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No.1 Document Flood Security Strategy Analysis

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1 Introduction

This strategy analysis has been derived from short intensive knowledge exchange between the EU China River Basin Management Project (RBMP) and the Development Research Centre (DRC) of the Ministry of Water Resources (MWR). The analysis was prepared by a team flood risk management experts and strategists from Europe and China. It has allowed expertise from the EU to be applied to some of the flood security issues faced by China that will be addressed by the implementation of the China 2011 No.1 Document on Accelerating Water Conservancy Reform and Development (No.1 Document) and other Chinese policy documents. The strategy analysis summarises the emerging issues into a brief format suitable to promote discussion on future water policy, development and research. The aim is to ultimately increase flood security in China in response to a changing climate, a growing population and increasing urbanisation.

2 Key messages

Flood management has always been a priority in China's water management, as it is in some EU member states like France, the Netherlands, UK and central European nations like Hungary and Romania.

Based on comparisons between the EU and Chinese approaches a number of themes emerge that may increase flood security in China and allow the optimum benefit to be gained from the implementation of the No.1 Document.

The key messages are that **to increase flood security integrated river basin management accompanied by a revision of the flood standards by a broadening of their scope from hazard to proportionate risk management would bring the maximum benefit**. Following this strategy would enable a modernisation of approach and significantly improved protection for a modern and quickly developing China.

In Europe similar approaches have allowed informed decision making, optimisation of expenditure and enhanced protection from flooding. Work will be needed to adapt these concepts and to build on the excellent work on flood risk management already in place in China. Recently Europe has seen a broadening of the scope of flood control and protection from the mostly infrastructural approach favoured by engineers towards complementary non-infrastructure management measures. Decisions need to include assessments of vulnerability in terms of socio-economic hazards and risks, exposure and resilience to provide a more integrated approach, bringing a mix of structural, non-structural and managerial measures.

Enhancing flood security requires a long term vision and should be integrally linked to spatial planning for urban and regional development in both developing and developed areas. Flood risk management is a fundamental element of development planning and should be incorporated in the design of infrastructure projects at an early stage, taking into account the social and economic development opportunities increased flood protection can bring. Modelling can test future development scenarios and identify options that could optimise decisions on the phased implementation of the No.1 Document. Infrastructure development can be prioritised to meet approved or agreed standards, suitable for modern China.

3 EU Floods Directive

Both China and Europe aim at reducing the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods. To facilitate this, a management framework for the assessment and management of flood risks is required.

The European Union has put this in place through the development and adoption of the EU Floods Directive[1], which takes a risk based approach. This requires the EU Member States to develop three essential work areas:

1 Flood risk assessments to identify flood prone areas

2 Flood mapping comprising flood hazard maps

3 Flood risk maps.

These documents provide the necessary basis on which informed decision making can take place on the third subject: the flood risk management plans.

Flood risk assessments are based on readily available information and studies on long term hydro-meteorological developments, in particular impacts of climate change on the recurrence of floods. The assessments include maps of river basins and descriptions of past floods and their impact.

Flood hazard maps and flood risk maps will be produced for river basins at an appropriate scale. These maps will indicate flood probability and return period, flood extent, flood water level and water velocity. They will indicate the number of inhabitants potentially affected, an assessment of loss of economic assets, and an assessment of other potential adverse consequences of future floods.

Flood risk management plans should take into account all relevant aspects such as costs and benefits, flood extent and flood discharge routes and areas, which have the potential to retain flood water, such as natural floodplains or artificial retention basins. Environmental objectives, soil and water management, nature conservation, spatial planning land use and navigation and port infrastructure are also considered in the plans.

Stakeholder engagement is an integral part of integrated river basin management in Europe and is a mandatory requirement under the Directives. All assessments, maps and plans should be made available to the public.

[1] EU, Directive on the assessment and management of flood risks" (Directive 2007/60/EC)

4 Integrated River Basin Management

A key lesson from Europe is the continued development and application of Integrated River Basin Management. The No.1 Document signals the need to shift focus of flood control from the mainstreams to tributaries and sub-catchments. Flood control engineering in one place may bring security but may also enhance flood risks downstream. The need for Integrated River Basin Management is further strengthened by the shift from heightening dikes to giving more space to the river through widening the river bed or creation of retention areas upstream.

In the EU the development of river basin management plans under the Water Framework Directive, and of flood risk management plans under the Flood Directive, are both elements of integrated river basin management. The two processes should use the potential for synergies and benefits taking into account the Water Framework Directive objective to achieve good ecological and chemical status, and ensuring efficient and wise use of resources.

Both directives require the appointment of competent authorities in order to ensure clear lines of responsibility for implementation and reporting. EU Member States must coordinate their flood risk management practices in shared river basins, including neighbouring non-member states, and shall in solidarity not undertake measures that would increase the flood risk in neighbouring countries.

In China there is a long history of establishing a specific competent authority to deal with flooding. For the Yellow River this was set up two thousand years ago, a comparable authority for the Yangtze River was established in 1925 and since the 1970s, competent authorities to harness the other five major rivers have been established. These approaches are useful in building relationships between provinces and across international river boundaries. Integrated river basin management is only possible when taking the stakeholder approach seriously. In China progress on stakeholder engagement has been made in the past ten years after the adoption of the principles “putting people first” and a “scientific outlook on development”.

5 Triple layer safety approach

Modelling approaches are not confined to structural engineering, and integrated approaches to flood security emerge as the most effective way of reducing flood risk. Europe is further developing the 'Triple Layer Safety' approach proposed in the Netherlands.

The 'Triple Layer Safety' approach IS a new element of flood management. It is the systematic combination of three layers comprising 1) "prevention", followed by two layers to minimize potential adverse consequences through 2) "protection" provided by local measures and smart spatial planning, and 3) "preparedness", which relates to crisis management, evacuation and temporary flood protection measures, for instance enhancement of early warning systems and providing instructions to the public on what to do in the event of flooding.

Prevention will, as always, be the most important layer. Importantly, standards for flood prone areas will be renewed, looking to flood risks rather than flood probabilities.

The effective use of the second layer, especially through spatial planning, is limited by the extent to which development of new areas for housing and other activities are needed. In China these possibilities are large since it is expected that in the coming 20-30 years around 300 million people will move from the countryside to the cities, this being 20-25% of the total Chinese population. Pressure for development of land with good transportation potential will continue to be intense, particularly around cities and along the coast and rivers. In the short term, it will be financially attractive to allow industrial or residential development in floodplains or areas suited for flood retention. In the long run, however, it is much cheaper, both financially and socially, to avoid settlement in flood prone areas as much as possible. Examples are mentioned in DRC (2012).

Alternatively, it can be very efficient in economic, social and environmental terms to make more space for water. Such a broadening of the approach for flood risk management will result in the need for better cooperation, both horizontally (between ministries and departments) and vertically (between the various administrative layers: national, province, city, district,…). It strengthens the arguments for the stakeholder approach and integrated river basin management.

In general, the potential benefits of the third layer are small in comparison to the benefits of an efficient level of protection in the first layer, because it only mitigates the consequences of a flood. Even if the total population of a flooded area could have been evacuated, the material losses will be large. Therefore, measures in the third layer should never be used as an argument to lower the protection level beneath the level indicated by efficient standards.

However, as long as the suggested enhanced standards are not adopted, and/or flood defences are not in compliance with the standards, the more urgent and effective the non-structural and managerial measures in the third layer can and must be.

6 Making Space for Water – Creating Room for the River

Strong dikes are only one way of protection. Lowering water levels in the main rivers under extreme conditions by enlarging the discharge profile or increasing the upstream water storage can be an effective alternative.

Protection from floods by repeatedly increasing the heights of dikes has its limitations both from a technical and a spatial planning perspective. This is especially true for urban areas, where dikes are built close to the river's edge to create more space for urban development. Heightening dikes will require more land or special construction techniques. In addition the flood risk is increased in case of dike failure, as the damage caused by the devastating power released by the higher river water levels.

Increasing the stream profile by widening the river bed or the space between dikes is not yet common, but already widely practiced in the Netherlands in the "Room for the River Program". This is achieved even with the Netherlands being one of the most densely populated countries in the world. A small scale variant of this is to reconnect rivers to their flood plains and allow seasonal flooding wherever possible in order to harvest the benefits of floods. These solutions can be achieved, if flood risk management becomes a core element of spatial planning together with the creation of urban development opportunities.

Making space for rivers is also ongoing in China, especially after the large floods on the Yangtze River in 1998 (CPCCC & SC, 1998). The first major retention basin was built on the Jinjiang sector of the Yangtze River already in 1952 as supplement to the natural storage provided by the Dongting Lake upstream from Wuhan and the Poyang Lake upstream of Nanjing. Also the Yellow River has a major retention basin along its lower reaches. In Europe small retention basins can be found along the Rhine River in Germany and the Seine and Loire Rivers in France.

The concept of making space for water will become even more important in China as flood control shifts from structural to integrated options with more emphasis on the tributaries, as flagged in the No.1 Document. In many cases these tributaries pass through cities and towns. This will bring major challenges and opportunities. In these situations it will be even more important to link urban development with flood risk management through appropriate spatial planning with a long term view. In addition, use of innovative approaches, alternative technical solutions and soft engineering will be essential. Use of socio-economic cost benefit analysis, with a long term perspective in mind, will be needed to identify the most cost effective options.

7 Economic assessment models

Dedicated modelling methods for economic assessment of flood risk have been adopted to optimise and enhance flood security in the Netherlands. These models focus on expected loss (flood risk), not only the probability of flooding. This cost benefit approach to calculate efficient protection standards is described in RBMP Technical Report 072 Efficient Safety Standards for Ring-Dike Areas. In the long run, the derived standards are assessed as the most efficient ones, taking all costs of infrastructure improvements and all benefits of reduced flood hazard into account, irrespective whether these costs and benefits are financial or non-financial.

The fundamental recommendation is that recurrence intervals of efficient standards for flood risk management should be proportional to the potential loss by flooding. When the potential loss becomes larger, then the recurrence interval should be increased by the same factor. The national standards for flood control in China established in 1994 may have been the right standards for 1994, but they would certainly not be the right safety standards for 2012. It is possible to illustrate this statement with some statistical figures. Between 1994 and 2011 real GDP has grown by a factor of 5.3. All other things being equal, the recurrence intervals given in the 1994 standards should by 2011 have been increased by factors ranging between 3 for low density rural areas to 9 for big cities. Also on average, the losses by flooding in China are a relatively high percentage of GDP (DRC, 2012). This also indicates that the standards are too low compared to current wealth at risk. As in the Netherlands, the standards are outdated and need revision.

Moreover, it has to be taken into account that an industrial society is less resilient to flooding than a rural society. The flooding in Thailand in 2011 is a recent example. The flood water was not excessively deep, but completely incapacitated a large part of Thailand's industry for many months, and in some cases for more than a year. The linkages between industrial facilities all around the world are critically important and a breakdown in one location seriously affects other locations up and downstream in the production chain. Also in China the increasing vulnerability of cities and the steady increase in the amount of losses per flood is realised (DRC, 2012).

The approach proposed in RBMP Technical Report 072 "Efficient Safety Standards for Ring-Dike Areas" provides a very different perspective to the flood safety standards currently in use in China, which have been in place since 1994. Since then the vulnerable assets in China have increased considerably and therefore the standards are in urgent need of review. This is further emphasised by the increasing risks from a changing climate, the increasing population and the continued migration into cities. An adaptation of this methodology would bring great benefits and would provide an opportunity to review flood security standards in a progressive way.

8 Flood engineering project appraisal

Through the No.1 Document, China is committed to significant expenditure on improving flood security and budgets have been increased. A large number of engineering projects will be brought forward for funding and construction. It will be important to assess the cost effectiveness of these engineering projects against a set of agreed national criteria and thus allow a ranking in order of priority.

The cost benefit approach outlined above can also be used for project prioritisation and optimisation of projects included in the No.1 Document implementation. Before projects are given the go-ahead they should clearly meet the required and agreed levels of protection. These should meet a set of recalculated efficient protection standards or show clearly how these could be achieved in a phased way. Adaptive water management scenarios and flexible engineering solutions can help to deal with the uncertainties of climate change. In this way the requirements of the No.1 Document can be achieved in the most cost effective way.

UK has an agreed system of approval for national flood risk programmes and projects to achieve the standards and levels of protection agreed by government. The Environment Agency lists and prioritises according to agreed principles and the Minister is invited to make a decision based on available budget.

Such a procedure will ensure that the most effective schemes go forward and the outcomes of the No.1 Document are realised. A development of the proposed financial modelling approaches would allow objective project appraisal to be undertaken and assessed against a broader flood risk management approach.

Setting flood protection levels in terms of probability of flooding or in financial terms within the national budget will, eventually, always be a political decision to be taken within the context of the entirety of priorities set by the government, this being Chinese or European.

9 Recommended research and development

The following work areas have been identified for future development and research. Only the most important recommendations are listed. A more comprehensive list may be found in RBMP Technical Report 090 “Potential Development and Research arising from No.1 Document Strategic Knowledge Exchange”. Mechanisms for collaboration and funding may be developed under the China Europe Water Platform (www.cewp.org).

- Short-term action
  - Further development and calibration of the Benefit/Cost analysis model to calculate the most efficient flood safety standards for flood prone areas
  - Evaluation of the Triple Layer Safety approach for China
  - Screening and appraisal of flood projects for the implementation of No1 Document
  - Catchment Flood Management approaches
  - Future Scenario Development – Changing Climate

- Medium-term action
  - Flood risk mapping combining aerial data and hydrological models
  - Publishing Flood Maps
  - Stakeholder engagement methods for China

- Research
  - Development of new flood models
  - Improved integration of increased urban development and flood risks in major cities
  - Urban Drainage Models – Sustainable Urban Drainage
  - Development and application of climate change scenarios for China.

10 References

CPCCC & SC, 1998. Opinions on post great-flood reconstruction, harnessing the rivers and lakes, and water infrastructure construction (ZF[1998]15), CPC Central Committee and the State Council, 20 October 20 1998.

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