Report on the Ramsar Advisory Mission (# 431) to the Indus Dolphin River Ramsar Site and associated floodplains

29 October – 5 November, 2012

CONTENT

Summary

After Pakistan suffered one of its most disastrous floods in 2010, the Ministry of Climate Change requested the Secretariat of the Ramsar Convention on Wetlands to organize an expert team under the Convention's Ramsar Advisory Mission (RAM) mechanism, to visit the wetlands along the Indus River floodplains and to a), devise a workable and cost effective strategy for wise-use of the floods b), to make recommendations for alteration in the prevailing flood control strategy so as to obtain maximum benefit from the flood water and c), identify high priority wetlands/Ramsar Sites for restoration by using the floods as a tool for restoration.

The Mission was composed of a team of four international and national wetland experts and was conducted from 29th October to 5th November 2012. Some 10 meetings were held with various government agencies and visits were made to a number of sites along the Indus River floodplains, particularly Lal Suhanra National Park, as well as Guddu and Sukkur Barrages.

The visit highlighted the fact that the Indus River is truly the lifeblood for Pakistan, flowing through the country to provide water and nutrients for agriculture, as well as food, energy and livelihood for people across the country, form the high mountains to the Arabian Sea. However, there is a lack of an integrated basin approach to the management of the river to maintain the many services and benefits that the river provides for people and the environment. Instead, management is conducted by various agencies, both national and provincial, with insufficient coordination between them, such as managing the river to minimize the impact from the annual floods.

The overall recommendations from the RAM are as follows:

- *A broad-based coordinating authority should be established for the sustainable management of the Indus River Basin in Pakistan and its resources, e.g. water, fisheries, biodiversity, as well as for pollution control and flood management;*
- *The coordinating body should be tasked with drafting and regularly updating an 'Integrated Indus River Basin Plan' to coordinate up-stream land-uses with the needs of down-stream users, which can also maintain the social, economic and environmental benefits that the river provides through maintaining environmental flows;*
- *The government should move away from the paradigm of solely using a hard-engineering (or structural) approach to controlling flood and which have been found around the world to not always being effective despite investing millions in constructing flood control structures;*
- *Instead, the government should take an integrated approach to flood management and consider including soft-engineering (non-structural) approaches, such as by managing floodplains and using, or restoring the lakes and ponds for flood water storage, and the replanting of riverine forests to slow the speed of the flood waters. There is a need to to take the traditional approach of looking at the annual floods as blessings and to maximise the benefits we can obtain from them.*
- *Over the past decades, the construction of upstream dams and other water control structures have reduced the amount of freshwater and silt reaching the Arabian Sea. This has had a range of impacts on the livelihood of the people and the environment in the Indus River delta. In managing the Indus River, such as for irrigation and for floods, we also need to ensure the*

environmental flows in the river so that downstream users can continue to benefit from the services that the river provides.

- *A number of sites along the Indus River were identified as being suitable for further investigation for conducting pilot projects on the restoration and management of floodplains for flood management as well as for the improving the livelihood of the local communities. These sites include the ponds by Taunsa Barrage Ramsar Site, as well as sites in the Indus Dolphin Ramsar Site and at Lal Suhanra National Park;*
- *The management plans that are being developed for the Ramsar Sites along the Indus River floodplain, e.g. Taunsa Barrage, should also discuss and provide recommendations on the management of the site for flood management;*
- *Activities under the pilot project would include the removal of illegal structures and encroachments into the sites which otherwise would obstruct the flow of water and impact on the capacity of the site to hold flood water;*
- *To control encroachment of the flood plains by illegal settlements and illegal structures in general, the staff of the Irrigation Department should be empowered and strengthened by facilitating them to enforce the Canal and Drainage Act (1873);*
- *The trial of alternative livelihood methods which are adapted to the annual floods for the benefit of the local communities; restoration and management of ponds and lakes for flood water storage; develop opportunities for biodiversity conservation (e.g. restoration of riverine forests and provisions of habitat for waterbirds) as well as for education and public awareness;*
- *Along with managing the flood plains there is an urgent need to manage the hill torrents that contribute to enhancing the vulnerability in the flood plains;*
- *To follow-up from the RAM, it is recommended that a group of key officials and stakeholders responsible for flood management in Pakistan as well as being involved in the pilot projects, undertake a study tour to China to see at first-hand the steps that China has taken to use an integrated approach to flood management and restoring environment flows in the Yangtze and Yellow Rivers.*

Abbreviations and Glossary

Ecosystem services: The benefits that humankind receive from the wide range of resources and processes supplied by ecosystems. This includes resources such as clean drinking water and processes such as the flood water control.

Environmental flows: This is the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems, and the human livelihoods and well being that depend on these ecosystems.

FFC: Federal Flood Commission

Floodplain: This is an area of land adjacent to a stream or river that is flooded during periods of high discharge.

IRSA: Indus River System Authority

Integrated Water Resource Management: This is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

NDMA: National Disaster Management Authority

PMO: Pakistan Meteorological Office

Polder: A low-lying area of land enclosed by dikes that has no connection with outside water other than through water controlled devices. Polders can include a), land reclaimed from a lake or sea bed b), an area of separated from a flood plains or marsh by a dike.

PDMA: Provincial Disaster Management Authority

RAM: Ramsar Advisory Mission

Ramsar Convention on Wetlands: The Convention on Wetlands of International Importance, also called the 'Ramsar Convention', is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Water scarcity: Where water is available but not sufficient.

Water stress: Where the demand for water exceeds availability.

Report of Ramsar Advisory Mission to the Indus River, Pakistan

29 October to 5 November 2012

1. Background

1.1 The Indus River

The Indus River lies within one of the major river basins of the world, with a total drainage area of over 1,165,000 km^2, a length of some 3,180 km and covering four countries, Afghanistan, China, India and Pakistan. It begins in the Tibetan plateau close to Lake Mansarovar, before flowing northwest to the Ladakh region, Gilgit and Baltistan, and then turning southwards along the entire length of Pakistan to enter the Arabian Sea (Fig. 1). In Pakistan, the Indus River Basin covers about 75% of the land area and supports some 95% of the population (Akhtar 2011).

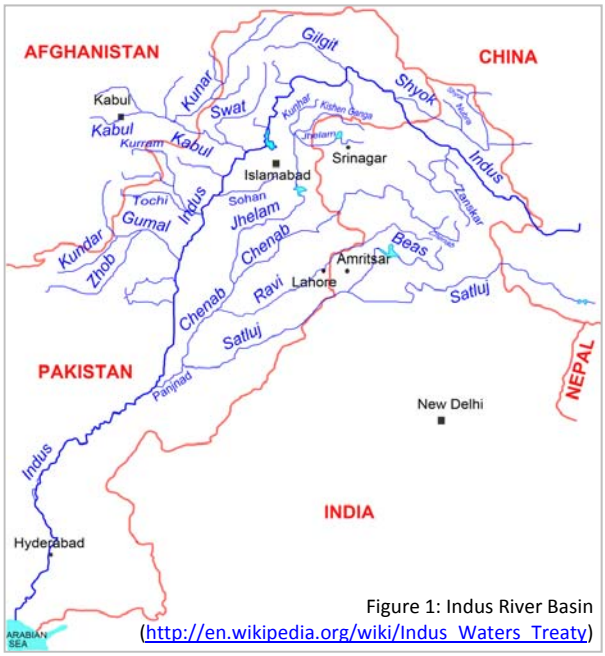

Figure 1: Indus River Basin (http://en.wikipedia.org/wiki/Indus_Waters_Treaty)

The river has an annual flow of about 272 billion cubic yards (207 billion cubic metres). Some of this water comes from the melting of the snows and glaciers in the high mountains of the Himalayas, Karakoram and the Hindu Kush but the main contribution is from the summer monsoon rains. The rains fall from July to September in the upper reaches of the basin in Pakistan and causes peak flows in the river to occur at that time.

The Indus River is the 'lifeblood' for Pakistan's population of nearly 180 million people, as well as being critical for maintaining a healthy environment. Communities from the remote mountain areas to the fertile plains and the urbanized delta areas, are all dependent on the river in one way or another, e.g. for providing food, water for irrigation, hydropower, industry, transport and household use.

In order to harness the waters of the Indus River for all of these uses, an intricate network of dams, barrages, ponds and irrigation canals have been constructed by people from the earliest civilizations to the modern day (FAO undated). Today, some 70% of the water from the Indus River is used for irrigation. There are three major storage reservoirs, 19 barrages and 43 major canals with a total length of 57,000 km which together, form one of the most intricate irrigation systems in the world and provides water for 80% (162,000 km^2) of the country's agricultural lands (Inam *et al*. 2007).

1.2 Management of the Indus River and its resources

In many countries with important rivers that supply much of the water for irrigation, industry and urban uses as well as for sustaining the environment, they have developed river basin authorities to be responsible for coordinating the management of the river and its resources. One example is the Murray-Darling Basin Authority in Australia that is responsible for planning the integrated management of the water resources of the Murray–Darling Basin (http://www.mdba.gov.au/about).

Within Pakistan however, there is no one single government agency with responsibility for coordinating the management of the Indus River. Instead, there are a number of agencies each with their own role such as:

- Indus River System Authority:
- Provincial Irrigation Department:
- Federal Flood Commission;
- National, and Provincial Disaster Management Authority;
- Environmental Protection Agency;
- Provincial Fisheries Department;
- Water and Power Development Authority.

Of these, the Indus River System Authority is the only one with any kind of coordinating responsibility between the provinces but then, that responsibility is just for allocating the available water from the Indus River between Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan under the 1991 Water Apportionment Accord.

1.3 Flood disaster management in Pakistan

Flood disaster management in Pakistan is under the responsibility of a number of different agencies. The Federal Flood Commission (FFC) prepares integrated national flood protection plans for the country and reviews the design and specification of flood works. The monitoring and forecasting of floods is under the Federal Flood Forecasting Division of the Pakistan Meteorological Office (PMO), who provides early warning data to the National Disaster Management Authority (NDMA) who in turn, will inform the provincial (PDMA) and district authorities to take action if necessary. The NDMA works with communities to reduce their risks and vulnerabilities from all disasters, including floods, and to respond to and carry out recover work after any disaster events.

These agencies coordinate their work closely at the onset and during the summer monsoon season to reduce the impact from any possible flood event. During that time, each province will have a flood warning centre with staff from PMO, FFC and PDMA to monitor rainfall and the risk of floods, and to coordinate any necessary response to sudden changes in the situation.

1.4 Rainfall patterns in Pakistan

Some 65% of the rain usually falls during the summer monsoon season from June – August (*kharif* season), with another 25% falling in winter (*rabi* season) and the remaining 10% at other times of the year. Historically, the country has been prone to extreme weather events and disasters and from the 1980's-1990's period, the summer monsoon which used to peak in August, began to shift and to peak in July

instead. The frequency of rainfall has been decreasing and when rain does fall, it does so at a very high intensity and over a short time. The summer monsoon zone where the rain falls is also shifting, from the north-east to the north-west by approximately 80-100km over the past 30 years. As a result, there is now a higher risk of flash floods in the western hills and river (i.e. Indus) as compared to that in the eastern river (i.e. Chenab and Jhelum) where the rains used to fall. These western areas, e.g. Khyber Pukhtoonkhwa (KPK), SE Punjab and central Sindh, therefore require more support for water management and for flood mitigation.

The problem with the erratic rainfall and increased flooding is that over the coming two to three decades, it is predicted that the increasing temperatures due to climate change will lead to faster melting of the Himalayan glaciers which in turn, will further increase flood risk and affect water resources (IPCC 2007).

At the same time however, there has also been an increase in the incidence of drought in Pakistan due to the reduced annual frequency in rainfall and the change in the distribution of the rain that does fall. This has led to decreased water availability and water quality in many arid and semi-arid regions. All of these changes have been attributed to the impact from global climate change.

Both floods and drought have a heavy impact on the health of the local communities particularly due to diarrhoea from poor quality water. In future, it can be expected that the incidences of illness and mortality will rise from the erratic and extreme weather events. A decrease in water availability will also mean that hydropower as a source of energy will become less reliable and it has been estimated that agricultural crop production in South Asia could decrease by up to 30% (JFIT 2010).

1.5 Floods along the Indus River

During the summer monsoon season each year, river floods of varying severity are common along the Indus River. There are two main hydro-climatic factors which affect the intensity of these floods. The first is snow melt from the mountains in northern Pakistan during winter which starts in March-April and reaches its maximum in July. The second, and more important factor, is the occurrence of south-west monsoon rain during the summer season (Akhtar 2011).

Historically, the annual floods along the Indus River have been looked upon by the communities living along the floodplains by the river as a blessing in bringing much needed water and nutrient rich sediment for the farmland. People were said to have adapted their way of life so that they were prepared for the annual floods and so it was possible to minimize the damage (Weil 2006). Over time however and in particular from the 18th century onwards, new hard-engineering ('structural') approaches were brought in to 'control' the floods, such as by constructing embankments to restrict the flood water flow and which would free up the land behind the embankment for the development of farming, industry and urban uses.

1.6 2010 Floods

Due to the impacts of La Niña weather patterns in the summer of 2010, unusually heavy rains some five times higher than normal fell in the upper parts of the Indus River catchment in two waves. The first was from the evening of 28th July through the whole day of 29th July. The second wave was from 6th to 9th August. The rain that fell has been ranked the second highest in the past 50 years and caused hill torrents in the

mountain areas as well as river floods in the plains (JFIT 2010). The peak flood that was recorded at Taunsa Barrage (1,085,000 cusec on 2 Aug 2010) corresponded to a 1 in 500 years flood event (JFIT 2010).

The damage the floods caused between 29th July and 26th August was one of the worst in Pakistan's history. Four provinces were affected, the Khyber Pakhtunkhwa (NWFP), Punjab, Balochistan and Sindh. It was estimated that about 5,000 people were killed or injured and some 20 million people were directly affected by water-borne diseases, lack of food, drinking water and shelter. Around 100,000 km^2 of land, including croplands was inundated and the economic cost was calculated to have been around USD 10 billion.

Apart from the heavy rainfall, a number of reasons were identified for the severity of the 2010 floods. One of these was the breaches in the barrages and embankments along the Indus River due to poor governance and mismanagement (JFIT 2010). Blame was also placed on the presence of illegal structures (e.g. bunds) and human encroachment into the floodplain alongside (medium sized) river channels as they constricted the flow of the flood waters. Although there is a Canal and Drainage Act (1873) that allows the government to clear illegal structures if they obstruct the flow of water, enforcement of the Act is weak. The people living illegally in the floodplains were reported to be difficult to remove because of the support they received from politicians who depend upon these people for their votes. Staff of the Irrigation Department suggested that a possible solution to this would be for them to regain their powers to control illegal structures, disturbances and breakage of the bunds, as well to have closer cooperation between the Forestry, Irrigation and other Department to control illegal activities as they used to have before. It was also reported to the RAM team that there were also problems with officially built structures such as bridges, e.g. that over the Indus River connecting Larkana and Khairpur restricts the flow of the flood water.

1.7 Background to the Ramsar Advisory Mission

1.7.1 The Ramsar Convention on Wetlands in Pakistan:

Pakistan was one of the earliest countries (12th) to accede to the Ramsar Convention on Wetlands, with the Convention coming into force in the country in November 1976. Since that time, the country has placed 19 wetlands sites onto the List of Wetlands of International Importance with four of these being located in the floodplains of the Indus Rive. These are Chashma Barrage, Taunsa Barrage, Indus Dolphin Reserve, and the Indus Delta Ramsar Sites. The Ramsar Administrative Authority in Pakistan is the Ministry of Climate Change.

1.7.2 Ramsar Advisory Mission (RAM):

In March 2011, Mr. Syed Mahmood Nasir (Inspector General Forest, Government of Pakistan) met with Mr. Anada Tiéga (Secretary-General, Ramsar Convention Secretariat) and began discussions on undertaking a Ramsar Advisory Mission (RAM) to Pakistan to suggest an economically viable, socially acceptable and ecologically sound strategy to manage the floodplains of the Indus River to minimize the risk of such devastating flood in future. The strategy would be based on successful strategies for reducing the threat of floods that have been used for the Yangtze River Basin, and other river basins around the world.

1.7.3 Objectives of the RAM:

The Objectives of the RAM were:

1. To devise a workable and cost effective strategy for wise-use of the floods;

2. To make recommendations for alteration in the prevailing flood control strategy so as to obtain maximum benefit from the flood water;
3. Identification of high priority wetlands/Ramsar Sites for restoration by using the floods as a tool for restoration.

1.7.4 RAM Team:

A RAM Team was established, composed of specialists in different aspects of wetland wise use and conservation, the management and restoration of wetlands, and the use of floodplain wetlands for mitigating the impacts from severe floods. The team members were Inam Ullah Khan (IUCN-Pakistan), Chen Zhang (Chinese Academy of Science, China), Xinqiao Zhang (WWF China Programme Office), and Lew Young (Secretariat, Ramsar Convention on Wetlands). During the Mission, the team was accompanied by representatives from different government agencies, such as the Ministry of Climate Change, as well as by representatives from WWF Pakistan. The itinerary and logistics for the mission was organized by both WWF Pakistan and the Ministry of Climate Change.

1.7.5 Itinerary:

The Mission was conducted over an eight day period, from 29 October to 5 November 2012. The full itinerary is provided in Appendix 1. During the course of the mission, the team held 10 meetings with a range of key stakeholders, including representatives from the Federal Flood Commission (FFC), Ministry of Climate Change (MoCC), both National and Provincial Disaster Management Authorities, Pakistan Meteorological Department (PMD), provincial Irrigation, Fisheries, Forest and Wildlife Departments, Water and Power Development Authority (WAPDA), IUCN and WWF Pakistan (Appendix 2 – 10).

1.7.6 Comments:

The objectives of the RAM were very broad and to cover the three topics adequately would require more time and resources than was available. Furthermore, there have been many reviews of the causes of the 2010 floods and recommendations made for alleviating similar floods in future. One such example is the very thorough report by the Judicial Flood Inquiry Tribunal in Punjab (2010). As a result, the discussions in this report will be based principally on the information that was collected during the RAM, from available references, and from the experience of the RAM team.

2. Floodplains in flood risk management

2.1 Floodplains and their value

A 'floodplain' is a flat or nearly flat area of land adjacent to a river or stream which floods when the water level rises during times of high discharge, such as after heavy rains. Floodplains provide a range of valuable ecosystem services, especially in flood risk reduction by helping to store the excess flood water and to slowly release it back into the river system and into the groundwater aquifers. This has the effect of reducing the peak height and speed of the flood discharge, so reducing the damage that may be caused downstream. Floodplains also act as spawning and rearing ground for many river fish species during the times of flood and

as the high water recedes. The flood waters also bring nutrient rich sediment which covers the flooded ground so making it particularly fertile for agriculture after the waters recede.

The conservation and restoration of wetlands play an important role in reducing the losses from floods. A study in the United States has shown that the cost of restoring the flood control function of 2,000 hectares of wetlands that are drained each year in the State of Minnesota would cost $1.5 million, as compared to the potentially millions of dollars that would otherwise be lost to flooding (EPA 2006).

A study of the economic value of floodplains in Washington State (USA) was also conducted and showed that the value for flood and storm water control alone could be as high as USD126,000 per hectare. However, this figure does not include the value of the many other services and benefits that floodplains provide for people, such as in providing food and water purifications. If those services were included, then the overall value of the floodplain would have been higher. The study also explained that the value of the services that a wetland provides would increase as the neighboring wetlands are lost, e.g. to development, or whose functions are impaired, e.g. due to pollution or over-use (Leschine *et al*. 1997).

2.2 Management of floodplains

Many ancient civilizations have developed alongside floodplains with their nutrient rich soils. The earliest people that lived along the Indus River were no exception. They developed the traditional *sailaba* cultivation system (Lamadrid 2010) to make use of the water and fertile silt that the annual floods would bring. There were also *katcha* areas some 5 to 25 kilometers alongside the Indus River which would flood each year and which were free of encroachment and habitation (JFIT 2010).

Historically, the communities living in the plains close to the Indus River adapted their lifestyle to avoid the damages from the annual floods by not constructing permanent settlements in the floodplain areas, and by having an effective communication network with those people living in the mountains who would provide early warning of impending floods (Weil 2006). However, the arrival of the British in the 18th century brought the concept of using a hard- (structural) engineering approach for control floods, such as through the construction of dams and embankments, rather than to live with and adapt to the flooding conditions. The use of embankments would also free up the land behind for agricultural, industrial and urban development as well as settlement and population growth. However, this would also mean that if the embankments were to be breached during unusually heavy floods, then the damage would be more severe to life and property.

Today, many countries have recognized that despite spending large amounts of money on such hard-engineering approaches to flood control, structures such as embankments may still fail to prevent the tremendous damage caused by floods waters and in fact, may make the situation worse. Apart from the impact on the population behind the breached embankment, restricting the flood waters to within embankments also caused the peak height velocity and height of the flood waters to increase in the narrower space and be propelled downstream at a greater force where it will inevitably cause more damage.

Experiences in the past decades have repeatedly shown just how ineffective embankments can be despite being constructed at high cost. For example in China, some US$ 20 billion was spent on flood control in 1996 but it still was not able to stop the devastating floods along the Yangtze River in 1996, 1998 and 1999 that caused damage estimated at US$ 25 billion (Section 3).

Hard-engineering approaches to flood management have not always succeeded in reducing the risk of flooding and in addition, they have also compromised the important ecosystem services that the natural floodplains provide. As a result, countries have begun looking at alternative solutions to reducing the damage from floods such as by taking an integrated approach to flood risk management, including the restoration and conservation of floodplains in a way that would also optimise the range of other benefits associated with these important wetland systems, and adapting to the annual floods rather than to control them. These ecosystem services provided by floodplains are often poorly considered in decision-making resulting in missed opportunities to deliver on multi-functional flood management solutions which can benefit a multitude of stakeholders (ADPC 2005; WMO 2009).

Examples of where countries have begun taking this integrated approach to flood risk management includes the restoration and management of floodplains, e.g. in China (Section 3), Switzerland (SAEFL/FOWG 2003) and the European Union (Blackwell and Maltby 2006; European Commission 2012).

In Pakistan, no plans have yet been developed to integrate ecological non-structural flood protection means, e.g. forests, swamps and floodplains, into a larger flood management plan (JFIT 2010).

3. Lessons learnt from floodplain management along the Yangtze Rivers, P.R. China

3.1 The Yangtze River

The Yangtze River with the total length of over 6,300 km is the longest river in China, originating from the Galadandong Mountains on the Tibetan Plateau and flowing into the East China Sea. Its head water is distributed over a vast area of high plateau wetland and lakes. The upper reach of the river is characterized by forests and charismatic threatened species such as the Giant Panda *Ailuropoda melanoleuca*. The Yangtze basin was identified by WWF as one of their 35 priority protection eco-regions, and is dotted with large lakes, and extensive wetlands with a rich biodiversity, e.g. the Yangtze River Dolphin *Lipotes vexillifer*, wintering waterbirds etc. The Yangtze River Estuary is also one of the biggest and most economically developed areas in the world.

The Yangtze River Basin covers 1.8 million km^2 and 19 provinces (municipalities, or autonomous regions), accounting for about 1/5 of China's territory, feeding 1/3 of the nation's population with grain production, and has a GDP accounting for 1/3 of the nation's totals. The Yangtze River Economic Belt has nowadays become the most vigorous and promising economic belt in China. The Yangtze River Basin also provides 36.5% of China freshwater resources, 52.5% of China's total mileage of inland navigation waterways, making it China's "Golden Waterway" linking the eastern, central and western parts of the country.

Location of the central floodplains wetlands downstream of Three Gorges Dam on the Yangtze River, China (WWF UK 2008, from Pittock and Xu 2010)

3.2 Floods in the Yangtze River

The Yangtze River is prone to regular floods and the ones in 1870, 1931, 1954 and 1998, have been particularly devastating. The most frequently-flooded area in the whole Yangtze River Basin is the Central and partial Lower Yangtze region which includes Hubei, Hunan, Jiangxi and Anhui Provinces. This is a low-lying region that is dotted by lakes, marshes, and meandering streams and cover 680,000 km^2 with a present population of over 230 million. As the population in this region increased over the centuries, various efforts were made to control the annual floods. One of the first of these was the Great Jinjiang Levee, completed in 1548.

Since 1950, 38 floods of different level have occurred in Dongting Lake (one of the two biggest lakes in the Central Yangtze River Basin with area of 2700 km^2 in high water season), averagely once every 1.5 years. However, large flood disasters are not only increasing in frequency but also in severity. They would occur once every 5 years from 1950's to 1970's, once every 3 to 4 years in the 1980's, and much more frequently since 1990's, with flood waters exceeding the flood control water level of the Yangtze River four times in the area during the 5 year period from 1995 to 1999. There was great loss each time due to the lack of a comprehensive anti-flood policy in the Lake area. For example, the economic loss caused by the floods in 1996 and 1998 were up to RMB 30.3 billion (approx. USD 4.9 billion) and RMB 19.7 billion (approx. USD 3.2 billion) respectively. Although the secondary-phase of flood control reinforcement in Dongting Lake commenced in 1996, the flood loss was still more serious.

Furthermore, the pressures from ever increasing economic developments and human population in the region, particularly in the past few decades, are leading to rampant deforestation, over-exploitation of nature resources in the upper reaches of the Yangtze River, and drastically shrinking of lakes and wetlands in central and lower reaches, seriously threatening the ecological integrity of the basin. Both flood risk and

escalating degradation of nature ecosystem have become pressing national issue with far reaching environmental and socio-economic consequences.

3.3 Floods in the 1990's

Rapid population growth and improper government policy during the 1940s to mid-1990s caused vast areas of the Central Yangtze floodplains and lakes to be drained and reclaimed to create new agricultural land. Dongting Lake, formerly China's largest, lost over 60% of its surface area and more than one thousand lakes disappeared altogether. Over the years, dikes were successively raised to protect the new agricultural land from flooding, cutting off thousands of floodplain lakes from the annual floods. These engineering works (costing USD 20 billion in 1996 alone) reduced the flood retention capacity of the river, and caused the river channels to rise above the surrounding agricultural lands. When those dikes were breached in the floods of 1996, 1998 and 1999, the losses of life and property were catastrophic.

In 1998, widespread unprecedented rainstorms occurred during June and July in the Central Yangtze Basin, causing severe flooding. In Hubei, Hunan and Jiangxi Provinces, rivers and lakes were rapidly filled. Torrential floods in the hilly regions, coupled with mudslides, caused devastating damages to villages along the rivers and killed many people. Flooding of lake and poldered areas was further aggravated by the upstream floodwater that arrived during August and early September. Consequently, vast areas behind the Yangtze River dikes were inundated for almost three months due to back flow of the Yangtze flood.

The 1998-floodwater levels recorded in the Yangtze exceeded the 1954 levels, the highest recorded in the 20th century. In Hubei, Hunan and Jiangxi Provinces, the flood affected some 79.6 million people, of whom 10.2 million were evacuated to safety, and 1,384 people lost their lives. After a long time, some 21.1 million people were still homeless and staying in temporary shelters. The total direct economic losses estimated for these three provinces were about USD$6.6, USD$4.0 and US$4.6 billion respectively, not including the enormous cost of flood evacuation, flood fighting and relief.

3.4 Lessons learnt from the 1998 Yangtze flood

3.4.1 Policy and Management: Learning from international experience

At the end of the 1980s, China stopped reclamation of natural wetlands. However until 1998, the floods caused many problems, such as loss of wetland function due to fragmentation and degradation in the flood plain and river systems; increased frequency and severity of flood disasters; and upstream erosion caused accelerated downstream siltation. Many of these problems were caused by there being a lack of awareness about the values and functions of wetlands; improper policies in dealing with floods and the natural environment; and institutional conflicts in the management of the flood plain and rivers. As a result, people began thinking about questions:

- What are the reasons for the 1998 floods having a heavier impact than that of 1954?
- Is it cost effective every year to use engineering input to protect the limited farmland in the flooded area?
- Is the use of dikes and dams the only way to fight floods?
- Did we take too much land from fluvial plains and rivers and did we leave enough space for flood?
- Are there other ways that people can live with floods in the flooded areas?
- Did we have the right way to protect our water resources?

- Did we fully involve the people in flood reduction?
- Did we consider all the water issues, including surface water and groundwater?
- What are the best ways to manage water resources?
- Is it better to have a single water management system or to have watershed management?

From then on, a series of international experiences were introduced to China to address the problem of floods, water shortage, water pollution and water management. In particular, was the experience from the Rhine River (Germany).

In the Netherlands, the new policy of 'Room for the River' based on the principles of the 'Living River Concept' was developed that considered natural river functioning. An adequate approach of the high water problems in the first place requires a better understanding of the functioning of the river's four driving forces. Solutions for the high water problems consist of a combination of technical, physical, environmental and governmental/institutional measures.

In order to decrease the risk of flooding, measures should apply to the whole river basin and not only to the weak spots. Not only is the role of the local council or province important in ensuring the effectiveness of flood control measures but also, coordinated inter-regional or basin level measures are necessary. After the floods in Europe in 1993 and 1995, the Netherlands, Belgium, Luxembourg, Germany, France and Switzerland formulated the 'INTERREG Rhine-Meuse Activities' (IRMA) programme that combines technical and spatial measures based on the principles of the Living River Concept to reduce flood risk. An important aspect of IRMA is also the reinforcement of the structures of co-operation on a basin level in the field of integrated water management.

The experiences showed to the Government of China that most of the strategies at that time for flood protection were merely focused on short-term solutions. Dredging, dike enforcement and other technical measures were mainly of local significance and will not contribute to long-term solutions. A long-term and lasting solution of reducing flood risk and requires other 'Living River' approaches. Considering only technical measures is no longer sufficient in order to offer enough protection against floods.

Only a combination of technical, physical, environmental and governmental measures will lead to a sustainable river system that offers a sustainably satisfying solution for the future.

3.4.2 Changing national policies from engineering to ecological approaches

In view of the flooding, the substantial loss of lives and international experiences, the Chinese Government formulated a '32-Character Policy' in 1998 with US$1.2 billion input, to counter the floods through interventions that were aimed at reducing flood risk by working with nature rather than fighting it. These interventions included:

- Placing a ban on logging and agriculture on steep slopes, and reforesting the hill slopes ;
- Demolishing dikes to open up polder areas for holding flood waters,
- Restoring several thousand square kilometers of flood plains to safely hold and slowly release peak floodwaters;

- Relocating settlements from flood-prone areas to higher ground safe from flooding;
- Reinforcing key embankments (Onishi *et al.* Undated; Ramsar Convention Secretariat 2010)

The '32 Character Policy' was the first time that the Chinese government considered the great importance of the 'soft', non-engineering measures for flood control and utilization. The floods in the Central Yangtze River shows that further reinforcement of engineering approaches to flood control would not completely eliminate flood disasters, and that the non-engineering approaches must be strengthened. The previous disorderly and unrestrained reclamation of flood plains should be and transformed into an orderly, sustainable approach where people can coexist harmoniously with floods. Land development and utilization must be moderated, in order to provide adequate flood storage capacity.

In the autumn of 1998, China's National Development and Reform Commission, Ministry of Water Resources, Ministry of Finance and other Ministries and Administrations worked together to develop the 'Polder Return to Lake Plan' in Hubei, Hunan, Jiangxi and Anhui Provinces in the Central Yangtze, covering the most important area of wetlands in the Central Yangtze. At the end of 1998, the plan was implemented and lasting about 6 years. With an investment of RMB 10.1 billion (about US$ 1.6 billion) into the 'Polder Return to Lake Plan', more than 2.45 million people was relocated from the farmlands that had been reclaimed from natural wetlands, and 2,900 km^2 of polders were restored to natural lakes, rivers and wetlands.

The ecological improvement was tremendous after the restoration of the wetlands. The wetland restored, enlarged and habitats recovered in Dongting and Poyang, the two big lakes in the Central Yangtze. Furthermore, from calculation by the Water Resource Departments of the 4 beneficial Provinces (Hubei, Hunan, Jiangxi and Anhui), the nature flood retention capacity in these areas increase 13 billion cubic meters (the total reservoir capacity of Three Gorge Dam Project was 22 billion). In addition, flood loses and input for flood fighting decreased by more than 2.5 billion Chinese Yuan (US$ 0.41 billion) every year.

3.4.3 River basin dialogue – the 'Yangtze River Forum'

With the new major policy changes and investment, such as the logging ban in the upper stream of Yangtze in 1998 and the introduction of the '32 Characters Policy', a strong foundation was established from which to launch a response at the scale required to ensure a sustainable future for the people and nature of the Yangtze Basin. In the past 5 years, millions of hectares of encroached agricultural slopes have been reforested, over 2 million people have been re-housed away from the flooded polder areas, and the biggest lakes in the central Yangtze have, for the first time in a hundred years, showed the trend of restoration. However, these successes can only be temporary progress if the various issues and conflicts across the basin are not tackled. The major gaps include the lack of a systematical comprehensive river basin plan which should, from the perspectives of national strategic development, set the river basin flood control objectives and call for actions of all related parties; lack of an effective mechanism for collaboration and cooperation between government departments at various levels due to the current sector-oriented river basin management and high degree of centralization.

However, in a historical transition period, the Chinese government has also been developing new approaches to govern the country. At the 16th CPC National Congress (2002), it agreed to adopt a human-oriented, balanced and all-dimensional approach to sustainable development, including the harmonization

of five main areas of future development. This included the harmonization between economic development and the human and natural environment, promoting a greater emphasis on resource preservation and the protection of the natural environment. In April 2004, as the first practice of these new philosophy, Premier Wen Jiabao instructed that "We should carefully consider and make a scientific decision about major national that have aroused a high level of concern in society, and with which the nature side disagrees". From the top leaders, the Chinese government is now showing its strong concerns on environment issues.

Realizing the ecological, economical and social importance of the Yangtze River to China, the major threats to the Yangtze and both gaps and opportunities to take action, it was proposed to establish a 'Yangtze River Forum' to provide a platform for public participation by all key stakeholders, to make a decision for the sustainability of the 'Chinese Dragon' (The Yangtze River).

The objectives of the Forum are:

- To provide to related official departments in both central and local governments, domestic and international organizations and NGOs, a platform for knowledge and information sharing;
- To facilitate and promote the establishment of a dialogue mechanism among the key stakeholders in the Yangtze River Basin, and to build a strong strategic partnership among them; and especially promote the collaboration among the provincial and municipal governments along the Yangtze and to establish a strong partnership and network;
- To facilitate coordination among different projects in the Yangtze River Basin to effectively utilize the various resources;
- To promote the development and implementation of the comprehensive development and conservation strategy for the Yangtze River Basin;
- To attract the attention and increase awareness of high level politicians, corporate leaders, scholars and international and public communities on river conservation and to revive the Yangtze River culture.
- To achieve these objectives, three organizational structure options (membership, possible host institution, operation mechanism) for the Forum were developed as below:

Realizing that many international, multilateral and bilateral organizations have many projects in this river basin (e.g. UNEP, UNDP, UNESCO, EU, WB, ADB, GEF, EU, DFID, AusAID, CIDA, SIDA, DGIS, AfD, JICA, JBIC, GTZ, TNC, CI, IUCN and WWF), many of these organizations were mobilized to join as founder members and to establish a Yangtze Development and Conservation Forum. For the operation of the Forum, every founder member holds the Forum organized every two years

Many of the related national governmental agencies are major participants of the Forum, they are:

- Yangtze Provincial People's Political Consultative Conference: Under the Chinese Peoples' Political Consultative Conference (CPPCC), every province and municipality has a provincial PPCC. The provincial PPCCs along the Yangtze organized annual conference to discuss the protection of water and aquatic environment. These conference conclusions are submitted to the State Council and have significant influence for the governance of the Yangtze River;
- Changjiang Water Resource Commission: vice-ministerial organization in the Ministry of Water Resource (MoWR); responsible for water quantity management and hydro-infrastructure;

- Yangtze River Valley Water Resource Protection Bureau: supervised by both Ministry of Water Resources and State Environmental Protection Administration (SEPA); responsible for both water quantity management and water quality monitoring and management;
- Yangtze Soil Preservation Commission: established in 1988 by the State Council; headed by the Sichuan Provincial Governor as the Commissioner, the ministers of MoWR, National Develop and Planning Commission (SDRC, current National Development and Reform Commission, NDRC), Ministry of Agriculture (MoA), State Forestry Administration (SFA) as Vice Commissioners, and also participated by other central government agencies;
- Yangtze Basin Fishery Resources Management Commission: vice-bureau level organization supervised by the Fishery Bureau of MoA; headed by the Deputy Director of Fishery Bureau of MoA;
- Yangtze Flood Prevention Commission: headed by Hubei Provincial Governor; responsible for flood prevention especially in the summer;
- Changjiang Maritime Safety Administration;
- Yangtze Navigation Bureau;
- Provincial governments along the Yangtze River.

There are also a few key governmental agencies which formed a founder member group to establish the Forum. For the operation of the Forum, a Forum Secretariat was established and the Forum organized every two years in different province along the Yangtze River Basin.

3.5 Integrated River Basin Management in the Yangtze River

With the start of China's National Five Year Plans in 1953, the top priority was on the economic development of the country and until the sixth Five Year Plan, little attention was given to environmental values. It can be argued that many of the water problems in China result from an ongoing denial of the importance of a healthy ecosystem for a sustainable economy, and from the lack of an integrated approach to river basin management. In the case of the Yangtze River for example, there are four river-wide authorities with responsibilities for the management of the river and its resources: the Yangtze River Resource Commission, the Yangtze Fishery Management Commission, the Yangtze Navigation Commission, and the Yangtze Water Resource Protection Bureau.

Nationally, coordination was poor or non-existent among local and regional river basins authorities. Most administrators and politicians, and most of the general public considered the exploitation of the river and its catchment area as an undisputable right. Overarching problems were addressed by the Ministry of Water Resources (MoWR), but mainly from an engineering point of view. Hydraulic mission thinking has been the dominant paradigm in Chinese water management, as illustrated by the many vast hydro-engineering projects, including the present South-to-North Water Diversion Project.

As conventional management approaches cannot address current river basin challenges effectively, the following problems were identified.

Lack of favourable legislation and regulations for proper river basin management;

- Unclear definition of responsibilities of interested government agencies;
- Lack of mechanisms and platforms for cross-sectoral and trans-jurisdictional coordination;
- Lack of policy mechanisms for river basin management;

- Lack of participation from stakeholders and wider public.

The river basin management system at that time was not able to meet the requirements of the situation, meaning a fresh IRBM philosophy and the associated methods and supporting legislation had to be introduced to support implementation of comprehensive measures and promote collective action by all stakeholders throughout the river basin.

In 2002, the China Council for International Cooperation on Environment and Development (CCICED) launched an IRBM task force to advise and inform the national government on a successful implementation of IRBM in China. WWF at that time had succeeded in getting a chair in CCICED. This made it possible to promote two candidates to co-chair the IRBM task force which had a clear view on IRBM and the importance of a healthy river ecosystem. The viewpoints of the co-chairs were important because they set the agenda for the task force and thus pave the route to the recommendations to the Chinese government. WWF also offered to co-host the task force secretariat in this way, further grounding their position in the task force.

In November 2004, the co-chairs of the IRBM taskforce delivered their recommendations to CCICED Annual General Meeting. These recommendations further found their way to the relevant ministries (in particular the MoWR) to be implemented. In 2006, the Changjiang Water Resource Commission began to revise the 'Yangtze Basin Comprehensive Utilization and Development Plan' to make it more sustainable and integrated. Although this is not a direct result from CCICED recommendations, it shows that efforts are being taken in order to implement a new way of thinking. Even more important was that the recommendation to establish a special Yangtze River Forum, in which all important stakeholders of the river basin are gathered, is realized.

3.6 Local legislations on wetland conservation

After 1998, the Chinese government began preparation for developing a national wetland legislation aimed at reinforcement of the natural wetland management and conservation for the benefit of flood reduction and biodiversity conservation. But for some coordination reasons, the legislation is not ready until now. Instead of the national wetland legislation, in 2004, China State Council announced one document on nationwide 'Reinforce the Wetland Conservation and Management'. Later, more than 12 provinces developed their own wetland legislations which covered most of the Yangtze River Basin and other areas in China, such as:

- Hunan Provincial Wetland Conservation Regulation, Oct. 2005
- Jiangxi Governmental Decision on Reinforce the Conservation of Wetland, March, 2006
- Anhui Governmental Decision on Reinforce the Conservation of Wetland, March, 2006
- Gansu Wetland Conservation Regulation, Jun. 2006
- Shanxi Wetland Conservation Regulation, Jun. 2006
- Guangdong Wetland Conservation Regulation, Sept. 2006
- Shanghai Wetland Conservation Regulation, May, 2007
- Hubei Wetland Conservation Regulation, Sept. 2007
- Liaoning Wetland Conservation Regulation, Oct. 2007

The local wetland legislation greatly improved awareness about the concept and status of nature wetland conservation which was first introduced from Ramsar, as well as the importance and benefit of wetlands for flood retention. Furthermore, together with the development of wetland nature reserves under local wetland legislations, more than 140 national wetland parks have been developed under the new policies during past 12 years which provided a great new wetland conservation opportunity for future.

3.7 Developing alternative solutions for local development

Although the "32 Character Policy" guideline was an important step in recognizing the important function of nature in the sustainable use of river basins, implementation of this policy was not easy. Soon after the proclamation of the "32Character Policy", it short-comings became clear; it did not properly address sustainable alternatives for "wrong land use within the river basin" (e.g. land reclamation for growing rice, extensive logging) and there were many complex institutional arrangements between water resource management and land use plans that hindered a successful implementation. Moreover, there was little or no awareness among the wider public of how a river (ecosystem) functions and that there was an urgent need of coordination between land use in the up-stream and down-stream areas.

To ensure that the 'Central Yangtze River Region Polder Return Lake Policy' was implemented smoothly, it was recognized that the development of alternative livelihood was the key issue. This was not only related to the current situation but it also affected the population who emigrated from endangered polders (flooded areas) in the future survival and development. Therefore, it is a matter that whether the central policy can be fulfilled or fail. If not properly developed immigrant life will be not guaranteed and the people will go back to the original places.

In 1999, WWF China developed a series of pilot projects to demonstrate the benefits of wetland restoration for biodiversity, and to seek alternative income options for farmers, based on the sustainable use of wetlands. One of these sites was at Xipanshanzhou polder, Donting Lake, one of the largest lakes in the central Yangtze River region. WWF China organized meetings for the local people to explain how the natural lake systems functions and how intervention of mankind during the past decades led to deterioration of the natural ecological functioning of the lake and increased flood risks. After these "awareness sessions" there was a joint exploration of alternative livelihoods which are in better balance with the natural dynamics of a large lake, such as Dongting Lake.

Eventually, after a series of workshop, WWF China's Dongting Lake Project began supporting several alternative income generating activities, such as animal farming (pig, duck, cow, hen and goat), fish cage farming and organic horticulture, to encourage people away from rice growing in the polder. The use of biogas as an alternative source of energy was introduced as well. Moreover, a number of households living in the polder were resettled to higher grounds.

One of the most motivating results of this approach was that apart from public support for the new way of life, the annual income of the people involved in the project increased more than 100%. In 2000, the income attributed to the project was RMB 1,465/household, while in 2003, the amount was RMB 2,881/household, and in 2004, it increased further to RMB 3,196/household. A WWF China survey (Schuyt 2005) demonstrated that households participating in the project had a higher income level than those not participating in the

project. In 2003, the average household income in the whole polder area was RMB 9,360/household (against RMB 2,000 /household in 1999). In addition to income, other important improvements of livelihoods have been generated as a result of this project (Pan *et al*. 2011).

Improvement in livelihood showed a ripple effect: neighboring families replicated activities such as biogas stoves or pig-farming even without the intervention of the Dongting Lake project. The project demonstrated active participation of, and benefits for women and elderly in the project. Raised awareness of the local community was another major outcome. The Dongting Lake example demonstrated that the livelihoods approach had lasting improvements.

During the project, various partnerships for livelihood development were built. At the local level, a community-based organization was created in which hundreds of families participated, as well as an Organic Farming Association which the farmers themselves managed. In order to explore and build a solid market for the product of organic farming and horticulture, organic agriculture companies were involved. These public-private co-operations provided support and marketing advice to farmers and the village's organic agriculture associations. The Ministry of Environmental Protection's (MoEP) Organic Development Center certificated some of the organic products that were grown, thereby assigning an official label to the products.

Due to the success of WWF China Dongting Lake project to develop alternative livelihoods schemes, actions were also carried out to restore the ecological value of the flooded wetland areas. More than 500 km^2 of embanked area (the former polder) were restored to wetlands. At present, these areas also serve as a flood retention area. This means that during high peak flows on the Yangtze River, these wetlands can be inundated to reduce the height of the flood waters. WWF China's preliminary biodiversity monitoring reports show that the diversity and quantity of vegetation has increased, as well as that of amphibians, fish and bird species. Environmental and heavy metal indexes of water (including dissolved oxygen, nitric salt, ammonia-salt, coli form, microbe population, and fluorine) show that the major indexes are lower as a result of wetland restoration, and are better than the health standards for water used to irrigate food crops.

Overall, the project was successful:

- As an example of working with the local community in developing and adopting alternative livelihoods systems that are better suited with the natural environment;
- In using participatory planning at the community level to provide entrance for discussion with higher level officials on more controversial water management issues, such as flood management policy and to embed the field level activities within the policy framework.

3.8 Summary

A number of factors contributed to the 1998 floods being so devastating. These included upstream deforestation causing erosion of the hillsides and accelerated siltation downstream, and fragmentation and degradation of the floodplain and river systems leading to the loss of wetland function. The basis of these problems were a), a lack of awareness about the values and functions of wetlands b), improper policies in dealing with floods and the natural environment and c), institutional conflicts in the management of rivers and the floodplain.

The terrible impact of the 1998 floods in China was the turning point for flood control and highlighted that the previous hard-engineering approaches to flood control was both costly and ineffective. This gave urgency to the highest-level of government to develop and implement an alternate and more effective flood management strategy as soon as possible. At the time, international experience highlighted the benefits of an integrated flood management approach which the Government of China was able to consider, adopt and adapt for the national situation. The result was the adoption of a series of new conservation and development policies, establishment of new wetland nature reserves and new local development approaches.

The '32 Character Policy' that the Chinese government issued after the 1998 floods used a 'soft', non-engineering approach to reducing flood risk by working with nature rather than fighting it. This approach has been not only been beneficial in managing the larger floods but has also brought socio-economic and environmental benefits. Some 2.4 million affected people were relocated from the most flood-prone lands to adjacent, higher ground. As a result, their livelihood has improved through a reduced risk from flooding and diseases, economic diversification, higher incomes, and better access to services. The environment has benefitted through improved water quality, recovery of biodiversity and designation of nature reserves. This 'soft' approach continues to be refined and was adopted as a key measure in China's 2007 National Climate Change Programme (Pittock and Xu 2010).

An effective integrated flood management approach depends upon a combination of technical, physical, environmental and governmental measures backed by collaboration and cooperation between all the relevant stakeholders, including government departments and agencies at various levels under high-level and centralized coordination.

However, despite the great progress that have been made, there remains many problems until now due to the existing national political structures and decision making procedures, pressures from natural resources management and exploitation, the land ownership and traditional land use in the Central Yangtze, and strong needs for national and local economical development. In Pakistan, some of the problems may be avoided before they occur.

3.8.1 Centralized Government with quick policy development and no legislation follow up

China has a centralized government with strong power on decision making once there a special or urgent situation is encountered. But at the same time however, there is sometimes a lack of full consideration of the impact from long term planning caused by quick decision making, lack of experiences, detailed study and evaluation on the later effects are very common in many of the national programmes.

The 1998 flood was a big event which totally reformed the traditional flood control thinking of the country. By this flood, the strategic ecological approaches on flood control were widely communicated to the whole country through the new "32 Character Policy" mentioned before. People endangered by flood in the Central Yangtze areas were removed from flood risk areas, huge areas of farmlands (more than 2900 km^2 of polder areas in the Central Yangtze) were returned to wetland, lake or river. The overall situation was good for the people and flood control. However, for the following reasons, the later effects were not as good as hoped.

Firstly, a lack of further new policies on ecological management planning for the restored wetland was one of the failures of the 'Big Polder Return Lake' programme. Huge investments were made on the relocation of the people threatened from the flood and large areas became the wetland, flood retention areas were increased. Due to lack of further planning and appropriate approaches on the protection and restoration, the exensive areas that were restored became blank areas with no clear management body and were later either occupied by poplar tree planting or crab-culture (the invaded species in the areas) which took over most of the important key species habitats, and totally converted the natural wetland ecosystem.

The other failure of the programme was the inconsistency of the policy with legislation which led to irregular natural wetland exploitation. Compared with other areas in China, implementation of wetland legislation is very hard. Until now, there is no national wetland law as a reference for either development or conservation. In the Central Yangtze, population growth and economic development are always the biggest pressure to the natural wetland ecosystem. The reason for certain wetlands still being in their natural condition are because people have not yet developed the skills to exploit hose areas. The present wetland habitats in the Central Yangtze region is have existed for thousands of years because they have been used for fisheries and agriculture by people. With the new technique and pressures from economic development, people will quickly develop skills and modern techniques, there will no longer be obstacles for wetland exploration. Taking East Dongting Lake as an example, since 2007, by new technique development, more than 13,000 ha of natural wetland have been enclosed by low dyke and developed as fish culture areas, including parts of the core area of the national nature reserve. The new technique can be so effective for working in a wetland that they can enclose a 600 ha wetland area in one night.

3.8.2 Problem with traditional agriculture and reforming

A strong demand for grain during the last century caused large ssale wetland reclamation. For example from 1950 until 1990, the area of Dongting Lake decreased from 4,350 km^2 to 2,700 km^2 . If counting of the historical reclamation of the wetland, more than 20,000 wetlands were reclaimed in the surrounding areas of the lake and river basin. For grain production in the areas mostly composed of rice, cotton and rape which are all the crops need to fight with flood every year. After 1990, the pressure for grain producton was reduced nationwide. Especially after the 1998 floods, the reform of local agriculture structure is strongly needed for both nature and human being. In 2000, there was a 4,350 programme plan developed aimed at further restoration of nature wetland areas in Dongting Lake from 2,700 to 4,350 km^2 and reforming the local agriculture with wise use of nature wetland approaches. If this programme is implemented, there will be a new beginning for a good example of people and nature living in harmony with floods across the whole country. But it was failed in 2003 due to firstly, the inconsistence of policy making of high level political body, the budget was not approved and there was no further funding on the programme; secondly, there were no further legislation on wetland conservation to support the plan; and thirdly, there were changes in the leadership of the Central Government.

3.8.3 Problem with existing law enforcement and nature reserve management

As discussed above, the wetland nature reserves in the Central and Lower Yangtze basin areas were developed very quickly, with more than 60 national level and provincial level nature reserves being established covering an area of 1,720,000 ha. With the economic boom in the region, most of the nature

reserves are now facing problems with contradictions between environment conservation and development. Apart from a National Nature Reserve Regulation announced in 1994, there are no other specific national law on wetlands and wetland nature reserve management. Any economic activity can be easily developed within a nature reserve areas. For example, East Dongting Lake National Nature Reserve was first developed with an area of 190,000 ha but in recent years, the real protected areas in the nature reserve has been decreased to less than 40,000 ha due to rapid development needs in the surrounding area. Many national and local economic plans have been developed e.g. the Dongting Lake Economic Zone, the local and national new traffic system plan, the harbor network in the lake and along the Yangtze River, etc. These exert huge pressures on natural wetlands and nature reserves. Within the last ten years, some national conservation policies have been developed by the State Forestry Administration and the Ministry of Environmental Protection, and the key conservation areas have been identified with National Conservation Zoning Plan. But the implementation of the plans is very weak compared with GDP oriented developing policy and so the zoning plans have no effects against economic planning.

4. Results of meetings during the RAM

4.1 Flood disaster management in Pakistan

Since the 2010 floods, there has been improved coordination between government agencies in flood management. The Federal Flood Commission, National and Provincial Disaster Management Authorities and the Pakistan Meteorological Office have a mechanism for closer cooperation and coordination to deal with flood management. Despite best efforts, another sever monsoon flood occurred in 2011 in Balochistan Province that affected some 77,500 people with 23 dead and 427 injured. In response, the government launched their largest ever relief operation costing over Rs 10 billion (approx. USD 104 million).

It was agreed by everyone whom the RAM team met that these extreme events were caused by global climate change that is having an increasing, but differing impact on the country. For example in 2012, whilst the central part of the country were suffering from floods (with 400mm in less than 24 hrs), Balochistan Province was experiencing a drought.

4.2 Future management of floods

In late 2012, the FFC was short-listing a consultant to begin work on drafting the 4th Flood Management Plan for Pakistan. Unlike previous Flood Management Plans, this one would take an integrated approach to flood management in the Indus River basin, as well as the Kharan closed basin and the Makran coastal basin. The work was planned to begin in January 2013, be completed within 12 months and the completed plan would have a life of 10 years. The Plan would not only look at floods along the Indus River as disaster to be managed but also, how to use the flood waters to provide benefits for people, hydropower development, irrigation, navigation, recharge groundwater for drinking etc. It will also investigate opportunities for storing the summer monsoon rains for use in times of water shortage and drought.

Part of the cause of the 2010 floods was blamed on the fact that the hillsides in the upper catchment of the Indus have lost about 30% of their water storage ability due to poor management. In the long-term, an

integrated flood management needs to be developed that will also focus on restoring the hillsides for flood management.

WAPDA stated that there was a need for the construction of more reservoirs which would serve to i), store the monsoon water and so minimize the risk of floods ii), provide water during time of low water or drought ii), provide water for irrigation and iv), hydropower generation. Some 32 new dams have been proposed with approx. eight per province. In constructing such dam, WAPDA also stated EIA's are always conducted on such projects and that their positive and negative impacts would be assessed.

4.3 Conservation management of Ramsar Sites along the Indus River floodplains

Presently, there are four Ramsar Sites located along the floodplains of the Indus River. They are Uchhali Complex, Chashma Barrage and Taunsa Barrage (Punjab Province), and Indus Dolphin Reserve (Sindh Province).

Both the Chashma and Taunsa Barrages are wildlife sanctuaries, supporting many important species that concentrate particularly at the pond areas located on either side of the Indus River upstream of the barrages. Normally, these pond areas are empty and they are managed principally to absorb the rising water behind the barrage when water is being stored for irrigation or for flood control (JFIT 2010).

The pond areas at Taunsa Barrage are owned by the Irrigation Department but since the 1960s, there have been disputes between government agencies and the influential local land-owners over the management of the ponds, such that the management has changed several times between conservation use by the Wildlife Department and use for agriculture by the local land-owners. There were also cases of illegal encroachment in the pond areas which after the 2010 floods were ordered to be removed. The ponds were also ordered to be handed over to the Wildlife & Fisheries Department for management as a wildlife sanctuary and for educational purposed with the help of reputable NGOs such as WWF (JFIT 2010).

Two years after the 2010 floods, the ponds at Taunsa Barrage was handed over to the Punjab Provincial Forest and Wildlife Department (PPFWD) for conservation management. However, the Irrigation Department can still place restrictions on the kinds of activities that can be carried out at the ponds, such as controlling the construction of further structures and settlements, and the timing of when to drain or flood the ponds. The original illegal settlers in the pond areas were removed after the 2010 floods but due to the presence of influential people, the settlers are now encroaching into the pond areas again.

Taunsa Barrage is a popular destination for visitors and students from surrounding areas, such as Multan. In 2011, WWF Pakistan and the PPFWD constructed eight mud check post at the site and hired 14-15 guards with motorbikes (funded by WWF) to stop encroachment into the area. An education centre has been opened and WWF are now carrying out a number of projects involving the local community. WWF has also produced a draft management plan for the site and Punjab Province has a Wetland Policy which considers the management of both Chashma and Taunsa Barrages.

The Punjab Provincial Disaster Management Authority stated that they would welcome cooperation with WWF to see how to improve the management of the three Ramsar Sites in Punjab Province so as to increase

the benefits that these sites provide for the communities living there. There could be opportunities for restoration of the wetlands so as to provide more food (e.g. fish) for local communities and so improve their livelihood.

4.3.1 Fisheries and the conservation of the Indus River Dolphin

Fishing is an important economic activity at all three of the Ramsar Sites in Punjab Province (i.e. Uchhali Complex, Chashma Barrage and Taunsa Barrage). Along the Indus River in the province, a well managed system of fisheries has been established. Fishing rights are given to contractors who are then responsible for the catch along particular stretches of the river. The contractor is responsible for the proper management of the fishing and for any offenses that they or their workers may commit. The Punjab Fisheries Department controls the season when fishing can be conducted as well as the size of the fish that can be caught.

In recent years, Sindh Province has moved from a similar system of fishing by contract to one with licenses that cost a nominal (Rs 100-150/year) with no catch limit. As the system is poorly controlled, there is now an estimated 2,000 to 4,000 fishermen (including some without licences), who try to harvest as much fish as they can from the river. Some of these fishermen also resort to using illegal methods, including poison which may also kill the Indus River Dolphins in the river. If offenders are caught, then they may only be given a small fine.

Sindh Wildlife Department has been conducting surveys of the Indus River Dolphin and have recorded an increasing trend in the number since the first survey in 2001, In the in the Indus Dolphin Reserve between Guddu and Sukkur Barrages, with some 980 Indus River Dolphins being recorded during the 2011 survey. In 2011 however, some 50 dolphins were found dead in the reserve and it is suspected but not proved, that the cause of death was poisoning. The Wildlife Department would like to carry out autopsies on the carcasses but do not have the equipment nor the expertise (Appendix 8). The city of Sukkur takes water from the river for household use so if fishermen are using poison to fish, then there may be an impact on peoples' health as well; (Appendix 9)

4.4 Conservation management of flooded forests along the Indus River floodplains

Flooded forests uniquely grow in narrow belts along the banks of Indus River and its tributaries, particularly in Sindh Province and to some extent in Punjab. Between Guddu and Sukkur Barrages, there are some 120,000 acres on the left bank and 200,000 acres on the right bank. The main plant species found associated with riverine forests are Babul *Acacia nilotica,* Shisham *Dalbergia sissoo* and *Tamarax dioica*. Other species include Khejri *Prosopis cineraria* and *Populus euphratica*. These forests provide multiple benefits, e.g. in flood storage, timber, thatching and as a result, areas have been designated as Reserved Forests.

Over the past decade, large area of flooded forests have been lost or disturbed due to the construction of embankments cutting off the water supply to the forests, or the forests were affected through encroachment by people to create farmland. There are also laws and order problems, with illegal cutting of the trees for timber and firewood, and to free up land for grazing and other uses. Due to changes in the course of the Indus River over the years, some of the flooded forests are now up to 3-4 km inland. There is a total area of 18,000ha of riverine forests now remaining and they are in need of urgent protection. The Punjab Forest and Wildlife Department are trying to restore certain areas and have re-seeded 7,500ha of

land where the trees are now growing. In future, the Punjab FWD suggested that new channel should be built to deliver water to the areas of flooded forests.

There are government regulations for the conservation of flooded forests but implementation has been difficult. For example, the Irrigation Department has an operation manual for embankments which states that trees should be planted at a width of 500m alongside the base of the embankments to protect them during times of flood. In addition, when the land outside the bund is leased out for agriculture, the farmer is required to replant flooded forests on 25% of the land and to farm on the remaining 75%. This is usually not followed though as the farmer (who is often backed by influential people) will cultivate the whole area so to maximise their profits (Appendix 8). There is reported to be a new Sindh Wildlife Act which is in the process of being approved and which would resolve many of the problems.

5. Discussion

5.1 RAM Objective 1: To devise a workable and cost effective strategy for wise-use of the floods

5.1.1 Establish a single authority for the management of the Indus River Basin and its resources

River systems are by nature integrated systems but frequently, they are managed by many isolated government agencies who work relatively independently without sufficient coordination or cooperation. This has often been said to be one of the main obstacles to effective river basin management. In order to remedy this situation, a number of countries have established mechanisms to promote effective integration, such as through establishing river basin authorities. Examples include the Yellow River Conservancy Commission, China (http://www.yellowriver.gov.cn/) and the Murray-Darling Basin Authority, Australia (http://www.mdba.gov.au/). Often under the goal of ensuring a 'healthy river', many of these authorities will be responsible for ensuring the sustainable management and sharing of the water in the river basin, taking into account impacts to the quality and quantity of flow due to climate change; flood management; water extraction for irrigation, industrial and urban uses; pollution from nutrients and hazardous substances; environmental and biodiversity needs; and other priorities. The responsibility of these authorities may also include the drafting of a comprehensive river basin management plan involving all the relevant government ministries, department and agencies to promote better governance of the water resources, management and conservation of the environment and biodiversity through information sharing, demonstration and public participation. Such plans can also complement the planning for national strategic development.

In Pakistan, a number of different government ministries, department and agencies from the federal to the local level, have roles in the management and use of the Indus River and its resources, e.g. water, fisheries, forests, wildlife etc. with insufficient integration and coordination between their activities, and with no single authority to coordinate their work and interests, especially in managing floods (JFIT 2010). As a first step to the effective and sustainable use of the Indus River and particularly for flood management, it would be wise to form a single authority for the integrated management of the river basin.

5.1.2 Development of an Integrated Basin Flood Management Plan

Although Pakistan has drafted three previous National Flood Protection Plans, none of these have taken a holistic and integrated approach to addressing flood management along the Indus River. The lack of an

integrated flood management plan was also highlighted as one of the main worries of the Judicial Flood Inquiry Tribunal that was established in Punjab, and they stated that this was an 'immediate necessity' and that the plan should focus on the whole Indus Water System (JFIT 2010). As a result of the change in attitude towards flood control since the 2010 floods (JFIT 2010), the 4th plan that is now in the process of being drafted under the responsibility of the Federal Flood Commission (FFC) will take onboard the principles of integrated flood management across the basin of the Indus River in Pakistan, to cover hill torrents and floodplains, and will include the use of floodplain wetlands in flood mitigation. As such it will be much more than just a plan for protection against floods but should also address how to harness the many benefits that floods can bring, such as nutrient rich soils, water for irrigation and for storage during times of drought, and restoration of biodiversity such as riverine forests. The issues of the safety of people, homes and infrastructure, as well as land-use planning also need to be considered. Due to these reasons, the 4th plan should be more accurately referred to as a 'Flood Management Plan', rather than a 'Flood Protection' or 'Flood Control' Plan, so as to help shift the approach from looking at floods as disasters, to floods as opportunities. We need to live with nature rather than to fight it.

To ensure that the final Plan adopts a truly holistic approach to flood control, the FFC has stated that the process of drafting the Plan will include open consultation and consider comments from all relevant stakeholders, such as relevant government ministries an departments (e.g. Ministry of Planning and Development, Ministry of Climate Change, Irrigation Department etc.), agencies (e.g. NDMA, PMO, WAPDA), NGOs and local communities, form the federal to the local level. Guidelines on drafting integrated basin flood management plans are available (APFM 2007).

The 4th Flood Control Management Plan will have a life of 10 year, from 2014 to 2024. In view of this long period, the Plan should be formulated in a way so that it is flexible enough to take into consideration any changes in flood risk that may appear in the coming years. In particular, will be the impacts from the shift in the distribution, timing and severity of the monsoon rains due to climate change (section 1.4) and the increased rate of melting of the upstream glaciers (IPCC 2007).

In developing the 4th Flood Control Management Plan, consideration should be given to other related policies and strategies, including the National Wetland Policy (Pakistan Wetlands Programme 2012) and the National Climate Change Policy (Anon 2012), as well as planned policy documents such as the National Water Policy and the National Sustainable Development Strategy. The purpose is to look for opportunities for synergies between these different important policy initiatives and encourage cooperation between different ministries and agencies to manage floods. In particular, is the draft National Water Policy which was produced in 2005 and which will provide a framework for improving flood management through institutional and legal reforms (JFIT 2010). However, the draft has yet to be finalized.

The most effective way of developing a workable and cost effective strategy for wise-use of the floods would be through the drafting of the 4th Flood Control Management Plan. The members of the RAM team would be happy to continue to provide support to the Government of Pakistan in the drafting of the Plan, to ensure that it incorporates the principles of integrated flood management to be able to recommend actions that can minimize the damage from future floods whilst providing benefits to, and helping local communities living in the floodplain region to adapt to future floods.

Whilst many of the stakeholders that the RAM team talked with agreed with an integrated approach to flood management involving all the relevant stakeholders, it seems that there may be institutional obstacles and it was suggested that high-level leadership would be needed to drive the process as well as ground work amongst the different stakeholder groups to make it happen.

5.1.3 Land-use planning for the Indus River floodplains

Pakistan lacks an adequate and integrated land use planning and supporting legislation system (SLMP undated). As a result, this has lead to illegal encroachments and activities along the Indus River floodplain and this was repeatedly reported to the RAM team as one of the major factors preventing effective management of the annual floods. Floodplain maps need to be produced and through these, to enact new legislation to demarcate the areas of land that should be set aside on each bank of the river for flood control and to stop encroachment in these areas. The production of land-use plans for floodplains would help to ensure that developments, e.g. roads, bridges and urban centres, are built in an appropriate location and manner so that they do not block the passage of water during floods and increase the flood risk (APFM 2007).

After the 2010 floods, the Board of Revenue in Punjab is reported to have mapped the floodplains in the state and the Government of Punjab is now considering introducing legislation to prohibit any construction within the floodplain area that may obstruct the normal river flow and to ban including unauthorized bunds and embankments (JFIT 2010).

Once the illegal structures have been removed, there will then be opportunities to develop the floodplains for alternative land-uses, such as agricultural systems that are adapted to the annual floods so that the local communities can continue to gain their livelihood from the land but in an orderly and secure manner. The restoration of retention lakes and ponds, riverine forests, could also be implemented to enhance resilience to floods. The development of appropriate agricultural systems and restoration techniques could be done by the relevant government agency together with experienced NGOs.

5.1.4 Maintaining environmental flows in the Indus River

Environmental flow is the quantity, quality and timing of water flow needed to sustain the ecosystems along the river from the source to the mouth, as well as to maintain the benefits that the river provides to people. By ensuring environmental flows, water managers are aiming to achieve a flow that maintains a healthy river and also provides for human uses.

During the RAM, the team learnt about the progress that has been made to manage the Indus River for hydropower production, providing water for irrigation and to control floods through the construction of dams, barrages and canals. Whilst this has certainly benefitted the country, there have also been costs in a reduced flow of the Indus River, the loss of the unique riverine forest ecosystems, a restriction in the range of the endangered Indus River Dolphin, and a range of impacts in the Indus River delta.

When alterations began to the Indus River in the 1940s with construction of the first major dams across the river, the amount of freshwater and silt load reaching the delta area and the Arabian Sea began to

decrease. Comparing flow before and after the construction of the Tarbela Dam, Randhawa (2002) stated that in normal years, annual flows was been reduced from 95.4 to 48.4 billion m^3 (77.3 to 39.2 maf)whilst in the dry years (10 percent probability), the annual flow was reduced from 31.6 to 13.5 billion m^3 (25.6 to 10.9 maf).

In 1991, the four provinces in Pakistan signed the Water Apportionment Accord to share the water of the Indus River (IUCN 2010). During the meeting, Sindh Province estimated that 10 maf (7%) of the flow in the Indus River was required to reach the river delta but presently, the amount is much less and will likely continue to decline due to the further construction of upstream dams and reservoirs (IUCN undated). The reduce quantity of freshwater from the Indus reaching the river mouth is causing the wells of the coastal villages to become saline and a loss in coastal protection services due to erosion of the mudflats and loss of mangroves (Drinkwater and Frank 1994; Menon 2005; Nasir and Akbar 2012). Despite this, some still consider any freshwater that reaches the seas as being 'unused' and 'a total loss' (Anon undated). Maintenance of environmental flows along the whole Indus River is therefore critical for the sustainable management of the river in future, to ensure that the services the river provides can continue to benefit the communities along the whole river (Kamal 2008; Kamal *et al*. 2013).

5.1.5 Water stress

Pakistan has been moving from a water stress to a water scarce country. Water availability has already fallen from 5,300 m^3 per person per year in 1950 to almost 1,000 m^3 in 2011, and the trend will likely continue due to changes in rainfall patterns, wastage and a growing population (Express Tribune 2012).

Irrigation of agricultural land is the main use of water in Pakistan, with 73% (104 million acre feet) of the water from the Indus River being taken out for irrigation and only about 35 maf flowing out to the Arabian Sea. Furthermore, the irrigation system is known to be highly inefficient, with about 35% of the water being lost in transit from the canals to fields and another 25% is lost because of inefficient irrigation techniques, with only 40% reaching the crops (Kamal 2008). Hussain *et al.* (2011) gives a similar efficiency rate of 35%.

The Ministry of Food, Agriculture and Livestock has targeted agriculture growth to increase by 5% per year from 2000 to 2010, with an increase in the cropped area by 0.5 percent per annum to be achieved by providing additional water to increase cropping intensity in irrigated area of the Indus basin (Randhawa 2002). If the trend continues, then it is essential to improve irrigation efficiency so as to relieve pressure on the Indus River for its precious and limited water supply.

There has been a growing voice for the construction of more upstream dams and reservoirs since the 2010 floods, for storing flood water and for providing water during the dry season and at times of drought (ul Rehman 2011). During the meeting with WAPDA, they mentioned that full Environmental Impact Assessments will be conducted for any proposal future dams and water holding structures. It is important that these EIAs also consider the impact of the structures on environmental flow in the Indus River.

5.1.6 'Indus River Forum' meetings

Communication and cooperation between the different stakeholder groups is one of the key steps for achieving an integrated approach to river basin management as well as for developing and implementing effective measures for flood control. In China, we have see the success of the 'International Yellow River Forum' hosted by the Yellow River Conservancy Commission every two years and the 'Yangtze Forum', in bringing together all the interested stakeholders to address the challenges for the management of the Yellow River basin and the Yangtze River Basin respectively. In a similar way, the organization of regular, e.g. biennial, 'Indus River Forum' involving all the relevant stakeholders from the government, academic, NGO and community level would also provide similar benefits.

5.1.7 Communication, education and public awareness

It is important to have a programme to raise greater awareness of the importance of the services and benefits that a healthy Indus River provides for the people of Pakistan and the need for the government to take an integrated approach for its management, especially the management of its floodplains for flood mitigation. Such a programme should be targeted from the level of the local community, land-owners, religious leaders and media, to that of the government, especially the younger officers.

5.1.8 Working group

A broad inter-disciplinary working group needs to be established to follow up on the recommendations from the report of the RAM, made up by the range of relevant stakeholders (e.g. government, academics and NGOs) working for the management of the Indus River and of the annual floods. This working group should receive high-level support from the government and be chaired preferably, at the level of the Prime Minister's office to ensure cooperation and coordination between the different government ministries and agencies.

5.2 RAM Objective 2: To make recommendations for alteration in the prevailing flood control strategy so as to obtain maximum benefit from the flood water

The prevailing flood strategy in Pakistan has been one where floods are looked upon as disasters and need to be 'controlled' with hard-engineerinng approaches such as the construction of dams and reservoirs. However, there has been a movement worldwide (section 2.2) towards an integrated approach where the benefits from floods, e.g. provision of water and nutrients, are also recognized and floods are 'managed' so as to maximize their benefits and to minimize the damage that severe floods can potentially bring.

At the policy level, the RAM team would strongly recommend to the Pakistan government that they adopt an integrated management approach to future floods along the Indus River and at the site level, to initiate projects at a number of pilot sites to trial techniques for the restoration and management of floodplain so as to maximise the benefits from the annual floods and to minize the damage that severe floods may cause. Such projects could be implemented by relevant government agencies, such as the Environmental Protection Department or by the Wildlife and Fisheries Department in conjunction with experienecd NGOs. However, before new techniques are suggested for flood control, there should be prior discussions with the local stakeholders to document traditional knowledge, methods and systems of managing and mitigation the impact from floods to see if those techniques are still appropriate and can be utilized.

The techniques to be trialed at each pilot site would depend on the situation at the site but could include one or more of these techniques:

- Restoration of silted river courses, channels, ponds and lakes connected to the Indus River and its tributaries;
- Remodelling of existing dikes and constrictions;
- Removal of all illegal structures, e.g. private dikes;
- Remodelling existing channels and construct new one, to increase the capacity to divert flood water to (new) wetlands and so reduce damages. (NGOs, MoCC etc);
- Investigate the capability of existing canals to accommodate surplus flood water and divert it to natural reservoirs, such as depressions in the ground and agricultural fields.

At the same time, trials need to be conducted on new alternative livelihood opportunities for the local communities living in the Indus River floodplains to help them adapt to, and benefit from the annual floods. This may be in the form of the local stakeholders assisting in managing the wetlands under a public private partnerships programme, e.g. with the Ministry of Climate Change or NGOs, so as to increase their incomes and improve livelihoods.

The restoration of flooded forests should be considered as part of the programme to restore the floodplains along the Indus River for flood control.

After the completion of the pilot projects and depending on their success, consideration could be given to developing a larger scale project to restore the floodplains along the Indus River for flood control. Funding for such a wider project could come from sources such as the 'Climate Change Adaptation Fund'.

5.3 RAM Objective 3: Identification of high priority wetlands/Ramsar Sites for restoration by using the floods as a tool for restoration.

From the field visits by the RAM team, a number of sites were identified where floodplain restoration and management projects could be conducted on a pilot basis. These were the ponds at the Lal Suhanra National Park and the Indus Dolphin Reserve Ramsar Site. Although it was not possible to visit the Taunsa Barrage Ramsar Site during the RAM, it is another potential pilot site because the management of the ponds at the site have been given over to the Punjab Forest, Wildlife and Fisheries Department, and WWF Pakistan have initiated a community conservation project at the site. WWF Pakistan has also helped to draft management plans for both the Taunsa Barrage and the Indus Dolphin Reserve Ramsar Sites.

In addition, a number of other sites in Sindh Province were recommended to the RAM team during the de-briefing meeting in Lahore on 5 November 2012. These were the Chotiari Reservoir, Hadero Lake, Keenjhar Lake, Halejie Lake and Manchar Lake.

As an initial step, a small project team should visit these sites, particularly Taunsa Barrage and the Indus Dolphin Reserve Ramsar Sites, to hold discussions with the local stakeholders at each site, e.g. farmers, land-owners etc., to find out how receptive they would be and the practicality of conducting trials for integrated

floodplain management at the each of the site for floodplain restoration and management to benefit flood control, local livelihoods and environmental conservation. From these visits, a prioritized list of sites can be drawn up for more detailed investigation and development of the pilot project.

6. Recommendations

The visit highlighted the fact that the Indus River is truly the lifeblood for Pakistan, flowing through the country to provide water and nutrients for agriculture, as well as food, energy and livelihood for people across the country, form the high mountains to the Arabian Sea. However, there is a lack of an integrated basin approach to the management of the river to maintain the many services and benefits that the river provides for people and the environment. Instead, management is conducted by various agencies, both national and provincial, with insufficient coordination between them, such as managing the river to minimize the impact from the annual floods.

The overall recommendations from the RAM are as follows:

- A broad-based coordinating authority should be established for the sustainable management of the Indus River Basin in Pakistan and its resources, e.g. water, fisheries, biodiversity, as well as for pollution control and flood management;
- The coordinating body should be tasked with drafting and regularly updating an 'Integrated Indus River Basin Plan' to coordinate up-stream land-uses with the needs of down-stream users, which can also maintain the social, economic and environmental benefits that the river provides through maintaining environmental flows;
- The government should move away from the paradigm of solely using a hard-engineering (or structural) approach to controlling flood and which have been found around the world to not always being effective despite investing millions in constructing flood control structures;
- Instead, the government should take an integrated approach to flood management and consider including soft-engineering (non-structural) approaches, such as by managing floodplains and using, or restoring the lakes and ponds for flood water storage, and the replanting of riverine forests to slow the speed of the flood waters. There is a need to take the traditional approach of looking at the annual floods as blessings and to maximise the benefits we can obtain from them.
- Over the past decades, the construction of upstream dams and other water control structures have reduced the amount of freshwater and silt reaching the Arabian Sea. This has had a range of impacts on the livelihood of the people and the environment in the Indus River delta. In managing the Indus River, such as for irrigation and for floods, we also need to ensure the environmental flows in the river so that downstream users can continue to benefit from the services that the river provides.
- A number of sites along the Indus River were identified as being suitable for further investigation for conducting pilot projects on the restoration and management of floodplains for flood management as well as for the improving the livelihood of the local communities. These sites include the ponds by Taunsa Barrage Ramsar Site, as well as sites in the Indus Dolphin Ramsar Site and at Lal Suhanra National Park;

- The management plans that are being developed for the Ramsar Sites along the Indus River floodplain, e.g. Taunsa Barrage, should also discuss and provide recommendations on the management of the site for flood management;
- Activities under the pilot project would include the removal of illegal structures and encroachments into the sites which otherwise would obstruct the flow of water and impact on the capacity of the site to hold flood water;
- To control encroachment of the flood plains by illegal settlements and illegal structures in general, the staff of the Irrigation Department should be empowered and strengthened by facilitating them to enforce the Canal and Drainage Act (1873);
- The trial of alternative livelihood methods which are adapted to the annual floods for the benefit of the local communities; restoration and management of ponds and lakes for flood water storage; develop opportunities for biodiversity conservation (e.g. restoration of riverine forests and provisions of habitat for waterbirds) as well as for education and public awareness.
- Along with managing the flood plains there is an urgent need to manage the hill torrents that contribute to enhancing the vulnerability in the flood plains.
- To follow-up from the RAM, it is recommended that a group of key officials and stakeholders responsible for flood management in Pakistan as well as being involved in the pilot projects, undertake a study tour to China to see at first-hand the steps that China has taken to use an integrated approach to flood management and restoring environment flows in the Yangtze and Yellow Rivers.

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The opinions in this report are solely that of the members of the RAM team and may not necessarily represent the views of the organizations for which the team members work. If there are any mistakes or inaccuracies in the report, then it is that of the RAM team for which we apologise.

Inam Ullah KHAN (IUCN Pakistan)
Lew YOUNG (Secretariat, Ramsar Convention on Wetlands)
Chen ZHANG (Chinese Academy of Science)
Xinqiao ZHANG (WWF China Program Office)

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