Integrated Water Resources Management in Karnataka, India: A New Approach[1]

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Abstract

The Karnataka Integrated Water Resources Management Investment Program, the first of its kind in India, aims to improve the sustainable management of increasingly scarce water resources in selected river basins in the State of Karnataka. It will establish and strengthen state and basin level institutions and support adoption of the principles of integrated water resources management. Investment support will be focused on modernization of existing irrigation infrastructure to improve irrigation service delivery and to expand urban water supply and sanitation services in selected secondary towns. Water sector organisations including relevant departments, government think tanks, water service providers, irrigation water user associations, and water users will be strengthened to enhance efficiency, productivity and sustainability in water use. Innovations in technology and financing modalities–such as micro irrigation and public private partnership, will also be implemented in one or more pilot sub basins to demonstrate the potential for replication in additional basins in Karnataka. Later, this approach would be helpful to refine and scale up in other parts of India.

1. Background

With more than 90% of Karnataka's water resources used for irrigation and, with issues related to water quality; drought and water scarcity; increasing demands from irrigation, towns and cities, industry and the environment; and, climate change; Karnataka faces important water resource management challenges. Without effective management of the available water resources, water is likely to become the binding constraint on economic development in the near future.

Modernization of irrigation infrastructure and management systems within the constraint of absolute water availability is a central component of improved water resources management. This is true across India and more specifically in Karnataka. The National Water Policy of India 2002, provides a comprehensive framework to guide States in setting their own policies and in developing their water resources. The National Water Mission (NWM, 2010) and approved by the GOI in April 2011 covers various aspects of the water sector for effective adaptation to climate change. The five goals proposed by the Mission are: a) comprehensive water data base in the public domain and assessment of the impact of climate change on water resource; b) promotion of citizen and state actions for water conservation, augmentation and preservation; c) focused attention to over-exploited areas; d) increasing water use efficiency by 20%; and, e) promotion of basin level integrated water resources management.

The nodal agency for the National Water Mission is the Ministry of Water Resources which has established a National Water Mission Directorate for Mission implementation. The Directorate has initiated preparation of the State Water Mission Plans and the take up of a few irrigation projects as benchmark projects to demonstrate 20% improvement in water use efficiency. GoK has identified Narayanpur Left Bank Canal (NLBC) under the Upper Krishna Project as the benchmark project for the State and has submitted a project to the Directorate for sanction.

The 12th Five Year Plan for India is still under preparation. However, the National Planning Commission has issued the document "Faster, Sustainable and More Inclusive Growth: An Approach to the 12th Five Year Plan" in August 2011 setting out the objectives and priorities. The document makes a detailed assessment of water sector issues and priorities for the 12th Five Year Plan and proposes an integrated strategy to be put in place.

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[1] This paper is based on the draft Concept Paper for the Karnataka Integrated and Sustainable Water Resources Management Investment Program, Prepared for the State Government of Karnataka and the Asian Development Bank, September, 2012.

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The State Government of Karnataka, Government of India (GOI) and Asian Development Bank have agreed on a program of technical assistance for preparing the Karnataka Integrated and Sustainable Water Resources Management Investment Program (KISWRMIP) to be supported under a multi tranche financing facility loan. The expected impact of the program is enhanced water security, sustainability and river environment for rural and urban populations in selected water-scarce river basins, which will be measured through improved access, incomes, and water resource conditions (quality and quantity). Its outcome is improved water resources management including both resource management and service delivery in irrigation and urban water supply and sanitation (WSS).

2. Karnataka Water Sector: A Brief Review

Vision and Policy: Karnataka State Government's overall water resource management strategy, reflected in its "Vision 2020," shifts focus from yield per acre to yield per unit of water consumed[5]. This change recognizes the need for policies to empower water user associations and to decentralize the management of irrigation systems.

Similarly, but more specifically, the Karnataka State Water Policy (2002) requires water resources planning, development and management in the State to be carried out using an integrated approach adopting a hydrological unit such as river basin or sub-basin; multi sectorally; conjunctively, for surface and ground water; and incorporating quantity, quality and environmental considerations for poverty alleviation, increasing incomes and productivity, equity, reduced vulnerability to natural and economic risks. It also proposes that solutions to water allocation and planning issues be found adopting a demand management approach, hence facilitating and ensuring stakeholder participation.

The Karnataka State Water Policy 2002 also proposes a participatory approach to water resources management. This is made more explicit in the Karnataka Irrigation Act 1965, which was amended in the year 2000 and 2002 to include formation of Water Users' Cooperative Societies at minor canal level for control, maintenance, repair and monitoring of irrigation works, and collection of levy and water charges. It also proposed forming water users' distributary level federations, water users' project level federations and a water users' apex level federation. While this is a narrow interpretation of participation in water resources management, restricting it to participation in operation, maintenance and management of irrigation systems, it is a necessary first step towards public participation in river basin management.

An assessment of the Karnataka Water Policy 2002 against IWRM principles shows that the Policy incorporates many IWRM features principles, such as the need to: (i) undertake water resources analysis, planning and management on the basis of river basins and groundwater aquifers; (ii) institutional reform and an apex body to facilitate cooperation and collaboration among users; (iii) demand management; (iv) more explicit water allocation; (v) direct involvement of all concerned stakeholders in planning for basin management; and, (vi) improved water governance.

The water sector objectives of the Water Resources Department (WRD) are set out in a range of GOK documents with short, medium and long term timeframes. The short to medium term objectives are to: a) complete all ongoing major and medium irrigation projects and construction of field channels / drains to prevent water logging and salinity in the command area; b) capacity building of the engineers and farmers; c) introduction of soil / water health card and, d) dam safety management and maintenance.

The long term objectives are to: a) realize the full irrigation potential of 4.5 million ha in the state (3.5 million ha under major and medium irrigation and 1 million ha under minor flow irrigation) from the current created irrigation potential of 3.6 million ha and, b) to implement IWRM principles based management system for all water resources in the State.

[5] January 2010. Government of Karnataka, Vision 2020, p.21, para.66.

COMMENT- THIS IS THE REVISED SWOT FROM THE DRAFT FINAL REPORT THAT YOU MIGHT LIKE TO CONSIDER OR USE AS APPROPRATE

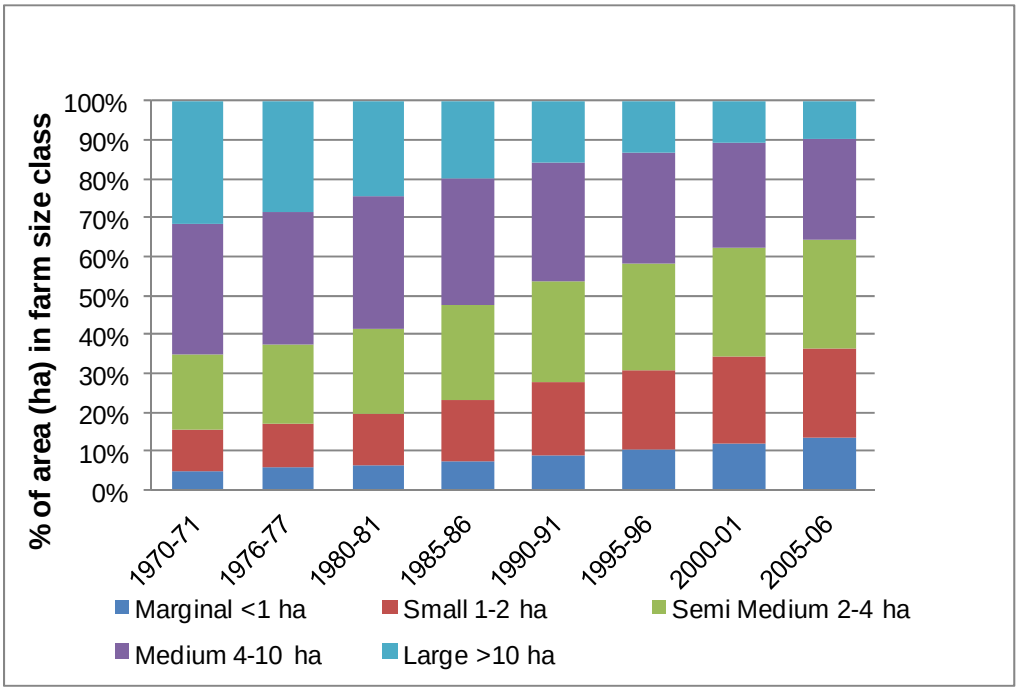
Strengths	***Weaknesses***
1. *Progressive and comprehensive, if not complete, policy statements for water planning and management* 2. *Acknowledgement by WRD of water resource management weaknesses and need for change* 3. *Skilled technical workforce* 4. *Actions to establish AC-IWRM and commence institutional (ie not organizational) reform of water management* 5. *Commitment of funds and donor support for actions to strengthen water resources management* 6. *Leadership and support coming from central government with water resources management recognised as a critical issue*	1. *Political awareness and support for implementing change.* 2. *Water agency predominantly an irrigation sector agency rather than a resource management agency.* 3. *Fragmentation and limited coordination of agencies, responsibilities and skills* 4. *Lack of effective operational level communication and coordination* 5. *Lack of public knowledge and hence support for better management* 6. *Rigid, outdated government service systems* 7. *Low priority afforded to improved governance and law enforcement (eg. of water abstractions)*
Opportunities	***Threats***
1. *Central government support for key actions to strengthen water resources management – data systems, groundwater and water quality management, subsidiarity in water management, creation of river basin management and state regulatory bodies, effective water pricing, modernization of irrigation projects to increase efficiency and effectiveness.* 2. *Alignment of agriculture and irrigation plans and actions to increase agricultural output and minimize water use through scientific and farmer centric planning and management,* 3. *Adoption of new technologies to leapfrog traditional water control infrastructure and systems* 4. *Use of local IT industries to develop water control systems, GIS based data systems and information sharing*	1. *Political instabilities; misunderstandings and misinterpretation of policy intent* 2. *Change of key leaders and loss of key drivers for change* 3. *Resistance to change and reform particularly by lobby groups* 4. *Water crises causing hasty but poor policy and planning decisions* 5. *Industry and hence employment to support rural to urban adjustment moves to other States where water is assured.*

3. IWRM Rationale

Karnataka is one of India's most progressive states and home to one-third of the information technology (IT) and back-office service industries. As a result, the state economy is one of the fastest growing with gross state domestic product (GSDP) growing by 6.4% in 2011-12. However, of the approximately 61.1 million people in Karnataka, about 14.23 million people (23.6%) lived below the poverty

line in 2009-10[6]. Recorded poverty rates in rural districts averaged about 26.1% (9.74 million people) compared to 19.6% (4.49 million people) in urban conurbations.

Economic development and growth in Karnataka is reducing the relative contribution of agriculture to GSDP. Though the contribution to GSDP has declined from about 18% in 2005 to 15.9% in 2011-12 agriculture remains the major source of employment for about 55% of the total population and about 75% of rural population. There is evidence of transition in the agriculture sector,[7] e.g. the average age of farmers in Karnataka is increasing as improved education, supported by national and state policies, opens new employment options for the youth. From 2001 to 2011 the rural population in Karnataka has decreased from 66.0% to 61.4% with a complementary increase in proportion of urban population[8] from about 34.0% to 38.6%[9]. However, the 2005-2006 Agricultural Census of India[10] shows that the trend for increasing division of farm holdings continues and the proportion of land in operational holdings of less than 2.0 ha increased to about 35% from a little over 15% in 1970-71[11]. National agricultural policies are promoting food security in place of food self-sufficiency. This may further prompt transformation of the rural economy in Karnataka where new, higher value, crops can be expected to increase farm household incomes. However, production of staple grains will likely remain a major proportion of the crop mix.



Trend in operational farm holdings (1970-2006)

Karnataka is one of the most water-stressed states in India, with about 61% of the State, the 5th highest percentage, participating in the drought prone area (DPAP) or desert development programs (DDP) in

[6] *2011 Census http://www.indiaonlinepages.com/population/karnataka-population.html (accessed 9 June 2012).*

[7] Sharma, A 2007 The Changing Agricultural Demography of India: Evidence from a Rural Youth Perception Survey, International Journal of Rural Management 2007 3: 27, available at: http://irm.sagepub.com/content/3/1/27 (accessed on 10 June 2012).

[8] The number of constituencies in Bengaluru has increased to 28 from 16 after revision of constituency boundaries for the 224 seat assembly in 2008. Chief Electoral Officer Karnataka - http://164.100.80.163/ceokarnataka/ (accessed 9 June 2012).

[9] Census 2011 http://www.indiaonlinepages.com/population/karnataka-population.html (accessed 9 June 2012).

[10] Government of India. Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi– http://eands.dacnet.nic.in/latest_2006.htm

[11] Increasing division of operational holdings will make increasing household income increasingly difficult as farm sizes become small and marginal. The additional risks involved in these crops may militate against the adoption of higher value crops by small holder farmers. Further research will be required to establish farming models, such as farming clusters, to achieve viable household income levels for farms below 2.56 ha, estimated as the minimal economic size. http://raitamitra.kar.nic.in/rsg.html (accessed 23 July 2012)

2003. [12] The westward flowing rivers are well endowed with water resources, although rainfall is concentrated in the SW monsoon period (June to September). The major eastward flowing rivers rise in the high rainfall areas of the Western Ghats and flow through increasingly arid areas in Karnataka. Each of these rivers is shared with other states and effective management of the water resources is critical for irrigated agricultural production. [13]

Water use in agriculture is important as Karnataka has limited water resources (1,608 m^3/person/year overall and approximately 1,072 m^3/person/year[14] in eastward flowing rivers)[15]. Agriculture accounted for about 84% of water diversions in 2000 and estimated water demands in the State may reach 52,366 Million m^3 (1,850 TMC) by 2025 from 37,419 Million m^3 (1,321 TMC) in 2000. Total demands are projected to grow at an average rate of 1.36% per year; but growth of agricultural water use is predicted to be 0.80% per annum while water use in the non-agriculture sector will grow at 3.08% per annum. This will result in a decline in agricultural use from 84% in 2000 to 73% by 2025 and a concomitant increase in non-agricultural use from 16% in 2000 to 27% by 2025.

Projected Sector Water Demands in 2025 (Karnataka State)

Sector	Water Demand 2000		Water Demand 2025		Growth Rate per Annum (%)
	Million m^3	TMC	Million m^3	TMC	
Agriculture	31,431	1,110	38,397	1,356	0.80
Household	1,647	58	2,594	92	1.84
Industrial	1,347	47	3,542	125	3.94
Power	1,497	53	1,846	65	0.84
Others	1,497	53	5,987	211	5.70
Total	37,419	1,321	52,366	1,849	1.36

Notes: Million m^3 = million meter cubed, TMC = thousand million cubic feet
Source: Karnataka Development Report 2007

The GOK Water Policy (2002) identifies the lack of appropriate arrangements at the State level to adequately consider water demands of different sectors and to plan and manage water as a key deficit in the state's institutional setup. Responsibilities for water issues continue to be fragmented between different departments without a formal mechanism to ensure adequate co-ordination. The fragmentation of decision making was recognized as resulting in sub-optimal management of Karnataka's limited surface and ground water resources that need to be systematically developed and properly utilized to enable the overall development of the State. The GOK "Vision 2020" envisages eliminating poverty in all areas and the achievement of the Millennium Development Goals by 2015. Achieving these goals will require enhancing human competencies and equitable growth for all people and regions throughout the state; institutionalizing good governance through increased transparency, accountability and participation in water resource management and utilization.

The GOK Water Policy sets out the strategic goal of ensuring water resources planning, development and management is done for each hydrological unit, entire river basins or sub basin, integrating multi-sectoral objectives, addressing conjunctive management of surface and ground water resources, and incorporating quantity, quality and environmental considerations, (**Error! Reference source not found.**1). Development projects and investment proposal are to be formulated and considered within the framework of

[12] Central Water Commission 2005. Water Data Complete Book, Central Water Commission New Delhi – available: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Water%20Data_Complete%20Book_CWC_2005.pdf (accessed 23 July 2012)

[13] Cauvery with Tamil Nadu, Godavari with Andra Pradesh (AP) and Maharashtra, and Krishna with Maharashtra and AP. For these rivers each state has a defined water allocation determined by interstate rivers disputes tribunals. The Pennar flows through AP and Tamil Nadu, North Pennar through AP, and the South Pennar through Tamil Nadu.

[14] Falkenmark Water Stress Indicator rates a country or region in "water stress" when annual water supplies drop below 1,700 m^3/person/year. At levels between 1,700 and 1,000 m^3/person/year, periodic or limited water shortages can be expected. When water supplies drop below 1,000 m^3/person/year, the country faces "water scarcity". Source: http://en.wikipedia.org/wiki/Water_stress (accessed 12 June 2012)

[15] The estimated total annual yield of the rivers in Karnataka is about 98,406 Million m^3 – CDTA Final Report

river or sub-basin plans so that the best possible combination of options can be obtained for poverty alleviation, increasing incomes and productivity, equity, reduced vulnerability to natural and economic risks and costs. Solutions to water allocation and planning issues will be found by adopting a demand management approach.

The quality of water in the rivers is deteriorating,[16] and many watersheds and forest areas are reported to be degrading[17] leading to rapid water runoff, soil erosion, and reservoir siltation. Groundwater is also over-utilized in 37% of the districts and a further 10% of districts are assessed as critical or semi-critical.[18] However the annual water use in the State is anticipated to continue to increase by up to 40% by 2025 due to urbanization and increased use by industry, agriculture and mining. Without improvement in water resources and water services sustainable economic growth and poverty reduction achievements may be at threat and vulnerable groups including women will be disadvantaged. The predicted impacts of climate change include increased frequency and severity of droughts and floods which may further reduce the effective water availability. Integrated water resources management and control of water use are urgently required to enable the GOK meet the growing water needs while maintaining sound basin water balances and the environment. In this context, improving the performance of irrigation remains a critical objective.

Approximately 2.46 million hectares (ha) of irrigation has been developed in Karnataka since 1947[19]; but cropping intensity remains below design expectations and substantial gaps persist between the irrigation potential created (IPC) and that utilized (IPU) in many systems. In 2009-2010 of 1.46 Million Ha, about 59% of IPC was utilized. Improving the performance of irrigated agriculture will involve improved management of water resources, upgrading of irrigation infrastructure and control systems, strengthening of management capacity, improvement of agricultural practices, and strengthening of farm to market linkages. The GOK has initiated a range of interventions to improve the irrigation services and increase agricultural production. These include State and National programs and schemes for development of improved agricultural and horticultural practices, crop insurance schemes, and efforts to accelerate completion of irrigation infrastructure developments.

Irrigated agriculture accounts for about 94% of water diversions, but suffers chronic problems of low distribution efficiency, productivity, farmer incomes, and poor sustainability. In a number of large schemes water distribution is inequitable, showing classic head to tail differences in irrigation services. In the head reaches irrigation diversions often exceed the allocated design rates, leading to high return flows which are captured in drains and recovered by downstream farmers using pumps and informal weirs. While the proportion transpired by crops in the initial diversion is relatively low, some estimate as little as 40% of diversion is beneficially evaporated, the overall percentage of beneficial evaporation within the irrigation system boundaries is likely to be greater. It is also likely that in many systems the efficiency of water distribution and productivity can be increased by improvement of the infrastructure and operational management. Adoption of alternate, low delta, crops and advanced irrigation technologies will contribute to increasing the beneficial utilization of water allocated to agriculture. This also reinforces GOK Water Policy and the Government of India's 12th Five Year Plan which emphasizes the need for improving water use efficiency given limited scope for increasing water availability.

Providing safe drinking water and sanitation is a high priority in the State's water as well as poverty reduction agenda. About 84% of the population has access to drinking water, and 38% has access to sanitation facilities. However, there are higher unmet demands: only 25% of urban local bodies (ULBs) can meet the defined per capita requirements, and only 11% of ULBs have a functioning sewerage system. Most ULBs have poor water distribution efficiency and high unaccounted water of up to 30-70% of water input to the distribution system. Meeting the rapidly increasing urban and industrial water demands remains a critical challenge, as does protecting drinking water allocations from other uses and the effective treatment, discharge and reuse of effluents from all sources.

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[16] Pollution from mining and other industrial activities has been reported by fishermen in Tungrabadhra. Source: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Fisheries_and_livelihoods_in_Tungabhadra_basin_Current_status_and_future_possibilities_Working_Paper_ISEC_2009.pdf (Accessed 10 July 2012) and by the Central Pollution Control Board in Polluted River Stretches in India, Criteria and Status, Central Pollution Control Board, 2011

[17] Degraded and wastelands in Karnataka cover 8.1 million ha (about 42% of the TGA). Highly degraded districts are Belgaum (0.81 million ha), Gulbarga (0.57 million ha), Bijapur (0.51 million ha), Koppal (0.49 million ha) and Bagalkot (0.45 million ha) Source: ICAR 2010 Degraded and Wastelands of India Status and Spatial Distribution. ICAR and NAAS, New Delhi June 2010.

[18] Groundwater Scenario of India 2009-2010, Central Groundwater Board, Faridabad, June 2010. Source: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/ground-water-scenario-of-india-2009-10-by-cgwb-mowr.pdf (Accessed 12 July 2012)

[19] Data for 2009-2010 seasons – source Economic Survey of Karnataka 2010-11 and 2011-12, Government of Karnataka.

The State has progressively developed appropriate policy frameworks to address these challenges, including State Water Policy 2002 (envisaging holistic improvements in its water management systems and institutions) and Urban Drinking Water Supply and Sanitation Policy 2002 (setting out sector targets and reform directions). Irrigation reforms have been initiated with participatory irrigation management (PIM) and the establishment of legally empowered water user associations (WUAs) and the progressive transfer of responsibility for operation and maintenance (O&M) of irrigation systems. The State's 11th Five-year plan (FYP: 2008-12) reaffirmed these directions.

In support of the GOK initiatives, the Asian Development Bank (ADB) provided a capacity development technical assistance (CDTA)[20] in 2010 to assist in advancing sector reforms and operations, and to prepare a roadmap to guide a transition towards holistic water management. The roadmap includes outline designs for refining the institutional framework and clarifying the functions of agencies to separate regulation, management and service delivery from development and construction roles. The CDTA also advised on the strategy and priority programs for the two critical sectors–irrigation and urban water supply and sanitation (WSS). The main recommendations focused on: (i) enhancing irrigation performance from modernization of infrastructure and management systems; (ii) reforms facilitate increased "crop per drop" and strengthening of participatory irrigation management (PIM); (iii) expanding UWSS service standards (24/7[21]); (iv) improved water distribution efficiency and management of O&M; and (v) exploration of the viability of alternate development and service models such as public-private-partnerships.

4. Vision for Water sector

Water Resources Management Vision

The Government of Karnataka has declared the period from 2011 to 2020 as the Irrigation Decade, with an objective of increasing the State's agricultural income and achieving food security. The GOK has adopted an IWRM vision of: "Water resources planning, development and management will be carried out adopting an integrated approach for a hydrological unit such as river basin as a whole or for a sub basin, multi-sectorally, conjunctively for surface and ground water incorporating quantity, quality and environmental considerations….*(and)* Development projects and investment proposal will be formulated and considered within the framework of river or sub-basin plan so that the best possible combination of options can be obtained for poverty alleviation, increasing incomes and productivity, equity, reduced vulnerability to natural and economic risks and costs. Solutions to water allocation and planning issues will be found adopting a demand management approach."[22]

Integrated Water Resources Management: IWRM is a concept and process that promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare equitably and without compromising the sustainability of vital ecosystems and the environment[23]. The essence of IWRM[24] is the integration and coordination of (i) management of surface water, groundwater and rainwater (ii) government and private sectors that are separately managing water resources; (iii) policy, resource management and service delivery of water; (iv) management, conservation, maintenance, scientific use of water resources; and integration of (v) economic, social and environmental outcomes; and (vi) issues related to food and energy security. There are wide range of tools[25] and attributes[26] available to achieve IWRM. Importantly the process is adaptive rather than a one-time intervention with a specified end point. The challenge is to turn the IWRM concept and process into a practical management tool that is implemented effectively in Karnataka. This will involve a step wise process that focuses on key actions at any one time.

[20] TA7418-IND: Integrated Water Resources Management and Sustainable Water Delivery in Karnataka which was implemented between 2010-2011

[21] "24/7" indicates a service objective of availability of potable water 24 hours per day 7 days per week.

[22] State Water Policy 2002

[23] http://www.gwp.org/The-Challenge/What-is-IWRM/

[24] Based on Government Order No. WRD 64 MBI 2011 Annexure – 2: Guiding Principles for AC-IWRM Dated: 07.02.2012

[25] The GWP describes such tools as enabling (policies, legal framework, investment and financing), institutional (appropriate and building), and management (information, assessment, planning, water use efficiency, economic, conflict resolution) instruments.

[26] The IWRM and Sustainable Water Service Delivery in Karnataka CDTA refers to 23 attributes leading to good IWRM.

Water Services Delivery Vision

The GOK has[27] as its vision 'Integrated water resource management to achieve scientific and efficient management of water, to increase "crop per drop" through a mix of improved efficiency of water application and net water gains through crop yield enhancement, adopt the practices that are environmentally sustainable and economically viable, close the gap between the demand and supply of water and to maintain the quality of water.'

Irrigation services: The GOK has as its objective to distribute water equitably and use water more efficiently. It desires to create an ultimate irrigation potential of 4.5 million ha under major, medium and minor irrigation projects and facilitate creation of an additional irrigation potential of 1.6 million ha by individual farmers using ground water. This implies the intention to provide irrigation to farmers cultivating at least 6.1 million ha of land in the State. The overall vision for upgrading and modernising the irrigation systems is to support increased crop production using less water by (i) ensuring supply of sufficient water; (ii) working with the water users; (iii) improve flexibility of supply to give flexibility to improve household; iv) provide irrigation infrastructure enabling increased agricultural mechanisation[28].

Domestic water supply and sanitation: For domestic water supply GOK is committed to providing drinking water at the rate of 55 litres/p/d in the rural areas, 70 litres/p/d in towns and 100 litres/p/d in city municipal council areas, and 135 litres/p/d in city corporation areas. In most areas water supply is not continuous but there is an intent to aim at 24 by 7 supply in municipal areas. There are no statements concerning objectives for the quality of water delivered or the drought reliability of supply but the Karnataka's Water Policy indicates a first priority for domestic water that assures greater reliability. To achieve this aim for domestic water supply, the GOK in partnership with urban local bodies intends to strengthen its efforts to provide all residents of urban areas, piped water supply and sanitation services at or near their dwellingsensuring universal coverage of water and sanitation services that people want and are willing to pay for; ensuring a minimum level of service to all citizens; and ensuring sustainability of the precious water resources of the State and enhancing the commercial and economic sustainability of the operations at the same time. In terms of rural water supply, GOK aims to achieve sustainability of investments in the rural water and sanitation sector leading to better health and improved quality of life. This will be achieved by increasing the rural community's access to improved and sustainable drinking water and sanitation services and by institutionalizing decentralization of rural water supply and sanitation service delivery to Gram Panchayaths and user groups**.**

Industrial water services: The GOK Industrial Policy 2009-14 states the objective of creating an enabling environment for robust industrial growth in the State by ensuring inclusive industrial development and providing additional employment for about 1.0 million persons by 2014. It thereby intends to enhance the contribution of manufacturing sector to the State's GDP from the current level of 17% to 20% by the end of policy period. World class infrastructure is aimed for to support and encourage investors. For this, industrial water supply schemes are to be expedited and supply of recycled and treated waste water to industries explored to enable better cost recovery and project feasibility. It would also facilitate implementation of mega water supply schemes for industries in selected locations. However, due care is to be taken to save water bodies, ecology and greenery by adopting IEMPs for region. Industries will be encouraged to adopt and implement appropriate measures for rational use of scarce resources and the conservation of water by adopting appropriate technologies including recycling of water and treatment of waste water. To encourage rapid industrial growth GOK has issued a State Policy for SEZ (Special Economic Zones) 2009. Under the Policy developers will be encouraged to use or set up infrastructure facilities and services including providing water supply and treatment, electricity and such other services according to GOK guidelines and standards.

Waste water management: The National Policy Statement for Abatement of Pollution, 1992 and the National Environmental Policy 2006 speak of an integrated approach for the management of the environment, the polluter pays principle, the development of fiscal and economic incentives for the management of pollution, Best Available Technology Not Entailing Excessive Costs (BATNEEC), and increased use of clean and efficient technology and production systems rather than end-of-pipe waste management. The Central Pollution Control Board (CPCB) has developed industrial use zoning approaches and guidelines for

[27] Results Framework Document for Government of Karnataka (Department of Water Resources) (2011-2014)
[28] Refer to section IV. C of this report

both water quality management and water quality monitoring (2008)[29]. These policies and the GOK State Water Policy, 2002 suggest the use of an IWRM approach for the management of water and environmental quality including a cross-sectoral vision for management of pollution. Under State pollution policy, pollution control is to be enforced in a framework of "economically viability". The Karnataka State Pollution Control Board (SPCB) plans that in future all effluents will require treatment to its standards for effluent water quality. No effluents will be allowed to discharge rivers even after treatment but may be used for agricultural irrigation. The SPCB[30] retain the option of tightening water quality standards for industrial effluents according to local conditions such as river conditions (in general a dilution factor of 8-10 is considered).

Other uses, fisheries, navigation, tourism and multi-use systems: There has been a significant decline in river based fisheries in the Upper Tungabhadra Sub-Basin due to diversion of flows from rivers for irrigation and other purposes, and pollution of streams. Management of river health as described earlier is needed in the sub-basin if river based fisheries are to recover. Fisheries in reservoirs, irrigation canals and tanks are significant however and these amount to important multi-use systems. Water based navigation is unlikely to be significant in the study area and water related tourism is thought to be minor. These sectors, especially Fisheries and Tourism would be involved in further development of a river basin plan to better identify these existing and possible uses. As important water users a by product would be their development of water related visions and goals and input into in water resources management Karnataka.

River and Ecosystem Health Vision

Internationally river health refers to the ecological condition of a river that is important for maintaining the services that river systems (wetlands and forests) provide to society such as surface water supply, groundwater recharge, good quality water, fisheries and fish breeding, birdlife including for migratory birds, recreation and tourism. These services can be lost as a result of human interventions and so systems for monitoring river health are often used. Characteristics of river health are often measured by changes from natural conditions of river flow and the need to ensure a minimum flow), water quality, stream morphology, stream biodiversity and the riparian land.

The Action Plan for River Systems proposed in the National Environment Policy 2006 lists among other actions promoting integrated approaches to management of river basins by the concerned river authorities, considering upstream and downstream inflows and withdrawals by season, interface between land and water, pollution loads and natural regeneration capacities, to ensure maintenance of adequate flows, in particular for maintenance of in-stream ecological values, and adherence to water quality standards throughout their course in all seasons. This is incorporated in the Karnataka State Water Resource Policy as water resources planning; development and management will be carried out adopting an integrated approach for a hydrological unit such as river basin as a whole or for a sub basin, multi-sectorally, conjunctively for surface and ground water incorporating quantity, quality and environmental considerations.

Water Quantity: River flow is an issue in the Tungabhadra sub-basin. It appears[31] no consideration has been given to river minimum flows in the design and operation of major and medium irrigation schemes and while there is high inter-annual variation of the monthly discharge, all rivers downstream of major irrigation off takes are often dry during summer[32]. Both the STRIVER 2006 studies and the CDTA reports express their concern about river flows. Furthermore, additional irrigation projects have been approved and this will considerably increase water demand. The Upper Bhadra irrigation, which is under construction, in phase 1 (of 3) adds an extra 30% of the current water demand from that of the existing Bhadra Project. Discussions with both government and local population suggests that in many months the waters in the river mainly consists of release of municipal sewage and other similar effluent and wastewater discharges, much of which is untreated. Groundwater also can be important for the maintenance of river and ecological health. Groundwater may discharge into the river or its wetlands at certain times of the year and provide an important source of water. Groundwater might also be important for groundwater dependent ecosystems

[29] http://www.indiawaterportal.org/node/697
[30] Chief Environmental Officer, SPCB
[31] IWRM and Sustainable Water Delivery in Karnataka CDTA, 2011
[32] http://kvina.niva.no/striver/

especially during extended dry periods where forests, shrubs and wetlands might live off groundwater. The overall trend in groundwater levels is declining and in some cases seriously so[33].

Water Quality: There are a large number of water quality issues in the river basin including both point and non-point source pollution. According to the SOE 2003 report on surface water quality in the Krishna basin most hot spots were identified along the Tungabhadra or Bhadra rivers. SPCB monitoring data on the Tungabhadra River suggests that the water in many months cannot be used for drinking because of poor water quality, while in other months it is only possible to drink after proper treatment. Major sources, and future risks of pollution, is municipal wastewater and none of the major towns in the basin have complete sewerage collection and treatment systems and they were poorly maintained and operated further reducing their effectiveness[34]. Rural sanitation coverage is very low. At the state level 63% of the total population does not have sanitation facilities with the figure rising to 83% for rural areas and this causes point and non point source pollution.

Industrial pollution is also another serious problem with 27 large scale industries in the river basin with sponge iron, distilleries, sugar and paper mills, causing problems including loss of crops when their polluted waters were used for irrigation[35]. There are a further 50 factories under various stages of implementation and 2,543 small-scale industries where the treatment of wastes is likely to be negligible. The release of inadequately treated industrial effluents has resulted has affected fish breeding and caused fish kills particularly in summer. This problem is further exacerbated by inadequate water in the river to dilute or clean the polluted waters. Surveyed fishermen stated that pollution and fish kills have affected their health and reduced income. In Hale Ayodhya, a 2004 fish kill was so serious that fishing communities were unable to fish for the whole year. Fishermen also attribute reduced fish catches to the excessive use of agro-chemicals[36].

Mining too has an impact on the quality of surface water in the sub-basin. More than 50 per cent of the suspended sediment load in both the Bhadra River and Bhadra Reservoir comes from upstream mining-affected lands on less than one per cent of the total catchment area[37]. Waste/tailing and dumps are also a serious problem in some areas carrying dissolved metallic and non metallic chemical compounds including cyanide from gold mining. The groundwater is also affected by poor water quality, both due to anthropogenic and geogenic causes with salinity, fluoride, iron, and nitrate being problems in selected locations.

Watershed management and sediment management: According to the State of the Environment 2003 report, soil erosion is one of the major causes of siltation of reservoir and tanks in Karnataka. Of all the State's basins, the Krishna and Lingamakki basins are considered the worst affected, with the Tungabhadra and Bhadra amongst the worst affected within the Krishna basin. A variety of factors cause this with the two major causes being loss of natural vegetative cover (including deforestation) and mining as there are active mines in 3862 ha of forest land in the basin[38]. The mine waste problem is exacerbated by abandoned and closed mines often not being rehabilitated and causing sedimentation and pollution long term. Erosion and sedimentation also results from overgrazing (eg. in Bellary) and nomadic grazers add to the grazing pressure.

In-stream water quality and management objectives: Achieving stream water quality and management objectives will require an IWRM based approach involving strong regulation of point source pollution from industrial and municipal effluents and wastewaters. Non-point source pollution from mining, agriculture and rural and urban sanitation and solid waste is also needed although diffuse sources from agriculture are usually difficult to control. There would need to be (i) stringent norms and licensing requirements for mines, including waste disposal, mine management, and mine rehabilitation; (ii) agriculture extension services to ensure appropriate agrochemical use and management; (iii) development of urban and

[33] the 2003 State of the Environment report 72 Taluks were categorised either as overdeveloped. In 1999, 56 of the 380 watersheds of the state were declared overdeveloped.
[34] IWRM and Sustainable Water Service Delivery in Karnataka. CDTA, ADB TA 7418 IND, 2011
[35] Field survey of villagers
[36] Manasi S, Latha N and K V Raju, 2009 Fisheries and Livelihoods in Tungabhadra Basin, India: Current Status and Future Possibilities, Working Paper 217. The Institute for Social and Economic Change, Bangalore, India
[37] Jagdish Krishnaswamy et. al. (2006) Impact of iron ore mining on suspended sediment response in a tropical catchment in Kudremukh
[38] STRIVER 2006

rural sewerage and sanitation; and (iv) develop appropriate solid waste, hazardous and medical waste facilities including recycling.

Equally important would be the need to ensure environmental flows in the river systems. The Central Water Commission Report of 2007 – Working Group to Revise WQAA[39] suggested that environmental flows should be made mandatory for all new infrastructure, and that remedial steps where possible should be taken for existing infrastructure too. It stated that – 'Minimum flow of any ten daily period to be not less than observed ten daily flow with 99% exceedence. Where ten daily flow data is not available this maybe taken as 0.5% of 75% dependable annual flow in cubic metres per second. One flushing flow during the monsoon of not less than 60% or 75% dependable annual flow in cubic metre per second'.

Initiatives of GOK relevant to IWRM:

a) The FAO has provided technical support to GOK to (i) build the capacity of engineers, (ii) demonstrate procedures for rapid assessment and modernisation of the irrigation projects[40] since scaled up for all the projects, (iii) GOK engineers who are master trainers for the MASSCOT program in India and internationally.

b) The World Bank supports the GOK in undertaking (i) the Hydrology project that is mainly focused on management of hydrological data for decision making and to build the capacities of the engineers in data collection and handling (ii) the Watershed Development project for water conservation and to enhance the agricultural productivity in the dryland/command areas (iii) the KCBTMP for rehabilitation of MI tanks is to provide sustainable and assured irrigation to the tank water users.

c) ICRISAT is supporting the GOK in a program called "Bhoo Chetana". This is activity uses field soil testing to guide crop management including fertiliser and pesticide application. As soil testing can indicate leaching, it will also influence farm level water use efficiency.

d) The 2030 Water Resources Group[41] (WRG) assists the GOK with a study with the aim of catalysing a transformative water reform process in the state. It has the following objectives:

- Analyse Karnataka's increased requirement for water to enable the state to meet its economic aspirations over the next 10 to 20 years.
- Identify practical options to meet this increased requirement and means to address challenges in their implementation.
- Identify policy and reform measures needed to improve efficiency of water use in the state.

Phase 1 of the study focused on Karnataka's largest water user segment – the Agricultural sector and Phase 2 of the project focused on industry and municipal sectors.

e) National Water Mission, Ministry of Water Resources, GOI supports the GOK with a project in Narayanpur Left Bank Canal (NLBC) of one lakh hectares with the expected benefits of a 25% increase in water use efficiency through adoption of all indicated engineering and non engineering measures.

Potential synergies and overlaps: A number of programs and projects listed above have interrelated and interdependent interventions and impacts though they are executed by different departments and agencies. While successful watershed management would arrest the rate of siltation of reservoirs, it would also impact on the inflows. Similarly, effective command area development works and agricultural extension could improve water use efficiency and contribute to better irrigation system operation and management including managing tail end problems. At the same time regenerated water from the command, assists groundwater recharge and inflows into down stream irrigation projects. This is clearly observed in such projects as Bhadra – Gondhi canals and TLBC – Vijayanagar Left Bank Canals. Finally, coordinated implementation of these programs could ensure better agricultural productivity and increased incomes for the farmers.

[39] http://wqaa.gov.in/reports/Report_on_Min_Flow_in_River.pdf

[40] http://www.fao.org/nr/water/espim/tools/MasscotWeb.pdf

[41] The 2030 Water Resources Group was formed in 2008 to contribute new insights to water scarcity. Members include McKinsey & Company, IFC, and a consortium of business partners: The Barilla Group, The Coca Cola Company, Nestlé SA, New Holland Agriculture, SABMiller plc, Standard Chartered and Syngenta AG.

Leveraging effective coordination and potential synergy among these programs would require their planning and execution within a sub-basin management perspective. Therefore moving to a river basin planning process involving all stakeholders within a basin management organization could be the institutional and technical process to synergize these programs.

Strategic management and coordination: The GOK is engaged with the above activities and is keen to implement IWRM with support from the ADB and other partners. The project needs to ensure coordination arrangements that look possible synergies and avoiding the overlapping activities by agencies involved to create an enabling environment for implementation of the IWRM. The GOK IWRM Steering Committee coordinates key stakeholders related to activities associated with Integrated Water Resources Management in the State. Currently, the Steering Committee is giving policy directions and reviewing the KISWRMIP technical assistance work but is expected to continue to provide policy guidance, coordination and reviewing the implementation of the State IWRM Roadmap. The AC-IWRM aims to synergize the Departments of Water Resources, Agriculture, Minor Irrigation, Groundwater, Industry, Energy, Urban Department, Rural Development, agencies/departments related to the Urban and Rural Water supply, Environment and Forest, Pollution Board, BWSSB, KUWSSB and other related agencies. It is promoting and foresees partnerships with international organisations including UN Water Group, (FAO, UNU, DESA, ESCAP, GEF, UNDP, WMO), NARBO, CGIAR, as well as with countries highly experienced in managing water scarcity in river basins such as Australia.

5. IWRM Initiatives

5.1 Advance Centre for IWRM

The GoK has commenced the introduction of IWRM into the State including building the awareness of IWRM among stakeholders and it intends to commence River Basin planning on a trial basis. In addition, important measures benefiting the farming community have commenced such as piloting better canal operation using flow measurement, introducing micro-irrigation in a larger area and productivity improvement through comprehensive soil and water quality management. It has also established partnerships with such international organizations as FAO, ICRISAT, IWMI, Water Resource Group 2030, etc. in supporting initiatives in the State.

However, to accelerate the move to sustainable water resources management and to fully convince and gain participation of stakeholders it is necessary to initiate a larger number of pilots with clearly defined objectives and beneficial IWRM outcomes. Piloting will assist lesson learning and enable adapting IWRM approaches to the specific conditions in Karnataka and India.

Some of the water sector issues that are proposed to be addressed through IWRM initiatives include low water use efficiency in agriculture, water logging and salinity, adoption of agronomic best practices, institutionally effective water user organizations, coordination of stakeholder departments and agencies; monitoring, evaluation and management of water resource infrastructure and services; awareness among the community about efficient and equitable water usage, especially in irrigation and domestic supply.

To facilitate the wider testing and adoption of IWRM, the GoK established the Advance Centre for IWRM in early 2012 after Cabinet approval which was preceded by an extensive consultation with various departments. The AC-IWRM will act as a think tank to the WRD with the objectives of (i) showing concerted efforts on the ground which can result in sustainable improvement in the management of water resources that ultimately benefit the State and farmers. And, (ii) breaking the compartmental and rigid framework of the departments and bringing coherence in their thinking, strategies and approaches by introducing more scientific and integrated management of resources, especially the land and water. In line with this, IWRM would be demonstrated to stakeholders as practicable and implementable at the field level.

. The AC-IWRM will engage in policy analysis and research, development of an updated water sector knowledge base, and assist the Water Resources Development Organization (WRDO) to provide leadership in the realization of IWRM in Karnataka. In partnership with Water and Land Management Institute (WALMI), Karnataka Engineering Research Center (KERC), Central Mechanical Organisation (CMO) and relevant departments, AC-IWRM will be the platform to facilitate pilot implementation of innovations in water resources management, modernization of irrigation infrastructure and management systems, development of appropriate basin management innovations, and increased stakeholder involvement in resource management. National and international partnerships will support critical analysis and updating during implementation of the IWRM road map. Implementation of the roadmap will follow the principles of: (i) informed participatory

decision making; (ii) accountability and transparency; (iii) coordinated and integrated actions by involved organizations; (iv) knowledge-driven decision making enabling adaptive management; (v) effective monitoring and evaluation against defined result targets; and (vi) efficient project implementation.

5.2 Policy Support

Policy Research and Development Issues: The GoK has clearly laid out areas of focus: a) to bring in the principles of IWRM into the water resources sector; b) to show concerted efforts on the ground resulting in substantial improvement in the management of water resources that ultimately benefit the State and farmers by improving the economy and farmer livelihoods, and, c) to make IWRM a practicable and implementable tool. The KISWRMIP proposes to support a selection of priority IWRM initiatives through support to the AC-IWRM. A priority of the Investment Program would initially be the irrigation and agriculture sector and also initiatives dealing with policy support; river basin planning; water service improvement; capacity building and human resource development; information and knowledge management; and, stakeholder analysis and communication strategies.

IWRM based policy activities include, (i) Water Productivity / Water Use Efficiency, (ii) Agricultural Productivity, (iii) Groundwater and Conjunctive Water Resources Management, (iv) Collaborations and Partnerships, (v) Policy and Legal Frameworks, (vi) Institutional Arrangements, (vii) Economic Instruments, (viii) Private Public Partnerships (ix) Climate Change, (x) Green Growth Initiatives.

Policy and Legal Frameworks: Water resources management in Karnataka is governed by many policies and pieces of legislation that are administered by more than 7 departments and agencies. The previous, 2002 National and State Water Policy lacked a comprehensive IWRM approach. This is being remedied in the 2012 Draft National Policy that brings in directions for water as a community resource, an economic good, cost recovery, providing water for the environment, and focussing the role of government as a regulator and facilitating strengthening of the water service industry including hand over to local communities and PPPs. Similar forward looking directions are being implemented at the national level with the 12th 5YP and introducing new Groundwater and Water Framework Laws. The proposed Investment Program supports: a) Carrying out SWOT analyses of the existing State policies and legislation and studying the State's IWRM experiences and advising on policy options; b) studying options and implications of proposed national policy and legislative actions that indicate probable shift in focus on the institutional roles and mandates of the various stakeholders and advising on policy and legislative options.

Strengthening Institutional Arrangements: Currently, at least 13 departments and 29 agencies deal with water in the State. As a result, agencies inevitably pursue their vision, objectives and programs independently with little cooperation and coordination and even at times with contradictions and conflicts and information resides in each agency with little sharing. Undertaking cross sectoral activities such as river basin management or consistent government wide policies is difficult under these circumstances. The proposed Program will support: a) River basin / sub-basin based planning and management through study and consultation process for conceptualization and formation of basin organization for stakeholder participation in basin planning and management in select pilot sub-basins; b) Strengthening the State Water Resources Authority and the IWRM Steering Committee to provide effective stewardship to the State's for IWRM and inter departmental coordination; c) Strengthening of the WRDO to emerge as the State's water resource data and information depository and develop an information and knowledge management system for IWRM; d) Strengthening of the proposed state groundwater authority in terms of groundwater aquifer mapping, modeling and monitoring processes and tools;

Economic instruments and Water Service Fee: There are wide range of market instruments such as water pricing, eco-compensation and water trading in various guises, that can be used to improve productivity, water use and economic efficiency in the water sector. The GOK has the lowest rates of water charges among comparable States and sees the water sector principally as an arm of social policy and as a result is reluctant to use market instruments that may have unwanted social consequences. Low or nil power charges as well as low water prices for domestic and agriculture use have serious impact on groundwater abstraction and it's sustainability as well as removing incentives for efficient water use, high crop water productivity and increased rural production. At a national level, the National Planning Commission has proposed that State governments levy a charge on all power for agricultural use earmarking the funds for groundwater recharge programs in the same aquifer. The State Water Policy also states that water rates for

various uses will be revised in a phased manner and fixed so as to cover at least the operation and maintenance charges of providing services. However, many challenges exist to implement these actions. Hence, the proposed Program will support, identifying and studying costs and benefits of potential and innovative economic instruments, provide options, for improving water management in the State.

Private Public Partnerships (PPP): Governments provide very large funding for capital, operation and maintenance, subsidies for agriculture and domestic supply and this is placing a burden on the government budgets. Due to low investment in O&M much of the infrastructure has deteriorated and operates inefficiently so that new capital vestment in modernisation is required. Various options such as PPP where the private sector assumes substantial financial, technical and operational risk in the project, BOOT (Build, Own, Operate, Transfer), BOT (build, operate, transfer) and BT (build and transfer) are options for private sector involvement. Governments are now considering the possibilities of involving private sector investors and managers in water management although to date private sector has been reluctant to be involved in PPP. Thereby, the proposed Program will focus on studying potential for private investment and public-private participation in water resource management.

Climate Change: Climate change is anticipated to result in more frequent drought for the Krisna Basin and the Western Ghats of Karnataka have been identified as one of the least resilient landscapes. The northern districts of the state will see drought incidences increased by 10% to 80% in the kharif season. For the Rabi season, droughts are expected to increase in most of the eastern districts. The October to December rainfall is expected to decrease in the south-west part of Karnataka. This is expected to have an adverse impact on agriculture in the State, especially in the kharif season with irrigated rice productivity expected to reduce by up to 8.2%.

The GoI has initiated the National Water Mission under the National Action Plan on Climate Change (NAPCC). The five goals proposed under the Mission are (i) comprehensive water database; (ii) promotion of citizen and state actions for water conservation, augmentation and preservation; (iii) focused attention to over-exploited areas; (iv) increasing water use efficiency by 20%; and (v) promotion of basin level integrated water resources management. A few irrigation projects are to be taken as benchmark projects to demonstrate 20% improvement in water use efficiency. GoK has submitted a proposal for the Narayanpur Left Bank Canal (NLBC) under the Upper Krishna Project as the project for the State. The proposed Program will support the preparation of the State Water Mission Plan, especially for the mission goals of comprehensive water database; increasing water use efficiency by 20%; and promotion of basin level integrated water resources management

Green Growth Initiatives: GOK has undertaken a number of different actions to address environmental and natural resource degradation. Additional opportunities present themselves and are likely to have a positive impact on the overall management of natural resources in the river basin. These include addressing future energy needs sustainably, comprehensive land and water use planning, sustainable forest management, environment friendly mining and quarrying, i.e. a move towards green growth and development process. In addition, it would be important to consider alternate and green energy sources and technologies for the future and there are several relevant projects in other States experimenting with this**.** Therefore, the proposed Program will focus on studying potential for and developing action plans for implementation of more such green growth and development initiatives based on national and international experiences***.***

5.3 Basin Planning

Integrated River basin Planning (IRBM) is a key tool of IWRM involving the management of the main hydrological unit (the river basin) and involving all water sectors (including the environment) and water users. River Basin Plans provide long-term strategies and set directions for future water resource management. These strategies take an action oriented approach to resolving the key water related issues across the basin as well as in priority parts of the Basin. The IWRM river basin plans differ from the traditional Masterplan style projects (sometimes that are usually sector based with limited consideration of other sectors and impacts and which treat the water resource as non limiting.

River basin issues and concerns: IRBM plans consider a wide range of issues and these will vary from Basin to Basin including for example managing climate change, floods and droughts, water sector development plans, management of the impacts of developments such as irrigation, watershed development, mining, hydropower, urbanization and industrialization, the river environment, salinity management, etc. A primary role of the plan is to address water resources including cross sectoral issues as well as to address upstream - downstream conflict such as results from the abstraction or pollution discharge to water bodies.

At an institutional and policy level, issues include (i) poor coordination and overlap between agencies and sectors with no single agency having a clear mandate for water resources management; (ii) limited participation of water users and the people in water planning; limited management of groundwater; (iii) lack of good data and rigorous analysis; and, (iv) uncertainty over water entitlements and allocations beyond Water Tribunal adjudications. For irrigation as the major water user, effort is mostly directed to infrastructure with pilot trials in taking an overall IWRM approach with strong management by water supply utilities with local water users, including measurement, volumetric based water pricing and on-farm water management recognizing the primary driver of farmer profitability.

Most of these issues are present to varying degrees in the river basins within Karnataka. A generally urgent issue is that number of the Basins within Karnataka are closed or near closed according to River Basin Tribunals and there is increasing demands and conflicts between water users there as well as with other States. As a result the program's river basin plan are likely to be focused on cross sectoral cooperation in improved water sharing including water saving.

Basin selection: The objective of the river basin sub-component of the project is to improve water resource conditions and management in selected, pilot river basins in Karnataka[42] by taking an IWRM approach which will include cross sectoral river basin organisations, preparing integrated river basin plans and implementing plan elements as agreed. The Upper Tungabhadra Sub-Basin (UTSB) has been selected as the first pilot for Integrated River Basin Management (IRBM). A further 1 to 2 River Basins will be selected later using agreed criteria. The GOK has undertaken many studies of various river basins of Karnataka and this information will be used to prioritize and assist selection of pilot basins according to agreed criteria. The Upper Tungabhadra Sub Basin (UTSB) has been selected as the initial pilot basin[43].

[42] *India: Karnataka Integrated and Sustainable Water Resources Management Investment Program. Project Number 43253, ADB, December 2011*

[43] *Adapted from 'Integrated River Basin Management- from Concept to Good Practice'. Briefing Note 2. World Bank and Component 2 draft Report 'Integrated Water Resource Management and Sustainable Water Service Delivery in Karnataka' ADB CDTA-7418 IND.* Suggested criteria for prioritizing other pilot river basins for study are: a)The Basin is a self contained hydrological unit/basin within Karnataka, b) Evidence of water management issues that cause/will cause conflict, c) Basin conflict has a dimension of interstate impact/conflict, d) The problem(s) is considered to be tractable from a technical, institutional and legal perspective to assist successful early piloting, e) Improved cooperation between agencies and participation of water resource users and managers is needed, f) There is technical, legal and administrative capacity to undertake the pilot, g) Key stakeholders are generally receptive to participating in a pilot project, h) Major related programs of initiatives are underway or about to commence. The Upper Tungabhadra Sub-Basin is selected as one of the pilot river basins: a)It is an independent, self contained hydrologic unit of Karnataka State, b) Water is scarce and water demands are increasing both from new irrigation projects but also urban areas and industry, c) Its terminus is another State in a stressed river basin (the Krishna Basin), d) Major water savings are expected from better water sharing and modernisation of existing irrigation areas, e) There is limited cooperation between agencies in water management and need to be better involved and informed of Basin water resource management issues, f) The previous CDTA studied and prepared a draft Framework Plan for the sub-basin as a starting point, g) WRD considers the UTSB to be a priority, h) New pilot irrigation governance reforms are taking place in the sub-basin.

The River Basin Organisation: A River Basin Organisation will be formed for the concerned river basins during the project and for the UTSB this is likely to be formed around the KNNL. The project will support AC-IWRM in considering the needs and options for this as the KNNL is principally an irrigation water supply service organization and lacks river basin management responsibilities. Broad forms of RBO include: a) Stakeholder advisory committees, b) River basin committees that oversee conditions and trends in the use and quality of basin resources and that recommends approaches to governments, c) River basin commissions that have stronger decision making responsibilities and accountabilities (including budget, system operation etc), d) River Basin development and regulation authorities that make have strong decision making and enforcement powers.

Membership can vary considerably from (i) a large membership involving all sectors government and non government through to (ii) a small RBO involving agency heads who are directly responsible for water management (usually multiple sectors) and that usually includes a stakeholder advisory committee. This latter model is possibly preferred in terms of decision making and government policy making and leadership.

IWRM Basin Planning Process and Implementation: The process for IWRM river basin planning would involve significant consultation with stakeholders as well as awareness raising throughout development of the Plan. The RBO, as the plan owner, is kept fully informed and involved in formulating the plan. The plan should be prepared systematically and involve the following: a) Form project management, support, and steering arrangements and project plan, b) Select the river basin(s), c) Compile the information and knowledge base (IKM) for the basin, d) Form stakeholder consultation arrangements and possible reference group, e) Prepare a River Basin Status and futures report and future basin scenarios, f) Identify and agree RB plan vision, objectives, goals and indicative targets, g) Undertake technical studies and scenario assessments, h) Identify and assess principal management options, i) Undertake a risk based assessment of the economic, social and environmental impacts of the scenarios and management options, j) Prepare River Basin Plan, k) Endorsement of the plan by the RBO and referral for government consideration.

The major investment would come in plan implementation. A major risk to the success of IRBM and the plan itself is that the process is often seen as being too academic, process based, and taking too long. To minimize the risk of this happening, it is important that there are low-cost, no regret activities undertaken during the planning process. Key factors of success include: a) An RBO that effectively involves water using sectors and communities in river basin management and planning, b) A strong AC-IWRM and good technical support in a limited data environment that can provide the studies, inventories, assessments and modelling leading to a river basin plan and water sharing and protection arrangements, c) An effective institutional and administrative arrangement for implementing the approved basin plan.

5.4 Water Systems Improvement

Overall Vision: The overall vision for upgrading and modernising the irrigation systems is driven by the measures required to support increased crop production using less water thereby enhancing irrigation area sustainability by: a) Ensuring supply of sufficient water in a timely manner through (i) improvement of the irrigation distribution infrastructure and (ii) better operation of this infrastructure; b) Working with water users in developing and implementing actions consistent with IWRM principles that will lead to sustainable irrigation systems; c) Working with the water users to improve their awareness of the value of water and developing their capacity to use it more efficiently; d) Improved flexibility of supply to encourage diversification of cropping aimed at providing maximum household income per unit of water used; e) Providing irrigation infrastructure compatible with increased mechanisation of agriculture.

Objectives of IWRM in Irrigation

Long term Determinants: The five elements of an analytical framework[44] and on which a rationale for irrigation modernisation comprised:

i. **Service delivery** concerning improved irrigation and extension services, and embracing both engineering infrastructure works and asset management, and human resource strengthening including

[44] *Refer Final Report, Integrated Resource Management and Sustainable Water Service Delivery in Karnataka, Component 4: Major Irrigation System and Agriculture Improvement Report, 2011*

capacity building. The quality of service delivery for irrigation embraced concepts of equity and delivery of seasonal quotas / allocations to schemes and also to WUCSs.

ii. **Concepts of Efficiency**, including efficiency of water use and "crop per drop", but particularly emphasising economic efficiency ("cash per splash") whereby farmers' crop choices are driven by maximising their revenues and livelihoods within the constraint of diminishing water availability.

iii. **Energy Use**, particularly addressing the need for policy change (in the long term) to support integrated water resource management objectives.

iv. **Resource Utilisation Rights** whereby WUCSs are allocated seasonal volumes of water (quotas) which they may use.

v. **Irrigation Area Sustainability**: where an IWRM approach is taken to manage the irrigation/WUCS area sustainably by addressing the local land, water and environmental issues.

While these five elements reflect a possible long term vision for irrigation services upgrading and modernisation their full adoption in the short to medium term is unlikely, and more modest determinants have therefore been developed in consultation with the WRD.

Short to Medium Term Determinants

Improved Service Delivery: Service delivery concerns both improved irrigation and agricultural extension, with the former largely the concern of the WRD – Nigam (regionally based water utilities) and Commend Area Development Authorities (CADA) and the latter, the Agricultural Department. Service delivery is defined at various hydraulic levels within the canal system, most importantly at the river diversion point, at the head of off-taking branch / distribution canals, and water provided to each WUCS***.*** Irrigation service delivery standards, in particular the volume, timing, reliability, flexibility and transparency of water supplies, are defined for each subproject and inform: (i) proposals for modernisation works; and (ii) operation plans. Many old irrigation schemes currently have poor condition, low service delivery standards, and a stepped approach to modernisation and improved service delivery may be appropriate. However, the need to have visible impacts within a few years to offset the risk of increased water scarcity means all aspects of improving the system will need to be addressed concurrently.

Increased Irrigation Efficiencies and Crop Productivity: With water, and not land, limiting irrigation area development in Karnataka, measures to increase irrigation efficiency and crop water productivity (particularly as increased farm household revenues per unit of water used) are central to the modernisation process. These measures may include improved infrastructure and management systems, to address operational and seepage losses, and improved agricultural extension to address on-farm losses and enable yield improvements. Flexibility of irrigation supply is often central to increased productivity, allowing water applications to be adjusted to meet crop demand as well as a variety of crops to be grown. Introduction of storage and buried piped water distribution within the WUCS command introduces considerable flexibility and may be considered.

Conjunctive Use and other Users: Conjunctive use of surface and groundwater is widespread on many existing schemes, with groundwater (pumped) supplies either supplementing canal supplies in the event of shortage, or totally replacing canal supplies. Irrigation system modernisation plans will promote sustainable use of groundwater use to meet seasonal / periodic shortages in the command area. The extent that canal supplies are used for washing, livestock watering and rural water supply needs to be quantified and incorporated into a modernisation plan for a scheme.

Main System Water Allocations and Irrigation Service Fees: Revised scheme water allocations measured at river diversion points are a first step for more equitable use of water, enabling the benefits of irrigation to be spread and new schemes developed. These allocations may reflect: (i) land and soil types and crops that may be grown; (ii) climatic conditions and crop water requirements; and (iii) for old schemes, the actual command areas taking into account urban / irrigation area expansion since development. The traditional rights of farmers will also have to be taken into account. Provision of bulk water supplies to WUCSs is enshrined in the Irrigation Act but has yet to be widely implemented. This would enable the quality of irrigation service delivery to cooperatives to be measured and irrigation service fees to be charged by volume. Particularly for old schemes the cost of the enabling infrastructure, flow metering and data transmission and processing could be prohibitively high. In this case water allocations may be adopted only along the main

canal. Once water entitlements, allocations and metering become well established, other low cost policy approaches to increasing water efficiency and productivity such as water markets and water trading become feasible. However this is a long term goal and needs to be approached conservatively.

Adoption of irrigation service fees to cover at least O&M costs is proposed, but based on level of service provided, traditional practice and practicality of implementation. Fees would therefore vary from scheme to scheme. Only where supply to WUCSs can be metered can charging be based on seasonal volumes provided, with the cooperative responsible for collection of fees from its members. It is expected that WUCSs where flow measurement is provided would collect and pay their water charges within 3 years.

Irrigation Area Sustainability: An integrated and comprehensive approach to managing irrigation areas is required to ensure sustainability. As water quantity issues are addressed by infrastructure and irrigation management improvements; issues such as a sustainable water balance, quality of water returns, water logging, salinity and drainage, land use and cropping patterns, solid waste management and drinking water supply (quantity, quality) and sanitation (as a source of surface and groundwater pollution) are likely to be increasingly important. Understanding and managing the area water balance is a key to the management of the water quantity. Taking an integrated and participative (IWRM) approach initially based on WUCS or CADA areas is the mechanism of achieving sustainable management. A pilot integrated and community based Land and Water Management Plans are proposed for one CADA area in order to test and adapt the approach to local conditions

Irrigation Modernisation Process: A progressive modernisation process is envisaged which includes the following, as appropriate for each sub-project:

i. Acceptance by all stakeholders of the existing state of irrigated agriculture and challenges facing the sector (eg declining water availability, the long-term consequences of poor water resource management, poor water use efficiency with unreliable supply to farmers).

ii. Identification and evaluation of options for supplying water appropriate for efficient management and water use including provision of additional off-line storage and night storage where feasible.

iii. Mapping of the command areas to confirm actual cropped areas, determine current cropping patterns and confirm that boundaries of Water User associations match hydraulic boundaries.

iv. Agree target future cropping patterns for the zones (by distributary command) – based on likely trends in cropping in the short to medium term.

v. Preparation of water distribution plans based on the updated command area and current / expected future cropping patterns.

vi. Identification of hardware/software operational constraints and agreement on requirements for future operation for improved service and efficiency.

vii. Agreement on future infrastructure requirements to support the improved operation leading to identification of requirements for infrastructure improvements. Infrastructure improvements may include (a) canal lining where justified; (b) structure repair / replacement for easier operation; (c) functioning gates; improvement of drainage systems to eliminate waterlogging.

viii. Improvement of command area distribution systems to enable more efficient and flexible delivery of water to individual plots. This may include tertiary level pipeline conveyance with surface channels and / or lay-flat hose from distribution points, and – if viable - sprinkler or drip irrigation.

ix. Provision of automatic flow measurement and transmission of flow data for the main canals and heads of major distributaries so that current operational status against plan can be monitored and corrective action taken where needed;

x. Capacity building of both system operations staff and water user organisations to provide more effective operation enabling more efficient use of water[45].

[45] *This may include modelling the crop yield - soil moisture balance such as with the FAO Aquacrop program in order to minimise water applied without reducing yields*

The challenges to achieve the changes needed for improved water resource management should not be underestimated. The project therefore needs to invest in piloting the various steps to achieve a positive outcome that can be more easily replicated.

5.5 Water Supply and Sanitation

The expected impact of the project will be (i) enhanced, i.e. continuous, water supply security (ii) improved river quality and environment through improved sanitation and (iii) improved water sector service provider competency, initially within the locality of the selected sub-projects; ultimately within the Tunga-Bhadra River sub basin. An objective of the project is to adopt IWRM principles and maximise PPP potential into the sector. The purpose of the Project will be to provide for the improved quality of life and health for the people within the selected sub-project areas. This will be achieved through improved Customer Service Levels and Operational Performance Standards contained in a Performance Service Agreement to be entered between the "asset owner" and the "asset operator", reduced levels of non-revenue water and by the efficient and environmentally friendly collection and treatment of wastewater, including sludge. A secondary purpose will be the improved performance of the ULBs for professional and sustainable service provision within the River sub-basin, to international standards.

5.6 Capacity Building

Capacity building and human resource development will be an important product of the assistance leading to the IWRM and Irrigation Program component outputs of: a) institutions and systems set up for holistic water resources management (IWRM); b) existing irrigation schemes modernized with strengthening of management systems and institutions including service providers and WUAs; c) a range of innovations to enhance basin water balance; and, d) sound multidisciplinary program management systems.

Key stakeholders/target groups central to the achievement of the Program and that will be focus of capacity building include: a) The Karnataka Water Resources Authority, b) The WRD[46] and AC-IWRM, c) The River Basin Organisation(s), d) Nigam, e) CADA and Agriculture Department, f) WUCS / irrigation farmers. Other stakeholders include other water related sector agencies including at District level, water related faculties of universities, catchment users (consumption and pollution) such as rainfed agriculture, foresters, fishers, industry, urban and rural communities, schools, etc.

Vision and delivery: The overall vision is for key stakeholders including water managers and users in selected water-scarce river basins in Karnataka to be managing the water and related resources so that water sustainability and security is assured and supporting the long term livelihoods and living conditions of Basin residents.

Capacity building will be most significantly achieved through on the job training (OJT) that is in integral part of implementing the project components of: (i) IWRM and River Basin Management, (ii) Irrigation Services and System Modernisation and Sustainability, (iii) strengthening of WUCS (WUAs) and farmers and, (iv) Program Management. Additional modes of capacity building and built on adult learning principles that will be structured according to the responsibilities, needs and best learning modes of the target group are: (i) training courses, (ii) workshops, seminars, and group discussions, (iii) case studies, role plays, and practical exercises, (iv) domestic and international study tours that are to locations that are dealing with similar problems in management of water scarcity. Internship training for newly recruited engineers without water resources training would be provided. Cooperation with international organisations such as IWMI, NARBO, UN Water Group, etc, as well as fielding international specialists as required would be undertaken. Where appropriate, delivery will use training modules developed for the stakeholder group delivered by existing training institutions to ensure a lasting legacy from the assistance.

A specific Capacity Building Program (CBP) that is integrated and includes the activities that will be implemented by the Program Components will be refined and prepared consultatively at the commencement of the Program and include: a) Assessment of the capacity and needs of the Stakeholder groups, b) Preparation the CBP including schedule, c) Identification of training organisations where relevant and not already captured in component OJT, d) Systematically implement the CBP including preparation of materials (eg. training objective, session topics, expected outcome, sequence and training method, etc), presenting

[46] *Including Water Resources Development Organisation (WRDO), Water and Land Management Institute (WALMI), Karnataka Engineering Research Centre (KERC), Central Mechanical Organisation (CMO) according to their relevant responsibilities*

capacity building activities in appropriate formats etc, e) Monitor and report on implementation of the CBP including that implemented by the Program components. Reports on training events should be individually reported on and include feedback on training and trainers, and conclude with a written assessment, f) Provide regular progress reports to the Program Steering Committee and at project completion.

A key determinant of the success of the Program will be involvement of a sufficient range of stakeholders, especially at a technical and support level such as from the AC-IWRM, WRDO, CADA and Universities etc, to ensure capacity building occurs for a large number of staff/technicians as well as to provide sound advice to the Karnataka Water Resource Authority.

5.7 Stakeholder Participation

Stakeholders relevant to the Program for IWRM and with interests in how water resources and river basins are managed comprise Government, Industry, Communities (rural and urban), civil society organisations Such stakeholders would be involved in policy studies, the development of the River Basin Plans and Land and Water Management Plans, and management of their local irrigation, river and watershed systems. There are many laws/acts and statutes, administered by over 37 agencies that belong to various departments. At the Karnataka government level the main stakeholders for the Program are:

Stakeholder	Water Related Role
Water Resources Authority	The highest or most authoritative body to advise on water policy and strategic direction. It is chaired by the Minister for Water Resources and comprises on government members and it has more than 50% non-government members including eminent specialists, academia, farmers unions, WUCS representatives. Its responsibilities are to provide advice on most aspects of strategic IWRM.
State Planning Board and Areas Development Board	The latter supports development in 'backward' areas.
Water Resources Department	Responsible for overall management of Karnataka's water resources. Formed from the former Irrigation Department and remains a principally focused on irrigation development and management 3 main functional units Water Resource Development Organisation, the Command Area Development Authorities and the Nigams. Also within WRD is the Central Mechanical Organization (CMO). The Water and Land Management Institute (WALMI) and the Karnataka Engineering Research Centre (KERS) are set up as societies under the WRD.
Water Resource Development Organisation(WRDO)	Responsible for investigation and planning of all major and medium irrigation projects, provides information to GoK on interstate water disputes. Collecting, processes and archives hydro-meteorological data and maintains and uses spatial databases of hydrological characteristics of catchments, rivers and streams digitally maps this information and shares with command areas. M&E of irrigation projects, and dam safety.
AC-IWRM	The AC-IWRM is being formed to be the leader for IWRM technical aspects of IWRM in Karnataka. It is to function as an expert think tank and advisory agency to WRD and coordinate with WALMI, KERS, CMO, and the WRDO.
River Basin Organisation	A river Basin Organisation is to be set up under the project
NIGAMS	Responsible for construction, operating and maintaining the main, branch and distributary supply and drainage systems. KNNL in the UTSB is responsible for major and minor irrigation; hydrological data, collection, processing and hydrological designs; M&E projects; resolving interstate disputes; research, development and training.
Department of Minor Irrigation	Responsible for all groundwater and surface water schemes, with cultivable command area less than 2000 hectares. Main objective is to bring more land under irrigation and conducts engineering works to do this; forms of water users organisations for completed schemes. Undertakes river bank protection works; assists fixing of water rates.
Scheme Level Water User Federations	responsible for conflict resolution along the 1st order canal; interaction with the NIGAM on behalf of its members; and representation on the River Basin Organisation
Distributary Level Water User Federations	responsible for resolution of conflicts along 2nd order canal; coordination of any participatory O&M of the secondary canals and drains and representation of the first tier interests at third tier level
CADA	responsible for on-farm development works; rostering systems, selection and enforcement of suitable cropping patterns; conjunctive use of surface and groundwater to supplement surface irrigation (in the minor irrigation sub-sector); development and maintenance of the main and intermediate drainage system (irrigation sector at large) and modernisation, reclamation of water logged areas, maintenance and efficient operation of the irrigation system up to the outlets of approximately 28 l/s capacity, extension and training, promotion of PIM
Water User Associations (WUCS)	Responsible for allocation of the group right between members; resolution of conflict between members; and capacity building of members Set up under the CADA according to the Cooperative Societies Act
Department of Mines and Geology	Responsible for groundwater including estimating the available groundwater resources, monitors groundwater levels and quality, advise on bore construction and rehabilitation; construct artificial recharge structures,
Karnataka State Natural Disaster Monitoring Centre	Provides scientific advice on drought management and maintains data bases, issues periodical reports on drought indicators, undertakes studies on drought management in drought prone districts
Tungabhadra Board	Set up (under 1956 Act) for the development of the Tungabhadra river. Regulation of supplies of water to the States of Andhra Pradesh and Karnataka, maintenance of the dam and Tungabhadra reservoir of the project, maintenance of the common portion of canals shared between states, issues lease for reservoir fisheries, implements upstream catchment protection measures, develops new hydropower schemes,
Department of Ecology and Environment: Technical Wing and the State Pollution Control Board	Mandate is to preserve and enhance the quality of the natural environment, including water, air and soil quality; conserve and protect flora, fauna and other natural resources; enforce environmental Acts and Rules; coordinate various environmental policies and programs.

Stakeholder	Water Related Role
(KSPB)	Conducts environmental audits and administer laws and regulations to protect the environment and its natural resources KSPB administers 2 Acts to control point source pollution discharges
Departments of Agriculture (DA), Horticulture Department (HD) and Watershed Development Department (WD).	DA involved with (i) command area development, (ii) soil and water conservation and watershed development, (iii) crop development, (iv) crop protection. HD deals with (i) fruits & floriculture, (ii) farms & nurseries, (iii) oil palm, (iv) vegetables, marketing & post-harvest management, (v) biotechnology, (vi) drip irrigation, and (vii) plantation crops & plant protection WD undertakes programs to conserve soil and moisture and to increase the productivity of land use.
Karnataka Forest Department	Works with Village Forest Committees and enters into partnership agreements with the forest department for planning and implementing various forest protection, conservation and development programs.
Karnataka Rural Water Supply and Sanitation Agency	Develops rural water supply and sanitation systems and assists local governments to deliver water supply services. Once the water supply system is designed and constructed, the scheme is handed over to the local government. Water used for urban purposes is taken under a water use permission
Department of Industries and Commerce (Industrial Water Supplies)	Takes a developmental and facilitation roles for the industrial sector Water used for industrial purposes is taken under a water use permission provided in the same manner as that for urban water supply
Karnataka Power Corporation and the Karnataka State Electricity Board	Responsible for investigation, execution operation and maintenance of power projects; and, transmission and distribution of electricity respectively. Water related responsibilities involve consumption of water as well as hydropower projects. Issues of resource allocation and use or cumulative impact assessment are not addressed within a river basin
Local Government • Zilla Panchayath (district level) • Taluk Panchayath (taluk level) • Gram Panchayath (village level)	Local governments have a responsibility, although yet to be clearly defined, for the management of natural resources. Such institutions are important for community empowerment and for involvement in river basin management. At a District level there is construction of underground water recharge structures to ensure availability of water in the drinking water wells; protecting drinking water supplies from irrigation wells, social forestry planning. Taluks construct and augment water supply works for less than 40 L/p/d Village GP provide sanitary latrines, and maintain water supply works
Irrigation Consultative Committees (ICCs)	Determine for command areas, the irrigation plan (time for water release, quantity and period of supply, area to be supplied at different times
Urban local bodies	Request scheme implementation and take over scheme on completion
Other Water Users	
Industry	Industry is a significant water user (groundwater and surface water) as well as being a serious source of point source pollution.
Hydropower	Private hydropower operators can affect downstream water (flow, quality and river bank) conditions as well as affect users of the reservoir such as fishers and recreationalists
Irrigation Farmers	Irrigation farmers and their practices can affect land and water conditions through inefficient practices leading to waterlogging and salinity, non point source pollution, as well as taking water beyond their entitlement. Downstream farmers may suffer the consequences of upstream inefficient practices
Fishers	Fishers have requirements for water supply of good quality
Watershed users	Watershed users especially rainfed agriculture but also forest users and tank management bodies affect catchment conditions and particularly water yield and water quality
Miners	Mines can be significant water users but most importantly can have serious water quality impacts both in the short term and after mine closure
Urban Society	Urban society has direct interest in water supply and clean water. They also often have a strong environmental consciousness especially as wealth and education increases.
Recreation and Tourism	Water related recreation and tourism is important in many communities and people
Civil Society Organisations	Civil society and NGOs often have a strong interest in water resources, environmental quality and living condition issues.

Public Awareness, Consultation and Participation: All of these stakeholders have interest in water resources management and to varying degrees need to be involved in water policy development, river basin and Land and Water Management planning. In order to best focus the most appropriate type of participation each of the main activities of the project will undertake a stakeholder assessment (identifying stakeholders, their interests and responsibilities for water resource management outcomes, prioritization of their direct involvement, appropriate form of involvement) appropriate to the project.

Forms of participation will include: a) Direct involvement in project development, planning and implementation through membership of project groups, b) Direct involvement through extension and WUA activities, c) Consultation at key stages of project development and implementation (eg. through public meetings, surveys, focus group discussions), d) Communication and awareness raising approaches such as through newsletters (paper and electronic), newspaper, television etc.

6 Programme Design

The impact of the proposed program is sustainable water security and sustainability in selected river basins in Karnataka State. The proposed outcome is improved water resources management in the Tungabhadra[47] sub basin in Karnataka.

[47] *The Tungabhadra sub-basin of the Krishna River is proposed as the focus for demonstration of IWRM approaches and for upgrading of services in selected irrigation systems.*

Program Outputs: The program over the ten year implementation period proposes to achieve the following outputs:

i. Strengthening of State and basin level institutions for IWRM: This will be based on further assessment (led by AC-IWRM) of institutional and policy approaches and development of a State IWRM Strategy based on assessments of approaches undertaken elsewhere in India as well as internationally. This will take a comprehensive approach including institutional arrangements; water policies and planning at state, basin and local levels; information and knowledge management; government investment and cost sharing; and stakeholder participation..

ii. Irrigation infrastructure modernized and management systems and institutions strengthened: key indicators will include 4 irrigation schemes (360,000 ha area) with a more modern and effective operation system; strengthened WUCS in the project areas, minor canal O&M transferred, improved water distribution and cropping practices adopted; improved WUCS operational framework and O&M cost recovery plan implemented for the selected subprojects;

iii. Innovations to improve the water balance with new technologies and institutional modalities including water efficient irrigation (micro irrigation, water saving cropping in groundwater irrigation areas, etc.); remote sensing of consumptive use and water productivity suitable for planning, management and monitoring purposes; an integrated open source water resource modeling system including ecological aspects for river basin scale planning and management of river operations; river basin planning to achieve sustainable water balances and adaptation to climate change; canal system management using telemetric systems and data management system linked to telemetric rainfall monitoring at selected telemetric locations; community based Land and Water Management Plans leading to comprehensive management of irrigation areas including water balance and conjunctive use, water and crop management, return flows and raising productivity; low pressure gravity pipe distribution and water saving irrigation techniques.

Environmental and Social Safeguards

Environmental Safeguards: Environmental safeguard assessments including an analysis of relevant environmental legislation have been made. An Environmental Assessment Review Framework (EARF) and an Initial Environmental Evaluation (IEE) have been prepared in line with ADB requirements. . The project also has to comply with the Government of India legislation including the Environmental Protection Act, 1986, the Karnataka Forest Act 1963 and the Ancient Monuments Act 1958 and these assessments are underway.

The preliminary assessment of the project area identifies a few environmental risks that should be addressed including (i) excessive and improper agrochemical usage resulting in health issues as well as surface water and groundwater pollution. This risk is likely to increase with irrigation intensification and the larger area under agriculture; (ii) poor crop and land management, such as monocultures resulting in reduced soil health and soil salinisation; (iii) poor management of quarries and borrow sites resulting in increased vector habitats, scaring of landscape and possible accidents at the sites; (iv) poorly planned project design interventions resulting in reduced access to water in villages for domestic and livestock needs as well as for irrigation during construction; and (v) larger areas under paddy and other high water usage crops creating waterlogging, salinisation and increased vector habitats. Some projects would require workin highly significant and archeologically important areas which will require careful planning and management.

To address these concerns planned engineering and agriculture interventions would need to incorporate appropriate design actions and the direct involvement of key stakeholders. This would include: (i) identification and development of an appropriate extension system to support farmers, (ii) appropriate Integrated Pest and Nutrition Management (IP&NM) interventions, (iii) systems for improved soil and crop management, (iv) design and irrigation application interventions that ensure protection of archeological sites in project area, and (v) appropriate drainage management and irrigation rationalization. The project Environmental Management Plan will also develop guidelines on the management of quarries, borrow areas etc. and identify required contractor clauses for labour safety and site management.

Social Safeguards: The Indian Government's mandate of adopting a comprehensive strategy for faster and inclusive growth under its 11th and Draft 12th Five Year Plans is closely aligned with ADB's country partnership strategy for India. The Government of India has the reduction of poverty as its primary goal under its current policy and the 11th Five-year Plan (2008–12) stresses poverty reduction and social development, aiming at reinvigorating the rural economy, creating jobs, providing essential service to the

poor, increasing manufacturing competitiveness, developing human resources, protecting the environment, and bridging the divides between regions, sectors and genders.

Agriculture forms the mainstay economy of the rural households in the project areas with more than 70 percent households engaged in primary sector activities with irrigated agriculture (more than 95 percent households) being dominant in the region. The project beneficiaries rely heavily on channel water for non-agriculture purposes such as for domestic needs and keeping livestock etc. Besides agriculture, the secondary occupations include dairy development and milk production. The subproject constitutes 85 percent marginal and small famers (less than 2 ha). Field Group Discussions revealed strong support for the project among all sections of the rural communities.

Positive socio-economic and poverty reduction impacts are seen as: (i) improvement in farm income and employment, (ii) improved access/equity of irrigation service delivery, especially to tail reach farmers, (iii) reduced water loss and wastage, (iv) enhanced agricultural practices, crop diversification, food security in particular for marginal farmers (under 1 ha) and landless households of the households of subproject, (v) strengthened WUCs and increased community participation and gender inclusion, and, (vi) improved health and hygiene condition. The project interventions have negligible land acquisition and negative resettlement impacts. In addition, in terms of economic benefits, poor households, especially landless households will benefit from increased hired on-farm labour, though expected increases are small and retained farm income for marginal farm households is expected to increase by 53% including the value of family labour retained by the family. The project has developed a Poverty Reduction and Social Strategy to provide safeguards as well as to assure the social benefits of the project.

Gender participation in participatory irrigation management in the subproject areas has remained low (between 10-15 percent) as WUCS membership is linked to landownership and 85% of men hold legal land ownership and hence access the WUCS platform. In addition, women's participation in training and agricultural extension in irrigation systems management and improved crop water management practices has been low. An overall lack of gender focus in institutional strengthening may be observed in the subprojects. From the field discussions, however, women in the project areas are progressive and with strong participation in various other government programmes. The project will consider how the *India Country Partnership Strategy 2009-12* action areas of (i) reduction/removal of gender bias in the functioning of institutions; (ii) development of vocational skills among female farmers; (iii) promotion of women's groups to improve their access to credit, agricultural technology, and markets; and (iv) reduction/removal of barriers to women's participation and/or representation in community-based institutions. The project will enhance and mainstream women's participation in irrigation management by developing a comprehensive sex disaggregated information base, identifying gaps and expanding women's knowledge through various training programs and assist their needs for water for household use, drinking, livestock and hygiene. The project will provide a platform for increasing women's participation in irrigation management, as there is visible pre-project gender imbalance. The project has developed a Gender Action Plan to promote gender-inclusive project design and implementation.

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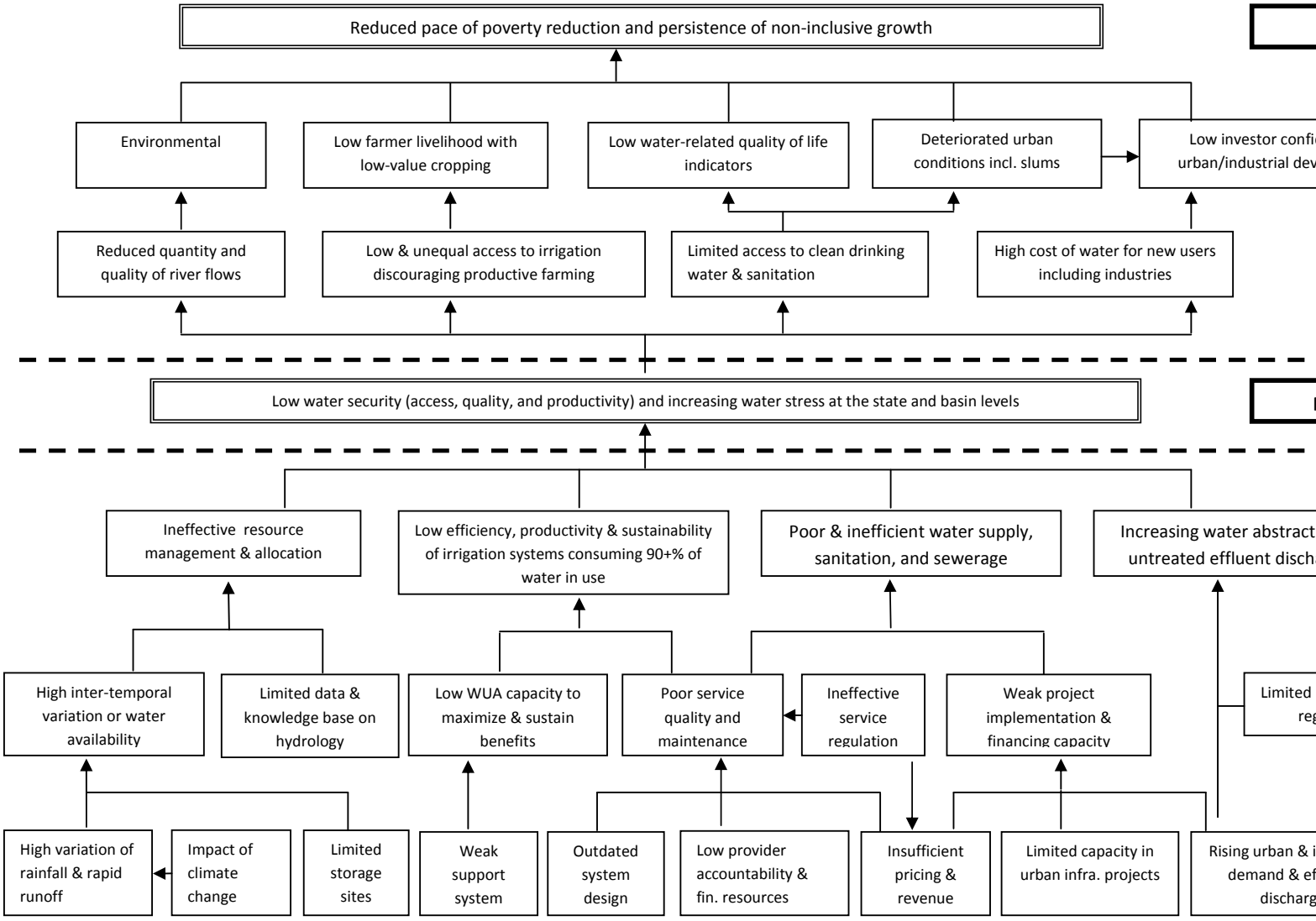
APPENDIX 1: PROBLEM TREE ANALYSIS FOR KISWRMIP



Best not to include as this is still under development and yet to be agreed

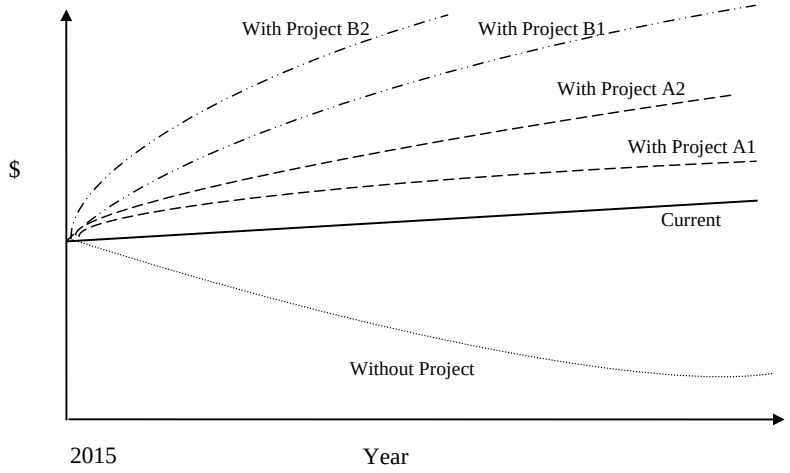
7 Expected Benefits

COMMENT: THE FOLLOWING IS BASED ON AN UPDATED ECONOMIC ANALYSIS:

Overall the Program is initially anticipated to modernise and extend 345,000 ha of major and medium irrigation systems that are low-performing at present, potentially benefiting about 1.5 million people. An additional 57 Thousand Million Cubic Feet (TMC) of water saving (1,700 million m^3) of water would be released for new irrigation on up to 160,000 ha.

Economic and financial analysis was undertaken for an initial candidate project for modernisation. The studied CCA comprised 4,600 ha and is a fully developed irrigation scheme with current cropping intensity of 138% which will not increase within the command area. Over 60% of the scheme is perennial crop (arecanut) and this area is expanding. Analysis of financial affordability, distribution of benefits and economic feasibility was undertaken, and the capacity and willingness of farm households to participate was assessed. Benefits are based on increased net crop production including as a result of, (i) increased yields; and, (ii) changed cropping patterns and areas. Costs included input costs, agricultural extension; support to WUC development; a proportion of overhead costs including consulting services, training, and administration; capital development costs; and operation and maintenance costs. A number of scenarios were compared including the baseline without project scenario (on-going degradation of the irrigation system causing increasing production losses) and with project scenarios (eg. loss/no loss of downstream production, percentage of channel lining and use/non use of water savings, and release of water savings to new irrigation). The project will also remediate and manage both potential environmental and social impacts from the modernisation activities although these were not valued. Crop production was based on cropping patterns, outputs, use of inputs and labour based on farm surveys in the subproject.

Figure XX: Schema for assessing modernisation scenarios



Scenarios involving increased water use efficiency, targeted canal lining and works to offset future water shortages indicated the strongest justification for future investment. A limitation of the analysis however was a detailed analysis of water use compared to water consumption, the significance of water returns to downstream water users and the extent of real water savings.

The overall Program is most focused on introducing an IWRM approach to water resources management in order to coordinate management by the water using sectors and, in particular, to take a river basin management approach to manage water quantity and quality. In particular, it will highlight the imperative that water consumption needs to be less than the sustainable surface and groundwater resource in the longer term and for transparent and rules based water sharing between users, including the environment. This aspect of the project is expected to have the greatest impact

and benefit both within the involved river basins but also more widely in other river basins in the state as well as potentially more widely in India.

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