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ISSUES IN SELECTION AND DESIGN OF
RURAL WATER PROJECTS.

by

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They should not be interpreted as reflecting the views of
the Institute for Development Studies or of the University
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Introduction

In order to set specific criteria against which the Kenya Government programme for rural community water supplies and individual projects can be evaluated, clear definition of objectives are called for. The overall aim of Governments is "to achieve high and growing per capita incomes, equitably distributed, so that all are free from want, disease and exploitation, while at the same time ensuring and guaranteeing political equality, social justice, human dignity and equal opportunity". (1) Some 80 per cent of the population live in rural areas with less than 11 per cent having piped water. Thus the majority of the rural population are exposed to risk of disease and prevented from realising their potential productivity by daily time consuming and arduous water carrying. It would appear a priori that a clean and easily accessible water supply is a pre-condition to meeting the broad national objectives. To alleviate this unsatisfactory situation there has been recently conceived a policy of providing basic communal water supplies throughout the country within twenty years. This programme will require an average annual investment of K£2 million. It is the purpose of this paper to discuss issues raised by this expanded programme and set criteria by which the priority of the programme and projects within the programme can be assessed. Following Warner (2) criteria may be categorised as: technical, economic, financial, social, political and administrative. These criteria are not distinct but are closely interlinked. For instance, financial criteria may be considered as a long run case of economic criteria. Clearly if financial aspects of the public programme were over-looked, in the long run economic growth would suffer. Despite overlaps, these criteria are discussed under separate headings and a set of basic appraisal criteria are suggested in the final section.

1. Technical Issues

Perhaps the widest overlap between the categories of criteria set out in the introduction is between technical and economic criteria. Almost all design decisions are within the sphere of the engineer but because of the bias of the writer and because design issues are discussed in general terms only, design questions are dealt with in a later section. This is further justified because engineers are seldom fully aware of the wide range of alternative uses for the scarce resources at their disposal and do not have a ready appreciation of individual and community time preferences. In the context of this paper technical issues refer to the appropriateness of designs to meet technical objectives. For instance if a pipe is required to carry 10,000 gallons per day it should have at least that capacity, it should not fail within prescribed time limits and it should be free of faults such as air locks during operations.

(1) Development Plan 1966-70
Government of Kenya
NAIROBI. 1966.

(2) Warner, D. "Planning and Evaluation of Rural Water Supply Programmes." ER B(P) Paper 68.3
University College,
Dar es Salaam

In a recent paper Classen (3) identifies the technical procedure as initiation, reconnaissance, evaluation, survey and design and construction. Perhaps one should add re-evaluation after construction.

In physical terms water can never be limited. It is always technically possible to deliver virtually unlimited amounts of water, if necessary as gallon cans of purified sea water. In practice there are severe economic constraints on the programme which are recognised by the engineer before initiation. At present there are more than 500 proposals for rural water schemes with the Water Development Division (WDD) which would probably require nearly £5 million in finance and more than utilise the available planning personnel. These proposals are the result of initiative in the rural areas by self-help groups, District Development Committees, or even individuals. Classen stresses that WDD should be consulted at an early stage in the initiation of a scheme, even if solely as an adviser in order to ensure technical and financial details are appreciated and adequately covered. In addition it must be noted that in some areas there are potential economies of scale. It may be preferable to have a large 'once for all' scheme, even if this means a delay, rather than two or more small schemes. With increasing activity in the water field by self-help groups risk of overlapping is enhanced. Procedures should be set up to avoid this. For instance the WDD should be promptly notified of registered self-help groups by Community Development Department.

After initiation a reconnaissance is necessary to ascertain whether there are grounds for a detailed feasibility study. In the reconnaissance phase the water source, its actual and potential yield are identified, the area and the human and animal population to be served are defined the type of layout most suited to the conditions is drawn up. If the reconnaissance study passes the other preliminary economic, social and political and administrative tests, it is then necessary to prepare a feasibility study.

Classen recommends use of the usual ecological zoning - high potential, medium potential, medium to low potential and low potential. This assists planning in so far as it indicates likely future population density and production per acre of land but use of the loaded words 'high potential' and 'low potential' when what is really meant is 'wet' or 'high altitude' and 'dry' and 'low altitude' may result in subconscious bias in favour of investment in the high potential areas. In terms of returns to water development whether measured as social or financial returns, it may be that there is more potential in the low potential areas. Certainly in many of the livestock areas of Rift Valley Province water shortage in drought periods is the determining factor for livestock numbers, and in the low altitude 'cotton' zones below the coffee areas it inhibits permanent settlement.

(3) This section relies heavily on this paper:
G.A. Classen "Criteria for Planning Water Supplies in the Rural Areas of the Coast Province" G.A. Classen WDD Nairobi, 1969.

Technical criteria are unlikely to prove difficult to establish. The only possible exception is where new techniques or materials are being used. At present civil engineering techniques and relative cost structures are changing rapidly as a result of improvements in machinery and operating procedures. Developments in large scale earthmoving have been dramatic in the last five years. For large jobs where full utilization of machines is assured (nearly 24 hours a day including servicing) it could be that even where foreign exchange is given a premium and unskilled labour is costed at its social opportunity cost of at or near zero, capital intensive techniques are more efficient. For smaller contracts full use of machines is difficult and high costs will result. In these cases it is likely that labour intensive methods are more economic even after considering the difficulties involved in hiring and supervising large number of workers. Potentially machines are quick, efficient and reliable but as the history of mechanised programmes in rural areas have shown, high costs can be incurred unless management is first rate.

There is at present a serious unemployment and under-employment problem in urban and rural areas and recent population growth estimates suggest the problem will increase rather than decrease unless massive efforts are made to alleviate the situation. There is a danger that visible and attractive but capital intensive schemes such as irrigation projects will be chosen. If employment generation is to be given additional weight in future development expenditures, rural water will almost certainly appear comparatively attractive.

New materials such as plastic pipes and fittings and fibre-glass well screens mean changed specifications each year. In the past WDD have shown innovative behaviour and this can be expected to continue particularly with the influx of additional staff. At Kabare in Central Province plastic pipe was used underground eight years ago when there was little experience with these materials elsewhere. Except for occasional damage, from burrowing animals this has been extremely successful.

Setting of technical standards such as one stand-pipe for every 40 persons, one well for 250 persons, 10 gallons per day per person or per cow, two gallons for a goat etc., may be useful for design work but they should not be slavishly adopted as rigid standards. In Kenya there is such a wide diversity of conditions that no two schemes are identical and therefore considerable discretion should be left to the engineer to meet special local circumstances.

This point has been refuted by the Ministry of Health/WHO Environmental Sanitation Unit who have based their most recent work on standardised designs. By so doing they are able to utilise the services of less qualified personnel for design. Whilst this has apparently been successful for the small schemes in their programme (average cost £1500), for larger schemes it might not be so appropriate.

One important set of technical criteria relates to capital and recurrent costs per family served. Other things being equal the schemes with lowest costs per family should be given priority. In Western and Nyanza Provinces the capital cost per family range from £10 to £121 with a mean cost of £35. With capital costs there is no evidence at present of economies of scale. With recurrent costs there is a large fixed cost element which is fairly constant whatever the size of the scheme. Thus average annual costs are generally lower per family served by large schemes than in small schemes.

2. Economic Issues

Definition of objectives - Economists implicit give additional weighting to their criteria by using words such as efficiency and welfare. Economic efficiency is concerned with maximising the size of aggregate consumption, often described as maximising the size of the national pie. National income maximisation is not equivalent to maximisation of national welfare. The latter is not achieved simply by producing the largest pie, as its methods of distribution is relevant, particularly in a developing country where there is generally wide disparity in incomes between the richest and the poorest sections of the community. The setting of economic criteria are further complicated as it is necessary to consider the time dimension. The problem may be defined as one of identifying a programme which will give a maximum contribution to national income subject to achieving satisfactory growth over time and satisfactory performance with respect to other objectives such as regional development or rural employment targets.

As previously indicated, Kenya has a number of policy objectives which, though laudable, are not necessarily mutually consistent. For instance, it is probably not feasible to obtain high and growing per capita incomes, equitably distributed among the population. It is possible to give priority to the necessary condition that national income should grow steadily and rapidly whilst recognising that it is not a sufficient condition. The general planning philosophy in Kenya is that a high national income enables the social priorities to be met but this social expenditure is not practicable if national income is low. At this stage in the development process it would be unwise to try to meet all desirable social objectives, such as piped water to all houses, as this would be at the expense of more directly productive investments. For this reason priority should be given in the early years of the programme to schemes where there will be a large productive response. Estimating response to water inputs is difficult because the output is not usually direct: e.g. increased labour productivity. In addition it is sometimes difficult to decide whether the water supply alone has resulted in personal and national income gains. Sometimes there are complementary response from a number of inputs and sometimes the growth would have occurred without the water.

If the water programme is to reach the high level of £2 million per year within three or four years, the programme has to be consistent with the planning strategy of the country. Thus emphasis should be placed on schemes which will produce large additions to the national income. The level of net direct benefits obtained by the recipients of improved water supplies is not the only measure of contribution to national income. Indeed it might be misleading. For instance, in a densely populated area such as the upper cultivated slopes of Mount Kenya or the Aberdare range where family incomes are comparatively high, the main benefit from piped water may be social - less arduous work for the women and children. The small farm size might preclude gains from increased labour availability or scope for increased numbers and improved breeds of cattle. In this case income may be high enough to bear charges. The repayment record would be good but additions to national income small. Let us take an opposite example. The Amboseli Basin is one of the worlds finest and most accessible game viewing areas and as such is a potential earner of foreign exchange from tourist revenue. Recent research has suggested that annual revenue from tourism will rise from £250,000 per year in 1968

to £1-2 million by 1980 whilst revenue from optimum livestock ranching with no game would be approximately £120,000 per year only (4). However, the welfare of the Masai herdsmen and their cattle that traditionally use the game viewing area as a source of dry season water has to be taken into account. Cattle numbers have increased in recent years mainly as a result of improved veterinary treatment and the stage has now been reached where prospects for game viewing are seriously threatened by the conflicting interests of the herdsmen. As water is one of the key variables in the system it could be that provision of alternative permanent water sources outside the game areas would go a long way toward satisfying the social problems and secure the national income growth from tourism. However, these projects would fail on strict financial productivity tests because direct revenue would be minimal.

Setting of specific economic tests to aid decisions on scheme selection are necessary because technical, administrative and financial resources are limited. Investment in Project A may necessarily preclude investment in another Project B. If economic criteria are to predominate, the first requirement is to produce an assessment of the direct benefits and costs of the scheme. For small schemes these can be expressed as a general statement but for large projects estimates of benefit/cost at ratios, net present value of benefits less costs and internal rates of return. Discounting should be carried out at the opportunity cost of capital which is generally reckoned by convention and convenience to be 10 per cent in Kenya at the present time.

A 'decision matrix' should be constructed showing the performance of alternative schemes or alternative scales of a particular scheme using other criteria such as the amount of skilled manpower in planning, execution and administration, unskilled labour employment effects and foreign exchange consumed. Even if economic criteria are not considered to be determining, in this way the costs of meeting social or political objectives can be readily appreciated in terms of economic opportunities forgone.

This theoretical ideal is unlikely to be attained for some time in Kenya because of scarcity of data and personnel. However, it is the direction to aim at by those responsible for the data collection, planning and design.

Programme evaluation.

The economic justification of the level of the programme is difficult because of problems in establishing the level of returns. Rural water is both a producer and consumer good. As a producer good it is possible in theory to estimate the producer's 'willingness to pay' for the input rather than go without it by estimating the demand curve and price elasticity of demand. In its use as a consumer good, we are dealing with mythical units of utility.

(4) Land use in Masai-Amboseli Game Reserve -
Staff paper: D. Western, University College
Nairobi, 1969.

Kenya is committing a significant proportion of its development budget to rural water development. Although it is possible that this would be continued even if economic benefits are not resulting, it would be better to take decisions in the light of facts demonstrating the impact of the programme. At present investment is justified by the intuition of decision makers who know benefits to water investment occurred in other countries and who see potential benefits in Kenya. The proposed scale of investment is now such that intuition is an insufficient basis for decisions. Accordingly it is the responsibility of the Ministry of Agriculture to obtain data from existing and proposed schemes so that rational decision making can take place and the level of programme modified to meet actual conditions.

Communal water development is indirectly assisting health improvements, dairy cattle husbandry, beef cattle production, cash crop production, tourist industry and other activities. Emphasis is placed according to the standpoint of the advocate. A very broad view of the programme is required because no simple scheme is exclusively a cattle scheme or a minor irrigation scheme. Nevertheless, at this stage two main types of scheme can be envisaged: first, water provision in rangeland areas and second, water provision in arable areas. In range areas three sub-types exist namely:-

- i) pure charity schemes where beneficiaries are poor and prospects for increased income minimal;
- ii) schemes where beneficiaries are poor and payment prospects not good but nevertheless social benefits exceed social costs. For example, schemes in areas such as Turkana to alleviate Government famine relief expenditures, or, schemes in or near game zones to keep herders and cattle from game viewing areas thus safeguarding tourist revenue;
- iii) schemes where production will increase because cattle numbers are determined at present by the carrying capacity of the land in occasional drought periods. In range areas such as the Masai Plains livestock reductions in drought years may have an indirect benefit in preventing over grazing, excessive run off and subsequent pasture deterioration and erosion. Provision of range water is really a separate issue to communal water supplies, but nevertheless, wherever water is installed in areas where cattle are likely to be the main beneficiaries, the ecological balance has to be closely examined. If water is limiting expansion of production by people dependent on animals, its provision can be expected to result in large increases in national income and a good repayment record.

In the arable areas there are three subtypes identified by forecast response to water:-

- (i) areas of high population density, generally with comparatively high incomes from cash crops such as coffee and tea. Repayment prospects are good but additional production may not result because the acting constraint is not shortage of labour, even at peak periods, nor shortage of capital but lack of land to allow for expansion and lack of technical know-how. Dairy cattle cannot be purchased because it would mean substituting for cash crops or subsistence food grains in order to obtain pasture. Thus the effect on national income is small;

(ii) arable regions with scope for expansion of crop area or yields when labour becomes available. Also areas where absence of drinking water for all the year prevents permanent settlement or keeping of grade dairy cattle. These areas exist in Western Kenya at high altitude and at the margin between coffee areas and rangeland. In these areas repayment prospects are good particularly if credit is provided for agricultural investment. The value added to national income by these projects should also be high.

(iii) dry arable areas where cropping of cotton, groundnuts etc. is possible in the brief rainy seasons and where beef cattle are also important e.g. lower Meru, lower Embu (Mbiri) lower Machakos. Here water investment will be a major improvement only if labour is a real constraint on production. Given the unreliable rainfall patterns and the importance of timely sowing in these areas this would seem to be a reasonable assumption.

Clearly there will be different financial and economic implications to the programme according to the weight of these scheme types. For maximum economic growth water should be provided to selected cattle areas and to the arable areas where population density is not too great. For financial returns cattle areas again have priority but also the densely populated arable areas with comparatively high incomes. In these latter areas the water source will not be too distant, gravity schemes are feasible and therefore capital and recurrent costs per family minimal. If financial criteria are to carry substantial weight this may result in individual connections in these areas to increase revenue performance although national income will not gain from this transfer of resources.

Design decisions. The type of water supply recommended for a particular area is determined largely by the engineering aspects of the scheme, and by the ecology which generally defines the population carrying capacity. Numerous alternative sources exist including wells, boreholes, lakes, rivers, springs, streams, dams, rock catchments, excavated tanks including jabias (water-proof rain storage tanks) and their modern equivalent the butyl sheeting tank. Water may be dispensed from these sources by a variety of methods ranging from simply using the source, simple pipelines or channels with point offtakes, partial reticulation with communal point offtakes or full reticulation. Water may be conducted by gravity or pumped.

There are thus a wide range of combinations of source and distribution system. In practice most of the alternatives are quickly eliminated by an engineer on technical grounds. Difficult decisions may have to be taken with regard to the scale of the scheme and the design of outlets. Often the scope of a scheme is limited because of clear topographical boundaries. However, on occasions decisions must be faced such as whether a large main pipe should be built or two river offtakes, one upstream and one down-stream. Possible water contamination between offtakes may complicate what is otherwise a routine technical calculation.

Time is another dimension to be considered in reaching decisions. It is likely that in many schemes water requirements will increase over time as a result of population growth, migration and increasing awareness of the utility of water. The problem is then to establish to what extent capital should be committed now in order to cope with future demands or whether investment should be deferred. It is certain that total cost will be very much higher if capacity has to be increased in ten years time for additional main pipes must be laid and other equipment installed. It is anticipated in the early years of the Kyeni scheme, only 25 per cent of capacity will be used and that it

may be 20 years before full capacity is utilised. The alternative of putting in, say, half of the capacity and returning in ten years for expansion was rejected on the grounds that savings would be small and uncertain and that technical problems were envisaged. On the other hand, there is inevitably a budget constraint on the rural water programme and more people will be served today, for a given sum, if there is no excess capacity in the initial schemes to allow for growth in demand. This dilemma can be resolved, in principle, by estimating the discounted costs for the two approaches and comparing these with the respective discounted benefits. Major problems exist with respect to choice of discount rate and cost estimation but the main obstacle in a programme of the nature is the difficulty of identifying and quantifying benefits. Intuitively, it would appear that the latter approach of a larger number of schemes with limited capacity is more appropriate at this time.

Evidence to support this view can be found by considering the question of the returns to varying amounts of water. What is the minimum amount of water required per family and what are the marginal returns to increasing supplies? These questions relate not only to the capacity of the system but also to the degree of sophistication. It has been shown that the amount of water people use is inversely related to the distance they have to walk. (5) G. White (6) found no such association though there was a clear difference in volume used between people who carry water any distance and people who have water in their house.

If there are high and constant marginal returns to water it will be more appropriate to put in fairly sophisticated systems supplying water to points at or near each dwelling. However, if there are low and rapidly diminishing marginal returns to supplies greater than the necessary minimum, there will be few benefits foregone if a large number of schemes are installed with limited number of offtakes. White in his study found that the marginal returns fall if supplies are more than 9-11 gallons per head per day. White concludes, "In promoting economic development in low income countries through supply of clean water, even where urbanisation is rapid, there appears to be special merit in a policy which favours wide distribution of small amounts of water rather than a policy which favours heavy withdrawal by fewer consumers." In Kenya small quantities are supplied. Design varies from about a maximum of 15 gallons per head per day (gravity schemes) to 4 gallons per head per day (pump schemes). In special instances such as the dry off-shore islands less than four gallons per head may be all that can be economically supplied.

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- (5) Warner, Dennis "Rural Water Supply and Development A Comparison of Nine Villages in Tanzania" Paper for East African Agricultural Economics Conference. Nbi. '69
- (6) White G. "Change and Disease in Africa - Domestic Water Use and Cost" University of Chicago mimeo 1968.

To some extent, this view is countered by a school that considers ample supplies equally or even more important than the quality of the water. (Hollister (7) and Watt (8)). This theory suggests that ample supplies may act as a dilutant and reduce incidence of disease because of better hygiene. Whilst this point may have some merit for ultimate development, it would appear that there are in Kenya large gains to be obtained at present by the alternative strategy of providing small quantities widely. On balance the Government policy of providing capacity in the main distribution system but restricting cost by providing only communal points is the correct one.

Decisions on the degree of sophistication of the schemes in the programme have in all probability been cleared because of the dramatic increase in cost with individual connections. In Kyeni the capital cost of the communal points design is £77,000 but with full private connections the cost exceeds £180,000. It is still questionable whether private connections should be permitted, even if full costs are to be met by users themselves as at Kyeni. There must be some competition for resources between public and private schemes and therefore large numbers of private connections could slow the national programme. However, private connections undoubtedly increase the revenue total from the scheme. As source of finance is likely to be a bigger obstacle to the programme than lack of engineers, fitters or pipes, the private connection proposal may be justified on these grounds.

Before supplies are installed the question of whether water quality should be improved, for instance by chlorination, has to be considered. A chlorinator and slow-sand filter might cost say £250, always less than ten per cent of capital cost and in many cases less than one per cent. For the SIDA programme* a filter/chlorinator in each scheme would increase total costs by £50,000 or 3 per cent of capital costs. It is not, therefore, levels of capital cost that prevent installation of these devices at this time. The problem is one of recurrent costs and maintenance. When a County Council budget runs low, expenditures on water quality may be regarded as non-essential. Skilled and regular maintenance is necessary for successful operation of sedimentation, aeration or filtration plants. The situation should be reviewed and the Ministry of Health might be asked to prepare a programme with the objective of providing safe water in all future water developments. This should include both an assessment of the risk of chemical and bacteriological contamination and procedures for successfully overcoming technical and administrative problems.

(7) Hollister, ACJ, et al. "Influence of water availability on Shigella Prevalence in Children of Farm Labour Families" Am. J. Public Health 45: 354 (1955)

(8) Watt, J et al "Diarrheal Diseases in Fresno County, California." Am. J. Public Health 43,728 (1953)

* A programme estimated to cost £1.75 m recently submitted to the Swedish Government for aid assistance.

One last point on design criteria relates to professional standards. Design for a particular scheme should be related to the values and objectives of the community that it is to serve. In practice the engineer often relates his designs to the values set out by the principles and goals of his profession. Often these principles and goals are formalised as prescribed standards and they are faithfully adhered to. These prescribed standards are sometimes borrowed wholesale, from either Europe or North America and not adjusted to suit conditions in a developing country. For institutional reasons design standards such as thickness of concrete for dams or percentage of steel in a structure are changed at a much slower rate than technical innovation would warrant. It is not unknown for techniques set down in the 1930's to be used today. This results in boreholes that are protected by stone fortresses being erected in villages of mud and wattle houses. Engineers generally have a professional bias (not conscious direction, though this is not unknown) to the most technically efficient method of construction.

In capital scarce economies substituting for capital costs by accepting increased maintenance expenditure in principle should prove the best policy because future expenditures are heavily discounted. In practice, obtaining finance for operation and maintenance costs is uncertain. Also organising and keeping to regular schedules of maintenance and repair is difficult and expensive in a large country with poor communications. For these reasons the bias toward technical rather than economic efficiency is probably not as serious as apparent, but nevertheless it needs considering.

3. Finance

No long term final commitment can be made to any development programme by the Treasury. General targets are necessary but it is appreciated that flexibility has to be maintained so that changes can be made should overall financial resource priorities change and should experience reveal the programme to be either too ambitious or too modest. A single financial year time horizon is too short in a planning situation and if rigidly applied it in effect precludes the use of planning as a tool for Government. Treasury already commits itself to long-term arrangements on the national road programme, power programme etc; even though no specific authorisations are made beyond one year, the loans and contracts entered into clearly bind the government to a long term programme. The size, dispersion and costs of the rural water programme clearly merit a similar approach.

It is conceded that water investments may be anticipated to have direct benefits and that the beneficiaries are in the main easily identifiable. Thus some charge must be borne. In principle there seems no reason why areas where large benefits occur should not pay for their own scheme plus a contribution for less fortunate areas. In practice it would be difficult to obtain more than the full costs of the scheme and use water as a revenue source. It may be possible to use devices such as the well known method used by many engineers whereby repayment of capital is charged plus a sum (sinking fund) to provide for replacement of the assets at the end of the project life thus making the beneficiaries pay twice in the first period of the project.

It has been proposed that a minimum flat rate should be levied in all projects equivalent to Shs. 1/50 per family per month subject to satisfactory income levels and low cost collection. On top of this minimum a further charge would be levied based upon a fraction of the assessed net benefits anticipated in that particular scheme. This is in a sense charging 'what the traffic will bear' but it should result in a more close approximation between assessment and revenue collected than has been the case in the past. This procedure together with measures to improve

the method of collection and enforcement of assessments should ensure good financial performance.

At this stage in the programme it is important that financial criteria are placed high on the list. However, decision makers should also note the indirect revenue and expenditures avoided when many of the schemes are installed. We have noted the safeguarded tourist revenue in Amboseli and savings in famine relief in other areas. Health expenditures may be expected to decrease. Increased rural welfare may slow down urban migration and thus save some of the huge social cost for urban services(9.) Also farmers will be kept in productive work rather than adding to urban unemployment. The repayment capacity of non-productive users, e.g. bars, may be high whilst that of productive users, such as dairy farmers, low at least in the early years.

4. Social and political criteria

Water supplies ought to be accorded priority by the people to benefit from them. Once installed they should be accepted and fully used. We require to know more about what influences a farmer's decision to use a particular source because there are always several possible sources and it is not always the nearest which is selected. Farmers have their own tests for water. In Kabare piped water is preferred because it is said to be warmer than the stream water and cause less colds. In parts of Masai Plain, mineralised water known as "olare" is preferred because it is thought to give health to cattle. In almost all areas clear water is highly regarded mainly for aesthetic reasons. It is important to know before design whether the users values lead them to prefer communal sources or private sources. In some areas privacy at collection might be ranked before convenience or cleanliness resulting in new tanks or boreholes being underutilised.

It is Government policy to seek strong local group participation in the planning and operation of schemes. The current interest in self-help projects for water is therefore one criterion for allocating priorities between regions. In 1968 the self-help schemes in the various provinces and the priority given to water is shown in Table 1. On the basis of this criterion emphasis would be placed upon investment in Central Province. However, it could be that demand for water is a result of rather than a cause of development and therefore use of this criterion would reinforce trends to regional disparity. In Central Province there are some extremely successful water schemes including Kabare and Zaina and it may be that self-help is a result of a demonstration effect. In Mayo in Tanzania water was placed as the highest village priority by villagers themselves after a survey had revealed school children had 90 per cent ascaris infection and 52 per cent hook worm (10).

Not to be underestimated is the possibility of using water investments as a vehicle of social revolution. With easy access to clean and plentiful supplies the womenfolk of Kenya are relieved of a considerable workload and have the prospect of new activities including improved domestic hygiene. There should be a considerable payoff to extension work in home-economics, hygiene and other related subjects following water schemes.

(9) There is some evidence that the reverse is the case.

(10) Kresler, J. "Uhuru na Paji - Health, Water Supply and Self Reliance in Mayo Village".
BRALUP No. 3, University College, Dar es Salaam.

Political criteria must also be recognised. The main effect is likely to be a wider spatial distribution than would occur if economic or financial criteria were pre-eminent. Most politicians wish to have projects in the areas that they represent in order to give benefits to the people that voted for them and to consolidate their position. Generally they are less concerned with the type of project than with the total value of the investment. Therefore in meeting the demands of inhabitants of a particular area expressed through their political representative, it is as well to consider whether investments other than water would bring greater benefit (or less cost). It might increase total national income if schools are placed in remote unproductive areas in order to increase ultimate mobility of the inhabitants rather than to provide water schemes.

Water is customarily considered to be a free good and therefore even if it is delivered to a homestead in a clean condition through pipes which require capital investment, it may still be regarded as a natural free good. This view among beneficiaries may be encouraged by politicians, making repayment prospects poor and thereby lowering the scope of the programme. Each scheme should, therefore, be selected on the basis of a firm commitment from the beneficiaries to pay some agreed amount for the water. It has been suggested that each users group living round a communal point should sign an agreement or contract for repayments and that powers be granted to the administration to enforce payment, if necessary by cutting off supplies.

5. Administrative Aspects.

Successful administration requires a policy, resources and capacity for execution. Policies are general statements of principles and objectives that motivate the plans and actions for a programme. Administrative resources include people, money, authority and materials. Green and Redmond include time, will and facilities as resources (11). Execution is a function that is necessary to achieve the objectives described in the policy. Litchfield's general theory of administration suggests that within each of these operations of policy, resources and execution there is a cyclical function of decision making, programming, communicating, controlling, reappraising (12). It is from this theoretical framework that criteria may be derived for testing the administrative process of the rural water programme.

Policy is being evolved by a Government Interministerial Committee in general terms. Members are obtaining an understanding of the issues which are raised by the overall objective of providing piped water to all rural communities within twenty years. From this understanding stems clear but broad definitions of the objectives which form the policy.

(11) "Comments on a General Theory of Administration"
E.J. Green and G.H. Redmond, Administrative Science
Quarterly, 1957.

(12) "Notes on a General Theory of Administration"
E.H. Litchfield, Administrative Science Quarterly, 1956

As objectives change because of emphasis on financial rather than social aspects of the programme perhaps a review and revision of policy can be made by the policy formulating body. With the recent reorganisation and offers of assistance from overseas, personnel should be sufficient to carry through policy changes. Finance from aid sources is also likely to be available but in any case given a will to develop rural water and an indication of its relative priority and a continuation of the current buoyant state of the economy, Kenya could support a programme within limits set by technical personnel including contractors. The necessary authority for the programme could prove to be a stumbling block unless controlling interests make explicit their long term commitment to the general programme and in particular the agreed time scale. Materials are available though delay in completion of some schemes may be anticipated as certain key items are not locally stocked in quantities sufficient to cope with the increased programme.

Litchfield's cyclical function can be expected to apply to Kenya from decision making through programming, communication to control. However, in the rush to get more schemes on the ground, a policy which is backed by the faith of decision makers in the size of benefits likely to accrue, re-appraisal has been accorded low priority. Attempts are being made to rectify this through surveys of Kabare/Inoi and Ministry of Health/WHO programme (13). But resources devoted to these appraisals are insufficient and only very superficial facts are likely to be obtained. If the administrative process is to function smoothly, information on performance has to be obtained. Information is an essential but costly input for effective planning and though more information might tend to make decision making more difficult it should also make it more effective.

6. Criteria for Selection of Projects

From the preceding discussion it is possible to derive a set of criteria to aid in project selection. In the short term, schemes will be selected on the basis of priority decided by their state of preparedness. Many of the schemes have been proposed years ago, have been fully designed and are ready for implementation. However, somewhere near 1,000 schemes have been initiated and a more definite set of criteria are required to judge between them. It is proposed to present one pre-condition, four major criteria and three sub-criteria that should be used to derive a programme that contains a mix of projects consistent with national objectives.

After a scheme has been conceived it has to be subjected to preliminary technical evaluation. Planning a scheme simply because an area is dry is a tempting exercise for those who wish to make the 'desert bloom' but some sifting on the basis of cost in relation to overall benefits is required. Satisfying technical conditions is thus the pre-condition.

Most schemes will be technically feasible and priorities have to be established on other grounds. The four criteria recommended are (i) contribution to national income, (ii) evidence of priority accorded by the beneficiaries; (iii) repayment prospects and (iv) social welfare needs.

(13) Surveys conducted by the writer for the Kenya Ministry of Agriculture of existing and proposed schemes, June-September 1969

Ideally the value added by the scheme should be equal to that added by similar investments elsewhere in the economy. Estimates of direct social benefits (net of associated costs) less direct social costs should be made. If it is anticipated that net indirect benefits would exceed those that normally arise from any investment then these should be considered too. A good example previously quoted was the safeguarding of tourist revenue from Amboseli Game viewing area. In view of data deficiencies it will be necessary to use approximate figures backed with heroic assumptions. However this will force the asking of the correct questions at the appraisal stage and it will be better than no evaluation at all.

Some authorities are concerned that water should not be foisted on rural communities at a premature stage in their development as this will lead to wastage and inefficient allocation of public resources. The most obvious indication of priority accorded to water by the potential beneficiaries is the offer of self-help in the form of either materials, cash or labour. Other indications of priority might be effective user group formation and lobbying their political representatives.

Rural water is generally considered to be a key factor of production or at least an input that indirectly promotes economic growth. If this view is correct it is important that the rural water programme is implemented as quickly as possible. The volume and pace of investment will be to some extent conditioned by the impact of the water inputs. One possible measure of this impact is the willingness of beneficiaries to meet the costs of the scheme. Anticipated revenue is therefore important in that a good repayment record will assist these responsible for obtaining allocations for further capital investment in subsequent schemes. Repayment demonstrates in a tangible way that investment is valued and it provides finance for later schemes. However in a very poor area there may be economic impact but no ability to pay. Conversely in a rich area it is possible that there is no economic gain but repayment prospects are good. This makes payment record a poor index of economic contribution.

Repayment prospect is a useful financial criterion when applied to the overall programme. Government cannot promote a programme based wholly on 'charity' schemes as this results in a drain on the Treasury and a loss of potential growth from profitable schemes. However, neither is a programme based solely on narrow financial productivity criteria acceptable. There are parts of Kenya where there is a great hardship with regard to water supplies and steps have to be taken to alleviate these conditions. Few would dispute the relevance of social welfare criteria to a programme of this nature but a wide range of opinions exist on the relative weight to be given to this criterion. In the early years perhaps 10 to 20 per cent of resources might be allocated to such schemes. This is a policy question still to be decided.

The three sub-criteria are (i) cost per family served; (ii) geographical dispersion over the country and (iii) measures of need for water as shown by distance to present source, quality of the water and reliability of supply. These sub-criteria are really special cases of the main criteria. If a scheme has a high cost per family it is unlikely to contribute as much to national income per unit of investment as a low cost scheme. Spatial considerations are important in a political context. It is likely and justifiable that some schemes receive higher priority when political ends are achieved. The third sub-criteria is a physical measure of need for water that relates to likely economic gains from the scheme and social welfare aspects.

Table 1. Self Help Projects for Communal Water Supply - 1968

Province	Cost of Type of Installation (£'000)				Total Water	
	Piped Water Supplies	Wells	Spring Protection	Dams & Water Catchments	(£'000)	% of total selfhelp
Coast	6.6.	1.0	0.2	0.9	8.8	5.3
Central	68.0	0.6	0.3	1.1	69.9	10.3
Nyanza	4.2	1.0	0.4	0.4	6.0	0.9
Rift Valley	6.3	1.4	4.5	3.1	15.3	2.6
Western	0.9	0.2	0.4	0.2	1.8	1.0
Eastern	5.0	5.2	0.3	6.2	16.6	6.1
North-Eastern	2.9	0.7	0.6	1.4	5.7	3.9
TOTAL	93.9	10.2	6.7	13.3	124.1	4.6