chapoto+	Dande	100	12	-	-
Nyaganda+	Uzumba	-	-	-	-
Nyakasoro+	Pfungwe	-	-	-	-
Sub Total		300	48	-	60
Nabusenga	Siabuhwa	-	3	-	(10)
Zinapi	Nkai	477	16	-	(30)
Tshongokwe	Lupane	38	21	7	(70)
Fanisoni	Nkai	65	10	-	(30)
Cheziya	Wankie	7	4	-	(13)
Lambo	Wankie	14	2	-	(7)
Likosi	Wankie	21	12	-	(10)
Vleir+	Majolo	-	4	-	-
Siamatelele	Siamatelele	-	7	-	-
Sub Total		622	79	7	220
VICTORIA PROVINCE					
Masvuvungwa	Chibi	-	60	-	(200)
Makonese	Chibi	-	56	-	(240)
Banga*	Chibi	-	5	(35)	41
Chilonga	Matibi I	525	120	-	222
Manjinji	Sangwe	109	40	-	30
Muteyo	Sangwe	-	15	-	52
Rapangwana	Sangwe	-	10	-	40
Gudo's Pool	Sangwe	-	13	-	(43)
St Joseph	Sangwe	-	6	-	23
Malikango+	Matibi II	265	24	-	-
Mapanzura	Masvingo	106	48	-	(160)
Tambara	Bikita	-	19	-	-
Roswa (N)	Bikita	-	-	(80)	-
Fuve (N)	-	-	-	(40)	-
Dabgwa (N)	-	-	-	(30)	-
Sub Total		1 005	418	185	1 062

MIDLANDS
PROVINCE

Mondi					
Matanga	Mberengwa	20	7	-	(15)
Nyahoni	Sabi North	128	22	-	25
Mwerahari/					
Sachipiri	Mharira	190	25	-	40
Shagari	Lower Gweru	30	26	-	120
Mtorahuku	Chiwundura	20	15	-	150
Mabodza	Chiwundura	14	12	-	120
Mabwe/					
Matema	Runde	1 110	48	-	60
Ngondoma	Zhombe	1 090	25	-	80
Senkwazi	Zhombe	110	30	-	40
Hozori	Silobela	80	7	-	50
Exchange	Exchange	160	60	(100)	250
Mhende	Chirumanzu	184	80	-	-
Dangura*		-	8	-	-
Charandura*		-	4	-	-
Sub Total		3 136	369	(100)	1 205
GRAND TOTAL		18 146	4 269	(1592)	5 825

* Community Scheme
\+ Community Scheme
(N) New Scheme Under Planning
\- Under number of plotholders, figures in brackets indicate the average number of families expected to occupy the scheme

Total number of families 5 825

Source: Department of Rural Development Draft Policy Paper on Irrigation Schmes in Communal Areas 1983.

APPENDIX (2)

CONDITIONS GOVERNING USE/OCCUPATION OF AN IRRIGABLE AREA

1. The holding will not be subdivided, sublet or under utilised without the necessary authority having been obtained.

2. The holding will be cropped fully in summer and fully or proportionately in winter depending on the water supply situation in the winter months.

3. The irrigator will observe all the conservation and irrigation methods as directed and advised by the appropriate authority.

4. Only the recommended crops and cultural practices will be allowed on the holding.

5. The irrigator will observe the correct use of fertilizers and manure; insecticides, herbicides and pesticides in the interests of all other irrigators at the same scheme.

6. No irrigator can hold land at an irrigation scheme while at the same time he holds land at another irrigation scheme, a dryland area or a resettlement area. Should the irrigator opt to go to another irrigation scheme, a dryland or a resettlement area, he is then required to relinquish his holding for re-allocation. The holding should be surrendered to the relevant authorities for re-allocation. This condition can be varied only with the authority of the Minister of Lands, Resettlement and Rural Development.

7. An irrigator wishing to engage in any form of business at an irrigation scheme must register such a business with the appropriate authorities.

8. Irrigators with cattle will observe the regulations relating to depasturing, dipping and controlled grazing as directed and advised by the appropriate authority.

9. Irrigators will observe the rules and regulations that may be evolved at the local level, by the management committees.

10. In the case of individuals or communities:

    (a) No individual or community will engage in irrigation without the necessary water right having been applied for and granted by the Water court.

    (b) Strict observance of the water right will be necessary to ensure that it is not exceeded. Water right papers will be made available to the appropriate authorities for inspection and checking.

    (c) Individuals or communities will be responsible for discipline within their schemes and will observe all other conditions and regulations as laid down from time to time by the appropriate authority.

11. An irrigator who shall have been evicted from an Irrigation Scheme for any reason whatsoever, will within 14 days of such an order being given, appeal to the local village court in the first instance for a redress, failing which he may then appeal to a higher court as the case may be. Should the appeal fail, or should there be no appeal at all, such an irrigator will not be permitted to hold land at any other Irrigation Scheme.

Source: Derude 1983

APPENDIX (3)

Permit Number ....

MINISTRY OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT

PERMIT TO RESIDE

Issued by the MINISTER OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT (hereinafter referred to as "The MINISTER"), in terms of Section 6 of the Rural Land Act (Chapter 155), to .... (hereinafter referred to as "the HOLDER").

The MINISTER hereby permits the HOLDER to reside on the residential site .... (hereinafter referred to as "the said site"). This permit is subject to the following terms and conditions:

1. The MINISTER may renew this permit and, at any time during the currency thereof, including any renewal, may, without notice, replace it with some other form of agreement on such terms and conditions as he may determine.

2. This permit may be revoked if, at his sole discretion, the MINISTER decides that the holder has failed to comply with any of its terms and conditions.

3. The MINISTER may, for any public purpose, revoke this permit any time and under such conditions as he thinks fit on payment to the HOLDER of such compensation as the MINISTER may determine.

4. The said site shall be used for residential purposes for the accommodation of the HOLDER and his immediate family only.

5. The HOLDER shall maintain the said site in a clean, sanitary and tidy condition and shall comply with any instructions that the MINISTER may issue for the upkeep of the said site and the prevention of nuisance and the maintenance of sanitary conditions.

6. The HOLDER shall pay all rates, taxes or other charges which may be levied on the said site by competent authority.

7. The HOLDER shall not carry on or allow any other person to carry on any trading, commercial or industrial operations on the said site.

8. The MINISTER, or any person authorised by him, shall have the right, free of charge and without compensation, to lay, construct and maintain roads, boreholes, pipelines, electric lines, sewerage, drains and ancillary works upon or under the said site.

9. On the expiry or revocation of this permit no compensation shall be payable to the HOLDER for any improvements effected by him on the said site;

   PROVIDED that the HOLDER shall be entitled, within a period of three months after the expiry or revocation of the permit, to remove any building and improvements constructed or effected by him on the said site.

   Any buildings or improvements that are not removed by the HOLDER within the said period of three months shall become the property of the MINISTER, whomay deal with them as he thinks fit.

10. Any act required or permitted to be performed by the MINISTER in terms of this permit may be performed on the behalf of the MINISTER by such officer in the public service as he may designate.

11. If any permit issued to the HOLDER by the MINISTER permitting the HOLDER to cultivate or depasture stock on the irrigation scheme is revoked, the MINISTER may, in his sole discretion, immediately revoke this permit.

Issued at............................this.............day of............19...

....

(Designated Official)

on behalf of the Minister of Lands, Resettlement and Rural Development, in terms of Statutory Instrument 247 of 1980.

Source: Derude 1983

APPENDIX (4)

Permit Number ....

MINISTRY OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT
PERMIT TO CULTIVATE

Issued by the MINISTER OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT (hereinafter referred to as "The MINISTER"), in terms of Section 6 of the Rural Land Act (Chapter 155), to .... (hereinafter referred to as "the HOLDER").

The MINISTER permits the HOLDER to cultivate an area of Irrigation Scheme approximately ....hectares in area, known as .... and as indicated on the sketch plan attached hereto (hereinafter referred to as "the holding").

This permit is subject to the following terms and conditions:

1. In the event of there arising any dispute as to the boundaries or location of the land which may be cultivated in terms of this permit the decision of the MINISTER shall be final.

2. The MINISTER may renew this permit and, at any time during the currency thereof including any renewal may without notice, replace it with some other form of agreement on such terms and conditions as he may determine.

3. This permit may be revoked if, at his sole discretion, the MINISTER decides that the HOLDER has failed to comply with any of its terms or conditions or has failed to make proper use use of the holding.

4. The MINISTER may, for any purpose, revoke this permit at any time under such conditions as he thinks fit on payment to the HOLDER of such compensation as the MINISTER may determine.

5. The holding shall be used solely for agricultural purposes for the HOLDER's exclusive benefit.

6. During the currency of this permit the HOLDER shall:-

   (i) personally, actively and continuously carry on agricultural activities on the holding to the satisfaction of the MINISTER.

   (ii) comply in all respects with the provisions of, and regulations made unddr, the Natural Resources Act (Chapter 150), the Animal Health Act (chapter 121), the Noxious Weeks Act (chaper 127) and all other relating to soil husbandry, farming practices and livestock management and shall further comply with all instructions which the MINISTER may issue for:
   (a) the prevention of damage to the sources and courses of streams;
   (b) the prevention and control of plant and animal pests and diseases;
   (c) the control or eradication of any plants harmful to crops and livestock.

7. During the currency of this permit the HOLDER shall permanently and personally reside on the residential site allocated to him by the MINISTER.

8. During the currency of this permit the HOLDER shall renounce and forgo all rights to cultivate any land or depasture cattle in any communal land.

9. The HOLDER shall not construct or erect, nor permit nor cause to be constructed or erected, any building or other structure on the holding.

10. The HOLDER shall pay all rates, taxes or other charges which are levied upon the holding by competent authority.

11. The HOLDER shall not, without the prior written consent of the MINISTER engage in any other occupation or employment during the currency of this permit.

12. The HOLDER shall not carry on or allow any other person to carry on any trading, commercial or industrial operations on the holdings.

13. The HOLDER shall permit any rights of way necessary to give access to other holdings should he be required to do so by the MINISTER.

14. The MINISTER, or any person authorised by him, shall have the right, free of charge and without compensation to lay, construct and maintain roads, boreholes, pipelines, electric lines, sewerage, drains and ancillary works upon or under the holding.

15. Any act required or permitted to be performed by the MINISTER in terms of this permit may be performed on behalf of the MINISTER by such officer in the public service as he may designate.

16. If any permit issued to the HOLDER by the MINISTER, permitting the HOLDER to reside or depasture stock on the Irrigation Scheme is revoked, the MINISTER may in his sole discretion immediately revoke this permit.

Issued at............................this.............day of............19...

....

(Designated Official)

on behalf of the Minister of Lands, Resettlement and Rural Development, in terms of Statutory Instrument 247 of 1980.

Source: Derude 1983

APPENDIX (5)

Permit Number ....

MINISTRY OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT
PERMIT TO DEPASTURE STOCK

Issued by the MINISTER OF LANDS, RESETTLEMENT AND RURAL DEVELOPMENT (hereinafter referred to as "The MINISTER"), in terms of Section 6 of the Rural Land Act (Chapter 155), to .... (hereinafter referred to as "the HOLDER").

The MINISTER permits the HOLDER to depasture stock, not exceeding in number the equivalent of .... livestock units on the Irrigation Scheme known as .... (hereinafter referred to as "the said scheme).

For the purposes of this permit the categories of stock shown in the first column shall be equal to the number of livestock units shown in the second column:

First Column Category of Stock	Second Column Livestock Units
Cattle under the age of 2 years	0,5
Cattle over the age of 2 years	1,0
Sheep and goats under the age of 1 year	0,1
Sheep and goats under the age of 1 year	0,2

This permit is subject to the following terms and conditions:

1. In the event of there being any dispute as to the total number of livestock units equivalent to the stock being depastured in terms of this permit the decision of the MINISTER shall be final.

2. The MINISTER may renew this permit and, at any time during the currency thereof, including any renewal, may, without notice, replace it with some other form of

agreement on such terms and conditions as he may determine.

3. This permit may be revoked at any time, if, at his sole discretion, the MINISTER decides that the HOLDER has filed to comply with any of its terms or conditions or has depastured stock in excess of the number permitted.

4. During the currency of this permit the HOLDER shall comply in all respects with the provisions of, and regulations made under, the Natural Resources Act (Chapter 150), the Animal Health Act (Chapter 121) and all other laws relating to soil husbandry, farming practices and livestock management and shall further comply with all instructions in respect of the said scheme which the MINISTER may issue for:

   (a) the prevention of damage to the sources or courses of public steams;
   (b) the prevention and control of animal pests and diseases;
   (c) the control or eradication of any plants harmful to livestock;
   (d) the maintenance of livestock carrying capacity through grazing and livestock management;
   (e) the protection of the soil against erosion.

5. During the currency of this permit the HOLDER shall permanently and personally reside on the residential site allocated to him by the MINISTER.

6. During the currency of this permit the HOLDER shall renounce and forgo all rights to cultivate land or depasture stock in any communal land.

7. During the currency of this permit the HOLDER shall not without the prior writen consent of the MINISTER, engage in any other employment or occupation.

8. The HOLDER shall not without the prior written consent of the MINISTER, construct or erect any building or

other structure on the said Scheme.

9. The HOLDER shall not carry on any trading, commercial or industrial operation on the said Scheme.

10. The HOLDER shall not by any act prevent or attempt to prevent any other person from exercising any right to depasture stock on the said Scheme.

11. The HOLDER shall not, without the prior written permission of the MINISTER, cultivte, cut any trees on, or remove any timber, grass or other vegetation from the said Scheme.

12. Any act required or permitted to be performed by the MINISTER in terms of this permit may be performed on behalf of the MINISTER by such officer in the public service as he may designate.

13. If any permit issued to the HOLDER by the MINISTER permitting the HOLDER to cultivate or reside on the said Scheme is revoked, the MINISTER may in his sole discretion immediately revoke this permit.

Issued at..........................this............day of............19...

....

(Designated Official)

on behalf of the Minister of Lands, Resettlement and Rural Development, in terms of Statutory Instrument of 247 of 1980.

Source: DERUDE 1983

APPENDIX (6)

CONDITIONS GOVERNING THE TAKE OVER OF GOVERNMENT SCHEME BY LOCAL IRRIGATION MANAGEMENT COMMITTEES

1. A local community organisation wishing to take over the running of an irrigation scheme must satisfy the following conditions:-

   (a) That they are in a position to carry out meaningful maintenance for the continued uninterrupted running of the Scheme.

   (b) That they can generate sufficient funds to run the Scheme.

   (c) That they can generate funds for major replacement works, and effect such works expeditiously in consultation with Government.

   (d) That a take over of a Scheme will not necessarily lead to domination by a few greedy individuals to the detriment of the rest of the irrigators or potential irrigators.

   (e) That effective discipline, including the collection of any service charges are carried out in the proper manner.

   (f) That the scheme is looked after properly in accordance with the rules governing correct agronomic, conservation and irrigation practices as advised by a competent authority.

2. It is realised that an appraisal of these conditions will require time. Therefore, the handover will be phased over a number of years of which three shall be a minimum and five a maximum during which the Government will shed some of its responsibilities to popular organisations. During the course of this process, the Government may be given sufficient justification to

withdraw the process completely if it is in the interests of the continued survival of the scheme and its people.

3. Notwithstanding any take over agreements, all buildings and other capital items associated with the irrigation scheme/schemes will remain the property of the state and cannot be bought, sold, destroyed or renovated without the appropriate approval having been obtained from the relevant authority.

4. Ministerial intervention can take place where there is a threat of collapse in the use of national resources.

Source: DERUDE 1983

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27 February 1983:	Foreign exchange snag a threat to water supplies, p 4
2 March 1983:	Valley's Water potential plumbed, p 3
28 March 1983:	Call for a hard new look at DDT, p 2
29 March 1983:	Soil Erosion, 'a threat to the nation', p 4

8 April 1983:	Work starts on $4 million Mutoko dam, p 2
14 April 1983:	Sabi River silting worsening, warns Conservation man, p 6
21 April 1983:	Zimbabwe fights the drought, Shortage of water will hit Irrigation, p 4
9 May 1983:	Protest at charges for water, p 3
9 May 1983:	$271 million Water Supply Plans are outlined, p 4
2 June 1983:	Rivers silting as farmers wreak havoc in forests, p 5.
22 June 1983:	Irrigation dams run out of water, p 4
6 September 1984:	$500 million dams scheme will irrigate 100,000 ha. more, p 7
19 September 1984:	Msipa vows to speed up work on water scheme, p 7
14 November 1984:	Big dams benefit the third World, p 5
26 August 1985:	AFC promises to get tough with defaulting creditors, p 11
6 April 1986:	Operation Water Weed Underway, p 1
1 July 1985:	Minimum Wage for the Low Income Groups, p 1

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INTERVIEWS

Below is a list of interviews conducted during fieldwork between 1984 and 1986.

Year	Place	People Interviewed
1984	Harare, Ministry of Energy and Water Resources Development	The Minister, Chief Water Engineer and engineers in charge of the provinces
1984	Harare, Regional Water Authority Head Office	Director of the Authority
1984	Harare, Department of Rural Development	Director of Agritex and Senior Officials
1984	Harare, Agricultural and Rural Development Authority (ARDA)	Director of ARDA and Senior Officials
1984	Harare, Ministry of Health	Director of Health Services and Senior Officials in charge of malaria and bilharzia programmes
1984	Harare, Faculty of Agriculture University of Zimbabwe	The dean of the faculty and lecturers involved in agricultural economics, soils and irrigation development
1984	Blair Research Centre Harare	Director of the Centre, Senior research specialists in charge of malaria and bilharzia programmes
1984	Harare, Ministry of Lands. Agriculture and Rural Resettlement	Director of the Resettlement Programme and Senior field officers
1984	Harare, Agricultural Marketing Authority	Managing Director and officials responsible for all controlled crops
1984	Harare, Ministry of Finance Economic Planning and Development	Fellow officers in charge of the disbursement of recurrent budgets for Ministry of Agriculture
1984	Mashonaland Province, Mwenje dam	Resident Water bailiff and engineers for the Gulliver Construction Company on site

1984	Harare, Mashonaland Provincial Office	The Provincial Water Engineer, the documentalist and senior officials.
1984	Bulawayo, Matabeleland Provincial Office	The Matabeleland Provincial water engineer, the documentalist and senior officials.
1984	Gweru, Midland Provincial	The Midland Provincial Water Engineer, documentalist and senior officers.
1984	Mazvikadei Dam, Mashonaland Province	Resident Water bailiff, and on-site engineers for the Italian Construction Company.
1984	Hippo Valley/Chiredzi Irrigation Schemes Masvingo Province	Water bailiffs for Lake Kyle, Bangala Dam Manjirenjiand the Esquelingwe Weir. Toured the main canals and lakes. Resident Water engineer for the Lowveld.
1984	Hippo Valley/Chiredzi Commercial Schemes	The Estate managers of the Anglo-American Corporation and Hullets companies
1984	Mid-Sabi, Chisumanje, Manicaland Province	Flew over the estates, met about 6 commercial growers of wheat. At Nyanyadzi met eight small scale producers. Met the resident irrigation officer and other government officers including pump attendant at Chisumbanje.
1985	Mutare, Manicaland Province	Provincial Water engineer and senior officers.
1985	Masvingo, Masvingo Province	Provincial Water Engineer and senior officers.
1985	Harare, Anglo-American Corporation Head Office (Chisumbanje - Hippo Valley)	The Managing Director (Zimbabwe)

1985	Gwenoro Dam/Scheme, Midlands Province	Water bailiff, resident irrigation officer, five small scale farmers.
1985	Ngesi Pick-up Weir Midlands Province	Resident Water bailiff
1985	Mondi Mataga Weir Midlands Province	6 small scale irrigation farmers and the Mataga based irrigation officer.
1986	Tsholotsho Irrigation Scheme, Matabeleland Province	Irrigation Officer and three small scale farmers.
1986	Mayfair Dam, Matabeleland Province	Resident Water bailiff and two commercial farmers.
1986	Silverstroom Dam, Manicaland Province.	Water bailiff.
1986	Exchange Block, Scheme, Midlands Province	Four Agritex officials, resident water bailiff, eight small scale farmers
1986	Harare, Donor Agencies	Met with agencies representing Britain, USA, Denmark, Germany, Norway, Japan and the World Bank.