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DEVELOPMENT OF DROUGHT RESPONSE POLICY OPTIONS FOR THE COST EFFECTIVE PROVISION OF WATER SUPPLY TO RURAL COMMUNITIES SUBJECT TO RECURRING DROUGHTS

Report to the
WATER RESEARCH COMMISSION
by the
Development Services and Technology Programme
Division of Water Technology
CSIR

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EXECUTIVE SUMMARY

1. PROJECT BACKGROUND

Drought, unlike most other natural disasters, is a slowly creeping hazard of nature. It originates from a deficiency (below normal) precipitation and results in water shortages particularly in the soil and in the surface water resources. Societal vulnerability to its effects is increasing, largely because of population growth, the increasing demand and competition for the limited water resources, and the poor planning of developments in catchments.

This project arose out of the recognition of the need to address the problem of water supply to rural communities in South Africa during drought. South Africa has a long history of providing drought relief to the commercial farming sector, which was biased in favour livestock farmers. In the last ten years, two severe droughts occurred in 1983/84 and 1992/93 with the former drawing attention to water supply to the urban sector and the latter to the developing rural sector. The 1983/84 drought was a national concern because it affected a number of major cities and raised concern for water supply to the power generation industry. Water rationing and water use restrictions were instituted in a number of towns and cities. The effect on rural communities did not receive he same level of attention, although the impact was obviously severe. During the 1992/93 drought however, few towns experienced water shortages because of the investment in infrastructure which had taken place during the preceding ten years. The plight of the rural communities led to formation of the National Drought Relief Consultative Forum in 1992. Severe hardship is experienced by the subsistence rural communities during drought not only due to a lack of adequate water supply for domestic use, but also as a result of increasing poverty due to a loss of livestock and crops. This background, and the recognition that in neighbouring countries definite strategies applied during times of drought have led to a marked decrease in the effects of drought on subsistence rural communities, prompted the formulation of this project.

It is the hope of the authors that this document will be of assistance to policy makers involved with the development of policies affecting the rural communities, planners involved with the planning of the use of resources for the development of the rural areas, and community leaders involved with the coordination of rural development projects.

2. AIMS OF THE PROJECT

The objective of the project was to develop drought response policy options with regard to water supply to rural communities subject to recurring droughts.

The aims in the development of the policy options were as follows:

- to identify the drought susceptible rural subsistence farming areas of South Africa (and the factors leading to their increased susceptibility);

- to investigate alternative water supply sources which may be more reliable during times of drought;

- to assess drought coping strategies and measures;

- to review policies used elsewhere; and

- to compile policy options relevant to South Africa.

3. SUMMARY

The main findings and conclusions of the project were:

- The drought susceptible rural communities are located in the former homelands and TBVC states which are also the most socio-economically disadvantaged regions.

- There is a need for the establishment of appropriate, effective institutions at local, regional and national level for the management of the water resources and water supply systems in South Africa. These institutions should be equipped with the necessary mechanisms and capacity to be able to respond to disasters through far reaching and systematic risk management. The adoption of the three tier structure with a catchment management approach as proposed by SCOWSAS would be a first step in this direction.

- Special attention needs to be given to capacity building in the rural community organisations responsible for the management and control of water supplies at the local level.

- There are basically two types of measures used in drought coping strategies: proactive and reactive measures. Proactive measures require sound institutions and institutional mechanisms and have three basic phases i.e. pre-drought, drought and post drought. Reactive measures give rise to the establishment and equipping of institutions only at the onset of drought and are related only to drought and post drought periods. Proactive measures taken after the 1983/84 drought largely eliminated impacts on the cities and power stations in 1992/93. The need is to extend these proactive measures to rural areas.

- There are three groups of drought mitigation measures, namely supply oriented, demand oriented and minimization of impacts and losses. Supply oriented measures are focused primarily on the augmentation of supply, demand oriented measures are focused primarily on the reduction of demand, and impact minimization measures aim to match the available supplies with a demand which results in the minimum impact.

- In view of the already low per capita consumption levels of water in rural communities the use of demand oriented measures is restricted, and rationing would be to ensure water is available for domestic consumption. Also the lack of development of infrastructure and the low economic reserves of these rural communities means that in general the pricing policy and tariff structure can at most recover the operation and maintenance costs, and hence should not be manipulated to reduce consumption which is already close to a life-line level.

- There should be a shift with regard to drought policy in South Africa with respect to the provision of water supply to rural communities from the current reactive "crisis management" situation to a more proactive response with emphasis in risk management in the planning for drought within the long term development process.

- Rural water supply development should be given more attention than in the past. It is important to foster a long term planning perspective in the development of rural water supply systems. Development should be geared towards providing sustainable basic water infrastructure especially to the approximately 50 % of rural communities who do not yet have an improved water supply. This will form part of the proactive drought coping strategies.

- The pre-drought strategies should focus on ways to make better use of existing surface and ground water supplies through the adoption of sustainable appropriate technologies and the judicious, conjunctive use of the water resources. In particular ground water supplies should be developed but carefully managed so as to provide a back-up during times of shortage from other resources. Alternative water sources which can be considered are, however, limited and include rainfall harvesting, mining of dolomitic reserves where they exist and salt water conversion. Of these the first is the most appropriate for use in rural communities.

- A strong and effective disaster relief policy needs to be developed pro-actively as severe and prolonged droughts are periodic events in South Africa. There is a need for the establishment of permanent drought structures within the national and/or provincial institutions with the formation of necessary committees and linkages depending on the option decided. Ad hoc drought committees to coordinate relief during drought disasters should also be institutionalised at district and sub-district levels.

- An effective early warning system needs to developed by the drought monitoring offices.

- Public works programmes should be incorporated in the policy to provide employment and income to communities during drought and to provide new or to improve existing infrastructure that will be beneficial to communities after the drought. Programmes should focus on provision of permanent infrastructure rather than temporary measures of water supply (such as tanker supply) except in

exceptional circumstances.

- The upliftment of the socio-economic status of those living at or below subsistence level should be the ultimate objective of any development initiatives in rural communities. Thus, an integrated development approach in which water supply is one element of the overall socio-economic development of the community should be adopted.

- Drought policy formulation has come through an evolutionary process having come through four stages in the last 150 years, i.e. famine relief, scarcity relief, drought relief, and drought management.

  The following were identified as critical elements or components that should be included in any drought policy for South Africa:

  1. A focus on the provision of basic infrastructure for water supply to rural communities through an approach which is community controlled and has strong community participation
  2. Development of an institutional framework in the water industry including support structures within and for rural communities
  3. Establishment of a national drought plan that takes into account rural communities
  4. Establishment of a permanent disaster relief body
  5. Capacity building in the rural communities
  6. Development of early warning systems
  7. Accelerated development of water supply to rural communities through the Reconstruction and Development Program.
  8. Conservation of the environment, particularly those elements which influence the water resources of catchments.
  9. Decentralisation of structures, services and decision making
  10. Application of proactive measures to deal with drought focusing on risk management rather than crisis management
  11. Use of appropriate, affordable and sustainable technology in water supply
  12. Research and development of alternative water supplies
  13. Application of supply oriented measures for drought mitigation
  14. Application of demand oriented measures for drought mitigation
  15. Cost recovery, tariff setting and financing of schemes
  16. Community and public participation including education on drought issues
  17. Creation of a disaster fund
  18. Ensuring there is adequate stock of equipment and spares at a regional level such as hand, diesel, electric and wind pumps and engines.
  19. The general standardisation of equipment.
  20. Creation of enabling climate for the promotion of rural development
  21. The training of adequate personnel to serve in the various sectors and levels involved in the water supply industry and the development field
  22. Systems approach (integrated development) to rural development

The drought policy options fall under two categories viz:
(1) Short-term
(2) Long-term

The short-term policies tend to address one to a few of the policy elements listed above and in turn may form components of the longer-term policies. The long-term policies tend to encompass more policy elements. The short-term policies will tend to address the immediate needs whereas long-term policies are aimed at setting up institutions and strategies for mitigating the effects of drought in a managed, participative framework.

The short-term policy requirements proposed are :

(1) An effective disaster relief policy;
(2) Accelerated development of rural water supplies

The long-term policy requirements identified were:

(1) The creation of an appropriate institutional framework for drought and water supply
(2) The implementation of a systems approach to rural development

To be effective, disaster relief needs to be implemented in a streamlined decentralised manner without extensive consultation. However, to achieve sustainability it is essential to move as quickly as possible, as water supplies are being developed, away from a non-consultative top-down approach to an approach which encourages community control and strong community participation right from the planning stage.

As implied in the description of the short and long-term policy requirements, the increased community control and participation must be facilitated by the creation of an appropriate institutional framework at all levels. This framework should take cognisance of the twenty two critical elements of an effective drought response policy listed above.

If community control and participation are not built up, operation and maintenance will become a problem and the benefits of improved rural water supply will not be maximised.

4. Contract Objectives and Project Contribution

The report addressed the aims and objectives to some degree. However, the nature of the problem of sustainable water supply to rural communities is not simple as testified by the poor results in the Water Decade. In general it may be said the problem is a development problem which encompasses a diverse number disciplines. Therefore, the depth and range of issues may not have been covered as would have been desirable.

The report relates drought susceptibility to both the physical and socio-economic framework in South Africa with in most cases, the socio-economic framework being even more important than the physical framework. The report offers the reader a useful though not exhaustive guide into the process of developing strategies for coping with drought. It suggests short-term and long term options with regard to drought policy for the effective supply of water to rural communities subject to recurring drought.

5. Recommendations

The policy options given form a foundation for a drought policy which will impinge on the implementation of rural water supplies so as to minimize the effects of drought and the need for reactive relief work in the future.

The report should therefore be used by policy makers, planners and community leaders in a proactive manner to influence how water supply policies are implemented, how early warning systems are developed and how relief work is organised and planned.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

ESA	- External Support Agency
IMDC	- Inter-Ministerial Drought Committee
GO	- Non-Governmental Organisation
RSA	- Republic of South Africa
RWSS	- Rural Water Supply and Sanitation
SCOWSAS	- Standing Committee On Water Supply and Sanitation
TBVC	- Transkei, Bophuthatswana, Venda and Ciskei
WSTF	- Water Supply Task Force
WRC	- Water Research Commission
WSSD	- Water Supply and Sanitation Decade
UNDP	- United Nations Development Programme

1. INTRODUCTION

Droughts are a natural phenomenon which gives rise to serious socio-economic consequences that usually lead to human suffering, *particularly by the rural poor* who are the most vulnerable. In addition grave environmental deterioration may result.

Drought is rather different from other natural disasters such as floods and earthquakes which start in a comparatively sudden manner, have a relatively short duration and are restricted to local influence. Drought in contrast starts slowly, is of a relatively long duration and has a creeping and pervasive nature covering vast areas. It seldom causes dramatic or sudden losses of human life, except through severe famine. Responses to the impacts of droughts are hampered by the difficulties posed in forecasting drought, and identifying its commencement, duration, severity and extent.

Southern Africa has suffered two severe drought events within a space of 11 years, each lasting in excess of 1 year (up to 3 years in some areas), and extending over much of the region. During these droughts many town and city councils have had to impose water restrictions on the residents in order to conserve their water supplies. Although resulting in a major public awareness of the drought, this has resulted in little real hardship or suffering. However in the rural areas the suffering and hardships experienced by the poorer subsistence farmers and other residents have been considerably more severe. Not only did many of their water supplies dry up necessitating even longer treks to collect water from alternative sources, but droughts have caused severe financial losses to these people who can least bear such losses.

Hence, although the occurrence of droughts has been a major consideration in the planning of water supplies for the major cities and larger towns, this has not usually been a consideration in the rural areas and in the smaller towns. Response to droughts in these areas has generally been reactive and weak, while in the cities proactive measures have been taken.

A purely reactive response to droughts as an "emergency situation" has usually resulted in vast sums of money being used for non-productive purposes, such as farmer debt reduction, tanker supply of water, the drilling of non-productive boreholes, and high administration costs. The opportunity for misuse of funds in such emergency response activities is also high, and in addition funds may be used to carry out work by "emergency response" organisations whereas this can usually be carried out more efficiently by organisations who have been active in the area for some time, and will continue to be there in the future.

There have been important exceptions to this general purely reactive response to droughts in rural areas of Southern Africa. These have been in the more

arid areas such as Botswana and Bophuthatswana, where the impacts of droughts, although as severe as in the other regions, have generally been much less than in the usually high rainfall areas. In these areas the response has not only been reactive, and furthermore a much higher level of pre-planning for drought occurrences has been carried out. This has reduced the inappropriate use of public and other funds, and has resulted in considerably less physical hardship being experienced the socio-economic impact of droughts being considerably less than in the other regions.

It is the aim of this study, therefore, to highlight the different options for drought response policies, in the hope that the next drought will find communities better prepared to face these occurrences and through the disaster relief policies being transformed as a matter of urgency into accelerated sustainable rural development.

2. DEFINITION AND SEVERITY OF DROUGHTS

There is a lack of a universally acceptable definition of drought. The definitions of drought depend either on professional standpoints such as meteorology, hydrology, and water resources development, or alternatively on the economic activity affected such as agriculture, domestic water supply, or power production.

Firstly, it can be stated that drought is a temporary feature of a region, the impact of which is felt over time. This has important implications on the policies adopted for dealing with droughts, and on how effectively they are kept to and implemented. For example, it is often said that good intentions voiced during a drought event are quickly forgotten when the drought is broken, or alternatively action to alleviate the impacts of drought are often initiated only some time after the onset of the drought, when an emergency situation exists over a large area. Consequently, any policy should take these factors into consideration, and specifically deal with action steps to be taken outside of drought events, as well as dealing with early warning systems and monitoring.

2.1 Basic Definitions

From a *meteorological* viewpoint drought exists when rainfall is abnormally low, that is, less than a critical precipitation that defines the initiation of drought (Bruwer, 1990; Solanes, 1986).

In *hydrological* terms drought exists when the actual water supply is below the minimum for normal operations and reflects a deficit in the water balance (Bruwer, 1990, 1983, Solanes, 1986). This is supported in another definition given by Cunha et al, (1983) where he states that drought occurs when there is a deficit in water including not only precipitation but also surface and subsurface water runoff and storage.

From a *water resources development* point of view, drought may be defined as a condition resulting in a reduction in the utilisable water resources in a region to the extent that restrictions on use must be imposed.

Agricultural drought exists when soil moisture is depleted to the extent that crop and pasture yields are considerably reduced (Bruwer, 1990; Solanes, 1986).

Perhaps the most common understanding of drought, particularly in the urban areas, is the restrictive use of *drinking* water. In well managed systems, this would be a result of a management decision to preserve supplies until rainfall

has replenished the water supply reserves. In many rural areas however, this would be a result of the drying up of a traditional supply such as springs, wells or boreholes.

Finally, the impact of drought on *power supply* implies a reduction in the optimum power output of a power generation system, whether hydro-power or water cooled thermal power systems.

From these definitions it is possible that drought impacts and/or severity may be defined very differently depending on the point of view of the assessor. Furthermore, the social and economic impacts of droughts should also be considered.

From a social and economic point of view, the definition of drought should not only consider water supply but also water demand. Therefore, drought depends on water use as well as on the density and distribution of users. Drought then occurs when a significant water deficit takes place, that is spread both in time and space (Cunha et al, 1983), or drought exists when the demand for water exceeds supply, usually over an extended period (Solanes, 1986). The word "significant" means that the economic, social or environmental impacts are important to man. This further implies that drought occurs when the water deficit exceeds a certain critical value and/or it affects at least a certain critical area.

2.2 Severity of Droughts

The criteria for establishing the critical drought magnitudes generally depends on economic factors. The critical water supply values for agriculture are related to the effects of water reduction on crop and livestock production. The critical values for domestic and industrial water supplies depend on the water requirements for survival, personal hygiene and necessary industrial production. These values depend on the standard of living and the life style in the region under consideration.

Droughts are basically economic and social phenomena. The general principles of economics can be used to find a unique definition of drought by applying the concept of water supply and water demand either for an individual user or for a set of water users or interests. In this context, drought severity could be measured using the properties of water deficit conceived or experienced in the different time series of water supply minus water demand.

As already stated, droughts are social phenomena. Their economic, health, well-being and other effects have significant social impacts, and hence drought severity could also be measured in terms of social impact criteria.

It is important to distinguish between drought and aridity. Both are

characterised by a lack of water. Aridity is a structural feature of a given environment whereas drought is a temporary feature or a form of imbalance that could affect both arid and humid areas, as long as water supply does not match water demand (Bruwer,1990). Meteorological drought and aridity are frequently associated, because the driest regions are usually those where variability of precipitation is highest. Economic consequences of drought are also important to less arid regions, for two major reasons: (1) because of unpreparedness of these regions to recurrent drought effects, and (2) because investments in agriculture and industry may be high and undergo major losses during drought (Cunha et al, 1983).

Economic impacts of drought are usually the most important among all drought impacts. Droughts have important consequences on the economies of both developed and developing countries or communities. From an economic point of view drought may be conceived as a shortage crisis resulting in price increases and reduction in overall economic activity. Economic losses caused are mainly due to the reduction in agricultural production (crops and livestock), industrial goods and hydro-power.

Besides direct social and economic impacts on agriculture and water supplies, drought usually also produces secondary impacts. These are social and environmental and may also have grave economic consequences. Some of these impacts are soil erosion, forest fires, plant diseases, insect plagues, decrease in personal and public hygiene, degradation in water quality, harmful effects on public health such as malnutrition, and a deterioration in the quality of the visual landscape. One of the dramatic long-term impacts of droughts combined with human activities, is the degeneration of productive eco-systems into desert in the process of desertification. The misuses of land are considered to be the basic cause of increased drought impacts and evolution toward desertification.

2.3 Management Implications of Droughts

The management of the impacts of drought is different in developed and developing communities. For the former, drought is an issue to be dealt with by rearranging socio-economic variables in such a way as to minimize the impact of drought (Solanes, 1986). In literature there are numerous examples on the management of water supplies to mainly urban areas through regulatory, economic and technological measures.

However, for developing communities drought is a problem that often is more difficult to manage due to a variety of reasons, the major among these being poor infrastructure, poor economies, lack of access to technology and lack of institutional capabilities to deal with the drought. The social impacts are also more significant. Even relatively mild droughts can have serious impacts on these communities

Droughts affect human well-being in several ways which can impair survival of people or force significant changes in the relationship between people and the environment. The groups most seriously affected are usually the economically marginal communities living at the subsistence level in the rural areas. Temporary or permanent migrations have been a common form of social migration. Other social impacts of droughts are unemployment, a deterioration in public health, significant institutional changes and sometimes radical alterations of the existing social order.

Hence the real culprit responsible for the severe negative impacts of drought may not be the drought itself, but rather the socio-economic structures where the affected are situated (Solanes, 1986). Therefore, the only realistic long-term effective measure would be to change the socio-economic framework within which people act to the extent that they are no longer so vulnerable to the impacts of drought (Solanes, 1986). This then points to the need for a two pronged strategy in preparing for drought: the short-term emergency measures for addressing the needs arising from the impacts of drought on specific communities, and the long-term approach of lessening the vulnerability of communities to the impacts of drought through changes in the socio-economic environment in which communities exist.

3. DROUGHT SUSCEPTIBILITY

Susceptibility to drought may be interpreted in two ways, viz:

- Physical susceptibility to drought brought about by climatic features.
- Susceptibility to drought as a result of socio-economic structures/framework/ status of communities.

3.1 Physical Susceptibility to Drought

[1]The major climatic feature in relation to drought is lack of precipitation and an increase in evaporation. Droughts are manifestations of climatic fluctuations (conceived as variabilities around averages) associated with large-scale anomalies in planetary circulation of the atmosphere. These lead to absence of precipitation or the occurrence of weak precipitation, during a large period of time over a region. Droughts are associated with slow prevailing subsiding motions of continental air masses. Local and regional factors of climate are also important in producing droughts, because they superimpose the local climatic anomalies on the large-scale planetary circulation extremes. This subsidence originates an adiabatic compression which leads to an increase of temperature and therefore a reduction in the relative humidity. This subsidence further produces an inversion of temperature, which increases the static stability of the atmosphere and so prevents the formation of clouds to generate precipitation. Droughts are often associated with persistent, predominantly anticyclonic weather situations. The subsidence of air masses is more intense in the east fringes of semi-permanent subtropical anticyclones, often called centres of action. When these centres of action are displaced from their average positions or are abnormally developed, they bring unusual dry or moist air masses into the region, which through subsidence produce the conditions that lead to droughts. These centres of action steer the position of the polar front and interact with the baro-clinic depressions associated with the polar front. This is displaced away from the normal latitudes to different zones where it provokes a decrease in precipitation.

South Africa is situated within the high pressure belt of the middle latitudes of the Southern Hemisphere where warm dry descending air associated with high pressure systems occurs over the greater part of the country most of the time, which is unfavourable for the formation of rain. This climate is modified by the influence of the warm, southward-flowing Agulhas current along the

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[1] Paragraph based on: Peixoto J P, Drought Characteristics, "Physical Processes Leading to Drought", In Coping with Droughts, Ed: Yevejevich V, da Cunha L, Vlachos E, Water Resources Publications, Colorado, 1983

east coast and the cold northward-flowing Benguela current along the west coast. The warmer east coast air masses are less stable and are more likely to give rise to precipitation. *Figure 1* Shows the mean annual precipitation over South Africa. Generally the rainfall is distributed unevenly with humid-subtropical conditions in the east and dry arid conditions in the west. The factors that influence rainfall vary from region to region. During the summer months low pressure troughs develop periodically over the interior. These troughs are oriented roughly NW-SE and have the effect of drawing in moist air from the north and north-east. The rising moist air cools and produces rain. These convergent systems are the source of most of the runoff producing general rainfall in the interior of South Africa, although their influence is diminished in the western half of the interior. Note that this variation does not imply drought conditions in the west, but rather the degree of aridity.

Figure 3 Indicates the percentage deviation from mean annual rainfall. The higher the percentage deviation, the more susceptible an area is to both droughts and floods. Orographic rainfall caused by winds forcing moist air up a mountain or escarpment slope occurs over the eastern and southern escarpments and mountain ranges. Since it occurs more frequently and for longer durations, river flow in these areas tends to be more reliable and less variable than regions that do not have a large orographic rainfall component. Cold fronts from the west and south west during winter are the main source of rain in winter rainfall regions of the Cape Province. Convectional thunder storms are the main source of rain in the drier areas. The major area of the country receives summer rainfall, except for the narrow area along the Cape western and south western coasts which receive winter rainfall, and a transitional area between the two, in which rain occurs during all seasons. The seasonal rainfall regions are illustrated in *Figure 4.*

It is apparent from these figures that only a small part of the country, in the east and the southeast in the summer rainfall region, and in the south, mainly in the transitional rainfall area, has a rainfall deviation of less than 20%. The rest of the country has rainfall deviations greater than 20%, indicating increasing susceptibility to drought. These progressively increase to over 40% towards the dry arid areas in the west.

South Africa is periodically afflicted by severe and prolonged droughts which are often terminated by severe floods (Department of Water Affairs, 1986). These droughts are usually associated with prolonged periods of anticyclonic activity over the inland plateau and consequently are most common in the summer rainfall region, especially towards the west.

Figure 2 Indicates declaration of agricultural drought (% time) per magisterial district between 1956 and 1986. A drought is broadly defined as occurring at 70% of normal rainfall and it becomes a disaster or severe when two consecutive seasons experience 70% or less of normal rainfall (Bruwer, 1990). A disaster drought implies that an area would qualify for State relief and experience a marked reduction in agricultural production concomitant with a high risk to stock or crops. Comparing *Figures 1 and 3* with *Figure 2* it is apparent that:

- in general the wetter areas in the east and extreme south (>600 mm mean annual rainfall), drought has been declared generally less than 30% of the time. These areas also have less than 20% deviation in rainfall;
- in the north, north eastern and western areas (mean annual precipitation <600 mm), drought has been declared over 30% of the time. The western arid areas are the most drought prone, drought having been generally declared over 50% and up to over 70% of the time in some districts.

Thus, on the basis of rainfall the more drought prone areas are the drier arid areas receiving <600 mm rainfall on average per year.

A study by Tyson (Bruwer, 1990) indicated that if a spatial average is taken for thirty-three widely distributed stations in the summer rainfall region, a clear oscillatory pattern is apparent in the rainfall series *Figure 5*, with its tendency to produce nine year spells of generally wet and generally dry periods in a quasi cycle of about eighteen years. The study further states that, "All future planning must be predicated on the assumption that it is a land of drought rather than a land of plentiful rain". This demands that drought planning be given greater attention to counter the impacts of drought.

3.2 Susceptibility to Drought as a Result of the Socio-Economic Framework

The impact of drought as previously stated to a great extent also depends on the socio-economic framework, structures and status.

Tables 1 and 2 give the salient features of and the socio-economic indices for the development regions of South Africa as shown in *Figure 6*. The main socio-economic indicators are illustrated in *Figure 7* for the regions.

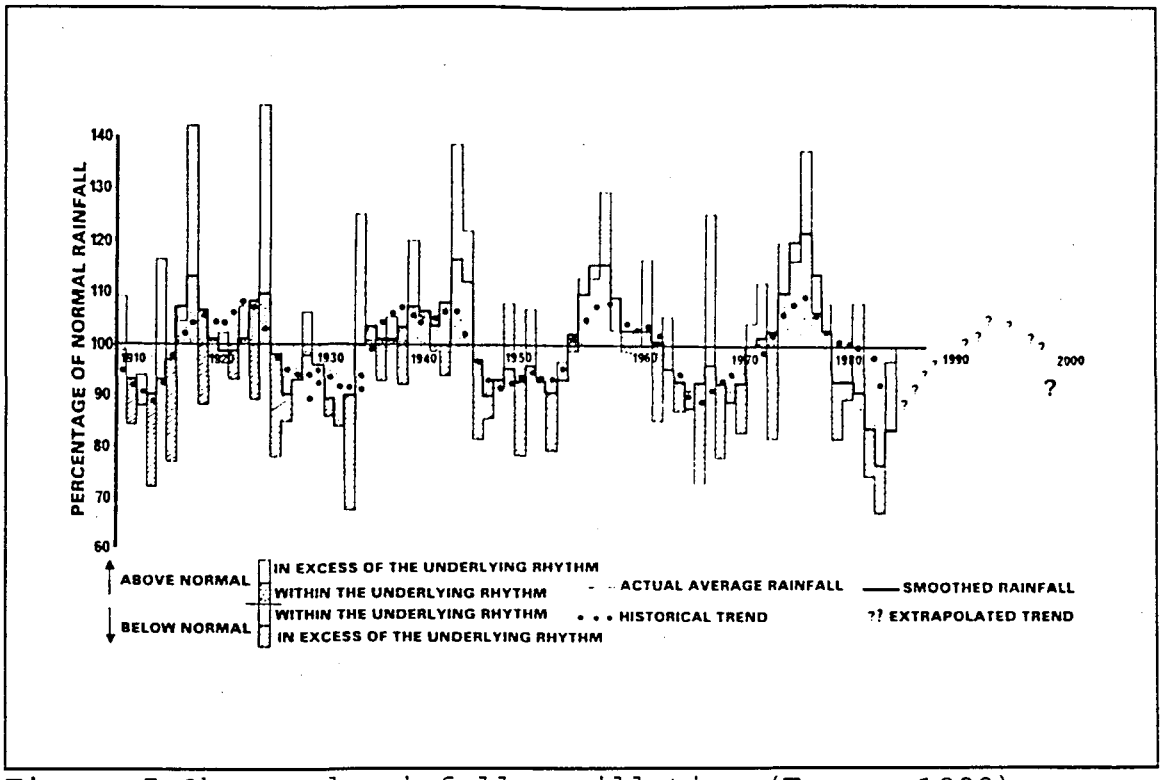

Figure 5 Observed rainfall oscillation (Tyson, 1988)

The regions B, J, G and most of A receive less than 600 mm rainfall annually, with most of region A, and some of region B receiving less than 200 mm annually. These regions also have over 20% deviation from mean annual rainfall with a significant portion of region A having over 40% deviation. These regions also have the lowest values for economic indicators given in *Tables 1 and 2,* notably the GGP and personal income per capita. They also have the lowest urbanised populations (generally <50%), indicating that over 50% of their population is rural.

Region G appears to be the worst off, although region B is drier and has had a higher percentage time of drought. Region G has had consistent below average achievement indicated by socio-economic indices except in population growth *(Table 2)* where it has the highest natural growth rate of 3.84%.

Region A while for the most part has a dry drought prone area except in the south, is highly urbanised. The arid nature of the northern part of this region has resulted in a very low rural population.

Regions C and D have fairly similar annual rainfall amounts and pattern except along the coastal belt of region D, which receives over 600 mm. From the *Tables 1 and 2* and *Figure 7* region C is marginally better from a socio-economic point of view. Region D, however, does suffer from the highest

Table 1: Salient features of the development regions of South Africa, 1990

Indicator	Region									Total
	A	B	C	D	E	F	G	H	J	SA
Area (km^2)	259 915	282 500	128 399	152 471	109 626	77 070	116 493	30 336	63 278	1 220 088
Population ('000)	3 633	1 122	2 694	4 793	8 748	2 023	4 418	8 791	1 829	38 051
Growth (1970 to 1990)	2,56	2,01	2,36	2,35	2,74	2,56	3,84	3,30	2,43	2,53
Adult males (%)	52,1	48,9	55,9	42,9	44,7	55,5	38,6	57,6	55,0	50,2
Density	14,0	4,0	21,0	31,4	79,8	26,3	37,9	289,8	28,9	31,2
Urbanisation (%)	91,0	59,0	65,0	58,0	52,0	56,0	31,0	93,0	66,0	66,0
Growth (1985 to 1990)	5,6	2,1	3,4	3,6	4,0	3,4	4,2	3,2	3,2	3,7
Literacy rate	81,9	59,2	71,3	66,2	70,1	66,9	63,2	79,6	68,7	71,6
Econ. active pop. ('000)	1 561	326	1 032	1 162	2 328	781	767	4 175	636	12 768
Participation rate	67,2	53,9	66,5	47,4	49,4	67,0	38,1	70,9	60,1	58,7
Absorption capacity	57,4	45,2	54,1	33,7	35,2	51,7	22,4	58,6	50,6	48,7
Unemployment rate	9,6	14,6	11,2	24,7	19,2	8,8	17,0	13,5	14,7	14,9
Dependency ratio	1,3	2,4	1,6	3,1	2,8	1,6	4,8	1,1	1,9	2,0
Nominal GGP (Rm)	30 804	4 494	14 746	17 107	35 609	22 874	7 453	92 080	13 688	239 153
Growth (1970 to 1990)	2,0	0,1	0,6	3,0	3,3	6,6	1,1	2,1	1,9	2,4
Percentage distribution	12,9	1,9	6,4	7,1	14,7	9,7	3,1	38,0	6,1	100
Nominal GGP*per capita* (R)	8 480	4 006	5 474	3 569	4 070	11 305	1 687	10 475	7 647	6 285
Nominal GGP/worker (R)	19 734	13 785	14 746	14 722	15 296	29 288	9 717	22 055	21 994	18 731
Personal income/GGP (%)[1]	93,2	87,0	68,1	90,2	87,8	41,0	87,6	77,3	54,6	77,0
Personal income *per capita* [1]	4 343	1 984	2 184	1 630	1 737	2 347	725	4 558	2 166	2 206
Life expectancy	63,5	62,6	63.2	63,7	63,8	63,7	62,9	64,7	63,8	64,0

1) 1985 Figures
Source: Development Bank of South Africa, 1991

Table 2: Socio-economic indices[1] for the development regions of South Africa, 1990

Indicator	Region									Total
	A	B	C	D	E	F	G	H	J	SA
Pop growth (1970-1990)	91	71	83	83	96	90	135	116	85	100
Adult males	104	97	11	85	89	111	77	115	110	100
Functional urbanisation	138	89	98	88	79	85	47	141	100	100
Literacy rate	114	83	100	92	98	93	88	111	96	100
Absorption capacity	118	93	111	69	72	106	46	120	104	100
Unemployment (inverse)	155	102	133	60	78	169	88	110	101	100
Dependency ratio (inverse)	154	83	125	65	71	125	42	182	105	100
GGP growth (1970-1990)	83	4	25	125	137	275	46	87	79	100
Nominal GGP *per capita*	135	64	87	57	65	180	27	167	122	100
Nominal GGP per worker	105	74	76	79	82	156	52	118	117	100
Personal income:GGP (1985)	121	113	88	117	114	53	114	100	71	100
Income *per capita* (1985)	197	90	99	74	79	106	33	207	98	100
Life expectancy	102	98	99	100	100	100	98	101	100	100

1) Indices above 100 indicate above average achievement, and *vice versa*.
Source: Development Bank of South Africa, 1991

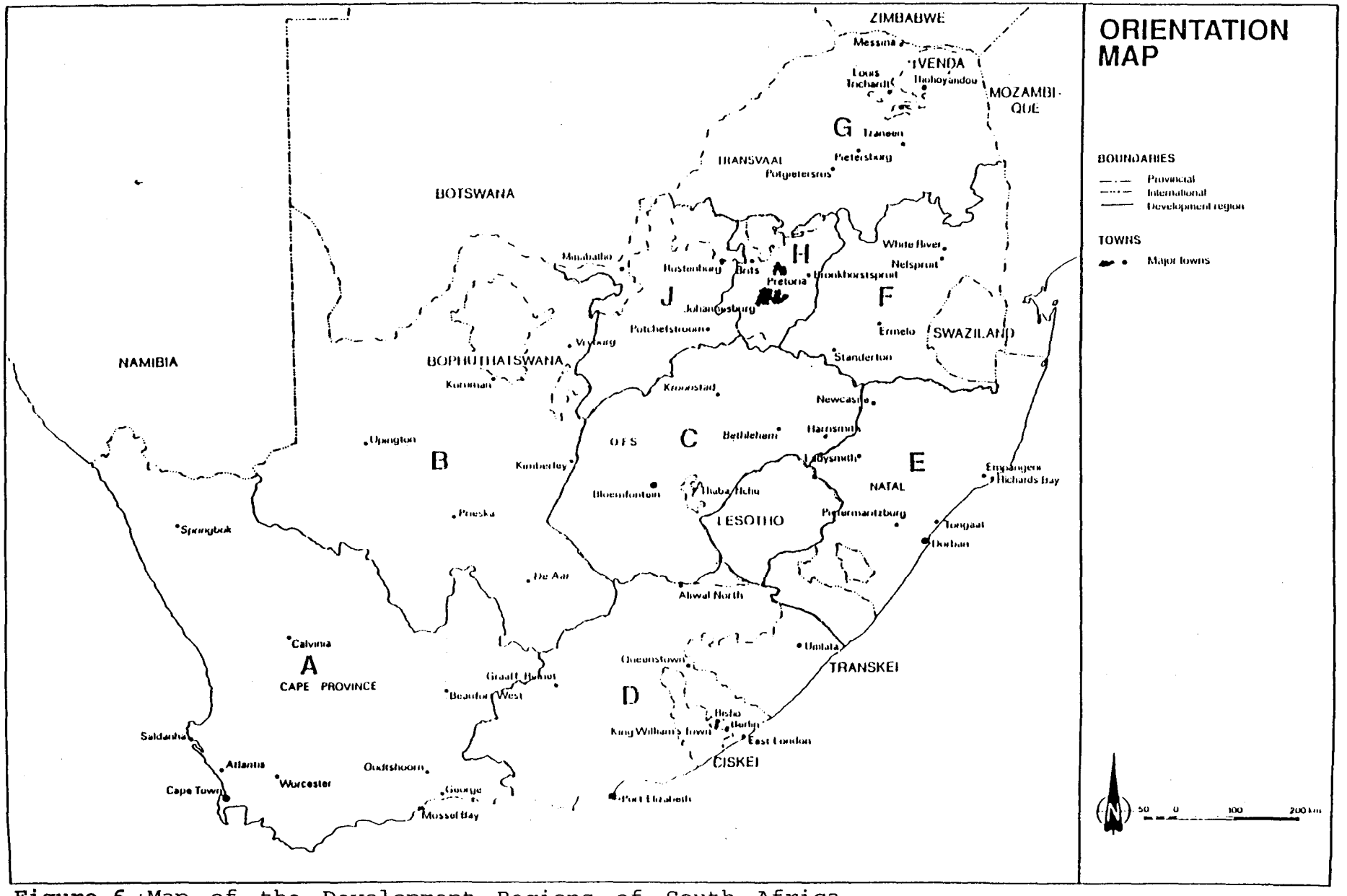

Figure 6 Map of the Development Regions of South Africa (Development Bank of South Africa, 1991)

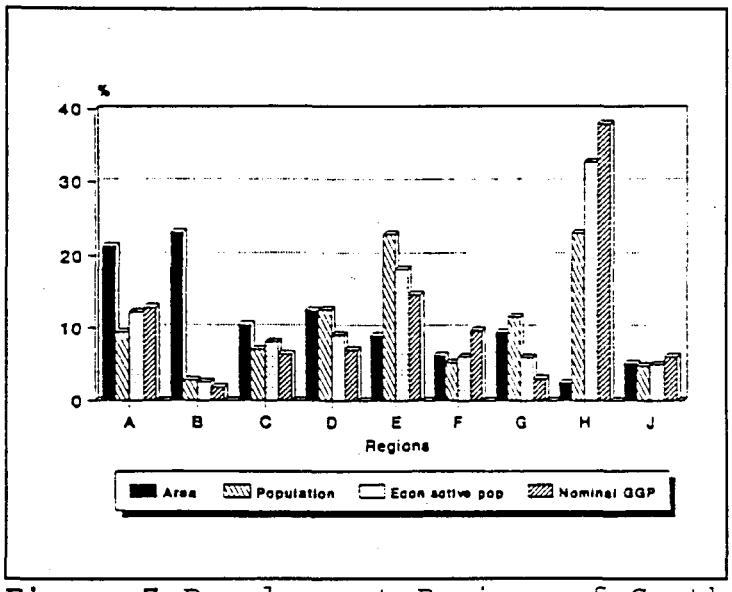

Figure 7 Development Regions of South Africa: Main Socio-Economic Indicators, 1990 (Development Bank of South Africa, 1991)

unemployment rate and has significantly lower personal income per capita than C although both are below the national average.

Region H is the financial and industrial centre of the country which is highly urbanised. This is the most advantaged area in socio-economic terms.

Regions E and F fall within the wettest areas of the country. Both have slightly over 40% of the population rural based. Socio-economically region F appears better off from *Tables 1 and 2* and *Figure 7.*

Region F has the second highest population density after H indicating it has the highest rural population density.

From the foregoing it does appear that the most socio-economically disadvantaged regions also appear to be those where the former TBVC states and self governing territories were located. These regions are also apparently drier and subject to recurrent drought with the exception of regions D and E. These regions also have the highest population densities when region H is not considered.

It is estimated that 42% of the population live below the poverty line; 40% of working age people have no job; and less than 10% of new entrants to the job market can find a job. Much of the grinding poverty that lies behind these figures is hidden in the former homelands (Johan van Zyl, 1993).

4. RURAL WATER SUPPLY IN SOUTH AFRICA

Water supply in the rural areas of South Africa has traditionally been obtained from wells, springs and rivers. Initiatives to improve the rural water supplies gained impetus during the International Drinking Water Supply and Sanitation Decade especially during the drought years of 1983-1986. Besides government institutions a number of non-governmental organisations are involved in rural water supply.

4.1 Water Supply In Rural South Africa

In most areas there are few data available on water supply coverage. It is estimated that nearly eight (8) million dwellers lack adequate water supply (SCOWSAS, August 1991). Most of these people are poor and tend to rely on state intervention for improved water supply. At present the department of Water Affairs is compiling a national data base on rural water supply (Bing, 1993). Thus, the following information[2] reflects estimates of the situation.

a. Lebowa

The Water Affairs section in the Department of Agriculture (Lebowa) is responsible for rural water supply. The water supply to villages has been improved through provision of boreholes and hand pumps, pumping from rivers and in a limited number of cases by spring protection and regional schemes. It is estimated that over 50% of the rural population is still without easy access to an assured safe water supply. These depend on wells, rivers and furrows. Construction cost, operation and maintenance costs are fully borne by the government although in some communities a nominal amount is paid for fuel.

b. Gazankulu

Gazankulu has the policy of supplying water through regional schemes drawing water from surface sources. It is estimated that 90% of the rural population has access to piped water. The other 10% depend on boreholes. The proper operation and maintenance of the regional schemes is a problem and in practice water is often not available at taps.

c. Venda

About 80% of the rural population have access to potable water. The principal

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[2] Based on: Appropriate Technology Group, "Guidelines on the Cost Effectiveness of Rural Water Supply and Sanitation Projects", WRC Report No 231/1/91, December 1991

source is boreholes serving 60% of the population, 30% obtain water from communal taps and 10% from wells, streams and rivers. The Department of Water Affairs (Venda) was responsible for water supply.

d. Bophuthatswana

The Department of Water Affairs (Bophuthatswana) is responsible for provision of water supplies countrywide and the Bophuthatswana Water Authority for maintenance of schemes.

The rural areas mainly depend on basic ground water supply schemes. These consist of boreholes equipped with windmills, diesel or electric pumps and hand pumps. Some regional schemes are in the process of being implemented and few rural areas have piped water.

Construction, operation and maintenance costs have been met by the government although in some areas the communities have contributed labour and pay a nominal amount for fuel.

About 60% of the rural population has access to reasonable water supply.

e. Qwaqwa

Most rural villages have access to regional water schemes. There are also borehole schemes and spring protection sources. At least 90% of the rural population have access to a safe water supply although not all are reliable.

A major problem is cost recovery and the government has to meet the costs of construction, operation and maintenance.

f. Transkei

The majority of the rural people depend on springs, wells, boreholes and rivers. Only 24% of the rural population live within the supply area of the regional schemes.

Windmills and pumps have been installed in villages, but about 40% of these are inoperative due to lack of maintenance. Thus, it is estimated that about 83% of the rural population has inadequate or unimproved water supply.

The Department of Agriculture and Forestry has overall responsibility for rural water supply.

g. Ciskei

The Department of Public Works is responsible for water supply in this

region. Boreholes are the basic water supply for rural areas.

h. KwaZulu

Rural water supply in KwaZulu is primarily under the Department of Agriculture. There are a number of non-governmental organisations (NGOs) also involved.

Most rural people have access to basic water supplies from springs, wells, rivers, boreholes and rainwater and in some cases out standpipe systems. Improved schemes cater for only 25% of the rural population leaving 75% without access to safe water supply. A recent study (Nokule & Mandisa,1991) carried out near Zululand University found 90% of those communities use springs and streams and the rest used mainly boreholes.

i. KaNgwane

Basic water supply to the rural population is from springs, streams and boreholes. An estimated 75% of the rural population have access to improved water supply. This is mainly through boreholes fitted with hand pumps/windmills or engine pumps. Some NGOs have been involved in spring protection.

j. KwaNdebele

Some 90% of the rural population has access to improved water supply from boreholes and regional schemes. The government bears the costs for construction, operation and maintenance and there is little cost recovery practised.

From the foregoing there is a wide disparity in the levels of provision of improved water supply between the various developing areas. The areas having the higher rural populations have very low coverage while some of the relatively small areas with lower population have very high coverage. It is apparent that over 50% of the rural population do not have access to safe, adequate and convenient water supply. They depend on basic sources such as springs, wells and rivers. The lack of any water infrastructure makes these communities not only more vulnerable to drought but it is more difficult to provide emergency relief.

On the other hand, those in the areas having a high coverage of safe water, the reliability of the systems is hampered by poor operation and maintenance and in some cases poor installation. Coupled to this is the poor rate of cost recovery. There are instances where the water is provided free of charge through public standpipes and charges are only to private connections and businesses. In other schemes there are no guidelines and mechanisms for cost

recovery. Related to this is both national and community affordability of the water service provided. This implies that, as more schemes are constructed, an ever increasing portion of the authorities' water budget will have to be for operation and maintenance. Some authorities are already concerned about this. This in turn leads to the question of sustainability of the rural water supply schemes. The less sustainable the more vulnerable to drought or any other event that may negatively impact on water supply, however small.

The map showing the practical availability of water for human consumption *Figure 8* lends credence to the proposition that lack of any basic water supply makes communities more vulnerable to drought. Those regions with a poor coverage of improved water supply had the lowest available water per person per day during the 1991-93 drought.

5. THE RECENT 1991-1993 DROUGHT EXPERIENCE[3]

A Water Supply Task Force (WSTF) was set up under the National Drought Steering Committee, (the National Drought Steering Committee represented the National Drought Relief Consultative Forum). In addition, there were other task forces formed for nutrition, agriculture, employment and development. The prime objective of the Consultative Forum was to address the drought disaster facing *rural* South Africans.

The WSTF was convened by the Rural Advice Centre and the Department of Water Affairs. The objectives of the WSTF were (Abrams, 1992 a):

- to be able to respond rapidly, flexibly and innovatively in locations of critical water shortages to firstly ensure survival, then to secure stabilised water sources and storage facilities and to address longer term water security;
- to carry out as much of the work as possible on a labour intensive, public works basis to generate some form of income for the affected thereby decreasing dependency on food aid; and
- to promote greater awareness of rural issues to the general public.

The first drought status report (Abrams, 1992) indicated that mainly rural communities in parts of the former TBVC states and the self governing territories were experiencing unavailability of adequate water from traditional sources (boreholes, springs, and rivers). However, at that time no information was available about Bophuthatswana, Transkei, Qwaqwa and KaNgwane. Few drought related problems were reported in the Western Cape although this is largely an arid area. The WSTF identified the need for an initial eleven field teams to be deployed to the TBVC states and self governing territories.

From the numerous drought status reports, it is generally evident that there was a negative impact of the drought on spring and stream flow, reservoir levels and ground water levels. However, it was not so much a problem of the shortage of water, but a shortage of readily available safe drinking water.

The drought exposed a number of rural water supply problems[7]. There were few, if any contingency plans for domestic water users.

High on the agenda was the problem of maintenance. High population pressure on schemes meant for fewer people, has exacerbated the problem. Most supply schemes had a maintenance backlog of months, if not years.

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[3] Based on Forster, S. F., " Tackling Critical Water Shortages During The Current Drought", Discussion at WISA meeting, Portland Cement Institute, Midrand, 18 February 1993

There were few maintenance programmes and many schemes had faulty reporting systems. In general there was a lack of community involvement in maintenance.

Operation of some pumped schemes suffered from fuel shortages as well as lack of trained staff. Absence of operators especially on payday, contributes to stoppages of operation. Lack of on-site decision making capacity hampers efficient operation of plants due to delays in decision making which should be delegated to on-site staff.

Proper planning and design of any project is paramount for its success and there has been very little community involvement in this for rural water supply. As a result of this top down approach, inappropriate, unaffordable and unworkable technologies and systems have been used. This had resulted in low assurance of supplies.

Cost saving, short cuts, little supervision of contractors and lack of community participation in the installation of schemes has led to poor installation and system failure.

The lack of catchment control, scheme control and enforcement is hampered by boundaries, manpower and penalties imposed. It was observed in a situation of scarcity, control of upstream users in another political region was difficult. Scheme control at abstraction works is easier but poor at community level. This is hindered by lack of manpower and the low penalties imposed.

Traditionally, despite the need and strong demand for an adequate water supply, such supplies have been relatively lowly valued in terms of what people expect to pay. This has further been entrenched by provision of rural water at no cost to the consumer. The result is a general lack of management of infrastructure.

There exists very little community capacity in rural communities. This is due to historical legacy of the lack of empowerment of communities, tribal culture, lack of comprehensive development policy by homelands, and remote decision-making or lack of participatory decision-making.

Apart from the rural water supply problems, the emergency relief effort encountered other problems. Basic drought works were seen as poverty entrenchment and as a threat to provision of high level services such as regional schemes. There also may be insufficient water for economic development such as irrigation in some areas.

[4]The WSTF was also constrained by limited resources. There were enough

[4] Based on: Hazelton D., Personal Communication, 1993

personnel to cover all areas effectively and mobilising specialists such as geo-hydrologists was not easy. Similarly, there was inadequate construction equipment and some of the available equipment from the public sector such as drilling rigs was in poor working condition. In addition, there was a lack of capacity in the positive borehole pump industry which delayed both in the installation of new pumps and the repair of existing ones. The commitment of Department of Water Affairs and Forestry and the Department of Agriculture staff working in the field under difficult conditions was however exceptional.

If the above constraints had been less severe it is likely that funding would have become the critical constraint as limited funds were made available to the WSTF from central government sources. Initially there were limited funds available which presented a financial constraint, and the presence of a disaster fund would have made it easier in the initial stages.

There were also organisational problems encountered. The Consultative Forum was a body composed of members from a diverse number of bodies, interest-groups and organisations. It was a weak structure because most members organisations and bodies were involved directly in drought work having their own drought programmes as well as working through the forum. It would not have been practical for all the parties to operate through the Consultative Forum's central steering committee at the time. However, a single national high level coordinating authority and regionally stronger liaison and co-operation through more formalised structures was called for. .

The political climate did not help the situation due to polarisation in some communities and the lack of full cooperation or acknowledgement of the serious situation by some homeland governments.

The lack of a disaster relief system affected the efficiency of operation. There was fragmented information and poor inventory of rural water supply assets. There was variable support, concern and commitment from various administrations, departments and grass roots structures. This contrasted sharply with the commitment and unity of purpose exhibited by all the role players - the Department of Water Affairs and Forestry, Eskom, consultants, contractors, material and pump suppliers - during the 1983/84 drought in ensuring that the Eskom Power Stations were not left short of water.

Despite these weaknesses the achievements of the WSTF were considerable. The problem of water supply in the various areas was addressed through a number of ways depending on the situation. These included:

i. Drilling of boreholes and installation of hand pumps and diesel engine driven pumps;
ii. Transportation of water by tanker;
iii. Improvement of existing systems where the problem was easy and fast to rectify.

6. COPING WITH DROUGHTS

6.1 Social-Political Perspective in Coping with Droughts

The variety of drought strategies and coping mechanisms must be understood through implementation measures at various hierarchical levels of systems, compatible both physically and institutionally with each corresponding level of such a hierarchy. At the individual level decisions are made primarily on the basis of assessment of individual needs and cost effectiveness with little attention given to the larger community or to far-reaching secondary effects. On the other hand, policies required for local communities are directed towards integration, coordination, and facilitation individual drought strategies. On a larger scale, the problem is of the optimal development and management of water resources for various uses in a context of integrated catchment management.

Response to an extreme event in a natural system can be directed towards either: (a) modifying the cause; (b) modifying the losses; or (c) distributing the losses. Thus some degree of reserves, flexibility and mobility are key traits to survival under drought (Vlachos, 1990). Glantz (1976) has distinguished the types of responses to drought as: (a) tactical; (b) strategic; and (c) ad hoc responses. Tactical responses are made to a particular drought situation at a particular time. Strategic responses suggest that there is recognition that drought is part of the climate regime and will occur from time to time, and therefore, ways to mitigate each impact must be constantly part of the planning process (in other words there must exist a general management strategy). Finally, ad hoc responses to drought are essentially "spontaneous" reactions based not on any long range policy and, thus, no two droughts will affect society in the same way. Another classification of drought responses is by differentiating along six dimensions or scales which are time, space, society, activity, perception, and technological level (Newman 1975 in Vlachos, 1990). Thus, the broad mechanisms of human adjustment to the natural environment include (Vlachos, 1990):

(a) engineering mechanisms, such as technological innovations and their applications;
(b) symbolic mechanisms, which reflect concern with culture and it constitutes norms and roles;
(c) regulatory mechanisms, which define public policy and social control; and
(d) distributional mechanisms, which specify the movement of people, activities and resources.

The various ways of coping with extreme events such as drought are grouped under absorption, acceptance, reduction and change, and are separated by three recognizable threshold levels namely awareness, action and intolerance

(Burton et al in Vlachos, 1990). In loss absorption, society absorbs the impact of drought while being largely unaware it is doing so. Loss acceptance is reached through the threshold of awareness. Loss is borne often by sharing it with a wider group than those directly affected spreading the loss among a variety of groups both rural and urban. Loss acceptance yields loss reduction through the threshold of action. The threshold of intolerance divides the loss reduction from radical change which occurs when the loss is seen as no longer tolerable. Each mode of coping does not stand by itself but most often appears as part of the management strategies that are a mix of human response to drought as affected by four factors:

(1) The presence of extreme events, depending on the frequency, duration, area extent, speed of onset, spatial dispersion of droughts;
(2) The localized experience with drought and the success of adjustment;
(3) The intensity of resource use, including higher capital labour investment; and
(4) The level of material wealth attained, implying that the presence of great material wealth increases the awareness threshold as contrasted to conditions of poverty for example.

Types of national drought hazard policies are distinguished between four different policies which are not mutually exclusive, namely:

(1) disaster relief;
(2) control of natural events;
(3) comprehensive reduction of damage potential; and
(4) combined multi-hazard management.

Risks from drought are a consequence of the character of both the physical and social systems as already stated before. The adoption and implementation of policies to mitigate the risk and negative consequences of drought can lessen the effects. Such a system is dynamic as changes in human use patterns and activities, as well as in the physical environment, alter levels of risks which can require renewed or continued adjustment.

Social system responses are conceived as comprised of four drought control measures (Yevjevich et al, 1978):

(1) Supply measures, intended to increase available water quantities during drought;
(2) Measures aimed at decreasing water demand through conservation;
(3) Measures needed to mitigate impacts by reducing losses; and
(4) Methods able to produce strategies for management through mixes of drought control measures seeking optimum solutions in combating droughts.

The general ability of individuals and communities to engage in proactive resource management strategies is primarily due to long-range public policy decisions, especially with regard to technological breakthroughs, reservoir construction, soil conservation, drought resistant plant research, and generally the creation of programme and policies with adequate resource development

focus.

In the efforts to respond to drought there is a gap between the intervention and the reality of making social political adjustment. This is due to the lack of knowledge for developing alternative institutional mechanisms as well as the prevailing attitude of simply responding to disasters through a crisis management emphasis (which implies a short range, piecemeal, segmented approach) as opposed to a far-reaching and systematic risk management that requires more emphasis on complicated social options and alternative schemes of organization and administration. This implies that there is a need to develop sensitivity to a variety of conditions and responses rather than to promote a blanket crisis management scheme that tends to work under both time and resource constraints. Thus, the fundamental question is whether particular institutions are capable of handling on a longer term the changing circumstances of both the social and physical environments.

6.2 Institutional Aspects

It is clear that there is a need to develop basic improved water supply systems for over 50% of the rural population in South Africa. This would indeed be a first step in ameliorating the negative impact of drought. It was clear from the recent drought that those communities in the regions where there was no basic improved water supply had the least available water. It was in general, more difficult to provide relief where there was no water infrastructure. However, the more wider issues are how to provide basic, improved water supply and to ensure both the new and existing water supplies are sustainable.

The recent UN Water and Sanitation Decade in the 80's, although achieving disappointing coverage, has provided useful experience on major approaches and strategies to be adopted in order to facilitate sustainable water supply and sanitation. In rural water supply, the underlying problem is essentially a general lack of a sound institutional strategy (Bing, 1992).

There are three key components to institutional issues. Structurally and in general, governments in the developing world are too centralized with weak or unrepresentative local governments. Secondly, sectorial rural water supply does not fit readily into a single government institution and there are several agencies where both governmental and NGOs are involved. Thirdly, external support agencies (ESA) have a major role in the provision of investment, sometimes up to 90%. There has been a recent trend for ESA assistance to be given where there has been progress towards cost recovery, community development and progressive sustainable service.

There has been a change in the view of the approach to rural development. Previously the provision approach has been used extensively in the rural areas of South Africa. Central authorities have provided water infrastructure and

managed it with no community involvement. More recently the provision/promotion approach is being used where communities are increasingly managing their projects. The promotion approach which involves the creation of an enabling environment such that communities take the initiative of initiating their water projects in rural water supply is rare. In this approach central authorities promote progress through provision of credits or grants and outreach work.

Guiding principles in water supply and sanitation development espoused in the New Delhi (UNDP, 1990) statement are:

- Protection of environment and safe health through integrated management of water resources and wastes;
- Institutional reforms promoting integrated approach and including changes in procedure, attitudes and behaviour, and full participation of women at all levels;
- Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes; and
- Sound financial practices achieved through better management of existing assets and wide spread use of appropriate technologies.

Against the background of the above principles the issues directly related to institutional arrangements are:

- Governments will have to assign greater priority to financing the water supply sector as it has important economic consequences;
- Operation and maintenance have to receive greater attention due to high costs or lack of operation and maintenance; and
- The major issue relating to institutional arrangements is capacity building. This includes institutional and human resources development and it is essential for ensuring efficient and sustainable use of physical and financial resources.

Capacity building requires:

- decentralization of structures and services to make them closer and more responsive to community needs;
- strengthened intersectorial cooperation;
- shift in the role of central authorities from that of providers to that of promoters and facilitators; and
- rethinking of human resources development policies to increase attention to gender issues, and promote the role of staff involved in low-profile functions such as operation and maintenance, community participation, applied research, communication and data collection.

A conceptual model has been proposed (Bing, 1992) based on most of the key ideas related to institutional developments. The model has three main players viz. central authorities, the community and the facilitators. The model is illustrated in *Figure 9.*

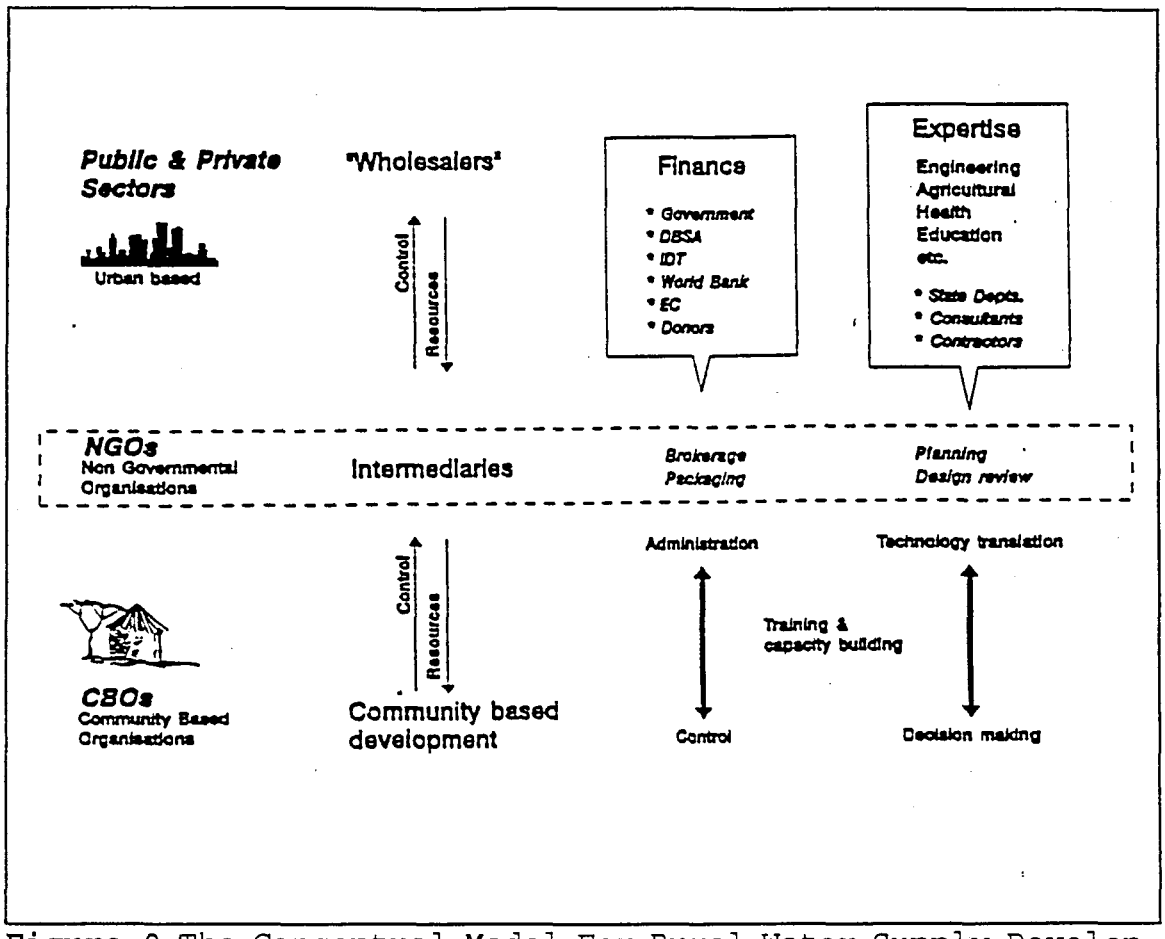

Figure 9 The Conceptual Model For Rural Water Supply Development (Abrams, 1992 c)

The central authorities represent natural and regional governments or their agencies. The facilitators are bodies or organizations that would provide the right environment within which sustainable rural water supply and sanitation (RWSS) development can take place. These could be private or public sector bodies that would function as an extension service. The community management structures could be organisations representing the communities. The relationship between the central authorities is characterized by the strong link, bridge, provided by the facilitator who plays the most important role in terms of sustainability. Important functions of the facilitator would be to :-

- establish a working relationship with the community;
- assess the development potential;
- assess the nature of the need/demand;
- assess the level of service that could be installed; and
- establish an education and training programme.

6.3 Institutional Options[5]

6.3.1 Institutional Deficiencies in Present Systems

Some of the main deficiencies identified with the present institutional arrangements are:

- Incomplete coverage of the country and a number of areas where no or only partial service is provided;
- Inadequate definition of national policy regarding quality, service standards and conservation of resources;
- Lack of a national organisation with clear authority for the setting of policies and standards;
- No comprehensive performance auditing system;
- The shortage of trained manpower and expertise extending across the spectrum of water supply and sanitation authorities;
- Lack of coordination between different authorities responsible for water supply;
- Inequitable system of resource allocation between different institutions;
- The situation in the homelands is aggravated by the artificial boundaries, shortage of trained personnel to operate and maintain the schemes and limited accountability of the supplying authority to consumers.

Guiding principles that should be applied for the design of a future water sector that have been put forward are:

- The policy must meet the needs of all the people and the institutional arrangements should cover the whole area and population of South Africa;
- National bodies should be responsible for setting and enforcing compliance with minimum standards and to assure social equity in the provision of basic services;
- In view of the limited water resources available in the country, appropriate overall water management systems, preferably catchment based, must be operated on a sustainable basis to ensure efficient use of resources;

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[5] Based on Standing Committee on Water Supply and Sanitation Options (SCOWSS), "Institutional Options For Water Supply And Sanitation", Discussion Document, June 1993

- All institutions should be accountable to their consumers and the directorate, management and staff should strive to be representative of the communities they serve. They must also be able to assist in the empowerment of the local communities and organisations through education and training.

The current situation of constitutional change at local and regional level, offers opportunities to meet unserved needs, eliminate ineffective structures, to build on what is working well through a process of review and intervention, and to improve on the overall effectiveness and efficiency making it possible to meet the needs of the people. At national level the increased awareness of the problems has created an environment conducive to introducing institutional reform.

6.3.2 Changing the Institutional Framework

The change in the institutional framework should be measured against the following criteria:

(1) Boundaries - Boundaries of operational areas should be such that there is clear responsibility for the provision of service and should take into account the sources of raw water and the catchment. Operational areas should be large enough to fully utilise technical and financial resources while striking out a balance between adequate accountability, economies of scale and responding to local needs;

(2) Effectiveness - Institutions must have access to the full range of technical, financial, legal and administrative resources to ensure appropriate levels of service to all communities. Co-operation and the sharing of joint schemes with other agencies, authorities and local communities must be facilitated.

(3) Finances - The service should be operated on sound business principles and the sector institution must have the necessary management abilities.

(4) Accountability - The institutions' plans and strategies should be accepted as appropriate by the consumers. Sound financial and performance auditing and reporting procedures should be in place.

(5) Environment - The strategies and plans of the sector institutions should be sensitive to environmental issues and sustainability.

6.3.3 Institutions

A three tier structure of institutions is proposed. The first tier would be a single national authority that would play a strong regulatory and planning role for water supply, sanitation and solid waste disposal. The second tier would be responsible for carrying out these responsibilities from source to the customer. A possible third tier option would be for delivery of services to end

consumers which would depend on prevailing local circumstances.

At the first tier, a central government institution would reflect the policies of the Government, lay down minimum standards, determine the allocation of water within the country and ensure the maintenance of required standards and the proper coverage of the country.

Three types of organisations are considered at the second tier that would be regionally based. These are:

(i) Politically based multi-functional organisations;
(ii) Regional cooperative organisations; and
(iii) Water utility based authorities.

The first two types of organisation have several drawbacks of which the two greatest ones are drawing of boundaries which conflict with the requirements for effective water management and over politicising of the management of water and related services. The third option is likely to be the most effective in the provision of water and related services and would ideally be based on catchment and economic considerations. However, for accountability a formal political link is required.

The third tier organisations have traditionally provided water and related services directly to the customers mainly in the urban areas. These are the municipalities and town councils. These could be seen as being politically based and are likely to be widely differing organisations as new forms of local government emerge particularly in the under served communities mainly found in the rural areas. It is these organisations that will have to receive more attention in institution building as discussed in 6.2.

7. DROUGHT COPING STRATEGIES

Two types of measures can be used in strategies applied to mitigation of drought impacts. These are:
(a) Proactive measures; and
(b) Reactive measures.

Proactive measures are defined as all measures, conceived or prepared by conscious and systematic actions, that may help in the alleviation of consequences. Reactive measures are basically improvised once there is drought and there are visible impacts already under way (Yevjevich, 1980). Reactive measures include the alternative of doing nothing. The difference between proactive and reactive measures is in the approach which is planning versus improvisation of various ad hoc measures. The decrease of various drought impacts in proactive measures should sufficiently exceed their cost in comparison with the effects of implementing reactive measures.

Proactive strategy measures have three basic phases. The first phase is the pre-drought preparation of various measures and is intended to make the water users more resistant to water shortage and deficit of prolonged duration. Experiences from previous droughts (types, impacts, active measures undertaken, reactive measures etc) are important.

The second phase of proactive strategy are the measures and contingency plans undertaken during the ongoing droughts and relate to changes in water supply and water demand that decrease the impacts of drought.

The third phase of proactive strategy are the post drought measures undertaken to minimise the spread of drought impacts beyond unavoidable geographic areas and their economic and social sectors involved.

Reactive measures are related only to the time phases of ongoing drought and post drought periods. *Figure 10* (Yevjevich V, 1980) illustrates this division of strategy measures and periods.

Drought coping strategies are composed of a mix of drought mitigation measures. Measures are of physical/technological and non-technological nature. The non-technological measures consist of economic, social, institutional, political and other measures intended to decrease impacts or distribute losses equitably.

Drought mitigation measures are classified in three groups (Yevjevich V, 1980):
(1) Supply-oriented, (2) Demand-oriented, and (3) Minimisation of impacts and losses.

Supply-oriented measures are intended to augment supply during droughts. These measures can be divided into, (1) better use of existing water supplies,

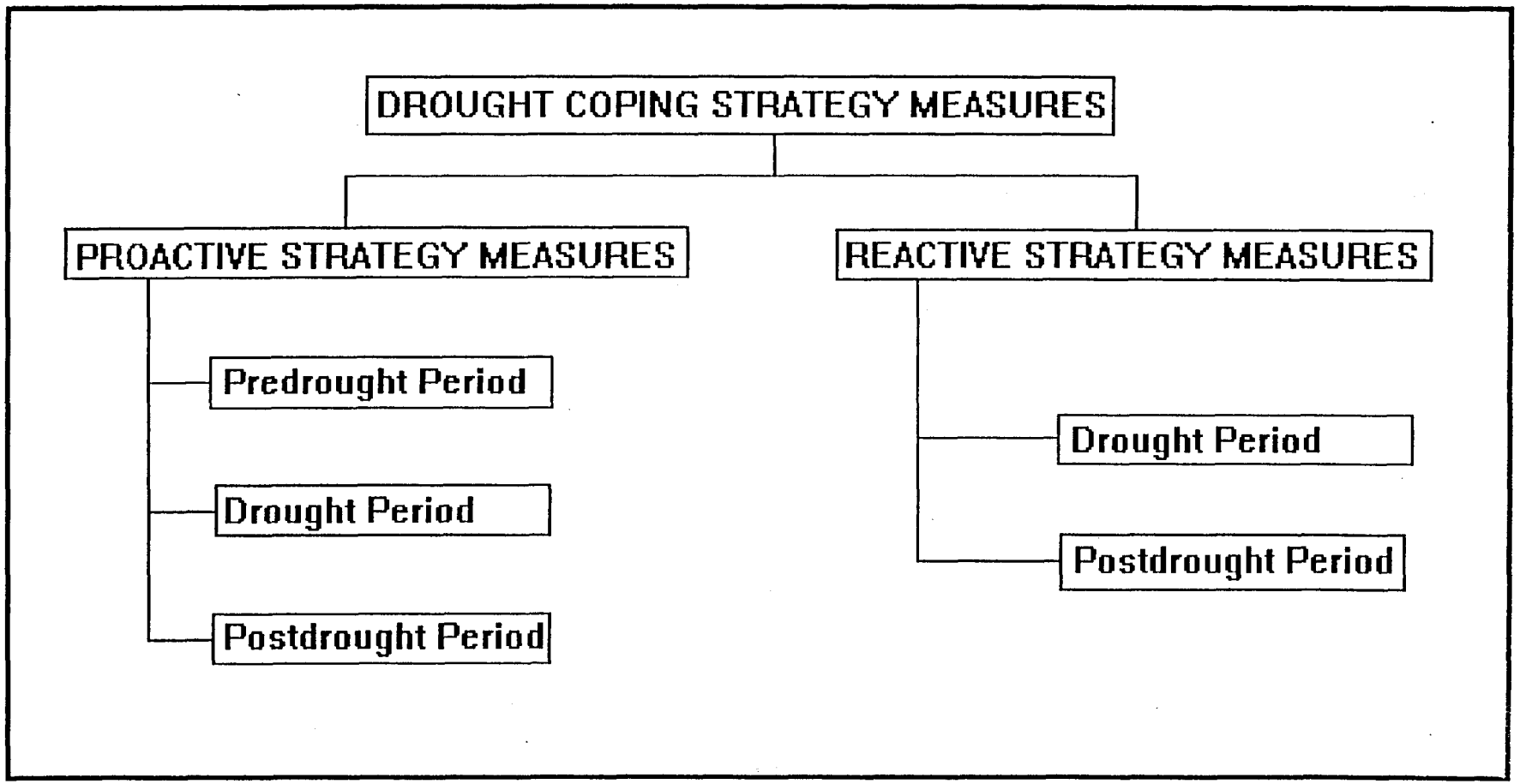

FIG 10. Division of the drought strategy coping measures (Yevjevich & Vlachos, 1983)

(2) development of new supplies, and (3) use of complex or unconventional approaches for increasing supplies.

Demand-oriented measures are intended to decrease demand during droughts. These are divided in (1) active, consisting mainly of legal constraints, public pressure, economic incentives for reduction of water use; (2) reactive, that is, recycling and production adjustments; and (3) impact analysis of demand-oriented measures that increase the total demand reduction.

Impact-minimisation measures are related to water users, water user environments, and various economic, social and administrative factors which minimize impacts of the adjusted supply-demand during severe droughts. These measures are divided in, (1) anticipation of drought, with forecasting and warning, and (2) spread of risks and losses (such as self-protection, disaster aid and various adjustments). They represent measures that permit an organised approach to required matching of supply and demand through acceptable impacts.

Figure 11 (Yevjevich V, 1980) presents an approach to classification of measures.

7.1 Supply Oriented Measures

There are two basic aspects in the use of existing water supplies. First, is the trade-off between present and future benefits in the use of the water immediately or the conservation/storage for future use. Second, the relationships between losses and intensities of water deficit most often do not compensate for future losses.

7.1.1 Better use of existing supplies

Use of surface water storage

This measure in drought mitigation is as old as the first reservoirs built to supply water in dry seasons and in dry years. The main problem with reservoirs is the large storage capacities required to meet deficits during severe droughts. Various methods and reservoir operational rules are applied in the operation of reservoirs to cope with drought. These are essentially searching for an optimal trade-off between the present and future benefits. Surface water storage has been long recognised in South Africa as demonstrated by the large number of public dams of which there are over five hundred, (Department of Water Affairs, 1986). These are used to supply mainly the metropolitan areas, towns and the commercial rural farming sector.

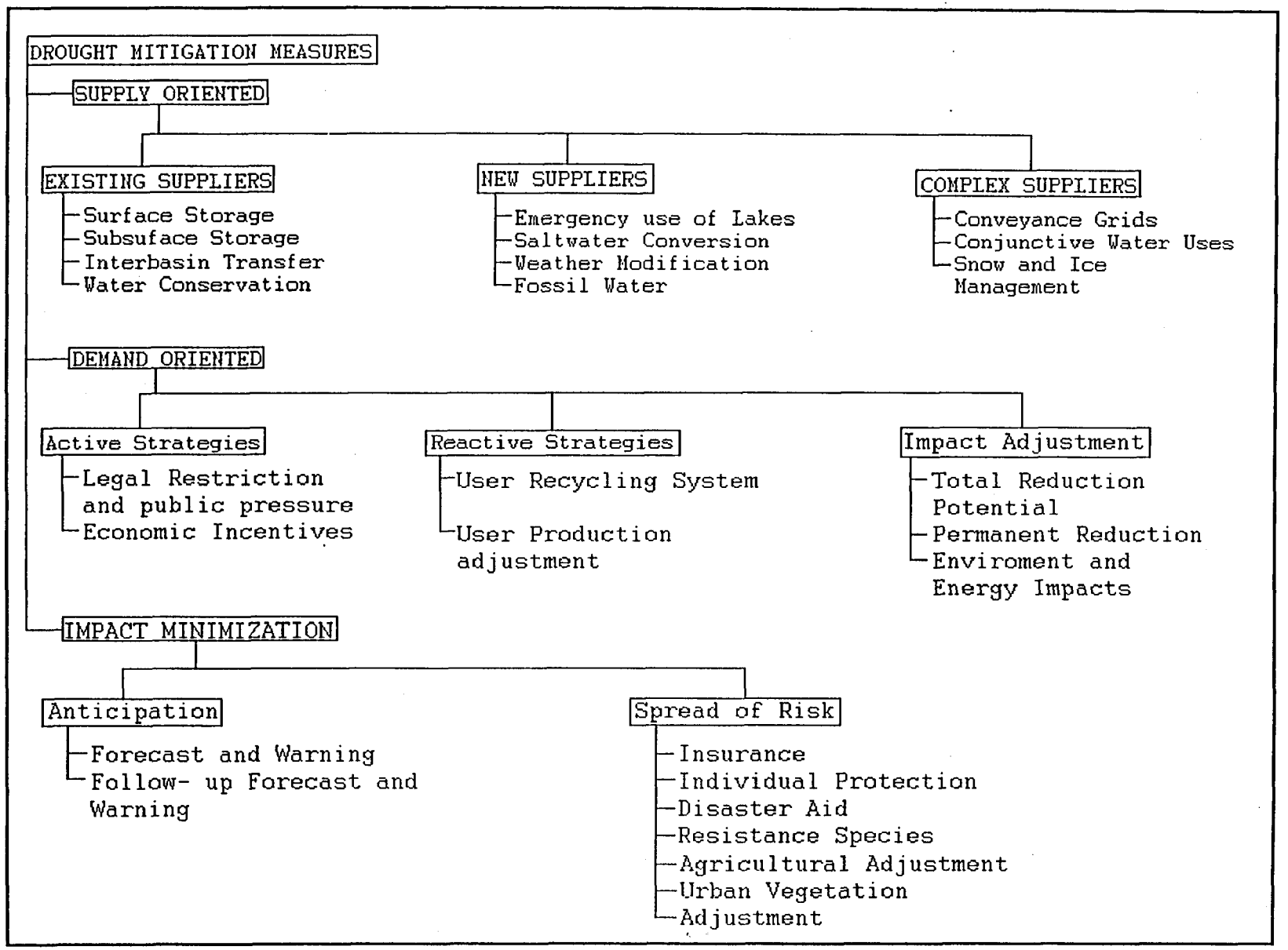

FIG 11. Drought mitigation measures, as orientated to supply, demand an impact reduction. (Yevjevich & Vlachos, 1983)

Use of subsurface water storage

This measure has significantly increased in drought alleviation with time. However, there exists the danger of overdrawing ground water, resulting in a decrease of its levels. This overdrawing is a consequenceof the policy of obtaining the maximum present benefits. The improved technology of induced natural or artificial recharge of ground water aquifers is an important aspect in the use of ground water as a drought mitigation measure. Another important aspect is the development of conjunctive water use technology, representing a proper planning of water storage, transfer, recharge, withdrawal and joint use of surface and subsurface waters. The principles and approaches applied to management in droughts of surface waters can be applied to management of subsurface storage as a drought mitigation measure. It is only relatively recently that this source has been recognised as an alternative source of water and already over 400 small and medium sized towns rely on ground water for their domestic supply (Morris R, 1993). As already seen in chapters 4&5 ground water was one of the major sources used through the drilling of boreholes and installation of hand pumps in the 1992/93 drought.

Inter-basin and within-basin water transfer and exchange

The transfer of surplus water in time via storage is often preferred over the transfer through conveyance lines. Apart from the investment that is specific to both types of water transfers, the transfer through conveyance lines faces the problem of how much water is available and under what conditions. Two basic factors constrain the drought mitigation potential of water transfers: (a) whether water is available for transfer or exchange at times of droughts, and (b) whether sufficient conveyance capacities are available for transfer or exchange, especially in the case of severe droughts of large areal extent and transfers over long distances. The transfer of water through conveyance lines is best illustrated by the emergency pumping of water from the Umsunduzi at Duzi and the Umgeni at Clermont to the Durban Heights Treatment Plant during the 1983 drought (Tayler, 1985). The transfer of water via storage occurs when a series of reservoirs is constructed in a river system and the surplus water stored in the upstream reservoirs is transferred during drought either inter-basin or within basin. There are a number of such systems in South Africa and the series of reservoirs in the Umgeni system is one of them.

Improving water supplies by water conservation

This is a feasible but often uncertain drought mitigation measure. Such conservation measures include the decrease of losses along conveyance structures, the management of important source catchments, soil conservation for increased infiltration and ground water yield, decrease of evaporation by general runoff management and similar practices. Most of these approaches to water conservation can be classified as extensive measures. Such measures assist during drought through, for example, the prolonged availability of water from a spring emerging from a well conserved catchment or supply of water from a well as result of increased infiltration into the aquifer. In South Africa

there has been concerted effort to control erosion and promote soil and water conservation in the Agricultural sector in terms of the Soil Conservation Act and the Forestry Act although much remains to be done in the application of these acts in the former TBVC states and homelands The reduction of evaporation from reservoirs and tanks by the creation of a barrier over the water surface is a drought coping measure that can be used in emergencies. Monomolecular layers have been used with limited success, the use of a sealant layer of solid floating materials such as blocks, rafts, or beads, or of wax that melts have been efficient in some cases (National Academy of Sciences, 1974, Cunha et al, 1980). Reduction in evaporation can also be achieved by inducing artificial water recharge which transforms surface water subject to evaporation to ground water which is more insulated from evaporation. Research on this in South Africa using mono-molecular sealants showed that wind effects and thermal currents could not be controlled on a large scale and continued renewal of the surface layer was uneconomic (Department of Water Affairs, 1986).

7.1.2 Development of new supplies in droughts

Construction of new surface reservoirs, further development or new development of ground water, new conveyance structures, and any new conservation measures belong to existing water supplies as soon as these measures are completed. New supplies are measures that are not normally used in non-drought periods but can be used or play a role in drought mitigation.

Saltwater conversion

This drought mitigation measure may serve as a new water supply in the following ways: (1) by continuously using the full capacity of saline or brackish water conversion plants at full capacity during drought and only partially or occasionally used in non-drought periods; (2) by having contingency, mobile equipment for saline or brackish water conversion in critical droughts or other emergency purposes that is used on a temporary basis; and (3) use of simple solar distillation equipment for individual houses in isolated areas.

Mining ground water

The use of deep waters (fossil or renewable), may be used as a drought mitigation measure when: fossil water is economically accessible, it is not highly loaded with minerals, and feasibility exists to eventually replace fossil water in times of regional water surplus through artificial recharge.

Rainfall augmentation

Rainfall augmentation through cloud seeding is feasible when adequate meteorological conditions prevail which rarely occur during drought. Dry season conditions considerably reduce the possibility of inducing rainfall,

which is the crucial season for drought relief. Conditions for rainfall augmentation through cloud seeding are considered to be favourable although limited to a local scale in areas where cold and wet air masses are swept upward over mountains than is the case with air masses over flat lands (Cunha et al, 1980). The rainfall augmentation projects carried out at Bethelehem and Nelspruit were inconclusive and showed that there is little evidence that precipitation, hail, lightning or wind can be modified artificially to any significant degree except on a local scale (Department of Water Affairs, 1986).

Dew and fog harvesting

Artificial mist collection devices are used in the form of nets with small meshes mounted on frames with proper orientation and slope in such a way as to intersect the air masses and cause water vapour condensation. These devices are placed at suitable places where air moisture is high such as mountain sides. The amount of water harvested by these techniques is usually small and only feasible where the air masses contain large amounts of water vapour, as with certain coastal and inland mist belts.

7.1.3 Alternative Water Supply Enhancements

Connection and extension of water supply grids

Integration of water conveyance grids or networks represents a potential drought mitigation measure, regardless of various complexities of connection between grids, and the extension of existing grids to incorporate adjacent grids. This results in the connection of a number of sources. The larger the area covered by a water supply network, or the area of interconnected networks, the smaller the probability of a drought covering the entire area. This enables the shift of water from a surplus subarea to a deficit subarea, analogous to the areal shift of surplus electric power in energy deficits. This measure is attractive in the water supply of large, adjacent, metropolitan urban and suburban areas, or in areas having large aerially spread regional schemes and may be applicable where large dense rural settlements are in close proximity. This may be also done on a temporary basis by installing temporary pipe links and temporarily installing pumps at suitable sites of emergency.

Enlargement of conveyance capacities

Conveyance capacities of open channels or pressure pipes may be increased during droughts to convey more water from other sources to alleviate shortages. This can be done by installing additional conveyance structures, enlarging or lining existing canals or by reinforcing the pumping capacity of flow under pressure in existing pipelines.

Transportation of water

The transportation of water by trucks and train is commonly practised as an

emergency measure and this was extensively done in the 1992/93 drought. However, it is limited due to the high cost and the availability of tankers. The other form of transport that has been used is by sea through tankers and towing of collapsible containers (Cunha L V et al, 1980). Proposals of towing icebergs from the polar regions have been made although this has not been done practically (Cunha L V et al, 1980).

Conjunctive use of all sources of water

This measure is a way of mitigating drought impacts by dividing drought deficits among the various sources of water (surface, subsurface, saline and other sources). This provides for added flexibility in coping with droughts. Pretoria (de Kock, 1988) and Verwoerdburg (Olivier, 1988) in 1987/88 supplemented the their water supplies with dolomitic ground water.

7.2 Demand Oriented Measures

The basic objective is to trim water use, provided legal economic and consent conditions permit it. This assumes a flexibility in water demand which can be decreased during droughts without significant impacts. Demand-oriented measures may be divided into three groups (Yevjevich et al, 1978): (1) active; (2) reactive; and (3) impact analysis of demand-oriented measures. However, these measures are imposed, in the final count, by inadequate water supply.

7.2.1 Active measures of demand reduction

These may be divided into those that are implemented by pressure (coercion) and those that are produced by inducements of various kinds (incentives) in order to reduce the demand pressure on reduced supplies.

Legal restriction and public pressure

This type of measure is basically achieved by direct or indirect coercion. It includes rationing, legal limitations and sanctions, and economic, social and political pressure. An appropriate institutional system is a basic prerequisite for implementation of this type of measure. Proper authority and responsibility are needed for effectiveness and the system may exist and activated during drought or created ad hoc. During the 1983/84 drought, certain restrictions were imposed by the City of Pietermaritzburg such as prohibiting use of hose pipes in washing of motor vehicles, watering of gardens, use of sprinklers and these became more restrictive as the drought worsened and rationing was introduced (Ackerman,1985). Similar restrictions and rationing were also implemented in Durban (City Engineer of Durban, 1985). The Rand Water Board had to introduce quotas to municipalities supplied (Hobbs, 1985).

Economic incentives for reduced water use

This is based on economic incentives not to use water beyond a necessary minimum, or on the penalties in the case of exceeding an allocated amount. Pricing is the economic inducement used whenever feasible. However, in the absence of individually metered consumers, it is difficult to exert economic control. Tariff designs should not encourage wasteful consumption. Tariff policies are useful in restraining demand when it is likely to outstrip resources.

7.2.2 Reactive Measures

These are consequences of intentional or unintentional active drought mitigation measures, or are imposed by physically forcing demand to match reduced supply.

Recycling systems

Portable water recycling equipment of low investment can be used as a drought mitigation measure. Other types of recycling water may be temporarily implemented to just fit the water quality tolerance of the same or the next user, in a sequence of water users along a river.

User production adjustments

This results from capacities of many water users to adjust either production or water use quantities in order to decrease water demand during droughts. Adjustments are often flexible, especially in water use in households. These measures are the most important reserve left for mitigation of impacts of most severe droughts, when the lack of sufficient supplies forces users to adjust their water consumption to the upper limits of economic and social tolerances.

7.3 Impact-Minimisation Measures

To reduce impacts of drought, three types of measures seem feasible: (a) anticipation of droughts when feasible, with timely preparations to meet them; (b) introduction of measures that spread risks and losses over a large number of individuals and groups; and (c) reduction of direct and indirect losses.

7.3.1 Anticipation of droughts

Drought can be anticipated by one of two methods: (1) forecast of droughts through the classical approaches of looking into the future; and (2) analysis of data by finding how often and how long droughts occurred and lasted in the past. However, it is often much easier to assess whether an ongoing drought is worsening such as through reservoir levels and other physical and social indicators.

Drought forecast and warning
At present there are no reliable ways of forecasting the occurrence of and projecting the extent of drought.

Measures of implementing forecast and warning
Drought is a slow and creeping natural disaster. Usually, no urgency is conceived in drought and sometimes when it is perceived it is too late for any preventative or pre-drought measures. The education of people may be considered a special drought mitigation measure. To store water and to start conservation needs time. The lead time in drought warning is usually short and the pre-drought supply-demand aspects of drought mitigation may not result in significant effects in most cases.

7.3.2 Spread of risks and losses

The spread of risks and losses in disasters is an old practice in any society. The larger the spread, the more acceptable are the risks and losses.

Drought insurance
This is not widespread and existing schemes are functions of political, socio-economic and cultural systems. These, have limited use in water supply.

Individual Protection
Savings in various forms by individuals or groups is another form of protection against drought. Diversification of activities is also another way of spreading risks and losses.

Disaster aid
Disaster of specific impacts, attracts relief and rehabilitation programmes by

social and political necessities. This is a drought mitigation measure of spreading risks and losses across local, regional, national, and international levels. These programmes take various forms such as, grants, human subsistence aid, technical assistance, and similar disaster aids. The problem resides with the proper selection of such a mix of disaster aid that fits the general and specific conditions of each drought and each area covered.

Agricultural adjustments

A mix of drought tolerant/resistant and common crops and or livestock represents a spread in risks and losses. Water conservation practices are also drought mitigation measures.

8. DROUGHT PROGRAMMES FOR RURAL COMMUNITIES IN INDIA AND BOTSWANA

Drought policy and programmes in most developing and developed countries have been post impact government intervention in the provision of emergency assistance to distressed economic and social sectors. This chapter looks at the drought policy and programmes for rural communities in Botswana and India.

8.1 Drought Relief Programmes in Botswana[6]

Rural communities in Botswana are settled in large villages mainly located along the eastern belt, bordering South Africa and Zimbabwe. This is largely due to surface water shortages over most of the country, although this is now partly alleviated by deep borehole drilling. Inflows of foreign aid and revenue from the export boom of beef and diamonds have been used by the Botswana government in its development programme since the 1970s, emphasising the provision of social services such as schools, health facilities, and village water supplies to rural communities; and the general improvement of infrastructure in the country. However, the national economic expansion has not been reflected in increased household incomes especially in the rural areas, except indirectly through social provision service and remittances. Those reliant on arable farming have remained highly vulnerable to climatic variations.

Botswana is one of the most drought prone countries in the region. For the rural communities droughts have resulted in reduced crop production and cattle losses have been dramatically concentrated among them. As a result, many rural families are deprived of their stores of wealth, and sources of draught power, income and animal products. This has serious implications for the nutrition levels in these communities, as well as for the longer term productivity in the small scale farming activities.

The alleviation of the immediate effects of drought has been a central concern of the government. This is due to close personal links of politicians and bureaucrats through family ties to rural areas, the prominence of drought experience in Tswana traditional culture and the reliance on rural votes for the democratically elected government. Experience in dealing with the consequences of drought has resulted in conservative financial policies and high level of preferences for investment and saving in social infrastructure, cattle holdings or financial reserves rather than spending for present consumption. A programme in the drilling of deep boreholes has largely addressed the assurance of water supply especially during drought. The

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[6] Based on: Morgan R, " Drought Relief Programmes in Botswana", In Curtis D et al Ed., Preventing Famine: Policies and prospects for Africa, Routledge, New York, 1988, pp 112-120

Botswana Technology Centre has carried out investigations into the feasibility of providing water through rainwater harvesting and the encouraging results have led to a number of rain water harvesting programmes being initiated involving rural schools and clinics.

Despite a history of drought, the gap between intervention and the reality of making social political adjustment alluded to in 6.1 existed until 1979. No national structures were in place to react quickly to drought. Committee structures, lines of responsibility, and relief programmes were hastily designed and the impact was small and late.

Evaluation of previous drought programmes in 1979 resulted in the establishment of an Inter-ministerial Drought Committee (IMDC) having national responsibility for monitoring of measures in times of emergency and under it are the district drought committees. It was recognised that temporary employment creation was an integral of the response to drought and the structure for the provision of gratuitous relief was restructured to use exclusively schools and health facilities where possible rather than traditional village authorities.

These changes resulted in the reduction of the lead time necessary for decision making. The provision of gratuitous relief to the vulnerable groups at nutritional risk has been effective and the nutritional surveillance system indicated a reduction of children under weight and having severe malnutrition during drought. Temporary work opportunities are offered at a basic wage in low technology projects selected by village committees. Most are complementary to the governments' programmes of social service provision although a minority are related to the agricultural sector such as small scale irrigation projects and clearing of firebreaks on grazing land. This strategy of preventing the collapse of rural incomes, and therefore purchasing power has prevented the rural traders from going out of business. The post drought recovery programme involves the measures undertaken through the extension services of the Ministry of Agriculture to protect the capacity of small farmers to continue their agricultural activities following the end of the drought. These are broad and include the provision of seed for staple crops and hiring or subsidization of draught power.

The success of the drought relief programme was due to certain preconditions. Firstly, institutional structures existed before the drought in functional form, whose capacities could be diverted to the extent necessary. This had resulted from the building up of social infrastructure and from the decentralization of government responsibilities. The second was the existence of a complementary capacity in the non-government sectors which could be mobilized as needed. Thirdly, domestic resources existed in the form of stable financial situation and budgetary reserves which were diverted to the drought programme. Finally, investment in basic water supply infrastructure resulted in the

assurance of water supply in most areas even during drought and the emphasis of drought relief was related to supporting the rural economy.

There are limitations to the approach used in Botswana. Much has been done to alleviate the short-term drought effects, while relatively little attention has been paid to reducing the underlying vulnerability of rural families to drought, or mitigation of the longer-term consequences of drought. Lack of security of rural incomes is due to the risky nature of rain fed subsistence farming and the lack of seasonal and permanent job opportunities. The public works projects are unlikely to become self supporting or permanent income earners. Thus, the need for short term projects that provide capital for sustained production and to give wage earners the incentive to invest part of their incomes. Two approaches are being used to reduce the vulnerability of rural communities. The first is to increase the levels of investment in agricultural research and extension programmes. The second as part of a rural recovery programme is the diversification of economic activities and farming systems.

8.2 Drought Management in India

The Government of India early recognised that, "Our famines are rather famines of work than of food", as recorded in a supplement to the Gazette of the Government of India, September 1868 (Hubbard M, 1988), when measures to be taken for the relief of the starving in times of drought were codified for the first time. The famine codes established the principle of government responsibility to prevent loss of life, preserve livestock and these have evolved to include prevention of physical deterioration and destitution of people and enabling them to resume ordinary life on the return of better times. The previous principle was that the public would be responsible for the relief of the helpless and infirm. Prior to the late nineteenth century no policy existed and food distribution, opening of relief works, and exemption from land tax took place in an ad hoc manner. The drought policy has gradually evolved through four stages namely (1) famine relief; (2) scarcity relief; (3) drought relief; and now (4) drought management (Subbiah A R, 1993).

The scarcity relief approach was essentially reaction to drought in with ad hoc measures such as free kitchens and other relief measures which was a similar approach to famine relief. However, the main objective was to prevent starvation deaths rather than to minimise the death toll. Scarcity denoted the beginning of the symptoms of distress whereas famine was a state of acute distress.

The drought relief strategy then replaced the scarcity relief approach and sought to ensure the integration of relief efforts with development programmes thus maximising the developmental content of relief expenditures. The scarcity relief strategy relied on social distress indicators, such as unusual movement of people and rising petty crime, but the drought relief approach mainly relied

on economic distress indicators, such as loss of crops and price increases. Lessons from the droughts of the 1970s revealed the existence of administrative, financial and logistic constraints of organising relief works for people in local drought affected areas. These problems were especially severe for massive relief programmes when severe and extensive drought forced increasing numbers of people to turn to relief works. This necessitated the development of a crop stabilization strategy aimed at keeping farm labour on the farm operation itself thus, lessening the burden on the state to operate a large number of projects. This approach also ensured that food was available at farm level, thus preventing an overburdening of the national food security network.

This stabilisation strategy became part of the drought management approach which has replaced the drought relief approach. The drought management approach differs from the drought relief approach essentially in the timing of government intervention and the inclusion of several departments in efforts to minimise crop losses. The drought management approach relies on agro- and hydro- indicators to determine intervention.

The dominant concern with the later two strategies has been the preservation of the quality of life through the maintenance of adequate drinking water supplies, health care and meeting normal energy needs and not merely the prevention of starvation. Reducing vulnerability through development programmes has strengthened the coping capacity of the population living in disaster-prone areas. The higher development status of a larger number of people has resulted in lesser dependence on government support through relief programmes in recent years. This has been achieved through an increase in both farm and non-farm income with the latter's proportion increasing from 23% in the 1970s to 33% in the 1980s.

The drought management practices include the following components:
1) operation of an early warning system;
2) drought preparedness measures;
3) conservation of water through water budgeting measures;
4) resource management for stabilising crop and animal production;
5) preservation of farmers' assets to enable quick recovery after drought.

State governments are primarily responsible for the management of all natural disasters with the central government supplementing the efforts of the states. The basis for operational management lies with the district level administration. A standard administrative machinery exists from village to national level which is activated to handle emergencies during drought.

The early warning system incorporates both physical and social-economic parameters. Meteorological monitoring of rainfall is stepped up by setting up a cell each year in June under the control of the director of relief for the state.

Rainfall data are collected by each development block (taluka) which may consist of up to and sometimes over fifty villages and sent to the cell. These data from the talukas are sent to the Meteorological Department and are compiled on a day to day basis and submitted to the director of relief and key secretaries of the state government. For hydrological monitoring the state governments maintain a system of monitoring the levels of major reservoirs. A cell is also set up in June each year by the Water Resources Department which monitors daily data on reservoir levels. The analysis of these data enables the state government to make policy decisions on the amount available for various uses and it is possible to assess when to cut down or bar the use of reservoir water for irrigation to preserve it for drinking purposes. A national network of observation wells is maintained by the Central Ground Water Board to monitor the behaviour pattern of ground water levels. This enables the state governments to make appropriate decisions as needed. Agricultural monitoring provides data on the progress of agricultural operations which is valuable especially with regard to crop failure. Nutritional surveillance provides data in determining the fall in calorific intake often about 600 calories between normal and drought times. Economic and social indicators such as the condition of the people, food grain and fodder supply, imports and exports of grain in the district, labour movements in search of employment, state of crime and grain thefts are monitored.

The drought preparedness measures include:

1) The food security system. This provides infrastructure for procurement, storage and distribution of food through a network of fair price shops;
2) Projects. These provide employment and also build assets to improve resistance to drought. These are prioritized as a) tube wells; b) ponds; c) field channels; d) soil conservation and water harvesting works; and e) road construction.
3) Infrastructure arrangements. A calamity relief fund provides funds to assist in managing emergency situations such as drought.
4) Drinking water. Efforts have been intensified in developing rural water supply under various projects such as the Accelerated Rural Water Supply Scheme. Significant among these measures has been the augmentation of the fleet of rigs available and the closer monitoring of their use.

Water conservation is practised through careful budgeting of water available from reservoirs as well as the exploitation of surface and ground water in order to obtain optimum benefits from scarce water. Priority in the use water starts with drinking water followed by fodder programmes and irrigation.

The crop stabilisation strategy has three major approaches. Firstly, water harvesting and moisture stress alleviating practices are introduced. Secondly, programmes that provide alternative cropping strategies are introduced.

Thirdly, measures for improving production in irrigated areas and non-traditional seasons through compensatory programmes are introduced.

Preservation of assets is enabled by the provision of employment so that the important assets are retained such as cattle and land. To prevent sale or death of the cattle, fodder is provided through fodder depots. Incentives are given for raising fodder crops.

Community participation is now recognised as critical to the success of any undertaking . Thus, community mobilization contributes to social motivation and the effectiveness of relief operations.

The district is responsible for the operational side of drought relief. On the basis of the information gathered, the district commissioner decides if it is necessary to open relief works for employment generation or to distribute gratuitous relief or both and recommends this to the state government. Once it is clear that a state of scarcity is impending the district master plans are finalised.

The district master plan for relief sets out the relief strategy. It is village based and prepared in consultation with local relief committees who are responsible for much of its implementation, and for bringing urgent cases to the attention of district authorities. The four major activities covered by the master plan are the provisions of employment, drinking water, fodder and the distribution of gratuitous relief to those unable to work.

Public works that are highly ranked are those offering employment to large numbers of unskilled people with as little materials, tools and machinery as possible. Works that will help communities through future droughts are preferred and these include:

- every known irrigation project (village tanks, percolation tanks, check dams)
- works which improve utilisation of ground water (contour banding works for rain water harvesting and soil conservation which include gully plugging, stream banding, terracing and land levelling)
- forest works (tree planting mainly).
- other works include repair of roads and the breaking and stacking of gravel which are preferred over new roads.

The relief manuals lay down the guidelines for the organisation, payment and related matters. Relief works are kept going until there is no more demand for employment or until the rains come and then they are wound down.

The provision of drinking water becomes more critical as drought develops and the water table drops and surface water disappears. For the rural population the norm adopted for planning is at least 9 *l* of water per capita per day. In the at risk areas the use of reservoir water other than for human consumption and preservation of livestock is prohibited. The district administration undertakes surveys to find possible drill and well sites, short lists problem villages, and starts drilling, digging, constructing pipelines, and

running water tankers to the most deprived areas.

In the provision of fodder the principle adopted is that there is a public responsibility for keeping alive the cattle belonging to the weakest sections of the rural population. During drought all grass suppliers in the affected state are obliged to sell to the state. The estimate of the shortfall of fodder is made up by molasses, wheat bran from flour mills and paddy and wheat straw. These are transported usually by rail to the affected areas.

The distribution of gratuitous relief normally begins before opening of relief works. People eligible are those unable to work or for whom no suitable employment can be found. This is given half in grain and half in cash and is stopped once the earliest crop is ripe.

There are six principles that underlay the success of the drought policy in India (McAlpin, 1987):

(1) Early intervention in the drought episode;
(2) Early intervention requires early warning and local knowledge;
(3) Relief is in the form of employment that generates incomes (employment is generated in ways and projects that facilitate the development of the affected area);
(4) Working capital for agricultural and pastoral populations is rebuilt at the end of the drought;
(5) The government of the affected region is in charge with all other actors' efforts supporting and supplementing the states efforts; and
(6) Development of successful policy has taken time and previous experiences have been used to update the codes over this time.

Subbiah (1993) has suggested an alternate drought management approach that would gradually reduce relief while increasing the capacity of drought prone areas. He proposes a systems approach which has been practised by traditional communities but has become gradually redundant with the introduction of technical advances, population pressure and the market economy. Traditional strategies have relied on primary (crops), secondary (livestock) and tertiary (off-farm activities such as employment and hunting) production systems. The systems approach to monsoon management illustrated in *Figure 12* emphasises the need to facilitate the creation of more jobs in the non-farm sector and hence the gradual transfer of labour from the farm to the non-farm sector. To do this, it is necessary to enhance the primary and secondary production systems. These would then be the basis of agro-based industries and combined with promotion of local handicraft skills and small scale industries would provide employment and hence greater income security at the tertiary production level. Adoption of a systems approach in upgrading the primary and secondary production systems and by building up tertiary production systems, it is possible to transform current drought management methods from resource transfer to resource regeneration. This would gradually reduce relief expenditure amounts and promote sustainable development.

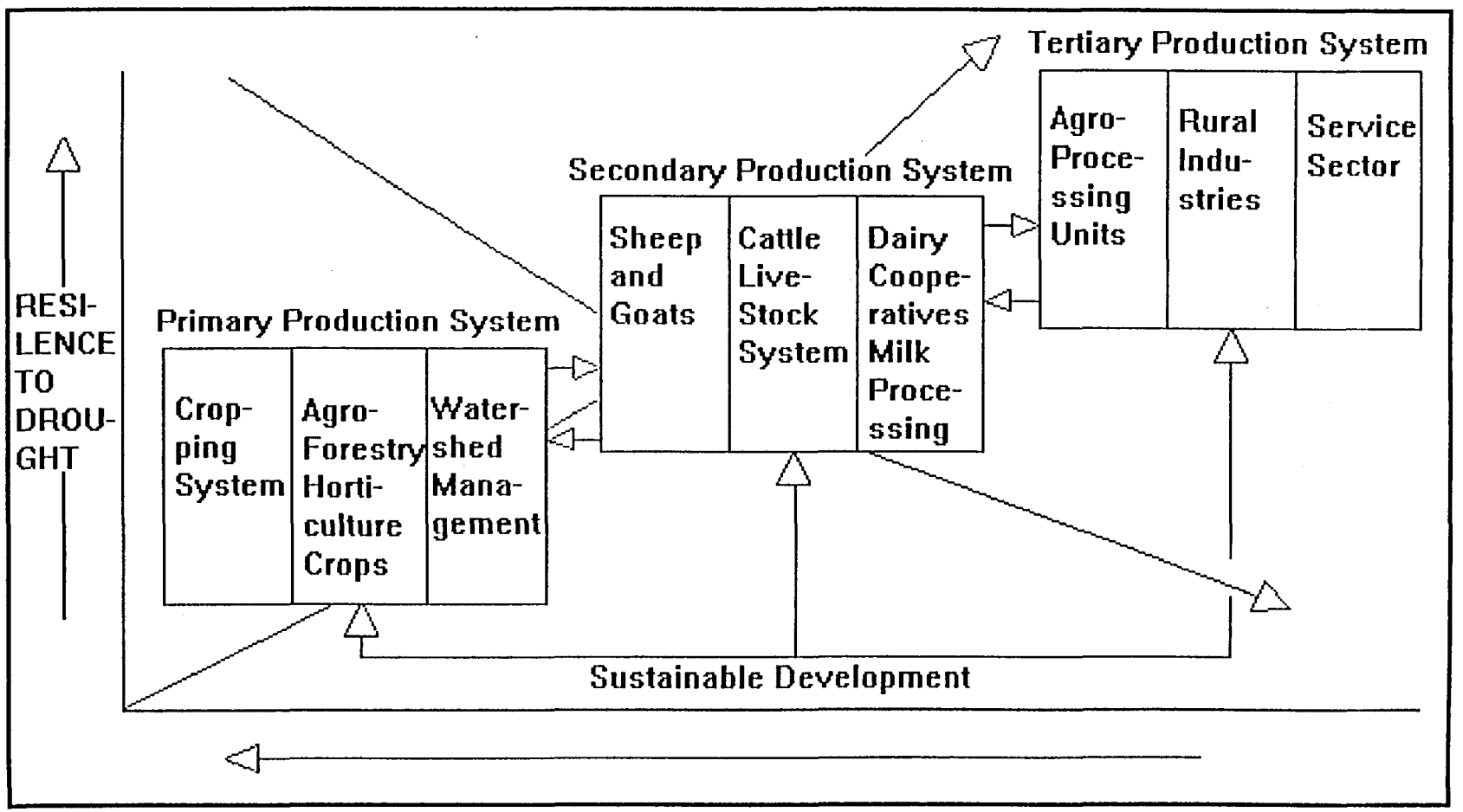

FIG 12. Systems approach to monsoon management (Subbiah, 1993)

9. DROUGHT POLICY IN SOUTH AFRICA

The South African Government has had a long history of involvement in providing relief to commercial farmers. However, it is clear from the ad hoc responses to the 1982-83 and the 1991-92 droughts, that with respect to the rural developing communities, there has been no specific drought policy.

For many decades, drought assistance programmes have concentrated mainly on providing relief to the livestock industry. The amounts allocated to the drought relief schemes have been rising over the years. These are reported to be R447 million in 1984-85 (Wilhite, 1987), R1,300 million in 1987-89 (Bruwer, 1990) and R4,000 million in 1991-92 (van Zyl, 1993). The National Drought Committee (NDC) has been administering the drought policy. At local level, the District Drought Committees (DDC) have been responsible for the designation or revocation of disaster drought areas according to criteria specified by the NDC. Due to the rising costs highlighted above the there has been a process of developing a better approach to drought management with the basic principle being that drought must be regarded as an integral part of the farming management programme (Bruwer, 1993).

For the rural subsistence inhabitants there have been no formal structures to monitor drought and to provide relief. Often the structures have been set up on an ad hoc basis (see chapter 5), often when drought has reached disaster proportions.

The general objectives of drought policy include reduction of vulnerability, promotion of sustainable development, and minimization of negative impacts of drought on people and the environment. The specific objectives include (Wilhite, 1993):

(1) More efficient use of water;
(2) Provision for an incentive for national and international organisations to exchange information and experiences related to drought;
(3) Emphasis on risk management, including crisis management;
(4) Improved organisational capacity and ability of governments to prevent and cope with drought emergencies;
(5) Reduced dependency on subsidies and internal and external assistance;
(6) Compilation of a record of drought occurrences and effects;
(7) Guaranteed supplies of drinking water for the affected population;
(8) Ensured food production;
(9) Ensured hydroelectric power production;
(10) Promotion of new technology and adaptation of available technology.

The drought policies for the effective provision of water supply to rural communities should place emphasis mainly on risk management strategies or proactive measures and should also have well developed crisis management strategies or reactive measures.

There is a wide disparity in the levels of development of infrastructure for the provision of water in the various developing areas of the country (Chapter 3). It is clear that even in those areas that have relatively better water provision infrastructure the systems are not functioning well due mainly to institutional aspects in the management. However, even with sound institutional arrangements there is a need to have certain levels of basic infrastructure development. Thus, there two dimensions to the problem: (1) infrastructure development: and (2) institutional capacity development.

9.1 Infrastructure Development

Proactive strategies are required in the normal development process in the provision of new and the improvement of existing water supply infrastructure making provision for drought as a way of effectively mitigating drought. This should aim at providing a basic minimum of 25-30 *l*/c/d to start with. As part of the proactive measures, adequate infrastructure development would be the most important initial stage of reducing the vulnerability to drought for 50% of the rural population without adequate or safe water supply. Appropriate, affordable and sustainable technologies should be used.

9.1.1 Better use of existing supplies

Use of existing water supplies

Where perennial rivers and streams exist and can be preferably utilised by gravity abstraction, these provide a cheap reliable source. Simple treatment technologies such as pre-filtration, sand filtration and disinfection should be used.

The reliability of these sources can be considerably increased. This is, especially with respect to drought, by conservation of high flows in non-drought periods by storage through dam construction. However, in the context of rural water supply, a series of earth dams along a water course maybe more favourable, constructed in a labour intensive manner through drought relief funds, rather than mechanised means. In favourable situations they can also provide irrigation and livestock water, thereby considerably hedging the particular community against drought.

Sand dams are suitable in streams and rivers that have either very low flow, or none at some period of the year, and where there is sand in the river bed. Sand dams have been used for drinking water for people and livestock in Namibia since 1907 (National Academy of Sciences, 1974). Sand dams can store water for longer periods than conventional open storage due to very low evaporation rates when the water table is below the sand. In drought situations this is a considerable advantage especially where there are natural underground fissures or aquifers. These can be built by communities in stages

of 1 to 2 metres to capture trapped silt using concrete or masonry. In favourable sites a series of these sand dams can offer considerable storage.

Spring protection offers one of the cheapest ways to provide safe water where these are perennial. Of considerable importance is protection and conservation of the spring catchment area not only to provide uncontaminated water but also to provide a sustained source even during droughts.

Surface runoff as a result of precipitation has been largely under used as a source of water in itself or as a complementary source in rural water supply. There are several ways of obtaining runoff.

Roof catchment systems with adequate storage to have the potential for significantly supplementing water for domestic use. Thus, they may help in the conservation of alternative sources for use during drought. Research (Gould J E, 1987, Gould J E, 1992a, Bradford B, 1992) has indicated that with installation of foul flush systems, the water collected almost meets, "WHO potable water standards", which is better than most traditional sources. In Thailand, unsanitary water handling was found to be a major cause of secondary contamination (Bradford B, 1992). For domestic water, a hard roof is required that is constructed of tiles or corrugated iron sheets. These roofs are increasingly being used in rural South Africa.

In Botswana, research has indicated that for the greatest efficiency in maximizing rainwater supply while minimizing costs, a storage capacity equivalent to 40% of the useful runoff is recommended (Gould, 1987). This would yield an average supply of at least 70% of useful runoff with 95% reliability. The tank size depends on mean rainfall pattern. For South Africa the storage for the various mean annual rainfall regions would have to be investigated.

Successful community based roof catchment projects have been and are continuing in Thailand (Gould, 1987, Gould, 1992a, Bradford, 1992) and Kenya (Gould, 1992b). In Thailand the jar programme success is attributed to favourable rainfall patterns, strong governmental and popular support at all levels including NGOs, community-based initiatives and involvement of the private enterprise sector in producing rain jars at an affordable price. In Kenya, the projects have had strong donor support, are located in drier districts and local builders operating privately have been responsible for thousands of rainwater tanks.

Ground catchment systems have been extensively used by commercial farming in South Africa. These are commonly earth dams constructed across seasonal ravines or scooped out in suitable locations. They are mainly used for supplementing livestock water supply. In rural communities in the Ciskei, there are similar systems but these, however, are not maintained. These

systems could be used to supplement livestock water supply and where feasible and with appropriate treatment for domestic supplies.

Rain catchment systems have the advantages of convenience by supplying at consumption point, low running costs, relatively good water quality from roofs, low environmental impact and are relatively simple to construct. They have, however, high initial costs per litre water supplied, compared to other methods and the supply is limited by the amount of rainfall and the catchment area.

Ground water storage

Ground water, where available in adequate quantities at shallow depths, of acceptable quality, both chemically and bacteriologically is a reliable source of safe water to rural communities. It is a cost effective option in most areas, either as sole supply or when used conjunctively with surface water (Morris, 1993).

Ground water is already extensively used for rural water supply in South Africa. It is primarily extracted through hand pumps although windmills and motorised pumps are also used. Ground water is generally considered to be out of phase or lags present weather conditions more than surface water and thus a more reliable source during drought. However, proper scientific siting and assessment of boreholes and well fields and penetration depth into the aquifer are critical factors in reliable supply. Over extraction or mining of ground water should be avoided. Pumping rates, sequence and duration should be developed and adhered to and a monitoring programme implemented (Morris, 1993). Thus, it is important to have good ground water management especially in those rural areas where ground water is used exclusively without a monitoring system.

Where saline or brackish water is available, solar distillation can be used for providing drinking water at individual household level using simple and cheap solar stills.

Inter-basin and within-basin water transfer and exchange

There is limited scope in the application of inter-basin water transfers for rural water supply projects in view of the costs involved and the complexity in the management involved. However, where the infrastructure exists especially in the form of dams already constructed for agricultural supply within basin transfers are possible where institutional capacity such as a second tier organisation exists. The problem lies with the allocation of water to different uses and the boundaries that exist, as mentioned in chapter 2, that limit catchment control. Thus, the preference for catchment based water authorities as mentioned in chapter 6.

Improving water supplies by conservation

The poor state of the infrastructure and the backlog of maintenance means that there is scope for improved conservation in existing schemes through reduction of losses. Upgrading of present schemes to yard connections or to some form of regulated supply such as water kiosks or vending machines from open public stand pipes as is the case in most rural water schemes would reduce the wastage. The improvement of water infiltration through soil conservation measures such as reduction and slowing of runoff by construction of percolation tanks, check structures, gully rehabilitation, and contour bunching would enhance the recharge of ground water storage. The reduction of evaporation by creating a barrier on the water surfaces of reservoirs wherever feasible should be done to conserve water during drought.

9.1.2 Development of new supplies during droughts

Saltwater conversion

The use of saline water from existing and new boreholes in the rural areas is an alternative source. There are many abandoned boreholes due to salinity. As a proactive measure it would be necessary to investigate scientifically, through hydrogeology, the potential of such well fields and develop contingency plans of their exploitation during times of drought. The problem however, is the availability of simple and inexpensive ways of desalination of the water. For emergency purposes, mobile equipment using conventional technology is an option especially where there is developed water infrastructure that could be connected to the equipment. Where no water infrastructure exists then two options exist. The first is the use of tankers to transport the water from the emergency plants. The second is the use of alternative technology in the form of solar stills to provide water to individual households. Although yields of distillate are generally low, mixing the saline water and the distillate at the appropriate ratio could provide sufficient drinking water for households, daily needs until the end of the drought.

Mining of ground water

Those areas endowed with dolomitic reserves of water present a feasible drought mitigation measure. There is a need to have extensive exploration and investigations on the reserves as well as the potential for exploitation of this source in the various regions. The management strategies, especially with regard to the recharge of these reserves after drought, would also require thorough investigation.

9.1.3 Alternative water supply enhancement in droughts

Connection and extension of water supply grids

This is potentially attractive to those areas where there has been widespread

development of water infrastructure to extend to various adjacent areas to form a district regional or catchment network. Such areas as Qwaqwa and Gazankulu have fairly developed schemes that could be linked or interconnected to cover larger areas. However, there would be various complexities to be overcome in doing this as well as the management of the resulting complex system.

Enlargement of conveyance capacities

The precondition for this is that the infrastructure must already be in place. In those areas where canals exist it is feasible to enhance conveyance capacity in such a manner that employment is also generated for the local community. As for reinforcing the pumping capacity the scheme should be well maintained and in good condition.

Conjunctive use of all water sources

It is unlikely that one source of water would suffice in the supply of water for most rural communities due to (1) the level of infrastructure development for each particular source as a result of limited funds; and (2) the dry nature of the environment where most of the rural population are living where the quantities of water from each source are limited. Thus, the conjunctive use of all water sources where feasible, provides a potent method for mitigating droughts. Over four hundred small to medium sized towns in the country rely on both surface and ground water for their supplies (Morris R, 1993). This however, is more complicated in terms of managing more than one source.

9.2 Institutional Capacity Development

For integrated water management there is a need to develop institutional capacity in all three tiers of the proposed structure of the water industry (Chapter 5). The third tier requires special attention and support and is likely to be the tier involved with rural water supply. As the 1992/93 drought highlighted, the primary problem was related to management, administration and maintenance and to a lesser extent the availability of water. For the effective mitigation of drought, proactive strategy in effectively building capacity in these institutions is necessary so that they are able to monitor and recognise the onset of drought and institute the necessary measures to mitigate drought.

9.2.1 Demand reduction

Restriction of water use

These institutions should be able to have the capacity to restrict water use during drought through rationing and social, economic and political pressure. These pressures can be exerted through, for example, decree by the local administration or educational campaigns on the need to conserve water once it is known a drought is imminent or it is already underway. Physical

inspections to ensure that water use is restricted to essential use and the authority to enforce this, such as, through fines or disconnection should be there. The ability to ration would depend on the infrastructure as well as the ability to monitor water reserves or levels. The criteria for rationing among the uses would be the levels of water reserves. This method is widely used especially to restrict water use for irrigation. Rationing the supply for domestic and livestock use would depend on the severity of drought.

Economic incentives for reduced demand

For the effective use of pricing there has to be certain basic levels of infrastructure in order to be able to meter consumption. The most basic would be water selling shops while individual metering for yard or house connection would be the ideal. An effective tariff structure is necessary and would depend on the infrastructure in place and should reflect sensitivity to the ability to pay for the particular community. It is in general, accepted that, the tariff should include the full cost for operation and maintenance which would be a charge per unit used. The portion of the availability charge that represents the fixed cost of the system would depend on the local circumstances. The availability charge is usually much higher than the charge per unit used. For example, in the KwaNyuswa water project completed in 1993 in Ndwedwe District, KwaZulu, the availability charge would be R 55-56 assuming a 15 year recovery period for the R 250 000-00 used to supply water to 300 households ignoring interest charges since the money was donated. A flat rate of R 7-00 is charged per household assuming an average consumption of 50 *l*/person in the whole scheme. Household spending on water supply and sanitation should be 1 to 1.5% of gross income (Raftelis G A, 1993). Therefore, from table 1 for region E from rows eighteen and nineteen the personal income can be obtained and each household should spend R 11-20 per month on water and sanitation. This is clearly inadequate if the availability charge is considered. During drought pricing has been and can be used to decrease demand but the flexibility in the use of this in rural communities would be greatly determined by the economic reserve in a particular community and maintaining a minimum level of supply of at least 30 *l*/person/day.

9.2.3 Impact minimization

Early warning system

Although the forecast of drought is not reliable at present, the lead time in drought warning can be reduced so as to implement drought coping measures and strategies as early as possible in the drought. The various third tier institutions through monitoring their water sources would provide data on their state and any other relevant data they would be capable of gathering such as rainfall. These data would be sent to a district or regional second tier institution which would analyze and store the data from various sources and pass them on to the body responsible for initiating and coordinating relief in the region. A simple method of reporting on the water source and supply

system situation could be based on completing a prepaid postcard designed for monitoring the particular water sources and systems in the given village(s) that would then be sent to the responsible second tier water institution for the area. This system has been used with success in Thailand (Pearson I, 1993, Personal communication).

Disaster relief

The implementation of the disaster relief could be enhanced by the participation of the local third tier organisation. This would be particularly useful in facilitating community participation. They would have a significant role in the choice of what public works programmes should be carried out and the in their implementation.

9.3 National Drought Plan

Wilhite (1992) recommends that governments develop national drought plans. Linkages and suggested organisational components illustrated in *Figure 13* represent the recommended structure of a national plan. It is essential that any national plan be integrated with provincial and local levels of government.

The 1992-93 drought highlighted the need to have a national drought plan that takes into account all sectors of the rural population and not just the commercial farming sector with a bias towards livestock farmers. As already seen earlier the existing structure is very similar to the recommended structure with local government levels being represented by district drought committees. Hence, the existing structure needs to be restructured to have provincial or regional drought committees to coordinate the district drought committees in their provinces. District drought committee would have to be formed in those regions where they did not exist previously as well as sub-district or village drought committees.

An alternative scenario would be to have the provincial governments as primarily responsible for the management of drought with the central government supplementing the efforts of the provincial governments. A similar structure as described above at provincial level with all the committees established at provincial level and district committees and local village or sub-district committees providing linkages at the grassroots level *Figure 14*. A national committee would exist only to coordinate the provision of national resources to the provinces when the provinces would require outside assistance to cope with serious the drought disasters. This scenario is likely if strong regional governments evolve.

The functions of the national or provincial drought committee (PDC) would essentially remain the same. These would be to firstly, prepare and coordinate the development of the drought plan and secondly, in the implementation of the plan during drought to assume the role of policy coordinator, reviewing

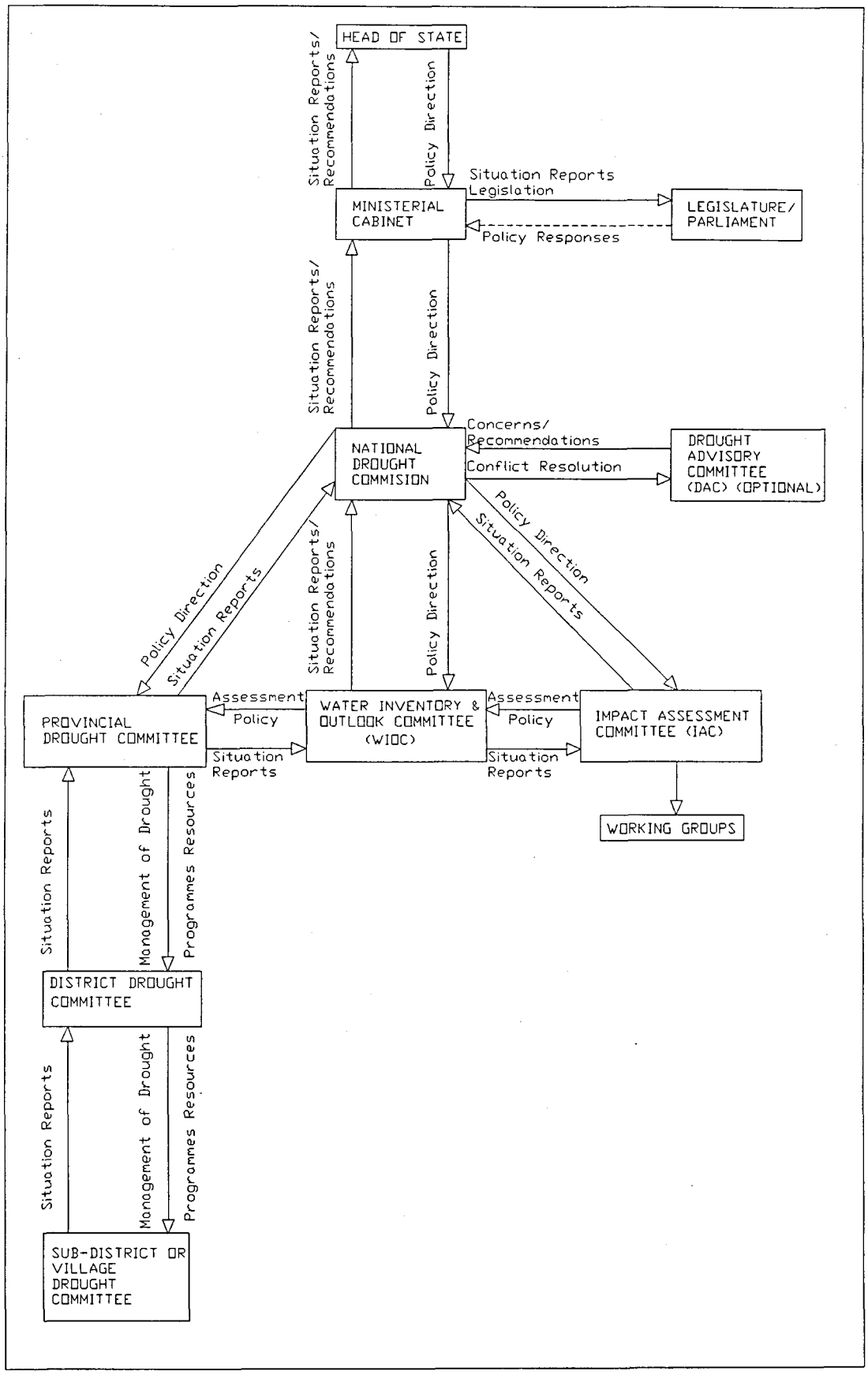

FIG 13. Linkanges and suggested organizational components of the drought plan process under the ten-step process (adapted from Wilhite, 1992), National Structure

alternative policy response options and making recommendations to political officials. A drought advisory council to allow and facilitate public involvement would be established by the NDC or PDC to assist in the flow of information and resolution of conflicts during droughts.

A Water Inventory Outlook Committee (WIOC) would be established to monitor current and estimate likely future water availability. The primary duties of the WIOC would be:

i. Inventory data availability and current observational networks.
   The WIOC would inventory current observational networks (eg. meteorological, hydrological) operated by governmental and non-governmental organisations and protect and enhance those networks where necessary.

ii. Determine primary user needs and develop and/or modify current data information delivery systems.
   Primary data and information needs of users should be determined with the network designers to ensure it is timely and in an appropriate format.

iii. Define drought and develop triggers and an early warning system.
   An index or combination of indices should be selected or developed that can be used to trigger specific and timely actions by government and non-governmental agencies. This would require that thresholds be established such that once these are exceeded, certain actions are triggered as defined in the drought plan. It is important to distinguish between early warning systems designed for drought and those designed for famine. Drought warning systems concentrate primarily on assessments based on components of the water balance. Famine systems incorporate many of these, but also include a wide range of social indicators.

iv. Identify drought management areas.
   Drought management areas may be defined on the basis of political boundaries, river basins or catchments, or agricultural zones. These would depend on the structure adopted as highlighted by the two scenarios given at the beginning of this section.

<u>Impact Component: Impact Assessment Committee (IAC)</u>

The impact assessment committee would represent those economic sectors that are directly and most seriously affected by drought such as agriculture and the water sector. The IAC maybe just one committee or it may form a number of working groups for each impact sector (eg agriculture, industry, water supply, environment) reporting to it. The latter would seem to be the more appropriate as this would most likely be able to identify and better evaluate the impacts.

Response Component: National/Provincial Drought Commission

The purpose of this component is to act on the information and recommendations of the IAC and evaluate the range of assistance from government and other sources to assist in water supply, the agricultural producers, and others during emergencies. Rational response options have to be determined for each impact sector. These options should examine appropriate mitigation measures on three time scales: (1) short-term (reactive or emergency) measures (2) medium-term (recovery), and (3) long-term (pro-active measures. These have been covered in chapters 7 and 9.1.

9.4 Backup Emergency Systems

The backup emergency systems available for rural communities are :
(1) drilling of new and rehabilitation of old boreholes;
(2) transportation of water by tanker;
(3) transportable plants including desalination units;

9.4.1 Drilling of new and rehabilitation of old boreholes

This is widely used as an emergency measure in the supply of drinking water during drought. The costs involved are travelling to the site, setting up on site, drilling which may depend on the material drilled, casing, testing and the installation of pumping equipment, usually hand pumps. This is relatively cheap compared to other emergency options and has the advantage of leaving permanent infrastructure on the ground.

9.4.2 Transportation of water by tanker

This is used as an emergency measure to supply water. The costs involved are the hiring of the tanker, the cost per kilometre driven and the water. It is a relatively expensive option and has the disadvantage of only being a temporary measure.

9.4.3 Transportable/emergency package plants including desalination units

These are relatively expensive and have the disadvantage of requiring skills and certain infrastructure such as power and skilled operators to operate them.

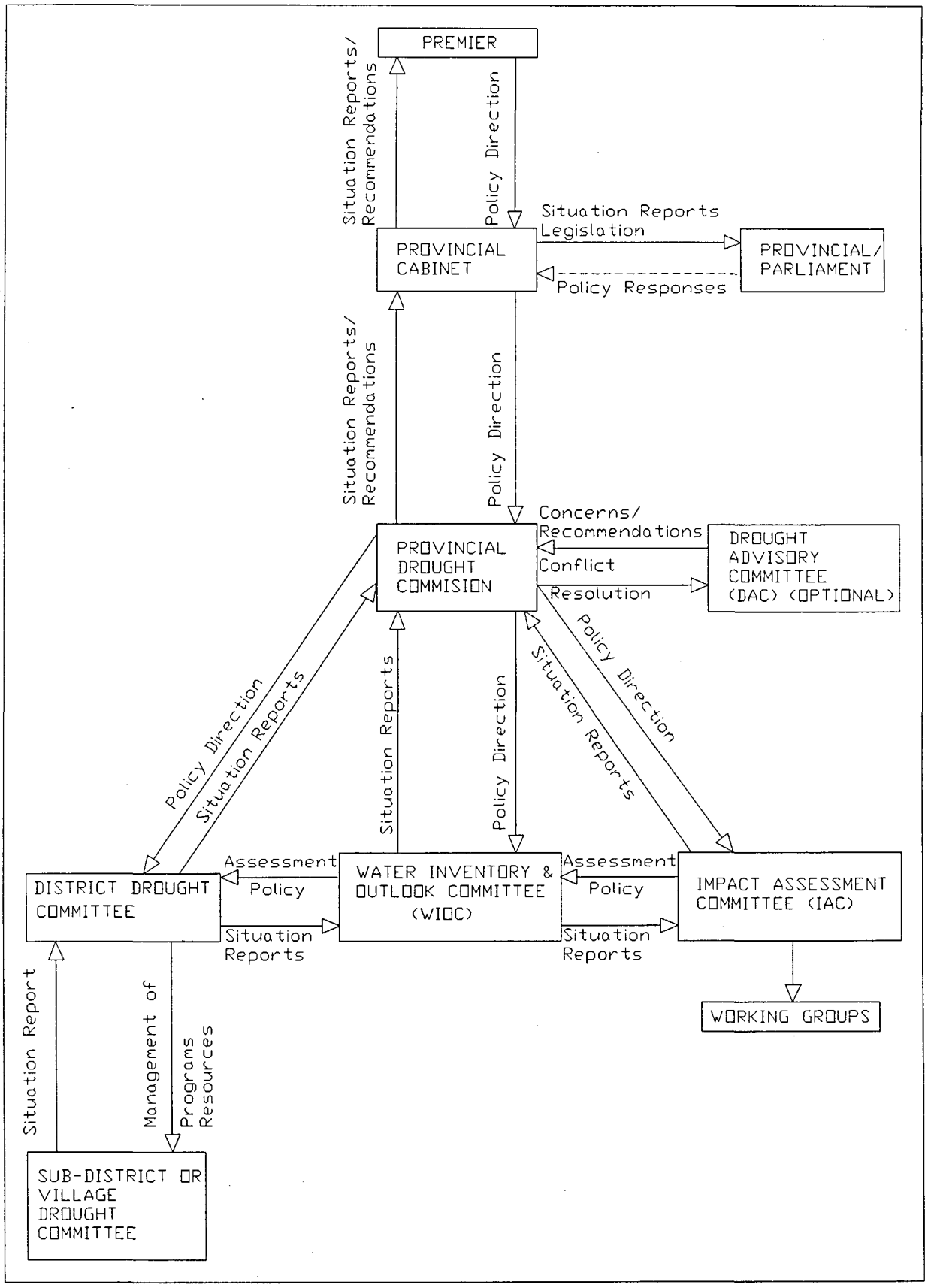

FIG 14. Linkages and suggested organizational components of the drought plan proposed under the ten-step process (adapted from Wilhite,1992) , Provincial Structure

10. DROUGHT POLICY OPTIONS

The various policy elements that are identified from the preceding chapters are as follows:

1. A focus on the provision of basic infrastructure for water supply to rural communities through an approach which is community controlled and has strong community participation
2. Development of an institutional framework in the water industry including support structures within and for rural communities
3. Establishment of a national drought plan that takes into account rural communities
4. Establishment of a permanent disaster relief body
5. Capacity building in the rural communities
6. Development of early warning systems
7. Accelerated development of water supply to rural communities through the Reconstruction and Development Program.
8. Conservation of the environment, particularly those elements which influence the water resources of catchments.
9. Decentralisation of structures, services and decision making
10. Application of proactive measures to deal with drought focusing on risk management rather than crisis management
11. Use of appropriate, affordable and sustainable technology in water supply
12. Research and development of alternative water supplies
13. Application of supply oriented measures for drought mitigation
14. Application of demand oriented measures for drought mitigation
15. Cost recovery, tariff setting and financing of schemes
16. Community and public participation including education on drought issues
17. Creation of a disaster fund
18. Ensuring there is adequate stock of equipment and spares at a regional level such as hand, diesel, electric and wind pumps and engines.
19. The general standardisation of equipment.
20. Creation of enabling climate for the promotion of rural development
21. The training of adequate personnel to serve in the various sectors and levels involved in the water supply industry and the development field
22. Systems approach (integrated development) to rural development

The drought policy options with respect to provision of water to rural communities subject to recurring drought proposed can be divided into two types. These are :

1. Short-term
2. Long-term

The short-term policies tend to address one to a few of the policy elements listed above and in turn may form components of the longer-term policies. The long-term policies tend to encompass more policy elements. The short-term policies will tend to be reactive whereas long-term policies will tend to be pro-active.

10.1 Short-term Policies

The short-term polices suggested are:

1. Creation of Strong Disaster Relief Policy

   This would focus on the alleviation of distress and the provision of water to communities during drought. This entails the creation of permanent structures that would have to be formalised nationally and regionally as suggested in 9.3. This would require the creation of a disaster fund and the building of capacity in both government and non-governmental agencies such as the equipping of government departments most directly involved with the necessary facilities eg the Department of Water Affairs with drilling rigs. The disadvantages with this approach are:

   - lack of adequate capacity on the ground to provide disaster relief especially when drought is extensive;
   - lack of capacity in industry to provide goods services at short notice as for example hand pumps and spares;
   - it is difficult to plan and implement public works programmes that will be sustainable after the drought; and
   - does not take into account the use of pre-drought measures that can minimize the impacts and hence the scale of the disaster relief.

   The advantages of this are:

   - it is faster to implement relief and there is less suffering since institutions and structures will be in place;
   - post drought recovery would be easier and faster especially if there is a strong component of post drought recovery in the relief strategy; and
   - fewer resources are used in development when drought is not taken into account and development funds could stretch further.

2. Accelerated Development of Rural Water Supply

   In view of the different levels of development of infrastructure in the country, its accelerated development, in particular in those areas where the supply of water is an acute problem, the RDP could provide the drive for the accelerated development of the infrastructure. This would be by using appropriate and sustainable technology and should be labour intensive. The advantages of this policy are:

   - provision of badly needed infrastructure and at the same time

employment in the short-term
- financing of projects maybe more readily available

The disadvantages of this approach:
- due to the accelerated nature of implementation, there it would be difficult to have enough time for capacity building
- the approach would tend to be a provision rather than a promotion approach.
- the capacity to carry out this programme that is, funds, personnel and other resources may limit the rate of implementation

10.2 Long-term Policies

The long term policies suggested are:

1. The creation of an appropriate institutional framework for water supply. This is especially with regard to rural water supply. This would be an evolutionary process and hence a long-term process. Once the top tier structure is identified it would be responsible for setting the policies regarding water supply. This would address most of the policy elements such as provision of infrastructure, setting of tariffs, capacity building, drought mitigation measures etc. This would have the advantages of:
   - providing adequate input in the design of programmes and projects by those best qualified in this field
   - considerably reduced costs of disaster relief during droughts;
   - emergency reactions may be well developed by these institutions;

   The disadvantages would be:
   - a tendency to view water supply in isolation to general development as whole.

2. The implementation of a systems approach to rural development. This would call for an holistic approach to rural development where not only issues relating to water are addressed but the wider issues of development resulting in the upliftment and improvement of the socio-economic framework in which these rural communities operate. This would represent the development and conjunctive use of water resources, the development of water infrastructure and the development of institutional capacity including backup which would be integrated into the general development process. Included in this process would be a strong disaster relief component. The advantages of this approach are:
   - improved sustainability of the water supply schemes;
   - local level monitoring and rapid response is possible;

- considerably reduced costs of disaster relief during droughts;
- emergency reaction can focus on the alleviation and minimisation of the economic impacts;

The disadvantages of this approach are:

- the requirement to set up the necessary institutional arrangements to facilitate the development process;
- the long term nature of development which means that in the interim there will be need to set up a strong focus on the disaster relief process;
- the development process will require enormous investment of resources.

11. CONCLUSIONS AND RECOMMENDATIONS

a. The drought policy options fall under two categories viz:
(1) Short-term, and
(2) Long-term

The short-term policy requirements are:
(1) To develop a strong emergency relief policy; and
(2) Accelerated Development of Rural Water Supply

The long-term policy requirements identified are:
(1) The creation of appropriate institutional framework for water supply and sanitation especially with regard to rural water supply.
(2) The implementation of a systems approach to rural development.

b. The drought susceptible rural communities are located in the former homelands and TBVC states which are also the most socio-economically disadvantaged regions.

c. There is a need for the establishment of appropriate, effective institutions at local, regional and national level for the management of the water resources and water supply systems in South Africa. These institutions should be equipped with the necessary mechanisms and capacity to be able to respond to disasters through far reaching and systematic risk management. The adoption of the three tier structure with a catchment management approach as proposed by SCOWSAS would be a first step in this direction.

d. Special attention needs to be given to capacity building in the rural community organisations responsible for the management and control of water supplies at the local level.

e. There are basically two types of measures used in drought coping strategies: proactive and reactive measures. Proactive measures require sound institutions and institutional mechanisms and have three basic phases i.e. pre-drought, drought and post drought. Reactive measures give rise to the establishment and equipping of institutions only at the onset of drought and are related only to drought and post drought periods. Proactive measures taken after the 1983/84 drought largely eliminated impacts on the cities and power stations in 1992/93. The need is to extend these proactive measures to rural areas.

f. There are three groups of drought mitigation measures, namely supply oriented, demand oriented and minimization of impacts and losses.

Supply oriented measures are focused primarily on the augmentation of supply, demand oriented measures are focused primarily on the reduction of demand, and impact minimization measures aim to match the available supplies with a demand which results in the minimum impact.

g. In view of the already low per capita consumption levels of water in rural communities the use of demand oriented measures is restricted, and rationing would be to ensure water is available for domestic consumption. Also the lack of development of infrastructure and the low economic reserves of these rural communities means that in general the pricing policy and tariff structure can at most recover the operation and maintenance costs, and hence should not be manipulated to reduce consumption which is already close to a life-line level.

h. There should be a shift with regard to drought policy in South Africa with respect to the provision of water supply to rural communities from the current reactive "crisis management" situation to a more proactive response with emphasis in risk management in the planning for drought within the long term development process.

i Rural water supply development should be given more attention than in the past. It is important to foster a long term planning perspective in the development of rural water supply systems. Development should be geared towards providing sustainable basic water infrastructure especially to the approximately 50 % of rural communities who do not yet have an improved water supply. This will form part of the proactive drought coping strategies.

j The pre-drought strategies should focus on ways to make better use of existing surface and ground water supplies through the adoption of sustainable appropriate technologies and the judicious, conjunctive use of the water resources. In particular ground water supplies should be developed but carefully managed so as to provide a back-up during times of shortage from other resources. Alternative water sources which can be considered are, however, limited and include rainfall harvesting, mining of dolomitic reserves where they exist and salt water conversion. Of these the first is the most appropriate for use in rural communities.

k A strong and effective disaster relief policy needs to be developed pro-actively as severe and prolonged droughts are periodic events in South Africa. There is a need for the establishment of permanent drought structures within the national and/or provincial institutions with the formation of necessary committees and linkages depending on the option decided. Ad hoc drought committees to coordinate relief during

drought disasters should also be institutionalised at district and sub-district levels.

l. An effective early warning system needs to developed by the drought monitoring offices.

m. Public works programmes should be incorporated in the policy to provide employment and income to communities during drought and to provide new or to improve existing infrastructure that will be beneficial to communities after the drought. Programmes should focus on provision of permanent infrastructure rather than temporary measures of water supply (such as tanker supply) except in exceptional circumstances.

n. The upliftment of the socio-economic status of those living at or below subsistence level should be the ultimate objective of any development initiatives in rural communities. Thus, an integrated development approach in which water supply is one element of the overall socio-economic development of the community should be adopted.

o. Drought policy formulation has come through an evolutionary process having come through four stages in the last 150 years, i.e. famine relief, scarcity relief, drought relief, and drought management.

p. The policy options developed need further investigation, development and refinement.

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October 1994

PRACTICAL AVAILABILITY OF WATER FOR HUMAN CONSUMPTION:

TBVC - Countries and Self-governing Territories
(4 February 1993)

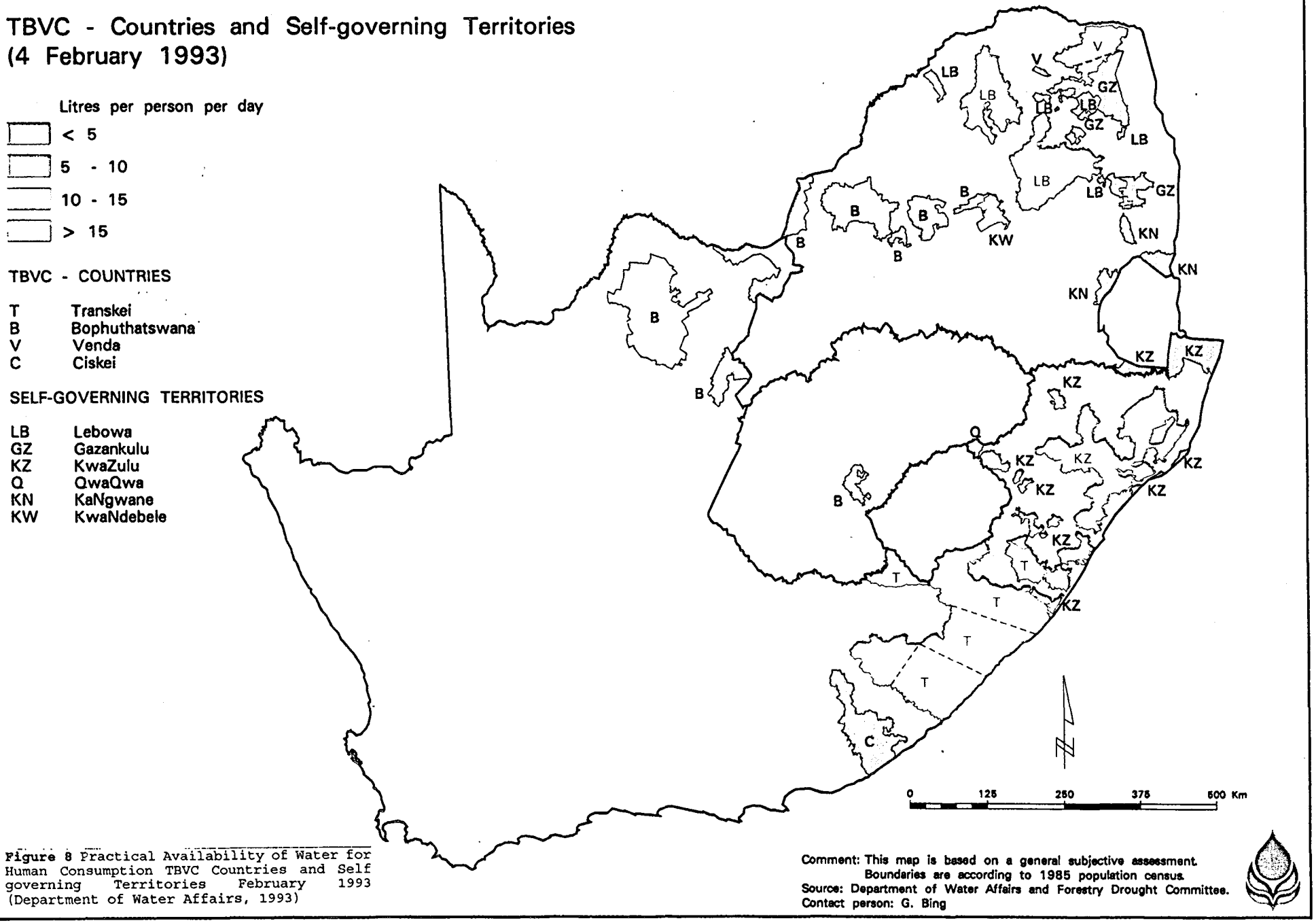

Figure 8 Practical Availability of Water for Human Consumption TBVC Countries and Self governing Territories February 1993 (Department of Water Affairs, 1993)

Comment: This map is based on a general subjective assessment. Boundaries are according to 1985 population census.
Source: Department of Water Affairs and Forestry Drought Committee.
Contact person: G. Bing

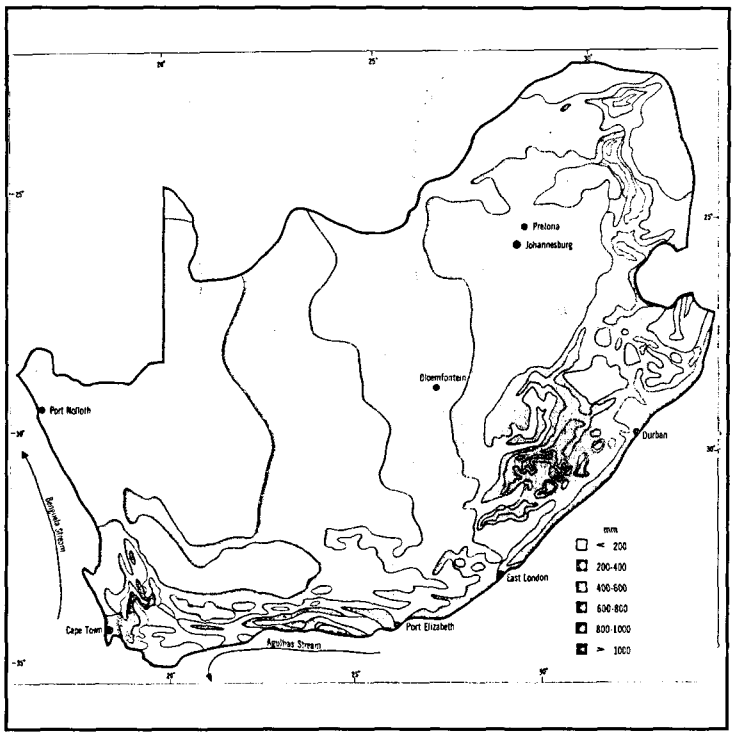

Figure 1 Mean Annual Precipitation (Department of Water Affairs, 1986)

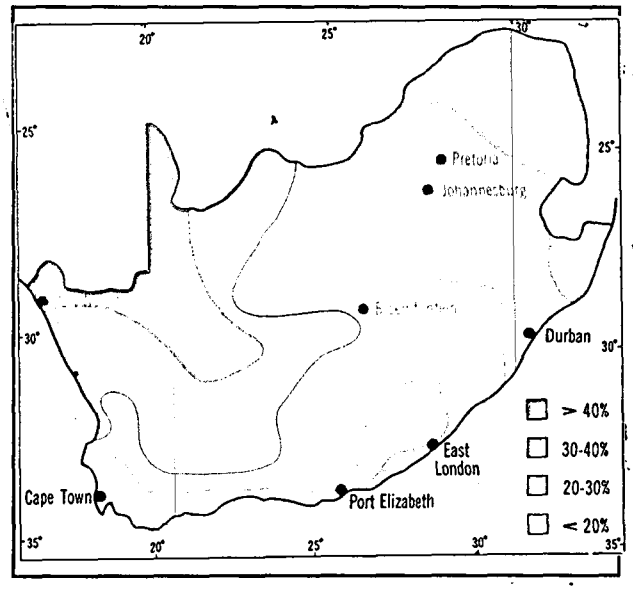

Figure 3 Percentage deviation from mean annual ranfall (Department of Water Affairs, 1986)

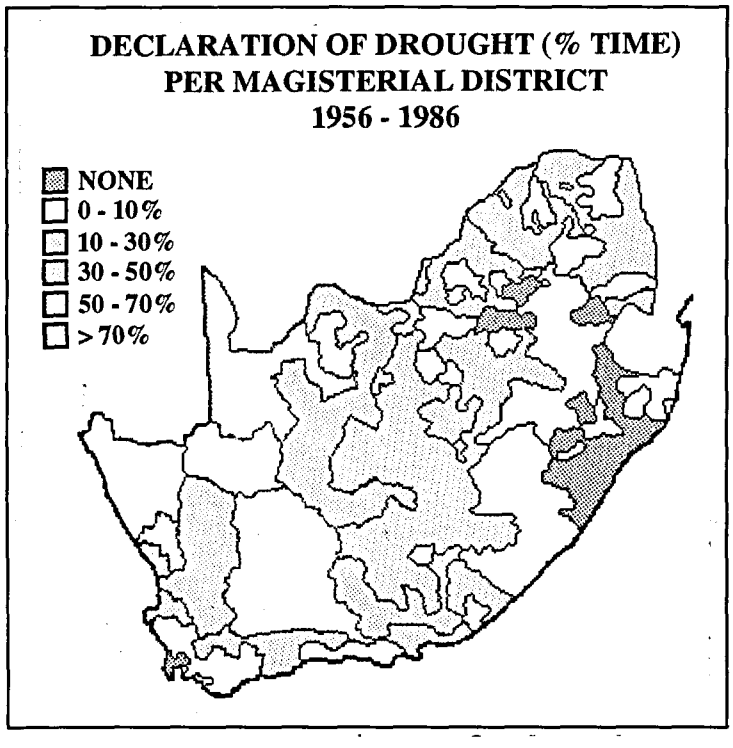

Figure 2 Declaration of drought (% time) per magisterial district 1956 - 1986 (Bruwer, 1990)

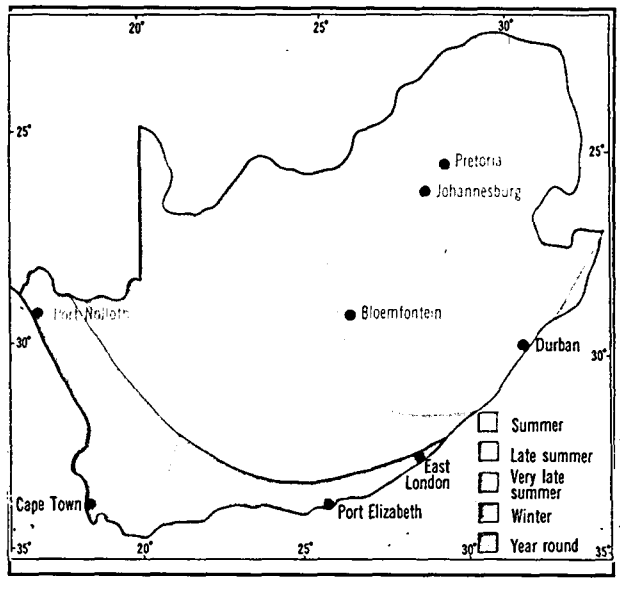

Figure 4 Seasonal rainfall regions (Department of Water Affairs, 1986)