River Rejuvenation - International Case Studies

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Content

Introduction

Pollution of rivers has profound implications on the aquatic life within the river as well as human beings who depend on the rivers. Depending on the level of deterioration, river rejuvenation aims at a new sustainable healthy river ecosystem.

River rejuvenation is an effort aimed at restoring poor health of overexploited and polluted rivers. It requires an understanding of the causes for the poor health and the restoration efforts. Avoiding direct entry of domestic sewage and industrial effluents into the river will certainly improve the river health. But flow of a river is its identity and the most significant variable of a river system. The rejuvenation of a river is best achieved by ensuring environmental flow in the river.

Similar problems have been faced across the world. Many countries have taken cognizance of the situation and have taken proactive steps to arrest the problem.

The purpose of this publication is to illustrate some of the practices followed in various countries and make a general assessment of whether they can be adapted to the Indian context.

RHINE

THE RHINE 2020 PROGRAMME

For the benefit of the Rhine and all waters running into the Rhine, the members from the International Commission for the Protection of the Rhine, intently co-work to blend the numerous interests of utilization and protection in the territory. In January 2001, the ministers responsible for the Rhine received "Rhine 2020", the "Program on the Sustainable Development of the Rhine" following the best "Rhine Action Program" (1987-2000). It decides the overall goals of Rhine security strategy and the measures needed for their execution for the following 20 years, including surface prerequisites and deadlines. Rhine 2020"supports the execution of the EC-Water Framework Directive and will add to accomplishing a "good chemical and ecological state" in the Rhine watershed.

PROBLEMS IDENTIFIED	MEASURES TAKEN
ECOLOGY	❖ Reactivation of 160 km² floodplains o Allow natural flooding to proceed; o Allow typical floodplain processes (erosion and rearrangement)—valuable habitats are reclaimed o A dynamic trade between floodplain and GW improves the soil ecosystem and self-filtration limit of water bodies o Measures: (i) Relocation of dykes (ii) Ecological flooding of flood maintenance regions behind dykes (iii) The more natural design of estuaries of Rhine tributaries ❖ Protection of floodplain ecosystems: (i) French-German wetland included in the Ramsar list (ii) Large Rhine floodplains declared as natural reserves (Habitats directive, Birds directive) ❖ Reconnection of at least 100 oxbow lakes or parallel water bodies to the dynamics of Rhine ❖ Increasing structural diversity of 800 km of riverbanks o Concrete/monotonous rock-bed banks replaced by near-natural shallow and gravel-rich banks

	○ Gravel islands, the introduction of deadwood- a variety of new habitats created for fish, aquatic plants, and invertebrates. ❖ Restoration of ecological continuity of the Rhine and its tributaries (Migratory Fish Programme) ○ Weirs and thresholds made passable to enable fish migration (short and long) for spawning, search for food, etc. ○ Construction of weir passages ○ 28% potential existing salmon habitats reconnected to the Rhine ○ Fish friendly turbines to reduce injury rates ○ Management measures at hydroelectric power plants or catch-and carry measures for eels to reduce fish mortality and injuries
WATER QUALITY	❖ Ban of pesticides like Atrazine and Isoproturon in multiple states in the Rhine floodplain ❖ IWAP (International Warning and Alarm Plan) ○ Warns all Rhine riparian states, especially the ones downstream, of an incident. ○ Also increasingly being used for the exchange of reliable information on water pollution measured by stations in the Rhine and its tributaries ○ When polluters are unknown, they are sought via IWAP ○ Means of communication updated; now operates via an Internet exchange platform ❖ Sediments Management Plan ❖ Cooperation of laboratories, standardization of analysis and evaluation ❖ Better identification and assessment of substances of concern ❖ Exchange of information intensified and handling, evaluating, and assessing of "new" and not regulated substances
FLOOD	❖ Improvement of water maintenance on the Rhine (and whole catchment zone) ❖ Support as well as development of floodplains, dyke movement, renaturation, extensification of agriculture, afforestation ❖ Reduction in flood levels by retention measures and riverbed extensions ❖ Room for Rhine programme in Netherlands ❖ Increasing flood awareness using web-based "Rhine Atlas" with flood hazard and risk maps. ❖ Improvement in flood announcement system
LOW WATER	❖ Low water monitoring system ❖ Establishment of common discharge thresholds and classifications for intensity of low water; (good early warning system)

THE SAN ANTONIO RIVER BASIN

The San Antonio Basin is relatively modest in both size and average annual watershed yield. Early Spanish explorers named the basin's namesake river after San Antonio de Padua, "Saint Anthony of Padua." From its spring-fed headwaters in Bexar County, the San Antonio River flows to its confluence with the Guadalupe River near Tivoli. Other streams within the basin include the Medina River and Leon, Salado, Calaveras, and Cibolo creeks. The overall limited water supply is an important issue in the basin. Groundwater has historically supplied the majority of water used in the basin, but over pumping has reduced base flows in rivers and in several springs that are home to threatened and endangered species. Despite conservation efforts, municipal water demands are expected to increase due to population growth, particularly within the city of San Antonio.

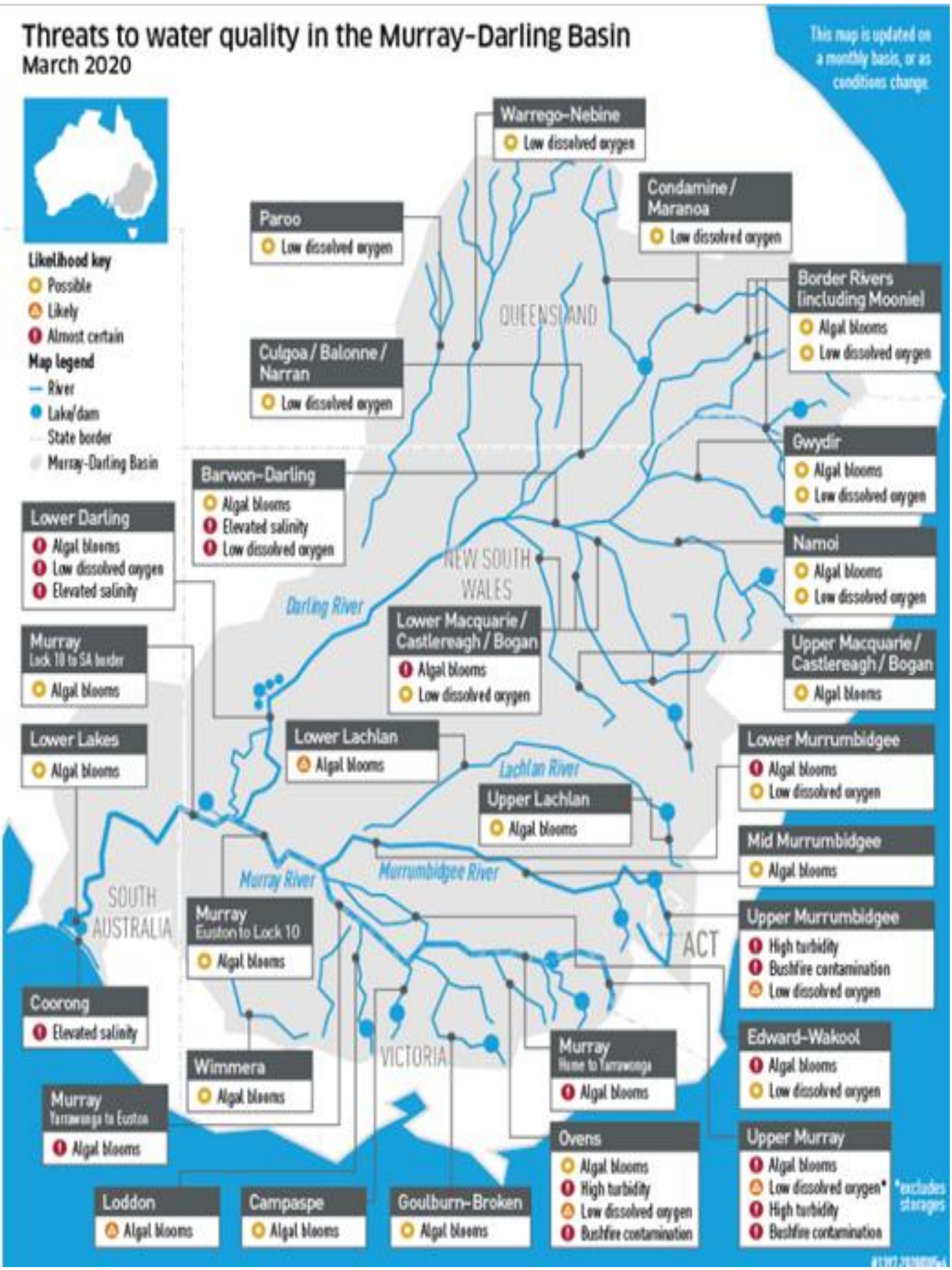
PROBLEMS IDENTIFIED	SOURCES	MEASURES TAKEN
POINT SOURCE	San Antonio Zoo	❖ Disinfect dry weather flow leaving from SA zoo- recommended UV Concentrations should be reduced to <50org/100mL
	Stormwater runoff	❖ Non-structural: Prevent accumulation of faecal material at the land surface making it unavailable for wash-off during runoff events o Management of pet waste, public education for pet owners o Control of Wild Birds, ban of birds feeding at public parks, etc., falconer program, removal of bird nesting locations ❖ Structural: remove pollutants that accumulate in runoff before runoff reaches receiving streams. ❖ Wet ponds and sand filters o Ex. Elmendorf lake eliminates bacteria through natural decay and settling; desilting of lakes to increase treatment capacity o Vegetated swales and strips prevent future dumping of debris (faecal material) into these vegetated areas (action taken by city administration)
DIRECT NON-PROFIT SOURCE	Wildlife	❖ Bats producing heavy loads of bacteria right above the river ❖ Installation of bat deterrent/exclusion features on the bridge to prevent them from returning after winter migration ❖ Control of Wild Birds, ban of birds feeding at public parks, etc. falconer program, removal of bird nesting locations ❖ Animal control centre near the zoo because the significant contribution of bacteria because of washdown activities (routine maintenance operations)
	Human origin	❖ Project to identify and repair illicit connections identified ❖ Restroom facilities and maintenance in areas with concentrated homeless population
	Flow Augmentation	❖ Activation of outfalls from reclaimed water; helps increasing assimilative capacity of the river, resulting in load reduction

MURRAY -DARLING

THE MURRAY- DARLING BASIN

The Murray–Darling Basin is a large area of south-eastern Australia where water flows through a system of interconnected rivers and lakes. The two main rivers are the River Murray and the Darling River. The Darling begins in Southern Queensland where the Culgoa and Barwon rivers meet. It flows into the Murray at the border of New South Wales and Victoria, and the Murray eventually reaches the sea just to the south-east of Adelaide. The Basin includes most of New South Wales, some of southern Queensland, the east of South Australia, northern Victoria and all of the Australian Capital Territory.

A total of 3.6 million people (including the entire population of Adelaide which is not in the Basin) rely on water from the Basin rivers for many uses, including drinking, washing, farming and irrigation. Over the years, the combination of natural droughts and increasing human use of the waterways for agriculture, manufacturing and communities has led to a decline in the health of the Basin.


Threats to water quality in the Murray-Darling Basin
March 2020
This map is updated on a monthly basis, or as conditions change
Likelihood key
Possible
Likely
Almost certain
Map legend
River
Lake/dam
State border
Murray-Darling Basin
Warrego-Nebine
Low dissolved oxygen
Paroo
Low dissolved oxygen
Condamine / Maranoa
Low dissolved oxygen
Border Rivers (including Mooniel)
Algal blooms
Low dissolved oxygen
QUEENSLAND
Culgoa / Balonne / Narran
Low dissolved oxygen
Gwydir
Algal blooms
Low dissolved oxygen
Barwon-Darling
Algal blooms
Elevated salinity
Low dissolved oxygen
Lower Darling
Algal blooms
Low dissolved oxygen
Elevated salinity
NEW SOUTH WALES
Darling River
Namoi
Algal blooms
Low dissolved oxygen
Lower Macquarie / Castlereagh / Bogan
Algal blooms
Low dissolved oxygen
Upper Macquarie / Castlereagh / Bogan
Algal blooms
Murray
Lock 10 to SA border
Algal blooms
Lower Lakes
Algal blooms
Lower Lachlan
Algal blooms
Lachlan River
Lower Murrumbidgee
Algal blooms
Low dissolved oxygen
Upper Lachlan
Algal blooms
Mid Murrumbidgee
Algal blooms
Murray River
Murrumbidgee River
SOUTH AUSTRALIA
Murray
Euston to Lock 10
Algal blooms
ACT
Upper Murrumbidgee
High turbidity
Bushfire contamination
Low dissolved oxygen
Coorong
Elevated salinity
VICTORIA
Murray
Hume to Yarrawonga
Algal blooms
Edward-Wakool
Algal blooms
Low dissolved oxygen
Wimmera
Algal blooms
Murray
Yarrawonga to Euston
Algal blooms
Ovens
Algal blooms
High turbidity
Low dissolved oxygen
Bushfire contamination
Upper Murray
Algal blooms
Low dissolved oxygen*
High turbidity
Bushfire contamination
*excludes storages
Loddon
Algal blooms
Campaspe
Algal blooms
Goulburn-Broken
Algal blooms

AREAS OF CONCERN	TOOLS	DESCRIPTION
WATER LIMITS FOR CONSUMPTION	Sustainable Diversion Limit (SDL) replace Baseline Diversion Limit (BDL)	❖ BDL is the limit to the extraction of water for use by industries, the agriculture sector and human consumption before the basic plan came into action ❖ SDL is the updated limit of extraction (applicable from 2019) based on hydrological modelling and updated estimations. o SDL is available on MDBA website for each sub-basin, streams etc. o SDL binding on all states in the basin
	Water resource plans	❖ Developed by basin states, WRPs set out the rules for how water is used at a local or catchment level, including new limits on how much water can be taken from the system, how much water will be made available to the environment, and how water quality standards can be met.
WATER FOR ENVIRONMENT	Environment Watering Strategy	❖ Long-term watering plans for the basin which sets out the improvements expected for 4 themes namely, flows and connectivity, native vegetation, waterbirds, native fish. ❖ Quantified expected outcomes are defined for each theme ❖ Also elucidates the possible strategies that could be adopted for maximizing environmental outcomes along with case studies
	Delivering Water for Environment	❖ Upon identification of specific sites that require water for its restoration, the water is delivered via a release by dams into rivers or pumping to the wetlands, ponds etc. ❖ Effective record of successes, progress and outcomes, and case studies available on the Murray- Darling Basin Development website
INFRASTRUCTURE, DEVELOPMENT, OPERATIONS & MAINTENCE	Murray-Darling Basin Agreement	❖ Basin states and the Australian government are signatories and jointly contribute funding for management of the system and its assets, water sharing among states, and directing operations. ❖ The agreement includes: o Asset management o Asset monitoring o Asset planning and analysis o River Murray operations o Responsibility, review and coordination o State water sharing and forward assessment o Operating the system o Local travel times ❖ SDLs are also defined to set the amount of groundwater that can be taken from the basin.

MANAGING GROUNDWATER		❖ Monitoring of water level and pressure to keep a check on sustainable abstraction and recharge. ❖ Monitoring of salinity levels as it has an impact on the health of the environment (rivers, wetland, trees and grasslands)
	Strategic Groundwater Research Partnership	❖ A three-year, $2 million strategic groundwater research project, in partnership with Flinders University, funded by Murray-Darling Basin to support groundwater knowledge and management in the Murray Darling basin. ❖ Research focused on issues such as the interaction between surface and groundwater, and groundwater recharge process and estimation techniques
MAINTAINING WATER QUALITY & SALINITY	Monitoring and water quality alerts	❖ Monthly maps generated highlighting water quality monitored by individual states ❖ Identification of potential threats ❖ Measuring water quality on biological, physical, chemical and aesthetic parameters ❖ Water resource plans include water quality management plans
	Salinity management	❖ 15 salt interception schemes diverting about half a million tonnes of salt away from river annually implemented in conjunction with Basin Salinity Management 2030 Strategy ❖ Development & Land Management: Smarter development methods to prevent saline groundwater from reaching plant roots; improved farming methods.
WATER MARKETS &TRADES		❖ Water in the basin can be traded between different users, within set limits. It encourages more efficient water use. ❖ Water entitlement, allocation and usage ❖ Roles and responsibilities of stakeholders defined

THE THAMES RIVER BASIN

The Thames river basin district (Figure 1) covers over 16,200km2. It encompasses all of Greater London and extends from north Oxfordshire southwards to Surrey and from Gloucester in the west to the Thames Estuary and parts of Kent in the east. In total over 15 million people live in the Thames district with many entering daily to work or visit. In addition to Greater London, other urban centres in the river basin district include Luton, Reading and Guildford. The Thames river basin district has a rich diversity of wildlife and habitats, supporting many species of global and national importance from chalk streams such as the River Kennet to the Thames Estuary and salt marshes. There are 17 management catchments that make up the river basin district, which include many interconnected rivers, lakes, groundwater and coastal waters. These catchments range from chalk streams and aquifers to tidal and coastal marshes.

PROBLEMS IDENTIFIED	ACTORS	MEASURES TAKEN
PHYSICAL MODIFICATION	Legislation and policy	❖ The local government & drainage boards grant consent for land drainage ❖ Inclusion of protection for freshwater and migratory fish ❖ Powers to ensure fish passes and screens for new abstractions and impoundment licences
	Operators and project undertakers	❖ E-learning site used by navigation, industry, manufacturing, NGOs and central government for flood risk management expert information on mitigation measures. ❖ Use of Environment Agency's 'Hydropower development: guidance for run-on-river hydropower
	Influencers and regulators	❖ Future management activities: o Review flood defence design standards for Water Framework Directive and Natura 2000 sites. o Carry out feasibility studies and designs for flood storage areas for environmental benefits
	Delivering Water for Environment	❖ Upon identification of specific sites that require water for its restoration, the water is delivered via a release by dams into rivers or pumping to the wetlands, ponds etc. ❖ Effective record of successes, progress and outcomes, and case studies available on the Murray- Darling Basin Development website
POLLUTION FROM WASTEWATER	Legislation and policy	❖ Grant and review of environmental permits under Environmental Permitting Regulations (England and Wales) 2010 ❖ Environmental permits for small sewerage discharge in designated sensitive areas. ❖ Review of areas sensitive to eutrophication ❖ Enforce restrictions and bans on the use of certain chemicals ❖ Consider the impact on water quality during spatial planning, decision making, development management, new infrastructure.
POLLUTION FROM TOWNS, CITIES & TRANSPORT	Legislation and policy	❖ Use of planning conditions, legal agreements and enforcement powers under the Town and Country Planning Act 1990 ❖ Power for rectifications under Building Act 1984 and statutory nuisance power under the Environmental Protection Act 1990 ❖ Power to prevent or clean up small-scale pollution under the Water Resources Act, 1991.

	Operators	❖ Use of sustainable drainage systems to remove silt. ❖ Minimize other chemicals to prevent polluting run-off ❖ Local government incorporates green and blue infrastructure into regeneration schemes ❖ Reduction in the impact of the use of pesticides by use of Amenity Assured registered weed control contractors under the Voluntary Initiative
	Regulators and operators	❖ Government and agencies apply MoU of understanding agreement covering strategic road network and remediation on high risk outfalls, operate under terms of MoU covering contaminated land, water discharge and use of pesticides ❖ Investigate and deal with misconnections, through National Misconnections Strategy group and by Defra's diffuse urban action plan
CHANGES IN NATURAL FLOW & WATER LEVELS	Legislation and policy	❖ Grant licences under the Water Resources Act, 1991 to regulate how much water is taken from rivers, lakes, estuaries and groundwater. Review of sustainability upon renewal of licences. ❖ Work to bring several exempted abstraction activities, such as dewatering, transfers for inland navigation and irrigation activities into regulation following public consultation and formulation of policy and legislation.
	Regulators and operators	❖ Implementation of Restoring Sustainable Abstraction (RSA) program to identify, investigate and solve risks due to unsustainable licensed abstraction. ❖ Complete Water Resource Management Plans and set out the supply and demand management over a 25-year period
	Influencers and project undertakers	❖ All sectors take up and encourage eater efficiency measures, including metering, leakages, audit, water efficient products and efficiency and education ❖ Local policies under Building Regulations, 2010 requiring new homes to meet water efficiency standard of 110 litres/person/day.
INVASION NON-NATIVE SPECIES	Legislation and policy	❖ Keeping and Introduction of Fish Regulations, 2015, and Wildlife and Countryside Act, 1981 to control the movement of invasive non-native species ❖ Ban on selling 5 high risk plan species including water primrose and floating pennywort ❖ Wildlife and Countryside Act, 1981: does not allow certain species to escape into the wild
	Regulators, operators, influencers	❖ Implement updated Great Britain strategy on invasive species, which includes species impact risk assessments, action plans, and rapid response. ❖ Work in partnership to influence recreational users to slow the spread by promoting "Check, Clean, Dry' actions. ❖ Central government helps the non-native species secretariat co-ordinate alert systems, species records and a central repository for information, including public online and smartphone submission of species record.

THE MEKONG RIVER BASIN

The Mekong River is one of the world's great river systems, flowing 4,909 km through six countries: China, Myanmar, Thailand, Lao PDR, Cambodia, and Viet Nam. The source of the river's great productivity is its seasonal variation in water level and the range of wetland habitats inundated. The Mekong River Basin's biodiversity is immense, even in comparison with other parts of tropical Asia. Its biodiversity is fundamental to the viability of natural resource-based rural livelihoods of a population of 60 million people living in the Lower Mekong Basin.

STRATEGIC PRIORITY	STRATEGIC ACTION
REDUCING KNOWLEDGE GAPS	❖ Conduct studies on: o Fish ecology o Rural livelihoods o Biodiversity o Transboundary impacts of climate change o Increased storage for flood and drought management o Use of surface and groundwater
OPTIMISING SUSTAINABLE DEVELOPMENT & COST & BENEFIT SHARING	❖ Assessment of alternate medium-term development scenario ❖ Basin-wide strategies for: ❖ Fisheries management and development strategy ❖ Sustainable hydropower management ❖ Regional master plan for water-borne transportation ❖ Regional strategy for flood management ❖ Implement and update Mekong climate change adaptation strategy and action plan ❖ Promote, further identify, and implement cost and benefit sharing opportunities and deal structures
STRENGTHEN PROTECTION OF MUTUALLY AGREED ENVIRONMENTAL ASSETS	❖ Analyse functioning and services of these assets and establish and agree on criteria for the selection and protection of these assets, including biodiversity sites ❖ Basin-wide strategy for the protection, development and management of the selected environmental assets
STRENGTHEN BASIN-WIDE PROCEDURES & NATIONAL IMPLEMENTATION CAPACITY	❖ Review of the MRC Procedures and associated technical guidelines and implement agreed improvement measures; ❖ Review institutional structure and capacity of the National Mekong Committees and implement support measures tailored to each country's needs ❖ Strengthen capacity in decentralised core river basin management functions.
IMPROVE NATIONAL WATER RESOURCES DEVELOPMENT	❖ Design guidance for mainstream dams ❖ Share experience and joint learning about water and related projects e.g., dams, hydropower and flood management ❖ Guidelines for ❖ Management of capture fisheries ❖ design and operation of irrigation systems ❖ Improvement of watershed management schemes ❖ Addressing climate change risks and opportunities ❖ Integrated Flood Risk Management Guidelines ❖ Regional Action Plan for Transportation of Dangerous goods
INHANCE INFORMATION MANAGEMENT, COMMUNICATIONS AND TOOLS	❖ Improve and establish regional flood and flash flood forecasting system ❖ Establish regional emergency communication network for flood and drought ❖ Harmonised methods, models, tools and databases for monitoring and assessment purposes

INCREASE COOPERATION WITH PARTNERS & STAKEHOLDERS	❖ Cooperation with ASEAN (Association of Southeast Asian Nations) in disaster and environmental management ❖ Strengthen strategic alignment and collaboration with the Greater Mekong Sub-region Programme ❖ Strengthen cooperation with China and Myanmar on technical exchanges, information sharing to capture potential benefits and impacts

DANUBE

THE DANUBE RIVER

The Danube river rises in the Black Forest mountains of western Germany and flows for some 1,770 miles (2,850 km) to its mouth on the Black Sea. Along its course it passes through 10 countries: Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Bulgaria, Romania, Moldova, and Ukraine. The Danube's vast drainage of some 315,000 square miles (817,000 square km) includes a variety of natural conditions that affect the origins and the regimes of its watercourses. They favour the formation of a branching, dense, deep water river network that includes some 300 tributaries, more than 30 of which are navigable. The river basin expands unevenly along its length. It covers about 18,000 square miles (47,000 square km) at the Inn confluence, 81,000 square miles (210,000 square km) after joining with the Drava, and 228,000 square miles (590,000 square km) below the confluences of its most affluent tributaries, the Sava and the Tisza.

PROBLEMS IDENTIFIED	CHALLENGES	MEASURES TAKEN
SEWAGE POLLUTION	❖ Untreated organic waste from: o Untreated municipal wastewater o Industrial pollution-paper and wood manufacturing ind., food-processing ind., livestock enterprises	❖ Investment of €22 billion in wastewater infrastructure ❖ Upgradation of 5000 municipal and for 40 million PE collection and treatment facilities ❖ Workshops & training for award of permit (in line with provisions of respective BAT reference documents including emission limit values) ❖ Certification of industrial facilities for updated technology standards

AQUATIC ECOSYSTEM- (Algal blooms block sunlight thus preventing growth of aquatic plants, depleting oxygen; other aquatic species may die; decomposition by bacteria)	❖ Nutrient pollution from: ❖ Run-off containing nutrients from agriculture (fertilizers), municipal and industrial wastewater	❖ Implementation and updating of Nitrates Action Programmes in > 60% of DRB (limits the number of nitrates in manure and fertilizer; regulation of conditions of their spread, regulates application) ❖ Limit of phosphate contents allowed in laundry detergents and dishwashing soaps ❖ Environmentally friendly agriculture practices (€70 billion invested): either obligatory and linked to financial support, or voluntary with financial compensation ❖ €10 billion Nutrient removals (a tertiary (bacterial) treatment of urban wastewater)- nutrient removal in mid-seized and big settlements reached 75%. ❖ Romania: o Integrated Nutrients Pollution Control- manure storage facilities o Connecting rural homes to sewage collection systems and treatment plants o Draft of "Code of Good Agricultural Practice" with accompanying training sessions ❖ Germany: o 13 demonstration farms using new env friendly methods of integrated crop protection with less nutrient pollution ❖ Austria**:** o 54 working groups led by qualified farmers share know-how through information sessions in local farming communities o Specific methodologies for removal of priority substances- activated carbon filter, membrane filtration or ozone treatment
CHEMICAL POLLUTION		❖ Integrated pest control for sustainable use of pesticides- preference to low or no-chemical pesticides ❖ Identification of sensitive areas, the establishment of buffer zones ❖ SOLUTIONS- research initiative for faster and more accurate identification of chemical pollutants. ❖ Also, created a comprehensive knowledge base for methods to reduce hazardous pollution. ❖ Steinhäule Waste Water Treatment Plant Association researching to identify suitable process variants to permanently reduce micro-pollutants. ❖ Powder activated carbon-decreases organic residue, largely eliminates a variety of micropollutants (pharmaceutical and less biodegradable residues). ❖ Succeeds biological treatment

		❖ Contact reactor, designed as a 3-stage cascade, and a downstream sedimentation tank.
RIVER TRANSFORMATION	❖ Human activities-Flood protection measures, hydropower plants, navigation, irrigation, land drainage, urbanization, dams, abstraction of water. ❖ Significant reduction in biodiversity	❖ 2-layer (quartz and hydro-anthracite) filtration plant ❖ Danube Accident Emergency Warning System (AEWS)- for transboundary water pollution. Sends out international warning messages to countries downstream with details ❖ Reconnection of wetlands and floodplains ❖ Austria-Building fish passes, connecting side-arms, creating gravel structures for spawning and breeding. ❖ Hungary- The reintroduction of native forests, removal of invasive tree species, ecological dredging of sidearm for silt and sediment removal, dismantling of the rock-fill dam, relocating heavy delivery pipelines below the riverbed
GROUNDWATER	❖ Over-abstraction ❖ Agricultural pollution-fertilizers (nitrates) and pesticides	❖ Hungary, Slovakia, Romania- Reconstructed drinking water supply network, revised legislation for licensing of wells; adapted agricultural production such as the use of drought-resistant crops; improved data on water-use; increase in several established protected areas; abstraction permits. ❖ Hungary- VIZEK project- fully electronic water licensing process. Provides credible data on actual agricultural water use to admin and water mgt. bodies, research agencies. New and more efficient irrigation systems (to reduce over-abstraction) ❖ "Wasserschutzbrot Unterfranken" initiative: encourages farmers to stop using fertilizer during final stages of crop production; receive compensation from water company; sell wheat at a fair price to flour mills; flour is milled and stored and used by partner bakeries; finished products sold as labelled products. (Consumers buy the bread knowing of the sustainable background) ❖ Won the German Sustainability Award ❖ Water-saving devices in households

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