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CONSIDERATIONS IN THE FORMULATION OF NEW FLOOD DAMAGE MANAGEMENT POLICY IN SOUTH AFRICA

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Floods periodically cause loss of life and damage to property. Provided adequate records are available, it is possible to forecast probabilities of flood damage. Governments have traditionally preferred controlling floods by physical structures. However, flood damage increases over time, partially induced indirectly by these structures, and institutional problems are quite common. Communities have historically not been involved, and inadequate attention has been bestowed on ecological aspects of floods and flood management. Future policy should aim at sustainable flood management, with an institutional system that facilitates sustainability. The paper outlines a framework within which such policy can be developed.

1. INTRODUCTION

Many areas in South Africa experience periodical floods of varying frequency and intensity. Damage to property and also life is common with floods once a certain level, duration and intensity have been reached. In common with most other countries, South Africa has traditionally aided people who have sustained losses at times of disastrous floods. What is needed in South Africa, as well as many other countries, is comprehensive policy regarding floods and flood damage. The questions to be answered for flood policy formation may possibly briefly be summarised as follows:

- What measures should be in place to reduce or eliminate flood damage?
- Who should bear what share of the costs of damage prevention, control and disbursements (should the latter occur)?
- What level of floods should be catered for, at what frequency and at whose costs?

The question whether the solution to flood damage control resides in structural or non-structural measures or what combination thereof has been

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debated extensively by academics and politicians over years. Flood damage simulation models were developed for both rural and urban areas to determine the benefits of various combinations of flood mitigation measures. White already observed in 1945 that non-structural measures were also necessary, but authorities in the world were apathetic towards non-structural measures. When countries experience serious loss of life due to floods, national authorities conduct studies to reduce the impact of floods, to find structural and non-structural solutions and to adjust flood management policy (Haque & Zaman, 1993 and Dempster & Brammer, 1995).

2. THE NATURE OF FLOODS AND FLOOD DAMAGE

Floods are one of the natural phenomena that cause great disruption and extensive damage. Vos (1982) stated that floods are responsible for approximately 30 per cent of all natural disasters and 40 per cent of disastrous cases due to catastrophes in nature. In the past a number of countries experiencing floods have made various attempts to relieve the effects of floods. This is especially the case in areas where floodplains have been developed in such a way that the floods that occur from time to time, cannot run-off without damaging developed areas. In spite of a better knowledge of flood hydrology, the implementation of improved technology and the application of huge amounts of money to protect areas against floods, flood damage has increased with time.

This increase is confirmed by Schoeman (1991) who, in a research on the average annual flood damage in South Africa, has shown that the mean annual flood damage in the Republic of South Africa (RSA) increased from R11,2 million in 1974/74 to R133,9 million (constant 1990-prices) in 1989/90. It reached a peak of R428,6 million in 1987/88. The historical event documentation indicates that flooding events on a national level is fairly frequent with significantly damaging events occurring on average between once and twice a year in South Africa (Van Bladeren, 1996).

Although the extent of the flood problem of the RSA is, seen from a national viewpoint, probably smaller than the problem of water scarcity, the occurrence of floods is of such a magnitude that attention has to be given to the problem.

3. PROBLEMS WITH FLOODPLAIN MANAGEMENT

Several problems complicate flood management policy formulation.

3.1 Governmental responsibilities

Governments have generally fulfilled a dominant role with regard to floodplain management by financing structural flood control mitigation measures in an effort to reduce flood losses. Witt (Director, Federal Emergency Management Agency) reacted as follows after the 1993 flood in the Mississippi river: "The time has come to face the fact that this Nation can no longer afford the high costs of natural disasters. We can no longer afford the economic costs to the American taxpayer, nor can we afford the social costs to our communities and individuals". In 1994 President Clinton appointed an Interagency Floodplain Management Review Committee to find permanent solutions for reducing flood risk. Only now are the real benefits of non-structural measures appreciated (Galloway, 1995).

Flood damages have been proven in England and Wales to increase over time. This gives rise to policy debates regarding flood control and flood damage control measures, appropriateness of floodplain development control and future utilisation of floodplains in England and Wales (Parker 1995). In Australia, with its experience in centralised decision making, many authorities, businesses and private concerns have limited incentive to make decisions or voice proposals concerning floodplain management. For this reason the flood management policy of Australia has been adapted repeatedly in order to provide functional and feasible guidelines to regional and local authorities to ensure that meaningful floodplain management can be applied (New South Wales Government, 1986). The same happened in India. National and local plans were not interrelated and as a result of poor communication and centralised authority, information is not exchanged amongst the various tiers of government (Ghosh, 1991). In South Africa flood damage also grows with time (Schoeman, 1991) and increasingly improved protection becomes necessary (FMC, 1998).

3.2 Community involvement

Communities have traditionally not been consulted in the process of approval and execution of projects (New South Wales Government, 1986). This led to inter alia conflict among producers, fishermen and members residing within and outside of the artificial leveés. Public participation in the planning, design and operation of projects is indispensable to floodplain management (Dempster & Brammer, 1995). Plans drawn up must be made public (Ghosh, 1991). Innovative ideas must be proposed by river authorities in order to enhance public participation in especially levees maintenance programs and to attempt to minimise the opposition of persons to certain

structural constructions. Bancid (1995) states the following: "Evaluations of a cross section of such projects completed in the past show that the agricultural and socio-economic benefits resulting from these projects can be greatly enhanced and their sustainability can be assured by integrating local people and their representative in all stages of project activities". The needs of a totally diversified local group can thus be satisfied and negative effects due to conflict can be minimised (Bancid, 1995). This emphasises the need for a multi-disciplinary approach to floodplain management.

3.3 Institutional problems

Many countries have experienced serious institutional problems with the result that potential flood damage continues to increase as time proceeds, with accompanying serious consequences in respect of loss of life and damage to property. In some other cases institutional network benefits resulted in decreased hazard losses. In cases where appropriate institutions have been established floodplain dwellers are considerably more aware of flood hazards and also handle floods more effectively (Haque & Zaman, 1993).

3.4 Flood damage escalation

Decisions on projects to reduce the effect of floods are usually based on cost benefit ratios. Various aspects such as additional development in floodplains, upgrading of existing structural works and detrimental environmental impacts of some development projects are often not accounted for in cost benefit analyses (Parker, 1995; Salem-Murdock & Horowitz, 1991). Backed by 20 years' experience, the World Bank concluded that many of the projections do not succeed in determining the exact magnitude of the internal rate of return because the aforementioned factors are not taken into consideration (Salem-Murdock & Horowitz, 1991). The net result is increased flood risk in floodplains and an escalation of potential flood damage despite the evidence of benefit cost ratios larger than unity (Parker, 1995).

The escalation effect (Figure 1) is illustrated in terms of an hypothetical example.

The first project (Project 1) is implemented in a floodplain where the annual potential damage of a 50 year flood is taken as R0,8 million. The potential benefit from this flood control measure exceeds the cost and results in a benefit cost ratio larger than unity. At the onset of year 19 the mean annual potential flood damage has risen to R1,25 million. This increase in potential

flood damage is mainly attributable to further development in floodplains; this development resulted from increased structural flood control measures (Project 1). Flood control measures and flood damage control measures are thus re-evaluated by taking into account the increased potential flood damage and as a result a further flood control project, namely Project 2, is developed on the grounds of a benefit cost ratio larger than unity. This new project is constructed in accordance with a higher protection standard, that is, to protect the floodplain against the 70 year flood. The project is implemented and gives rise to, say, a raising of the artificial leveés. By year 29 previous experience has been repeated and the mean annual potential flood damage has continued to rise (due partly to improvement in the living standard of the floodplain inhabitants), but in this case at a decreasing rate since few new entrants can settle in the floodplain.

4. METHODOLOGICAL FRAMEWORK

4.1 Sustainable management system

Several flood management systems exist in the world. During the past decade the accent has changed to sustainable development of floodplains. The World Commission on Environment and Development (WCED) defines sustainable development as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Adams (1995) quotes Barbier (1987) in this regard: "there is an emerging consensus that sustainable development should be directly concerned with increasing the living standards of the poor and it must address intergenerational equity and the extent to which costs and benefits of development are unequally borne by different people" (Pearce *et al.* (1988), quoted by Adams, 1995). According to Haque & Zaman (1993) sustainable development can be viewed as the furtherance and management of all resources in floodplains, in such a way that the economical, social, aesthetic and environmental needs can be actualised while cultural integrity, essential ecological processes and life support systems are maintained. Sustainable development must embrace transparent and effective utilisation of the ecosystem in such a way that the advantages are promoted in the long term.

Many, if not most development projects have a significant impact on the environment in floodplains (Adams, 1995; Salem-Murdock & Horowitz, 1991). In order to ensure sustainability, the harmful effects of development must be eliminated as far as possible (Walmsley & Davies, 1991). Jacobs and Iwra (1994) put it as follows: "It is clear that development must be

environmentally sound so that during the process of development we do not destroy the resource base on which development itself depends". Haque & Zaman (1993) point at the essentiality of an holistic approach, as opposed to the structural strategy; human aspects of water resource management and a sustainable floodplain development system which will ensure benefits to all participants, must be part of policy. Ghosh (1991) points out that flood management schemes should be handled within the framework of integrated long term planning and that this should take place in consideration of plans for other development such as irrigation, electricity and household water provision as well as orderly development of the local economy and urban development.

4.2 Flood attenuation measures

Where floods are as critical to the economy and the community as in Bangladesh, a policy aimed only at the attenuation of floods certainly cannot provide the ideal solution (Haque & Zaman, 1993). Structural solutions will at best provide a limited solution to an intricate and extensive problem and could give rise to disadvantageous consequences for the ecology and the environment. The traditional approach to water management, namely by means of cement and bulldozers has proved to be ineffective (Van Zyl, 1995). Custers (1993) criticises the flood management plan co-ordinated by the World Bank and states that structural measures such as artificial levees do not reduce flood water but rather displaces it to other areas. The flood problem in Bangladesh is not purely a case of "hydraulic thrusts", but much rather problems related to delicate consequences to the economy, ecology, community, demography, transport, settlement patterns and even political and cultural problems (Islam, 1990). A comprehensive strategy is required to deal with the aforementioned aspects.

4.3 Strategy towards flood prevention

Preparation is the key strategy to disaster mitigation (Mukhopadhyay & Das, 1992) and shifts the accent from reactive to pro-active action. Flood management plans are required in order to be pro-active. In order to put this into practice, it is the general tendency to devolve flood responsibilities down to local government level.

A floodplain management system is depicted diagrammatically in Figure 2 and will be discussed forthwith.

4.3.1 National flood management policy

In order for the flood management systems of regional and local authorities to be guided, and ordered national government has to formulate and implement an appropriate flood management policy. The following aspects should be covered in a national flood management policy:

- Flood prone land is a valuable asset which should not be allowed to fall into disuse by unnecessary restriction on development.
- All development should be treated on an equal basis; by for example imposing a single flood line as the flood standard, certain proposals which may otherwise have succeeded could possibly be disapproved or unjustifiably limited (New South Wales Government, 1986). It is therefore a requirement that all development proposals be treated on individual merit.
- The objective of the national flood management policy should be to minimise flood impact on individuals, inhabitants and private and public institutions.

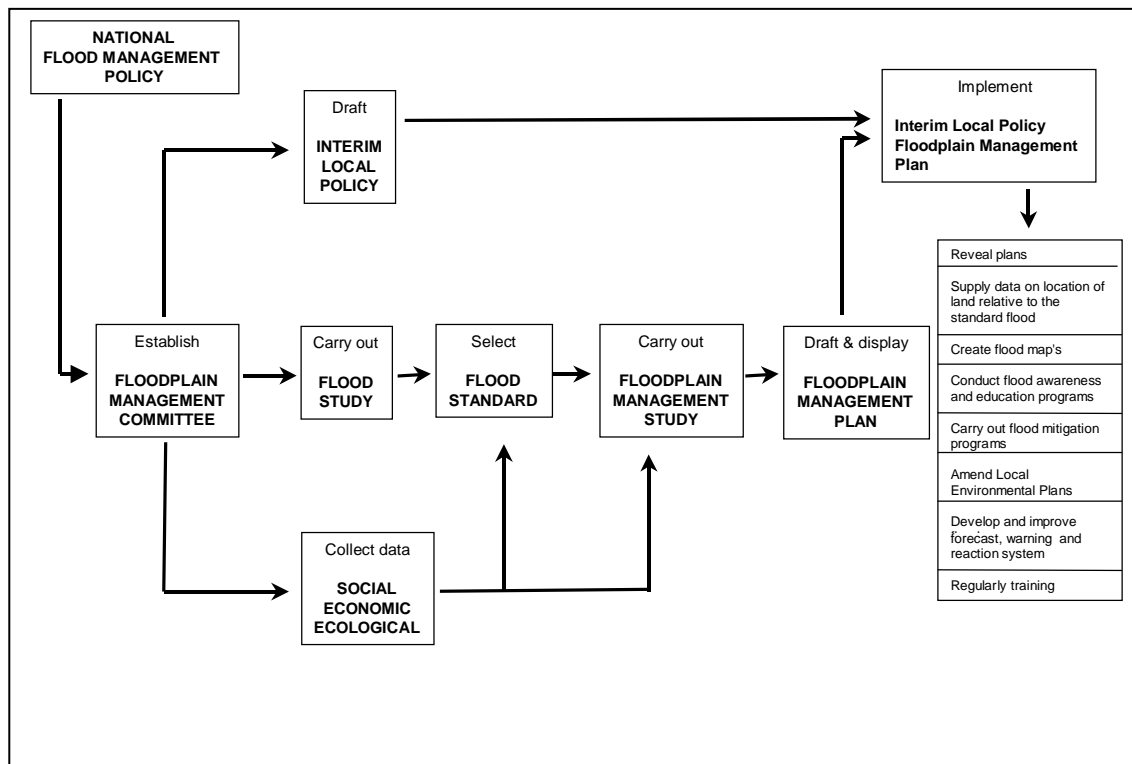


Figure 2: Adapted floodplain management system

Source: New South Wales Government, 1986

4.3.2 *Floodplain Management Committee*

Following the formulation of an appropriate flood management policy the application of the policy can be facilitated and co-ordinated by the formulation and implementation of the floodplain management plan (FPMP). This objective could best be realised if a local authority appointed a floodplain management committee (FPMC). (New South Wales Government, 1986). The committee must be representative of a community.

4.3.3 *Flood studies*

The FPMC is responsible for the supervision of the execution of appropriate flood studies in their area of responsibility. A flood study is a comprehensive technical survey of the behaviour of floods. The nature and character of flood hazards are provided by flood studies in that hydrological and hydraulic data (flood level, flow velocities and proportional flow at various cross sections, flood probabilities and the extent of flooding) in floodplains are made available. Existing problems and future development proposals can be taken care of by undertaking more intensive studies in order to obtain detailed and accurate information concerning the flood characteristics. These studies constitute the primary technical foundation for the formulation of an FPMP and provide technical background from which authorities can derive a suitable flood standard. Thereby management measures or precautions can be defined in respect of flood prone areas.

4.3.4 *Flood standard*

With the abovementioned hydrological and hydraulic data known, the next step is to choose a suitable flood standard. The choice of a flood standard for an area is a fundamental decision which must be taken since the standard is the point of reference for the preparation of the FPMP. The flood standard, also known as the designated flood, determines the area available for development. Consequently the merit approach is indispensable to the choice of a flood standard (New South Wales Government, 1986). The establishment of a flood standard on a merit basis entails the balancing of social, economical and ecological aspects without the raising of potential risk to property, life or structures. Historical floods are usually the only basis on which flood standards can be established. Inappropriate decisions may be taken where only relatively short historical flood records exist (New South Wales Government, 1986 and Myburg, 1998). With the development of appropriate flood damage simulation models it would be possible to determine a suitable

flood standard by means other than through historical flood records (Du Plessis *et al.*, 1995).

4.3.5 Flood management studies

After entire social, economical, ecological, hydrological, hydraulic and flood standard data have been determined, it is possible to conduct floodplain management studies. Floodplain management studies are undertaken in order to identify suitable flood control and flood damage control measures. The effectiveness of these control measures towards improved management of floodplains can then be determined in an attempt to reduce the effect of floods on existing and proposed developments. No single floodplain management option will be generally sufficient. An optimal combination should be investigated, which will require complicated and extensive studies and professional services. The aspects mentioned can only be executed meaningfully if appropriate flood damage simulation models are available.

Social disruption caused by flooding is often more meaningful than the directly tangible flood damage. This was clearly illustrated by the 1995 Christmas flood in Pietermaritzburg. Conventional procedures are commonly used to conduct economic analyses (New South Wales Government, 1986). The economic advantages of various flood control and flood damage control measures are established by estimating the damage which could be prevented as indicated by the flood damage simulation models. In order to account for all relevant aspects the method of executing a holistic integrated catchment planning and discovering (heuristic) approach is replacing the deterministic and forecasting approach (Tané & Xingzhao, 1993). In order to prevent further degradation of floodplains, floodplain management plans should contain all relevant ecological aspects for further development. Knowledgeable analyses concerning the environment of the river system and catchment areas are required for this (New South Wales Government, 1986).

4.3.6 Environment plan

Ecological sustainability can be ensured only if environmental development also is carried out in order to protect the main elements contributing to the integrity of the river and floodplain. This involves land uses, hydrology, plants, animals, humans, water courses, water quality and aesthetic attractiveness. These must be identified. The implications of different alternatives must be developed and flood attenuation proposals be estimated for the environment (New South Wales Government, 1986). According to Adams (1995) development projects have a significant impact on the environment in

floodplains. Measures such as dams and artificial levees will influence the extent and duration of floods. The life cycles of indigenous plants, fisheries and water bird species depend on floods and can be affected by the control measures. Therefore the flow in river courses is assured even in the off season. Negative impacts arise in Africa because engineers, economists and other developers possess limited knowledge about the correct ecological and human usage of wetlands in Africa (Adams, 1995).

The admissibility of development of any area is usually specified in a local environmental plan (New South Wales Government 1986). The preparation of an FPMP for a specific area should not be done in isolation but should be viewed as a component of a river system in a totally integrated catchment area.

4.3.7 Floodplain management plan

When the aforementioned steps have been concluded it becomes possible to develop an appropriate policy and a floodplain management plan. The primary objective of an FPMP is to lower the impact of floods and to spell out the flood related responsibilities of individuals, owners, floodplain inhabitants and private and public concerns. Aspects such as hydraulic categorisation, hazard categories, development type, land uses, ecological and social description and analyses, flood control and flood damage control measures, local flood management policy and requirements of environmental legislation must be afforded attention during the preparation of an FPMP (New South Wales Government, 1986). Guidance with respect to development decisions can be provided by means of an interim local flood policy until such time as the FPMP is prepared and ready to be implemented. The FPMP should also embody the National Governmental Policy as its point of departure.

No plan can be implemented at once. Funds availability will play a decisive role in determining the timing of certain actions. A strategy is therefore required for implementing the FPMP over a period of time. Procedures should also be introduced for the appropriation of financial aid from national government by local authorities when they need funds for implementing the FPMP.

5. NATIONAL FLOOD MANAGEMENT POLICY OF SOUTH AFRICA

The methodological framework above can serve as framework for new flood management policy for South Africa. The methodological framework integrates various aspects in order to prevent or at least retard the escalation of flood damage in floodplains. To enable authorities to manage floodplains effectively and to ensure sustainable development inside them, authorities have

to compile a floodplain management plan. A floodplain management plan must be comprehensive and must provide an effective framework for the development of land and water resources in catchment areas (Dempster & Brammer 1992). The primary objective of a flood management plan is to attempt to find permanent solutions to flood problems. Subsequent to the recent floods (the past 10 years) in various places in the world, it has been shown in several studies that the flood management policies of specific countries have influenced the course of development in floodplains without however managing to halt it (Dempster & Brammer 1992; Parker 1995; Galloway 1995 and New South Wales, 1986)

In order to comply with the idea of sustainable, integrated long term planning in the compilation of development plans (Adams, 1995 and Ghosh, 1991) a holistic approach to integrated catchment management is proposed for South Africa. "A holistic co-operative approach is necessary which would ensure in achieving a sustained minimal standard human life for the people and protection of the environment. There is no other alternative for the survival and betterment of the people of the region" (Bancid, 1995).

Various activities are associated with sustainable integrated floodplain planning, as depicted graphically in Figure 3. Activities named in Figure 3 should firstly be investigated individually by provincial and local authorities, whereafter results should be integrated in order to arrive at a sustainable integrated flood management plan. A multidisciplinary approach is clearly indicated. In terms of this approach it would be unreasonable to expect from provincial and local governments to house expertise and specialist services on a permanent basis. Consequently, an institutional network approach is proposed for South Africa whereby specialised services, most of which could and should be privatised, could be provided to provincial and local authorities. This approach will facilitate installation of the desired institutions for South Africa and reduced hazard losses in floodplains (Haque & Zaman, 1993).

Time and space prevent discussing the activities appearing in Figure 3. Such detail is however, not the aim of this paper; the aim is only to introduce the new concepts towards floodplain management that should be taken into account when the new national flood management policy for South Africa is formulated. When all aspects in Figure 3 are done in harmony with one another, floodplains will be sovereign. This will assure sustainability in floodplains and therefore permanently reduce flood damages.

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