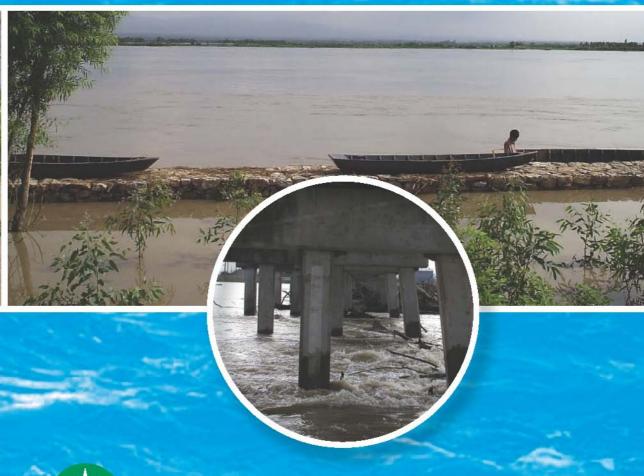
ICID POSITION PAPER ON THE MANAGEMENT OF RIVERINE FLOOD RISK

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Working Group on Comprehensive Approaches to Flood Management (WG-CAFM)





A Position Paper on the Management of Riverine Flood Risk¹

INTRODUCTION

Among natural catastrophes, flooding has claimed more lives than any other single natural hazard. In the decade from 1986 to 1995, flooding accounted for 31% of the global economic losses from natural catastrophes and 55% of the casualties. The damaging effects of flooding are likely to become more frequent, more prevalent and more serious in the future. The burgeoning population of our planet is leading to the increasing exposure of people and property to the hazards of flooding. This is also the case when developmental activities² extend due to population



pressures to areas of high risk. It may be expected that this will be further aggravated by the effects of climate change. At present, there are not sufficient and effective measures globally to limit the growing chance and consequence of flooding. The evidence is that flood risk is increasing and continuing vigilance is needed to ensure that existing systems are maintained and improvements introduced. Formal arrangements in this respect are

essential to counter complacency and forgetfulness.

It is imperative that human society adopts a risk management approach if there is to be harmonious co-existence with floods. In practical terms, the chance of flooding can never be eliminated entirely. However, the consequences of flooding can be mitigated by appropriate behaviours and actions. Both rural and urban communities are affected by flooding, as they are by water related issues generally.



¹ The credit for the main version goes to WG-CAFM, in particular to its Chairman Mr. Dick de Bruin and Mr. Peter Borrows (U.K); the version was circulated to National Committees before WWF 4 for taking an ICID position on the subject. Several useful comments were received. The amendments to the main text were done in Central Office in the light of the comments from National Committees.

² USCID comment

This serves to emphasise the need to manage flood risk in the context of both natural river basins and water management generally. It follows also that successful flood risk management is dependant upon the active support of all on whom the effects

of flooding may impact; those directly at risk, the civil authorities and the wider community and its leaders.

The effects of climate change are insidious and chronic and cannot be brought under control quickly, especially with the inadequate measures already agreed. Climate change and desertification should be considered globally as well as locally³. Specific floods can also be caused by ice accumulation/landslide in riverbeds and ice melting due to high temperature, breach of embankments, drainage congestion etc. ⁴



Immediate action is both possible and needed to begin to reduce the exposure and vulnerability to flood hazard (and drought) of people and property and, thereby, enhance food security. New, long term strategies that address the use of flood prone areas must include measures that are noticeably effective within at least one generation. Water management must be an essential consideration in spatial planning.

The management of flood risk from rivers in low lying areas in both urban and rural situations is specific to individual circumstances. In many flood prone urban areas, protection levels are well below an economically justifiable standard. In rural

areas the levels of risk accepted especially in respect of agricultural and pasture or other fields under horticulture and in barren lands adjoining settlements are relatively higher.

In some areas, flood risk from the sea will also need to be taken into account, but this is beyond the scope of this position paper. Similarly, flooding that results from the inadequacy of urban drainage, ice melting (climate change), and flash floods are also not dealt with. However, they are serious issues that require attention.



The issues are approached broadly under four general headings in this position paper: viz. planning, technical, operational and institutional.

³ UzNCID

⁴ UzNCID, PANCID and INCID

PLANNING

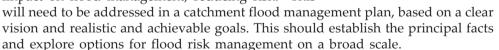
- * Spatial planning and land use must take all aspects of flood risk and water management into account
- * Flood risk management must be catchment based and needs related

The fundamental unit of a water management system is the river basin, a natural and clearly defined geographic feature. All too often, political boundaries are neither co-terminus with these borders nor with their catchment or sub-catchment components.

But at the highest level, natural features dictate policies and plans, with due adaptation to reflect political and administrative realities. A river basin management plan should seek to reconcile the management of all water issues – both of quantity and quality. This will need to consider both surface and ground waters, and their interaction and with both man-made and natural features amended by human settlement, agriculture and industry. Biodiversity and sustainability will require consideration as, of course, will socio-economic matters such as demography,

wealth, climate and climate trends. This information should serve to inform water resource planning, including both drought preparedness and flood risk management.

Flood management and risk control measures also have an impact on drought issues, which can be given attention by integrated planning. Proper irrigation (water supply) planning during droughts (especially use of low water demand crops) can have a positive impact on flood management, reducing risk. This



Flood risk management should be addressed in the context of the entire river basin and more particularly, flood risk should be addressed in the context of sustainability and the natural environment. Flood risk management should be related to water management. Management measures should command public support through appropriate consultation⁵. This should lead to policies that, can guide strategies of flood risk management and land use zoning on a more local scale. From these strategies, operational requirements, specific projects and associated funding needs can be formulated. Such plans and strategies will need to be revisited and reviewed at periodic intervals to take account of changed circumstances – physical, economic and demographic. There is an urgent need for (regular) maintenance, in particular when it comes to structures that are part of a



flood defence system. A distinction should be made in floodplain zones and flood prone zones. Socio-economic dynamics in a developing society can lead to a population explosion and economic investments in flood prone zones; this requires an official regular update of safety standards and linked measures⁵.

Note:

A river basin denotes the geographical area discharging to a particular estuary and may include more than one catchment. In very large river systems, it may be appropriate to distinguish between separate catchments of significant tributaries.

An important element of any flood risk management plan is the identification of risk. This can be accomplished at different levels: at catchment scale; at "district" scale

(which can be made to match political or administrative boundaries) and for

individual sites. Such risk assessments will need to consider not only the chance and consequence of floods, taking into account any existing protection measures, and also examining the consequences of failure or overtopping of defences. Inevitably, there will be uncertainties, but these should be clearly identified together with the assumptions made and risk management measures taken. The implementation of a reliable flood protection system requires time. There is a need for a consistent political support during the implementation period⁵.



The flood risk management measures needed to address both primary and residual risk should be outlined in general. Because defences do not provide absolute protection against flooding, it is essential that residual risk is considered. Where the consequences of a flood are unlikely to result in loss of life or significant economic loss, no action may be required. However, in densely populated urban areas or rural areas potentially exposed to deep or fast flowing floodwater, measures to protect life and mitigate damage to property will be required. These measures may include both structural and non-structural .

Non-structural approaches to flood management comprise those activities, which are planned to eliminate or mitigate adverse effects of flooding, and relate operational activities or responses at the time of flooding.

⁵ NETHCID, ICID.UK

Structural approaches to flood management – dams, levees, dikes, diversions, flood ways, etc., which provide some control of flood water by storage, containment or flow modification or diversion – may or may not be used conjunctively with non-structural approaches, but are not a prerequisite to the use of non-structural measures⁶.

Even where primary defences are provided, flood forecasting and warning arrangements are necessary. This is especially the case where temporary or secondary defences are used and require time for installation, and these will need to be augmented by formal emergency response arrangements. Planning in this respect will necessarily involve all the organisations with a role in rescue and recovery, including voluntary organisations where this is

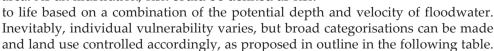


relevant. Regional cooperation in respect of shared rivers is helpful in facing the challenge⁷.

On the basis that 'prevention is better than cure', land use planning and regulation should be considered simultaneously given their vital role in flood risk management. Indeed, these should be the principal flood risk management tools. Since flooding is only a problem because of the occupation of naturally flood prone areas, it is axiomatic that to prevent flood risk developing or increasing, either there must be no further development of floodplains, or it must be so sited, constructed and serviced that not only are the lives of occupants not jeopardised, but also that they may continue with minimal disruption or interruption during inundation of the surrounding land. This implies a legislative framework that can be implemented

with confidence in its success. This is a fundamental requirement since the regulatory and operating authorities, if they are not one organisation, invariably will be managing aspects of flood risk as it affects land owned by third parties. Inspection and enforcement have central roles to play in ensuring that plans are implemented as intended.

It follows that flood plain zoning is one approach that can minimise the dangers to life and property, consistent with economic use of this valuable land area. As an illustration, risk could be defined as risk



⁶ INCID

⁷ BANCID

High risk	Danger for all	No development
	Danger for most	Daytime occupation only
Medium risk	Danger for some	No ground floor accommodation
		Flood resistant or resilient property
Low risk	No danger (but damage)	Flood resistant or
		resilient property
		No essential civil
		infrastructure
No risk	No danger	No restrictions

In agriculture also, land use must recognise the vulnerability to flooding and the potential impact on crops or livestock. There will be a need to accommodate requirements related to the natural environment, and this will not necessarily be to the detriment of productivity. Good husbandry can minimise soil erosion, a cause of channel sedimentation and related flooding, and an uncultivated buffer strip alongside rivers can serve the same purpose as well as limiting the run-off of chemicals and pollutants to the receiving watercourse. It may also serve as a recreational amenity and provide enhancement to the natural environment. Carefully managed flooding can increase the fertility of flood plains and replenish groundwater stocks as well.

Another consideration in planning is that of social disruption, either the passive effects of the inevitable disruption to people's lives or more violent reactions. Alongside this aspect is the need to educate, inform and influence those with a role to play in flood risk management, including the public. There is a need to build up resilience to hazards in a society. Policies must stress the need of people's participation. For the (regular) composition of (updated) risk maps, the experience of older generations in a society should be mobilized. A mass awareness programme is best undertaken in a structured way that is complementary to policies and avoids raising expectations or causing alarm. The use of maps that indicate the natural floodplain of rivers can help in this respect, provided that what they represent is made as clear as possible like some of the past events and the concerned spots, together with their limitations.

It is important to recognise the subtle distinction between flood plain and flood prone areas. Flood plains are natural features that represent the extent of floodwaters in an extreme meteorological event. They are, of course, flood prone

⁸ JNC-ICID

areas, but these latter may include also areas that could be affected by a blockage in a river, some other artificial interference with the natural processes or be reclaimed land.

In case flood prone zones are transformed into retention areas, by-pass systems, etc., loss of productive agricultural land requires specific compensation measures. For mitigation schemes, both structural and non-structural measures must be distinguished. The preservation of pervious surface areas as farmland should be considered to be well maintained places, in particular in urbanized areas. Green farmland can still exist in urbanized areas and provide urban residents space for relaxing, preventing fire from spreading and evacuating people during a hazard event⁹.



TECHNICAL ISSUES

- * Design should use recognised codes but be open to innovation
- * A consistent methodology should be used to justify expenditure
- * Management measures should seek to work with natural processes and respect the natural environment

Before measures to manage flood risk can be implemented, the nature and scale of the risk have to be identified through a systematic assessment. This will be based on knowledge of topography, geology, land use, hydrology and demography, together with an evaluation of the economic and social implications of floods of differing magnitudes. A pre-feasibility study that justifies the need to take action, will usually be followed by a full feasibility study that examines the options and recommends a course of action based on a consistent justification and prioritisation methodology that considers whole life costs and economic, environmental and social criteria. Central to the choice will be the standard of protection and the manner in which this is achieved. It is unlikely that the design standard will be maintained for the life of the structure without intervention. Even with maintenance, structural integrity can deteriorate and ambient conditions, be they catchment or climate related, will not be stable. For these reasons, the actual standard of protection should be reviewed at appropriate intervals related to local circumstances and any required action taken.

⁹ INC-ICID

Increasing use is made of modelling, usually computer based, to investigate scenarios and undertaking detailed design for implementation. Care is needed to ensure the input of representative data duly recognising the likelihood of an undue emphasis on precision in output may obscure inaccuracy. Nevertheless, complex analyses are now possible, allowing more sophisticated solutions to problems than has been possible previously. This underlines the importance of robust data collection, validation and archiving methods, supported by a well maintained instrumentation network in the field.

The costs, related to the collection of reliable information from residents on river issues (including environmental and polluting issues) should be able to at least balance the cost of installing expensive monitoring systems for early warning of floods. Preparing a collecting system (of necessary data) for maintaining or managing rivers from riverine residents is important. This system should collect data in normal periods and in case of an emergency, measures to collect and analyse data directly from residents may be useful ¹⁰.

As well as primary defences, non-structural approaches, such as dredging or flood warning may feature in the solution. Structures will need to be designed and constructed to recognised codes of practice or proven local methods, and may take the form of embankments, bypass channels or storage areas. In each case, both "hard" or more natural forms of construction may be appropriate and will need to work with natural processes as far as possible to achieve durability. Changes in circumstances will require a review of design, including the standard of



protection that defence measures provide. The use of design approaches and codes should not preclude innovation and this should be echoed in contractual arrangements, subject always to the need for probity, technical rigour and close supervision. Testing of new ideas through research and development is essential for the introduction of more efficient or effective flood risk management measures. Design must take into account safe operation and the health and safety of those who may come into contact with the defence measures.

The storage structures/dams built over the years may help in proper management of flood waters by reducing the flood losses and providing much needed water for irrigation, hydro-power, domestic and industrial purposes during the low flow season¹¹.

¹⁰ INC-ICID

¹¹ INC-ICID

Permanent guarding and monitoring of dams and key water regulators is necessary in view of the perturbing terrorist (man-made hazards) activity¹². Farmland may be viewed as a place for infiltration and storing rainfall¹³.

Another issue that should be taken into account at the design stage is water pollution. Damage from flooding is made worse by contamination with sewage. Hazardous materials and chemicals stored in flooded areas may affect water quality with the possibility of seriously contaminating agricultural land, damaging buildings and directly and/or indirectly impacting on human and animal health adversely. Pollution of water systems and the aquatic (environment) is a serious matter and disadvantageous for all uses and needs specific attention.

OPERATIONS

- * Budgets and plans must provide for life time operation and maintenance
- * Robust data collection and management is needed to support decision making
- * Supervision and enforcement are necessary to ensure that flood risk management measures are not compromised

Risk Management strategy requires that the disaster be defined first. An engineering document will refer to an average frequency of occurrence of 10 years, 20 years, 100 years and so on, as the criteria by which an event can be termed as a flood disaster according to the importance of flooded areas. With such a definition it would be possible to plan how to prevent and minimize the effect of such events¹⁴. Flood risk management should be viewed as a continuous activity.

Risk may be defined as product of hazard and vulnerability ¹⁵. The physical defences when employed to manage risk require regular attention to ensure that they perform as intended. It is essential, therefore, that both human and financial resources are sufficient for this purpose. Inspection, maintenance, repair and renewal of defences should be part of a scheduled programme based on an assessment of the consequences of failure. It is important to establish a benchmark for the condition of different types of defence, such as earth embankments, concrete revetments, brick structures etc. Consistency of approach is vital if funding is to be directed to where it will deliver the greatest value. In this respect, procedures are required to determine the point at which further repair or maintenance of a structure no longer represents the most efficient use of funds. Failure to inspect and maintain may lead to a local collapse of a defence and compromise both the

¹² UzNCID

¹³ JNC-ICID

¹⁴ INCID and INC-ICID

¹⁵ IRNCID

safety of those defended and the value of the investment in the remainder of the system of defences.

When discussing relief operations and evacuation related to floods, the logistics and experience relating to other hazards are also relevant, e.g. earthquakes, wild fires, droughts, etc. This holds particularly for power, food and medicine supplies¹⁶.

Rivers and watercourses also need regular inspection and attention. Erosion of the river bed or banks and shoaling will change their hydraulics and, in some circumstances, hydrological behaviour. This may impact on flood risk. It needs experienced personnel to recognise both the effect and the potential consequences. These staff will have a role to play during floods to ensure the integrity of defences and respond to any indication that defences may be breached or overtopped. In the case of established communities in flood risk areas, there may be a need to deploy secondary defence arrangements if the consequences of failure are sufficiently serious. Anti-river erosion measures form a part of these considerations¹⁷.

Some of the operational activities need to be combined with the regulation of third party activity within or close to the river. In general, any activity which is likely to interfere with the natural processes in either a river or its floodplain, should be discouraged or controlled through appropriate legal instruments. Infringements should be the subject of a formal notice that will lead either to voluntary removal of the cause of concern, or initiation of legal proceedings to do this.



Whether or not communities are protected to some degree by defences, a flood warning service provides a measure of security against the sudden or unexpected onset of flooding. Flood forecasting is a specialised activity dependant on current information on catchment state, weather and knowledge of the behaviour of the rivers. The interpretation of these data ideally requires a time series record in order to relate to past floods and from them predict impact. However, empirical methods combined with knowledge of hydrology can provide indicative forecasts. Where funding allows, a network of rain gauges and river level recorders with telemetry support should be established in order to improve the reliability, accuracy and timeliness of forecasts and associated warnings. A close relationship between meteorological services and river managers is an essential component of a good flood forecasting and warning system. Hydro-meteorological monitoring and forecasting is the corner stone of risk management¹⁸.

¹⁶ USCID

¹⁷ INCID

¹⁸ UzNCID

For adequate early warning in international river basins, data exchange is crucial. It must be reliable and accurate and for urgent and crucial basin wide matters such as flood control. A free exchange of data between organizations and countries (riparian states) given its value to mitigate distress to people is strongly recommended¹⁹.

Since the purpose of flood warnings is to avoid loss of life and minimise damage to property, it follows that warnings should be received by all those for whom they are intended and that they should take appropriate action. It is vital that those at risk understand the availability of the service, understand its operation and the actions expected of them, and act. This is likely to require collaboration between different organisations, based on clear accountabilities and good communications. This may also involve



cooperation of administrative units (provinces, states, etc.), in neighbouring countries, when basins are international ²⁰.

Consideration should be given to providing an indication of the confidence limits in the forecast and the extent and severity of flooding. Major floods are beyond the competence of individuals to cope and arrangements for institutional support are essential in these circumstances. For instance, evacuation plans will need to involve parties outside the flooded area, including voluntary organisations. In other words, emergency planning for the civil community must take account of flood risk. It must also recognise the different vulnerabilities, aspirations and behaviours of the various neighbourhoods at risk from floods.

Such arrangements not only reduce the impact of floods, but also hasten recovery and limit the economic impact of the flood. In this respect, it will be important to maintain awareness of flood risk, flood warning and management arrangements amongst all involved, including the civil authorities and the public, through publicity and campaigns. It is important that records are kept of any floods that occur, not only to strengthen databases and inform the response to future floods, but also to learn lessons to improve flood management generally.



¹⁹ PANCID

²⁰ INCID

INSTITUTIONAL MATTERS

- * Governance arrangements must be open with clear accountabilities
- * Human resources management must be organised to attract and retain personnel at all levels
- * Public support should be sought through an open dialogue supported by access to relevant information
- * Legislation must provide adequate powers and sanctions to allow effective flood risk management

Planning, delivery and continuing maintenance of flood risk management measures and actions are dependant on political support. This needs to be backed by legislation that makes clear the powers and responsibilities of all involved with flood risk management as well as those who may be affected by flooding or whose activities may cause or aggravate flooding. It is vital that the institutional arrangements for governance of the different aspects of flood risk management facilitate an open and informed dialogue between government at national and local levels, their supporting agencies and beneficiaries of the service.

National norms on safety and risk must be implemented at all levels. The authorities involved at these different levels have to communicate and cooperate among themselves on regular basis²¹. It is important that those at risk from flooding or for whom flood risk is a relevant issue, have access to the operating authorities and information. Governance arrangements and accountabilities should be clear and transparent and encourage effective and efficient services. These must include procurement based on recognised contractual arrangements that are not vulnerable to misuse by the offer of gifts, inducements or rewards. Audit measures should be implemented that provide assurance that financial matters are conducted with probity.

This applies not only to funding and the relationship between public and private finance, but also to financial arrangements that are in place to support recovery following a flood. Practices vary from country to country, with private insurance and government compensation playing differing roles. The balance between the two may relate to standards of protection and this may raise questions of social equity. All too often, the disadvantaged in society not only live in cheaper accommodation, possibly cheaper because of the flood risk, but also do not have the financial means to afford insurance if it is available. The result can be destitution and, if on a large scale, a significant and detrimental effect on a national economy.

²¹ NETHCID, ICID.UK

Prioritisation methods are needed that direct funding to greatest need and that use resources efficiently without environmental, social or generational detriment; that is, a sustainable approach. This presupposes a consistent approach to defining need based on an appreciation of risk. Care is needed to ensure that investment projects remain capable of performing as intended throughout their design lives, with adequate funding and technical support for maintenance and operational activities. Performance of all systems need to be monitored against meaningful targets that relate to the delivery of flood risk management services through planning, regulation, asset management, operations and maintenance. A sound legal basis is also needed wherein attention is given to adequate regulation, supervision and reliable enforcement. Adequate tuning of these two sectors mostly implies the need for a fundamental institutional reform in the public sector at all levels²². In some cases, reorganization is warranted given the new sets of imperatives. For example, in established systems, a change in the approach to governance is required.

The flood management services are dependant on the strength of the cadre as reflected by their skilled and experienced staff and management capacity.

Operating authorities must have suitable arrangements for capacity building, including a career structure and remuneration system that attract and retain the necessary human resources.

The development and achievement of basin wide and effective flood risk management is dependant on the authorities in charge recognizing that rivers are a natural feature and do not recognise national boundaries. In circumstances where more than one country has river management responsibilities,



agreements should be negotiated based on the principles that would apply in the case of a single administration.

International cooperation in dealing with environmental water crisis – forest and land degradation would be desirable in the long run. An international cooperation plan in the extension of the usage of advanced technologies available in the developed countries to developing countries and consistent implementation of Kyoto protocol is required to be undertaken on priority²³.

CONCLUSION

Flood risk will continue to increase unless there is a fresh approach to the occupation and use of, and investment in, flood prone areas, together with more effective measures to control the human impact on the global climate. Flood risk

²² NETHCID, ICID.UK

²³ INACID

management is an integral element of water management which itself is closely linked to land management and must be a consideration in spatial planning. The knowledge and tools exist to manage flood risk, but the most urgent need is to prevent the exposure of yet more people to the hazards of living in flood prone areas. Our knowledge and tools then need to be applied to reducing the vulnerability of those already at risk through reducing both the chance and consequence of flooding. Governments need to establish clear institutional, financial and social mechanisms and associated processes for flood risk management, in order to ensure the safety of people and property and, thereby, contribute to food security, poverty reduction and sustainable economic growth. Only then can there be harmonious co-existence with floods.