PROJECT PREPARATION TECHNICAL ASSISTANCE

ADB TA 7954-IND

FEASIBILITY REPORT

for the

Karnataka Integrated and Sustainable Water Resources Management Investment Program

VOLUME 1: MAIN REPORT

April 2013

Prepared for the State Government of Karnataka and the Asian Development Bank

By

DHV BV, The Netherlands in association with DHV India Pvt. Ltd.

Abbreviations

AC-IWRM	Advanced Center for Integrated Water Resource Management
AIBP	Accelerated Irrigation Benefit Program
CADA	Command Area Development Authority
CDTA	Capacity Development Technical Assistance
CMO	Central Mechanical Organisation of WRD
DPR	Detailed Project Report
EA	Executing Agency
EARF	Environmental assessment and Review framework
EIRR	Economic internal rate of return
EMMP	Environmental management and mitigation plan
FIRR	Financial internal rate of return
FY	Fiscal Year (April 1 – March 31)
GAP	Gender Action Plan
GOI	Government of India
GSDP	Gross State Domestic Product
IA	Implementing Agency
ICB	International competitive bidding
IEE	Initial environmental examination
IP	Indigenous people
IRBM	Integrated River Basin Plan
IWRM	Integrated water resources management
KERC	Karnataka Engineering Research Center
KISWRMIP	Karnataka Integrated and Sustainable Water Resources Management Investment Program
KNNL	Karnataka Neeravari Nigam Limited
KUIDFC	Karnataka Urban Infrastructure Finance Corporation
KUWSDB	Karnataka Urban Water and Sewerage Drainage Board
LDO	Land Development Officer
LWMP	Land and Water Management Plan
MCM	Million Cubic Metres
MFF	Multi-Tranche financing facility
MIS	Management information system
NCB	National competitive bidding
NGO	Non-government organization
O&M	Operation and maintenance
PIM	Participatory irrigation management
PMU	Project Management Unit
PPP	Public Private Partnership
RBO	River Basin Organization
RP	Resettlement plan
SGOK	State Government of Karnataka
SPCB	State Pollution Control Board
TLBC	Tungabhadra Left Bank Canal
TMC	Thousand Million Cubic Feet (1 TMC = 28.317 MCM)
WALMI	Water and Land Management Institute of WRD
WRA	Water Regulatory Authority
WRD	Water Resources Department, Government of Karnataka
WRDO	Water Resources Department Organization, Government of Karnataka
WUCS	Water User Cooperative Societies

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EXECUTIVE SUMMARY

The Project Area

1. The State of Karnataka lies in the south of India and covers an area of 191,976 square kilometers, or 5.83% of the area of India. It is the eighth largest Indian state by area with over 61 million inhabitants. The two main river systems of the state are the Krishna and its tributaries (Bhima, Ghataprabha, Vedavathi, Malaprabha, and Tungabhadra) in the north, and the Cauvery and its tributaries (Hemavati, Shimsha, Arkavathi, Lakshmana, Thirtha, and Kabini). Both these rivers flow eastward and fall into the Bay of Bengal.

2. The Tungabhadra sub-basin (TB), the main pilot area for this project, lies within the Krishna River Basin and largely within Karnataka. Rainfall for the sub-basin follows a monsoonal pattern, and roughly reflects elevation which ranges from 1,200 m to 500 m. Annual rainfall is from 300 cm in the south (Western Ghats), and to less than 50 cm in the northeast. Droughts are frequent. During the southwest monsoon of June to September, the sub-basin receives on average about 70% of the annual rainfall, September being the wettest month. The average annual runoff from the sub-basin is about 6.6 km^3.

3. The command area of the Gondhi Anicut canals of this project is in Bhadravathi Taluk and has an average annual rainfall of 769.4 mm and a tropical climate. June to September are wet months with October and November experiencing little rainfall from the NE monsoon. The topography of the command area is uneven and undulating with moderate slopes of 0.5% to 3% with a medium slope from the canal to the river.

4. The Gondhi Anicut canal is a small scheme of 4,600ha constructed 60 to 90 years ago with a 74.4 km main canal on the right bank (4,253 ha) and 14.5 km on the left bank (212 ha). There are 20 tanks in the command. The Gondhi canals currently benefit from return flows from the adjacent Bhadra command area and these are expected to reduce as the Bhadra system operation is improved. Modernization of Gondhi is required to mitigate adverse impacts. The canals are unlined and in poor condition and the bottom 60% of the system is believed to receive its irrigation supply from the Bhadra system rather than through the canal system which is blocked with sediment in some places. The system is suitable for inclusion in Tranche 1 as design work is already in progress and the area is suitable for piloting improved distribution systems and management.

Socio-economic Conditions

5. The command area comprises an approximate population size of 67,057 in 12,861 households with an average family size of 5.2 and 970 females per 1,000 males (Census 2001). Scheduled Caste and Scheduled Tribe comprise 18.8% and 3.3 % of the population respectively. Most of the villages are well connected and serviced by metal roads, water supply and electricity, health centers schools, and agricultural services. Linked to this are indicators showing good progress in human development sectors. The poverty level of the project area is lower than the national average. The average annual household income is INR 72,134 ranging between INR 132,632 for large farmers to INR 42,375 for the landless.

6. The Worker Female Participation Ratio rate is 45% and male workers constitute 68% of the total workers, while female workers account only for 32%. Male and female participation in agriculture and allied sectors are 49% and 26% respectively. Women constitute 49% of the population and have a relatively low literacy rate of 52% (Census 2001), compared to males (67%). Approximately 85% of men are the main decision makers of households and manage the household finances and 80% possess legal house/land ownership. Participation of women in Water User Cooperative Societies (WUCS) is low at 10-15%.

7. From household survey data the mean farm size is 1.18 ha and there is a decline in farm size from the canal head (1.7 ha), middle (0.92 ha) and tail (0.75 ha), 29% of farms in the head reach were medium size, just 2% in the tail reach. The majority, 53%, of farms in the sample were marginal (under 1 ha), only 3 farms were over 4 ha. Households below the poverty line were mostly landless (18%) or marginal (73%). Distribution of farm size by caste was generally similar, except that all of the Scheduled Tribe households were landless.

8. Irrigated agriculture is dominant in the subproject (more than 95% of households) and the main crops grown are paddy, sugarcane and garden (arecanut) /semidry crops. The project beneficiaries also rely heavily on channel water for non-agriculture purpose like meeting their domestic needs such as washing, bathing, health and hygiene and keeping livestock etc.

9. Key water related issues raised were insufficient water reaching tail end farmers, and, uncontrolled water is causing waterlogging in villages, damaging homes and causing unhygienic living conditions. More than 95% of farmers considered that lining and modernization work of canals would benefit their well-being and livelihoods.

10. The farmers supported the proposed interventions with 70% of households willing to participate in construction, make cash and labor contributions, and participate in extension, and in WUCS provided they got assured water supply and government commitment.

Agriculture

11. Paddy is the main seasonal crop in both Rabi and Kharif and sugar cane and arecanut are the perennial crops. Kharif season cropping makes use of irrigation as well as monsoon rainfall, while Rabi season cropping, though assisted by rainfall, makes use of residual soil moisture following Kharif and is otherwise dependent on irrigation.

12. Pumped water, mostly from the river is utilized for conjunctive use by farmers in the middle and tail reaches particularly during scheme closure (1 month in late November and December), and in the lower part of the scheme (below km 44 on the right bank canal) during the closure of Bhadra canal in May to July. Water may be pumped several kilometers from the river. There are small areas of drip irrigation for arecanut. The area served by pumped water is not known, but may be 20% to 30% of the crop area.

13. Fertilizer use on Gondhi scheme is considerably higher than the state average, and said to be twice recommended rates. There is no soil testing and the nutrient status is not known. The use of organic manure and farm yard manure is low. Micro nutrient deficiencies are increasing. The application of pesticide has also become common. Farm labor costs are increasing, and farmers are increasingly adopting mechanized agriculture, especially tractor ploughing, weed control, and transport, seed planting, and contract combine harvesters.

14. Investigations found that 75% of the gross command area was cropped and the rest is built up and farmstead areas, river, roads, non-crop trees, land out of command, and open water; 37% of the cropped area was under seasonal crops, 49% tree crops and 12% under sugar. According to the household survey cropping intensity in the area is 131% overall and about 160% on land with no perennial crops. The cropping pattern is dominated by paddy rice with around 40% of the area in both Kharif and Rabi seasons. The Gondhi scheme is fully developed, with almost 100% cropping in both Kharif and Rabi seasons. There is potential to improve yields in the Gondhi area through improved crop water management, crop diversification, improving cropping systems (eg. for arecanut, SRI rice), drainage, soil fertility management, and pest management.

15. The mean annual agricultural income from the household survey was Rs 54,000 per household, ranging from Rs 5,000 to Rs 330,000. Other non-farm income was relatively small.

Assessment of the Irrigation System

16. The main canals are contour canals and the height above the river increases with distance downstream. The system is in poor condition, most notably the right main canal where water appears to be unable to pass from head to tail as a result of sediment blockage from about km 45. Below this water comes from the Bhadra system as overland flow and intercepted drainage (most likely the source of the sediment). The downstream 40% of the Gondhi system is therefore vulnerable to water shortage when the Bhadra system is not operating. The water balance, agricultural water requirements and canal flow requirements were calculated to assess the engineering design of the project's Detailed Project Design (DPR).

17. There are 20 tanks within the right bank command area many of which are enlargements of the main canal. One of these tanks commands about 260 ha and has gated outlets to enable active management of supply. There are about 150 pipe outlets, typically serving 20-320 ha directly from the main canals. Some of these have gates but they are never operated and others have no gates at all. The result is uncontrolled release of water. There is no engineered drainage system although there are many reports of waterlogging.

18. The primary objectives of the modernization include supply of canal water to the lower Gondhi canal section and to save water that is to be transferred to a newly constructed irrigation area in the Upper Bhadra.

Responsible Government Institutions

19. The responsibility of operation and maintenance of the Gondhi Anicut Project (anicut and canal works) lies with the Karnataka Neeravari Nigam Limited (KNNL) through its field office of Chief Engineer, Upper Tunga Project (UTP) Zone, Shivamogga. The project is under the jurisdiction of the Superintending Engineer, Bhadra Reservoir Project Circle, B R Project.

20. Responsibility for the command area aspects of the project, including construction of field irrigation channels and drains, command roads, reclamation waterlogged soils and formation and support to WUCS lies within the jurisdiction of the Bhadra Command Area Development Authority, Malavagoppa, Shivamogga. Agricultural support services for government schemes and subsidies are provided through the Shivamogga District Agriculture Department Office. There are 3 Community Service Organizations active with canal irrigation in the project area.

Water User Cooperative Societies (WUCS)

21. There are 9 WUCS in Gondhi Right Bank Channel 3 of these have entered into Memorandum of Understanding (MOU) with KNNL on water management and have benefited from a one-time functional grant which is kept in the Bank as fixed deposit. On the left bank there is potential to form one WUCS. Overall the effectiveness and activities of WUCS in the project area is very limited.

Proposed Project

22. The overall objective of the project is to modernize the irrigation infrastructure so that a fully functioning irrigation system is left in place and WUCS that are independent self-sustaining entities capable of fulfilling their responsibilities including irrigation management;

equitable distribution of water to farmers; O&M of minor canal system and collection of irrigation water charges; and, capable of interacting with service agencies including KNNL / CADA, Agriculture Department, Horticulture Department and other Departments to ensure that they receive necessary services. The goal is a significant improvement in water use efficiency coupled with an increase in agricultural productivity which in turn should lead to substantial improvement in the income of farmers.

23. The Gondhi scheme is proposed for inclusion in the first tranche of KISWRMIP because modernization is needed and, although the scheme has a small area, the 74km length of the right main canal replicates many of the operational issues of much larger systems. In addition, the Gondhi canal has, for many years, received supplementary water as return flows from the adjacent Bhadra canal system but this source of water is diminishing as that system becomes better managed. The terrain in the Gondhi command area is suitable for piloting alternative distribution systems and the area is sufficiently small to give potential having fully-functioning WUCSs within the implementation period.

24. The proposed interventions reflect the perceived project needs identified during the socio-economic survey activities. The following interventions are envisaged to upgrade the Gondhi system with a command area of about 4,600ha.

25. Proposed Tranche 1 project components comprise:

Project 1: Modernisation of Bhadra Canal Control and Gondhi Command Area
Sub Project 1-1: Canal System Infrastructure Upgrading
Sub Project 1-2: Command Area Development
Project 2: Improved Operation and Maintenance at all levels of the system
Sub Project 2-1: Improved Operation and Maintenance at all levels
Project 3: Strengthening of KNNL and CADA System Management
Sub Project 3-1: Institutional and Management Systems Strengthening
Sub Project 3-2: Assessments of Tranche 2 projects
Project 4: WUCS and Agricultural Development
Sub Project 4-1: WUCS Institutional Development & Capacity
Sub Project 4-2: Agricultural Development and Livelihood Enhancement

26. Specific interventions include:

- Repairs to the Gondhi anicut and canal headworks.
- Improvement of main canals and distributaries including provision of concrete canal lining and upgrading of canal access roads.
- Repair / replacement of all canal structures including bridges and crossings, drainage inlets and relieving weirs, pipe outlets and provision of new structures such as cross regulators. Ramps into canals for laundry and animal drinking will be provided.
- Modification of current on-line storage tanks where feasible to become actively managed off-line storage and enhancement of existing off-line tanks.
- Where feasible, remodelling of the drainage inflow and relieving weir arrangement to avoid water (and associated sediment) entering the main canals unless required.
- Managed conjunctive use of canal water, water stored in tanks and groundwater where possible. Small pilots of gravity pressurised irrigation from the main canal.
- Command area development works comprising lined channels, low pressure gravity-supplied pipe distribution and improved drainage.
- Provision of electronic flow measurement with telemetry at about 20 locations on the main canal and drainage system and flow measurement at all outlets. Electronic flow

measurement and control systems will also be provided for the Bhadra canal system and selected locations on other irrigation schemes in the K8 sub-basin.

- Capacity development of system operations staff and water users.
- Strengthening of WUCS for effective water management, agriculture and minor system O&M.
- Agricultural extension and on-farm water management training. Proposed agricultural interventions to support DPR implementation are to address (i) Soil Fertility, (ii) Irrigation Water Savings and IWRM, (iii) Cropping Patterns and Intensification, (iv) Farm Mechanisation, (v) Chemicals and Pest Management (vi) Agricultural Extension and Communications, (vii) Research and Demonstration.

27. Implementation scheduling is an important aspect of the project for management particularly as construction is to take place in relatively short canal closure periods.

28. Reports on 'Crop Water Requirements and Design Discharge', 'Gondhi Irrigation System: Use of Precast Concrete', 'Construction Schedule' and 'Agricultural Intervention Outlines' are presented in Volume 2.

Initial Environmental Assessment

29. The main detrimental environmental impacts from the project are likely to be during the construction phase with the main activities of concern being procurement of material, transport routes, material storage, and possible labor camps. These concerns relate to: (i) safety of the workers and local population, (ii) waste disposal, (iii) impact on local ecosystems, (iv) reduced access by the local population dependent on sites, (v) long term degradation of sites such as erosion or waterlogging due to inadequate rehabilitation, (vi) damage to local infrastructure, and (vii) health risks from poor site management or safety and labor management.

30. Possible modification to the operation of tanks may have some impact on the associated wetland system however the environmental impact of this is likely to be minor. Agricultural interventions and intensification are likely to result in more targeted use of agrichemicals and result in issues from waste and container disposal.

31. Overall however and on balance, these environmental impacts are likely to be manageable and minor. The Gondhi sub-project is classified as Category B. The Bhadra subproject has a very limited set of activities and as a result the sub-project is classified as Category C.

32. The impacts of the sub-project are likely to be managed with appropriate interventions and any additional unforeseen issues and impacts should be recorded and monitored. The *'Initial Environmental Evaluation'* including *'Environmental Management Plan'* and *'Bhadra sub Project Environmental Considerations'* are provided in Volume 2.

Resettlement

33. Field assessment of the likely social and Rehabilitation & Resettlement (R&R) impacts found no anticipated major resettlement issues. The field assessment of a few canals and with the beneficiary communities revealed that the right of way (RoW) for the canal system seems to be available. Very minimal temporary impacts may be involved especially if construction camps are establishment. This will be confirmed during detailed planning. The project is likely to fall under Category C with regard to resettlement impacts for which only a resettlement framework incorporating the Indigenous People (IP) issues is proposed.

Indigenous People

34. Indigenous people constitute a very small proportion of the command area population (3.3 percent are Scheduled Tribes, ST), and nearly 40 percent of the project villages do not comprise any ST population (Census 2001). Considering the sub-project interventions, their likely impact on the ST is expected to be minimal the project is classified as Category C.

Financial and Economic Analysis

35. An economic and financial analysis was carried for the sub-project. The engineering base cost of the sub-project is $US 23.66 million (INR 1,301 million) which with costs for WUCS and project management and contingencies becomes INR 1,460 million. O&M costs were estimated as INR 800/ha which increases by 25% for the unlined canal scenarios.

36. Water charges are paid by farmers according to crop and season. In future, collection of water charges will be undertaken by the WUCs, and used for O&M, 30% being passed on to WRD for overheads. Water charges are included in the crop budget models, but even at 100% collection the water charges are only about 30% of the total O&M cost.

37. Crop budgets were prepared for Kharif & Rabi rice, other semi dry crops (maize), sugarcane and arecanut. Key inputs, fertilizer and harvest labor were related to yield rates. Yield rates with the project increase by 20% over three years and by-products are directly linked to yield. Inorganic fertilizers and harvest labor are linked to the yield rate. SRI rice is being adopted in Karnataka, and it is envisaged that this will be introduced into the subproject.

38. Farm models were prepared for marginal, small and medium farmers using the average farm size for each and assuming a farm family labor rate. Analysis shows that retained farm income is expected to increase by 53%, 41% and 41% respectively for marginal, small and medium farm households.

39. The economic viability of the Subproject is assessed by estimating its economic internal rate of return (EIRR) and benefit-cost ratio over an expected scheme life of 25 years. Sensitivity analysis was undertaken for the key perceived risks. An assessment of the impact of the subproject on poverty reduction is also undertaken. The social discount rate for NPV is assumed at 12%, which is high compared to other investment opportunities, but is the rate normally assumed for development projects in India. Project benefits relate to delivery of water beyond km 44 of the canal as the current supply from Bhadra is planned to cease reducing a total production loss of 20%, changed cropping patterns and improved yields, and the transfer of 0.5 TMC to the Upper Bhadra scheme. A series of scenarios were tested including canal rehabilitation without lining. The economic returns are estimated as follows:

Scenario	Without Yield Reduction (%)	Saved Water Net Return (%)	EIRR (%)	NPV (Rs million)	B:C ratio
With Lining					
A1a: Gondhi scheme, 100% lining	*0*		*9*	-138	0.8
A1b: Add avoided end of Gondhi loss	*20*		*17*	274	1.2
A2: Add diverted water value	*20*	*25*	*22*	631	1.4
Without Lining					
B1a: Gondhi scheme, no lining	*0*		*15*	102	1.2
B1b: Add avoided end of Gondhi loss	*20*		*26*	514	1.4
B2: Add diverted water value	*20*	*25*	*32*	871	1.7

'Gondhi Subproject Base EIRR Report', *'Financial & Economic Analysis: Markets and Prices*' and *'Crop Physical and Financial Budgets*' are provided In Volume 2.

Project Institutional Arrangements

40. The Executing Agency will be KNNL. Implementing agencies will be: (i) Upper Tunga Project Zome of KNNL for civil engineering works, implemented through private contractors; (ii) Bhadra CADA for on-farm infrastructure works in Gondhi project; and (iii) WUCS Support Service Team for WUC activities (and extension?). A project steering committee will provide oversight and guidance.

41. The Project Management Unit (PMU) will be responsible overall for delivering the KISWRMIP and it will be located in in Munirabad within the KNNL with the Chief Engineer, Irrigation Central Zone, Munirabad as the Project Director. The PMU will comprise 4 administrative staff, including for monitoring, and 9 technical staff.

1. PHYSICAL ENVIRONMENT

1.1 Location

1. The State of Karnataka, in the southern part of India is confined roughly within latitude 11°35' North and 18°30' North and, 74°5' East and 78°35' East. It is situated on a tableland where the Western and Eastern Ghat ranges converge into the Nilgiri hill complex. The state covers an area of 191,976 square kilometers, or 5.83% of the total geographical area of India. It is the eighth largest Indian state by area. With over 61 million inhabitants (2011), Karnataka is the ninth largest state by population and comprises 30 districts. Kannada is the most widely spoken and official language of the state. Karnataka is bordered by the Arabian Sea to the west, Goa to the northwest, Maharashtra to the north, Andhra Pradesh to the east, Tamil Nadu to the southeast, and Kerala to the southwest. The state extends to about 750km from North to South and about 400km from East to West.

2. The two main river systems of the state are the Krishna and its tributaries (Bhima, Ghataprabha, Vedavathi, Malaprabha, and Tungabhadra) in the north, and the Cauvery and its tributaries (Hemavati, Shimsha, Arkavathi, Lakshmana Thirtha and Kabini) in the south. Both these rivers flow eastward and fall into the Bay of Bengal.

Tungabhadra Sub-Basin (K-8)

3. The Tungabhadra Sub-basin, the main pilot area for this project, lies within the Krishna River Basin and largely within Karnataka. It contains three river systems; Bhadra, Tunga and Varada. Each of these rises in the Western Ghats and flow eastwards. This area is shown at Figure 2. The Tungabhadra River is an eastern-flowing river of southern India in the State of Karnataka. It is the chief tributary of the Krishna River and is formed by the confluence of two rivers, the Tunga and the Bhadra, at Koodli in Shivamogga District. These rivers rise in the eastern slope of the Western Ghats at Gangamula which has an elevation of 1,198 meters. The Tungabhadra flows east across the Deccan Plateau for a distance of 530 km, joining the Krishna River in Andhra Pradesh state, from where the Krishna continues east to empty into the Bay of Bengal. There are three major reservoirs formed by dams in the sub-basin: Bhadra, Tunga and Tungabhadra Reservoir which were constructed for large irrigation projects. The Vadara River joins the Tungabhadra just before it flows into Tungabhadra Reservoir. The catchment area upstream of the Tungabhadra reservoir is 25,820 km² and the river flows a further 170 km from the reservoir to Andhra Pradesh and a further 90 km to the Krishna river.

Gondhi sub-project

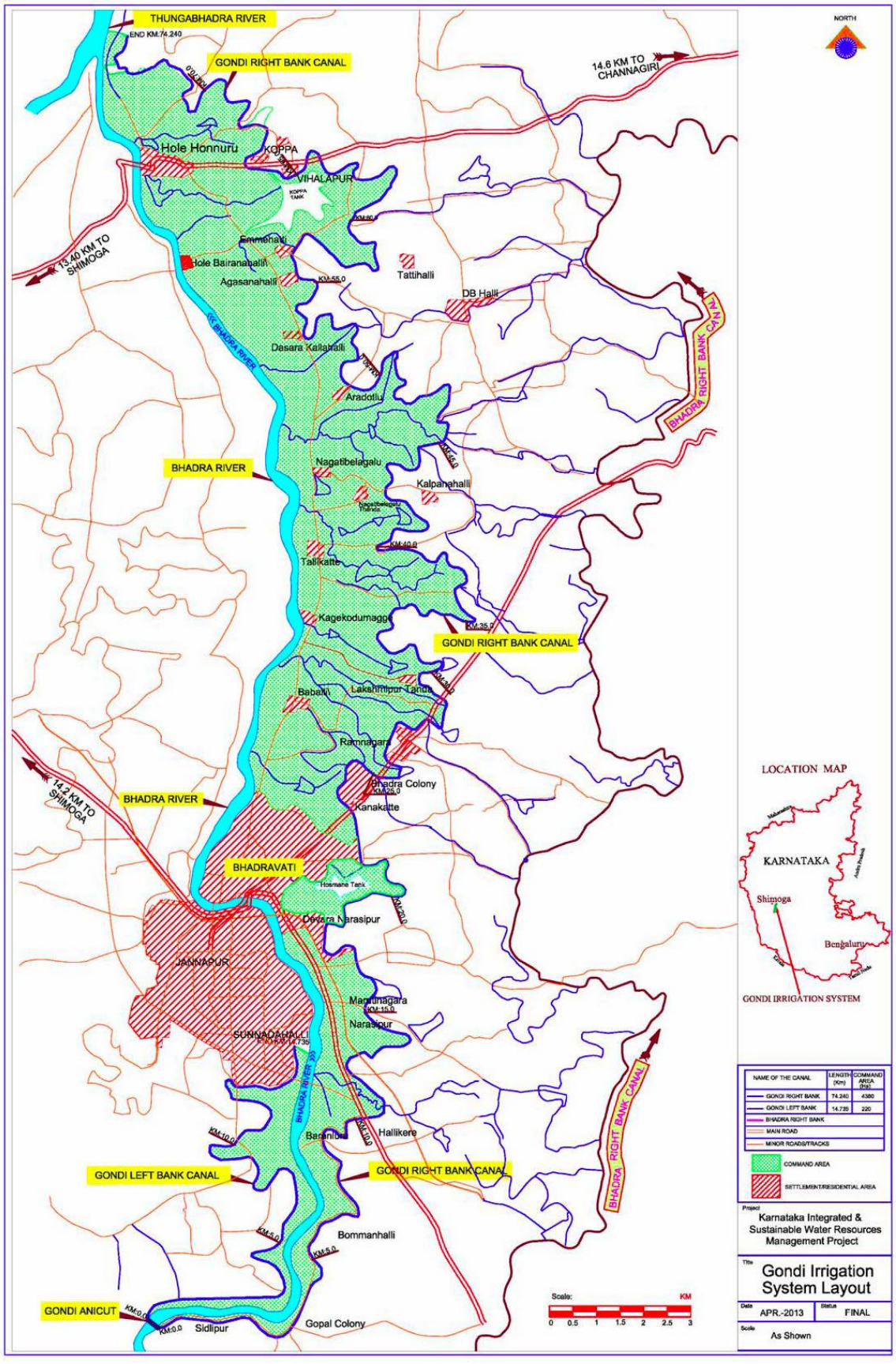
4. The Gondhi Anicut was constructed 14.5 km downstream of Bhadra Reservoir across the Bhadra River near Gondhi Village in 1916 and completed in 1926. Gondhi is 11.56 km from Bhadravathi Taluk, Shivamogga district at a latitude 13 46' N and longitude 75 41' E. The Gondhi Channel (sub-Project) has a Gross Command Area (GCA) of 5,060 ha, a Cultivable Command Area (CCA) of 4,600 ha and a sanctioned atchkat (command area) of 4,465 ha[1]. Gondhi Channel is designed for two crops i.e. kharif and rabhi season and has an allocation of 3 TMC (84.9 Mm³).

5. There are two main canals originating from Gondhi anicut:

6. The right bank canal of the anicut was commissioned in 1926 and completed in 1927 and has a design discharge of 265 cusecs (7.5 cumecs). The length of the right bank channel is 74.4 km with 16 distributaries with a total length of 34 km, and 130 Direct Pipe Outlets (DPOs) and 20 balancing tanks for a command area of 4,388 ha.

[1] Modernization of Gondhi Anicut and its canal Network in Bhadravati Taluk, Shimoga District, 3G Consultants

Figure 1: Layout of Gondhi Irrigation Scheme



7. The left bank canal was commissioned in 1951 and completed in 1953-54. It has a length of 14.5 km with a design discharge of 20 cusecs (0.57 cumecs) and has 20 DPOs providing water for 212 ha.

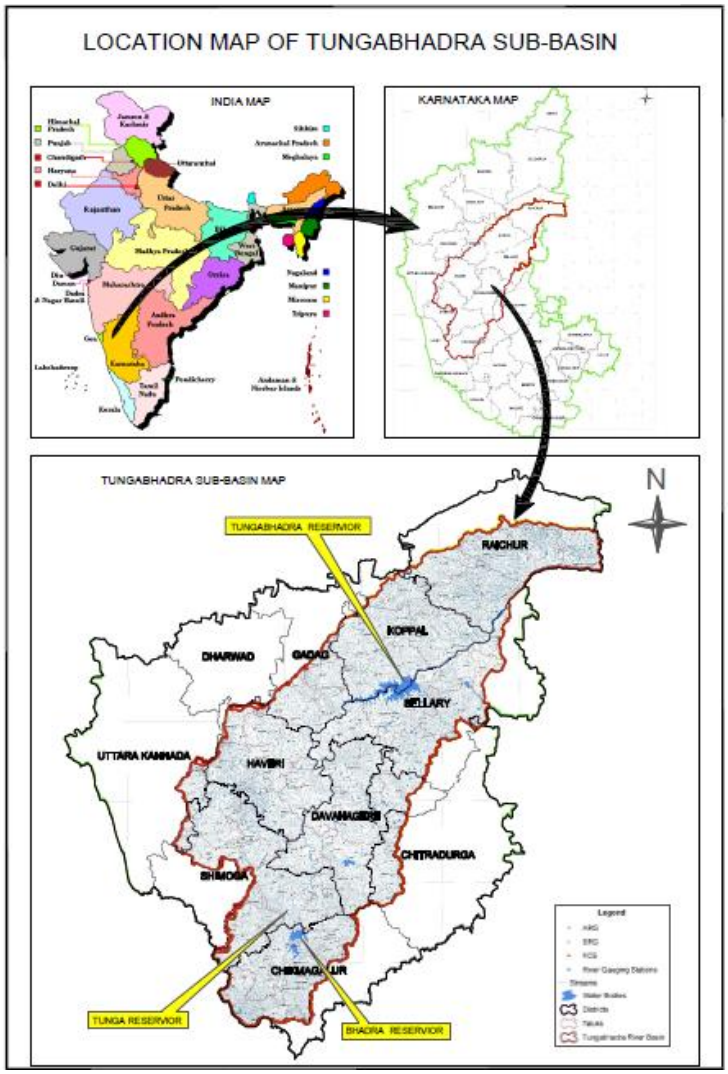
8. In addition to the direct supply from the Anicut, Gondhi canal also receives water from the Bhadra main canal due to poor canal water management and also drainage from the irrigated land. In critical times, intentional releases for Gondhi canal are made from the Bhadra system. Modernization of the Gondhi system is proposed to enable more effective and timely water delivery and improved water use efficiency to mitigate against the reduced return flows from the Bhadra command area arising from improvements in the operation of the Bhadra system. It is envisaged that the work will include some pilot activities such as detailed flow measurement and gravity piped distribution which, if successful, will be replicated elsewhere.

1.2 Climate

9. Karnataka experiences four seasons the winter in January and February is followed by summer between March and May, the monsoon season between June and September and the post-monsoon season from October till December.

10. The Rabi (dry season) and Kharif (wet season) agricultural seasons correspond to the months of November to April and May to October respectively.

Figure 2: Tungabhadra Sub Basin



11. For meteorological purposes, the State has been divided into three zones namely (a) Coastal Karnataka (Dakshina Kannada and Uttara Kannada Districts), (b) North Interior Karnataka (Belgaum Bidar, Bijapur, Dharwad, Gulbarga and Raichur Districts) and (c) South Interior Karnataka (the remaining Districts of Bangalore Rural, Bangalore, Bellary, Chikmagalur, Chitradurga, Kodagu, Hassan, Kolar, Mysore, Mandya, Shivamogga and Tumkur Districts). Of these, the coastal zone receives the heaviest rainfall with an average rainfall of about 3,638.5 mm (143 in) per annum, far in excess of the state average of 1,139 mm (45 in). Agumbe in the Shivamogga district receives the second highest annual rainfall in India. The highest recorded temperature was 45.6 °C (114 F) at Raichur and the lowest recorded temperature was 2.8 °C (37 °F) at Bidar.

12. The annual rainfall in the state varies roughly from 50 to 350 cm. In the districts of Bijapur, Raichur, Bellary and Southern half of Gulbarga, the rainfall is the lowest varying from 50 to 60 cm. The rainfall increases significantly in the Western part of the State and reaches its maximum over the coastal belt. The South-West monsoon is the principal rainy season during which the State receives 80% of its rainfall. Rainfall in the winter season (January to February) is less than one percent of the annual total amount, about 70% of the summer seasonal total (March to May), and for the post-monsoon season about 12%.

13. For the Tungabhadra sub-basin, rainfall follows a monsoonal seasonal pattern, and in terms of annual average rainfall, follows roughly according to the topographical elevations. While annual rainfall in the sub-basin, reaches more than 300 cm in the south (Western Ghats), it falls to less than 50 cm in the northeast and droughts are frequent. During the southwest monsoon months of June to September, the sub-basin receives on average about 70% of the annual rainfall, September being the month with the highest rainfall. The variations in the annual rainfall from year to year are large. The average annual runoff from the sub-basin is estimated at about 6.6 km^3.

14. The command area of Gondhi Anicut canals is located in Bhadravathi Taluk (a group of villages forming an administrative sub-division of the District division) which has an average annual rainfall of 769.4 mm and enjoys a tropical climate throughout the year. The relative humidity ranges from 27% to 88% and June to September are wet months with October and November experiencing little rainfall from the NE monsoon.

1.3 Geomorphology

15. The state has three principal geomorphological zones: The coastal region of Karavali, the hilly Malenadu region comprising the Western Ghats, and the Bayaluseeme region comprising the plains of the Deccan plateau. The bulk of the state is in the Bayaluseeme region, the northern part of which is the second-largest arid region in India. The highest point in Karnataka is the Mullayanagiri hills in Chickmagalur district which has an altitude of 1,929 meters (6,329 ft).

16. The topography of the Tungabhadra sub-basin ranges from hilly to mountainous in the extreme south of the basin, with elevations up to 1,200 m, to the flat terrain of the lower (northeast) part of the catchment at around 500 m elevation. Large areas of national park and conservation areas exist in the upper part of catchment and notably Kudremukh National Park (600 km^2) and Bhadra Tiger Sanctuary (490 km^2).

17. The Gondhi command area is uneven and undulating with moderate slopes of 0.5% to 3% with a medium slope from canal to the river.

1.4 Soils

18. Eleven soil orders groups are found in Karnataka, viz. Entisols, Inceptisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, Aridisols, Vertisols, Andisols and Histosols. Depending

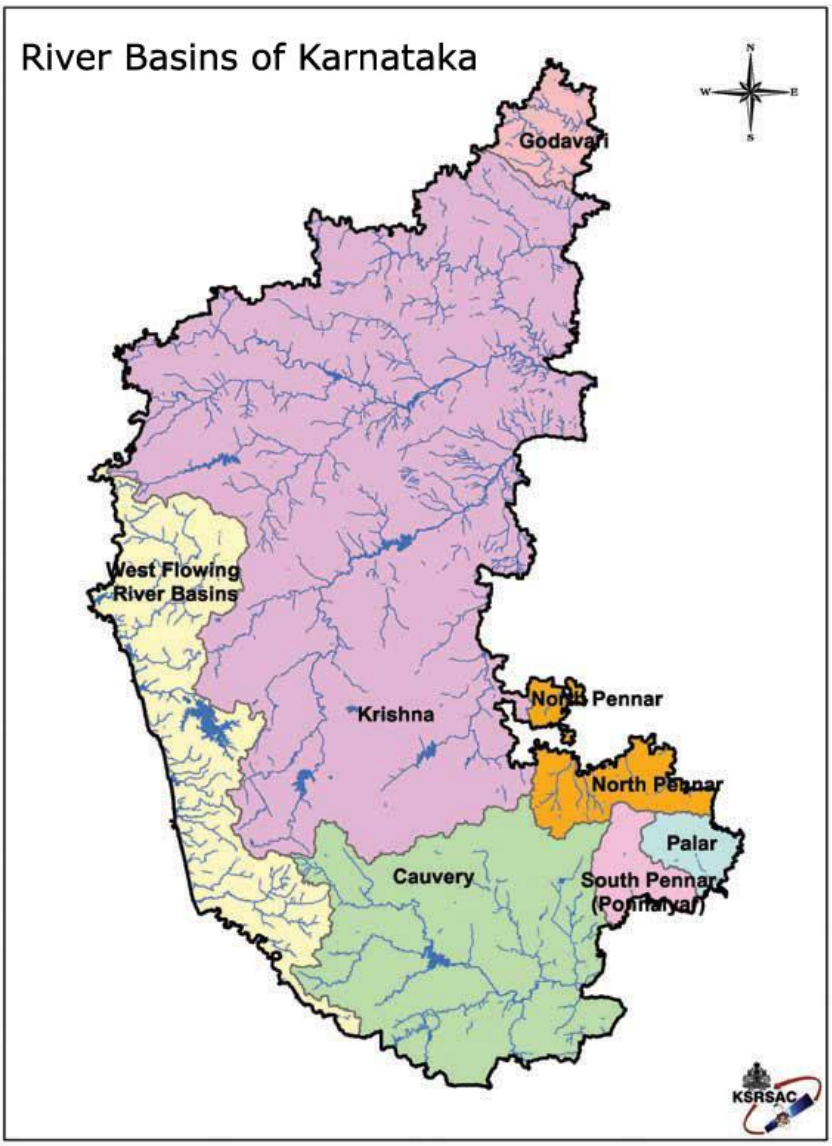
on the agricultural capability of the soil, the soil types are divided into six types, viz. Red, lateritic, black, alluvio-colluvial, forest and coastal soils.

19. The Gondhi command area largely comprises red sandy loam mixed with red soil to an extent of 80%. Clay soils are in 18% of the command area and black cotton soils in about 2% of the command area.

1.5 Surface Water Resources

20. Karnataka accounts for about 6 per cent of the country's surface water resources of 1,869 thousand million cubic meters (thousand Mcum)[2] or 66,000 thousand million cubic feet, (TMC). About 40 percent of this water is in the east flowing rivers and the remaining in the west flowing rivers. There are seven river basins with which their tributaries drain the state Figure 3.

Figure 3: River Basins of Karnataka



[2] http://www/wrmin.nic.in

Table 1: River Systems and Yields

River systems	Drainage area in thousand Sq.km.	Average Annual Yield in MCM (TMC)
Krishna	111.74	27,451 (969.44)
Cauvery	34.27	12,034 (425.00)
Godavari	4.43	1,415 (49.97)
North Pennar	6.94	906 (32.00)
South Pennar	3.76	906 (32.00)
Palar	2.97	
West flowing rivers	26.39	56,600 (1998.83)
Total	190.50	98,406 (3475.24)

21. As per the master river basin plans, the total utilization likely under major, medium and minor irrigation projects using surface water is 48,000 MCM (1,690 TMC). In the Tungabhadra sub-basin, water sharing and allocation is based on the Krisha Water Dispute Tribunal (KWDT) award which prioritizes drinking water as first followed by irrigation, industries and environment. Total water allocation across the sectors is 230.31 TMC out of which, agriculture sector gets the major share of 94.3%, 3.72% for industrial usage and 1.96% for drinking water use.

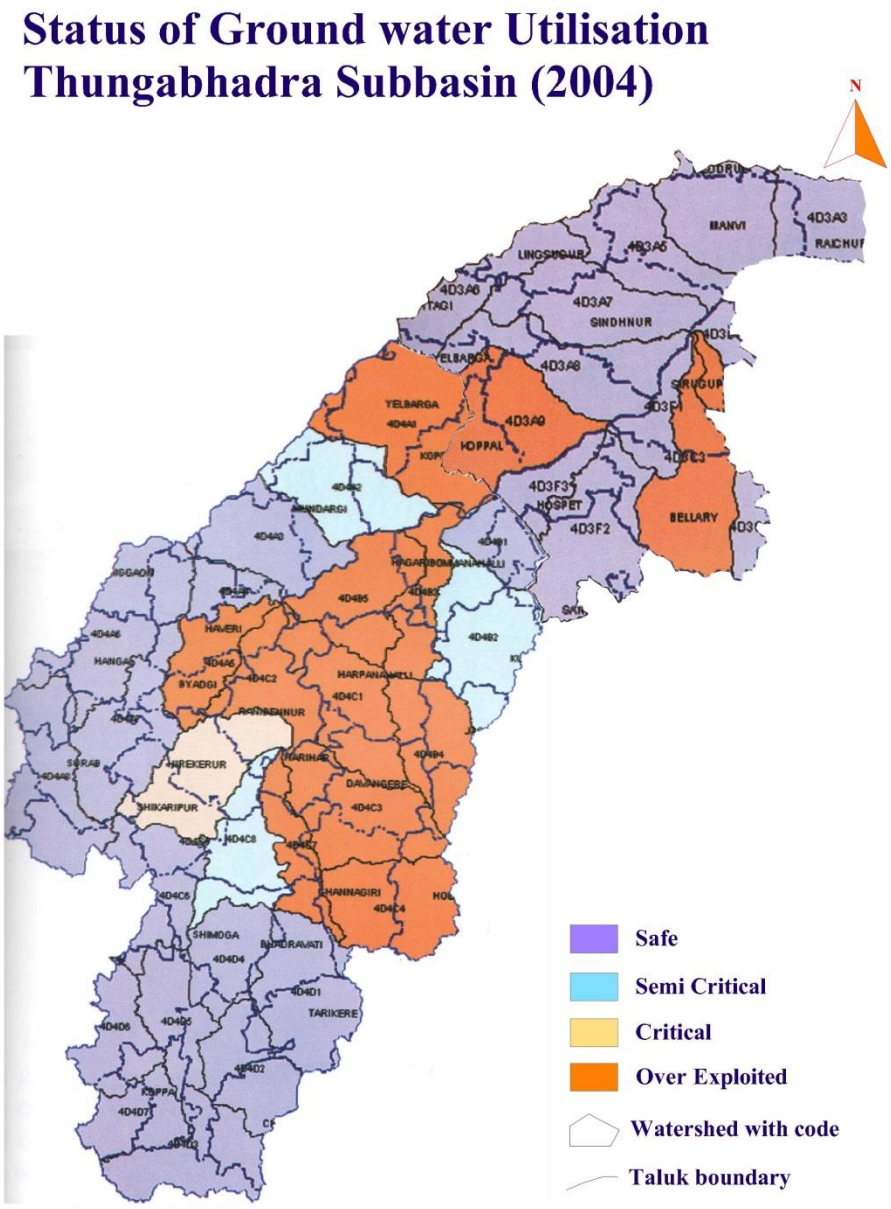
Figure 4: Sub Basins of the Krisna River Basin

The Gondhi Anicut is allocated 3.10 TMC (87.80 MCM) of water in the KWDT award.

1.6 Ground Water

22. Groundwater resources are estimated with the watershed/catchment as a unit. Karnataka state has been divided into 234 watersheds spread over 13 catchments; 10 watersheds fall fully in command area and another 76 watersheds fall partially in the command areas. Krishna basin code is 4D and the catchment codes for Tungabhadra sub-basin are 4D3 (Lower Tungabhadra) and 4D4 (Upper Tungabhadra).

Figure 5: Status of Groundwater



23. The net annual groundwater availability in the State in 2009, as per the assessment of the Department of Mines and Geology and the Central Ground Water Board was around 14.81 billion cubic meters (BCM), which is less than the 15.30 BCM as per the 2004 assessment and 16.30 BCM as assessed in 1992. Since the first survey in 1986-87, the number of tube wells in Karnataka has increased nearly 20 fold by 2006-07 to 733,227 while the number of dug wells has decreased by 40% to 244,475. More than 95% of groundwater pumps are powered by electricity.

24. With over 1 million wells, the increase in bore wells and over extraction has led to rapidly falling groundwater levels. The total replenishable groundwater resource has reduced from 16.3 BCM in 1992 to 15.3 BCM in 2004, with the draft of groundwater increasing from 4.1 BCM to 10.7 BCM during the same period. Groundwater sources that include open wells and bore wells have emerged as the largest source of irrigation in the State irrigating 45% of the net irrigated area. In order to provide the legislative environment as envisaged in the

Water Policy, the State enacted the holistic Karnataka Ground Water (Regulation and Control of Development and Management) Act, 2011.

25. The 2004 report on groundwater resources[3] of Karnataka reports that the groundwater development stage for Bhadarvati Taluk (675 km²) is classified as safe with only about 30% of groundwater potential being developed. The specific situation for the project area is not indicated. The Minor Irrigation Census for Shivamogga District[4] reports groundwater statistics across the whole District but does not differentiate between surface water irrigation district and rainfed areas. For Shivamogga, there are a total of 24,608 groundwater schemes, with 5% being of depth 0-20m, 1% 20-40 m, 8% 40-60m, 48% 60-80 m, and 39% greater than 80m. Of the nearly 30% reporting constraints to utilization, 75% were due to lack of water. This high proportion of groundwater pumping from great depths (>80m) is likely to be a consequence of the 100% government subsidy on the cost of power for operating pumps for groundwater extraction.

26. In Tungabhadra Sub-basin, the aquifers in about half of the catchments are categorized as either "semi-critical", "critical" or "over exploited" [5] (Figure 5). In the south and southwest of the sub-basin, the "safe" catchments are predominantly located in the areas that receive greater precipitation. Most of the districts Chikmagalur, Shivamogga and Uttar Kannada are considered "safe", but also the semi-arid parts of Dharwar, Gadag and the northwest of Haveri. The "over exploited" catchments are generally located in Bellary, Davangere and Chitradurga and Western Haveri.

27. For the Gondhi sub-project area and subject to hydrogeological conditions, groundwater could be a supplementary source of water for perennial crops during the periods of canal closure. However, the groundwater potential is not well understood. Some tubewells have been installed for drip irrigation of arecanut but it is believed that the yields are relatively low.

[3] Department of Mines and Geology (2005) Report on Dynamic Groundwater Resources of Karnataka as of March 2004. June 2005. pp 132

[4] Department of Minor Irrigation (2011) Report on Fourth Census of Minor Irrigation Schemes 2006-07

[5] 'Semi critical areas' are those where stage of groundwater development is 70 – 90% & water table during either pre or post monsoon shows a significant long term declining trend.

'Critical areas' are the areas where the stage of groundwater development is more than 90% and long term water level trend of either pre-monsoon or post monsoon shows a falling trend

'Over exploited areas' are the areas where stage of groundwater development is more than 100% and long term water table trend show significant declining trend.

2. DESCRIPTION OF EXISTING SYSTEM

2.1 Scheme Development History

28. The Gondhi anicut was constructed between 1916 and 1926 and the right main canal was commissioned during 1926-27. Construction of the left main canal took place between 1951 and 1954. The long thin shape of the command areas, and the near contour main canals, mean that unit area modernization costs are relatively high as well as posing challenges for introduction of structures for improved flow control and flow measurement.

29. Urbanization of the command area is slowly occurring. The largest town in the command area is Bhadravathi which straddles the Bhadra river and marks the end of the left bank command. In the tail of the right bank command is the small town of Holehonnur. It is recommended that the scheme's command area of 4,600 ha (according to the Original Project report) be reviewed prior to finalizing designs to take account of any urban encroachment on agricultural land.

30. As a small scheme of 4,600ha constructed 60 to 90 years ago with a 74km main canal it includes problems typical of much larger system but is of a size suitable for rapid implementation. The Gondhi canals currently benefit from return flows from the adjacent Bhadra command area and these can be expected to reduce as the Bhadra system operation is improved and modernization of Gondhi will mitigate any adverse impacts. This system is suitable for inclusion in Tranche 1 because design work is already in progress and the area is suitable for piloting improved distribution systems and management.

2.2 Canal System

31. The Gondhi canal system comprises narrow command areas on both banks of the Bhadra river. The 14.5 km left main, near contour, canal commands a narrow strip which extends about 8 km along the river and varies from about 0.1 – 2.5 km in width. The 212 ha left bank command area is irrigated by 20 DPOs.

32. The 74.4 km long right main canal similarly commands a long narrow strip of land, about 32 km long and 0.5-4.5 km wide, with 130 DPOs and 16 small distributaries and commanding about 4,253 ha.

33. There are about 20 reservoirs / tanks in the command, the largest being the Koppa tank located just south-east of Holehonnur which commands 272 ha. Many of the tanks are on-line enlargements created where the right main canal crosses side valleys. Other tanks are located on the drainage system where they intercept the return flows.

Table 2: Table Canal Details

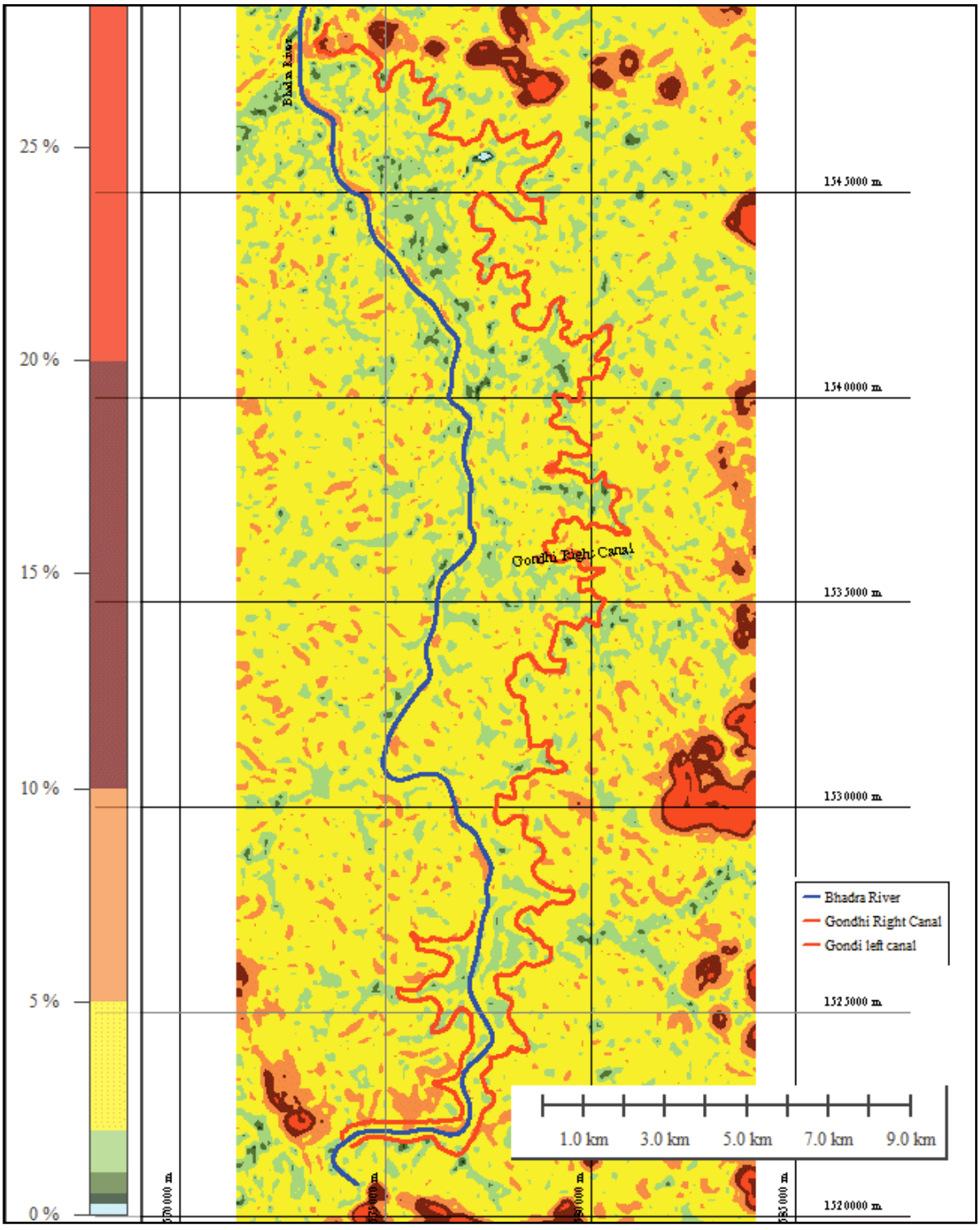
Canal	Length	CCA	No / length of distys	No of Outlets
Left Main Canal	14.5 km	220 ha	0	20
Right Main Canal	74.6 km	4380 ha	16 / 34km	130

Source: Detailed Project Report 2012

2.3 Drainage System

34. Most of the command area has moderate slopes towards the Bhadra river and the area is dissected by about 12 small to medium streams which provide a natural drainage network. Drainage is not a problem except for some localized waterlogging immediately downstream of the main canal. Slopes in the overall area commanded by the canals, as determined from the SRTM DEM, average 2.8% with a maximum of 10%.

Figure 6: Slope Map



3. MODERNIZATION REQUIREMENTS

3.1 Integrated Water Resources Management

35. Integrated Water Resources Management (IWRM) is a comprehensive, participatory planning and implementation tool for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of ecosystems for future generations.

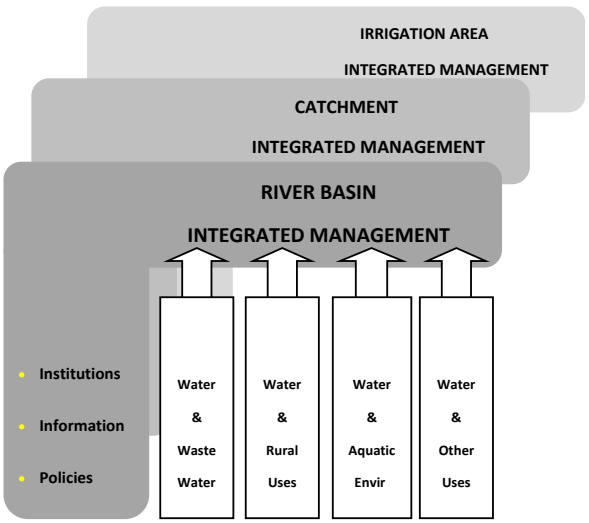
36. Important attributes of IWRM include:

- recognising that the pool of water that can be managed and used is finite
- coordination of sectors that manage, use and impact (eg. via pollution) sectors;
- planning and managing water according to river basin, sub-basin and irrigation water supply boundaries and the extent of the available resource;
- integrating the management of land, water and vegetation;
- integrating the management surface water and groundwater;
- integrating the management of water quantity and quality;
- taking scientific approaches to planning and management;
- using a balance of policy and investment measures to achieve outcomes; and,
- involving water users government, non-government, civil society and the private sector

37. The multi-sectoral approach of IWRM differs from the traditional form of water resources management where individual water using and impacting sectors such as irrigation, urban water supply, sanitation and industrial discharge, hydropower, etc., plan and develop water projects separately to meet their own needs and objectives. Often the finite extent of the resource and impacts on other sectors including the environment is not considered and this leads to water shortages and conflict.

38. The following diagram illustrates the IWRM model that coordinates water using and impacting (eg. polluters) sectors to achieve IWRM goals. IWRM at the river basin scale is often referred to as Integrated River basin Management (IRBM) and this includes smaller hydrological scales of catchments/ watersheds through to irrigation areas. At a higher level, there is the State IWRM framework that spans all of the State's river basins and water using sectors as well as the overarching National level that spans all States. For IWRM to function properly, appropriate institutions, information and knowledge management and policies and plans are required.

Figure 7: IWRM Framework



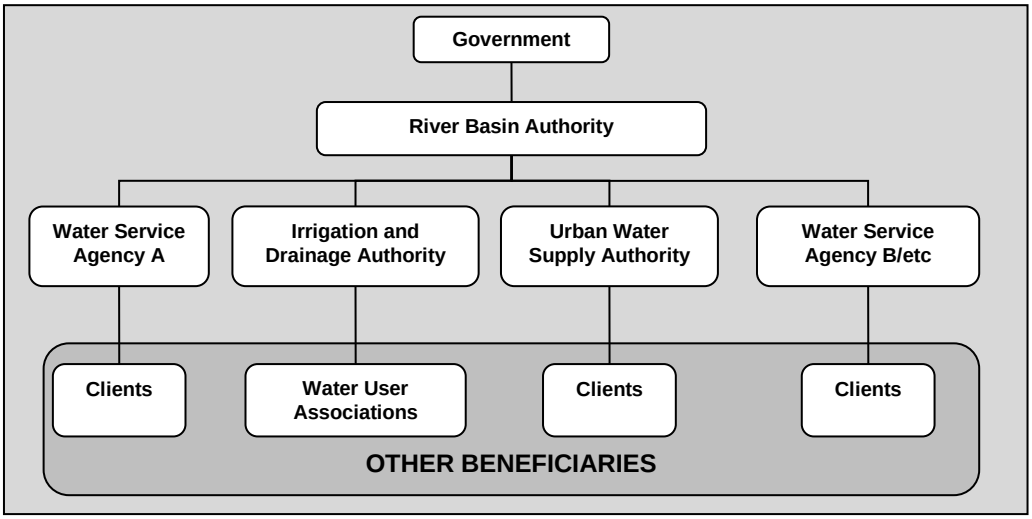
39. Based on international experience[6], effective IWRM has been found to have fairly common features where:

(i) The institutional framework is both robust and flexible, and includes modern legislation and an integrated policy framework,
(ii) Planning and management is knowledge driven. Strategic assessment uses good data collection and management procedures and uses the data to support planning and decision making
(iii) Integration is built into institutions, resource management, and policy and the environment is recognised as a legitimate water user,
(iv) Community awareness raising and participation is a key part of water resources management so that communities understand and contribute to solutions through local management and actions.
(v) There is monitoring to evaluate whether the river basin is being managed sustainably.
(vi) A single agency is responsible for coordinating overall water resources planning and management with the authority to issue licences or permits for water abstraction and effluent disposal.

IWRM Institutional Framework

40. The institutional framework arrangements for water resources management in an IWRM context are shown in the following figure. River basin authorities decide water sharing and pollution discharge arrangements and bulk entitlements, including abstraction periods, for water management agencies (authorities, companies) in compliance with government policies.

Figure 8: Example of the IWRM Institutional Framework



41. These water management agencies, such as irrigation and drainage authorities, urban water supply and sanitation authorities, hydropower operators, dam and river operators, catchment managers, flood management authorities, etc.; are responsible for providing water related services to their respective clients consistent with these entitlements.

42. The agencies should respond to the requirements or their water service users such as irrigators, tank users, dryland farmers, fishers, recreationalists, catchment users such as dryland farmers and foresters, navigational users. Specifically for Irrigation and Drainage Authorities they would consult and involve water users in advisory committees that are

[6] ANZDEC (2011) Integrated Water Resource Management and Sustainable Water Service Delivery in Karnataka. Component 1: Institutional Analysis and Proposed Reforms for IWRM. Final Report. ADB TA 7418-IN p5-6.

focused on service requirements and standards. The Authorities would involve themselves in supplying services to meet client/WUCS/farmer needs; water planning according to seasonal water availability; maintaining a register of water users and their water user accounts; water ordering and supply systems and their operation and maintenance; asset management; and measurement and recording of water supply.

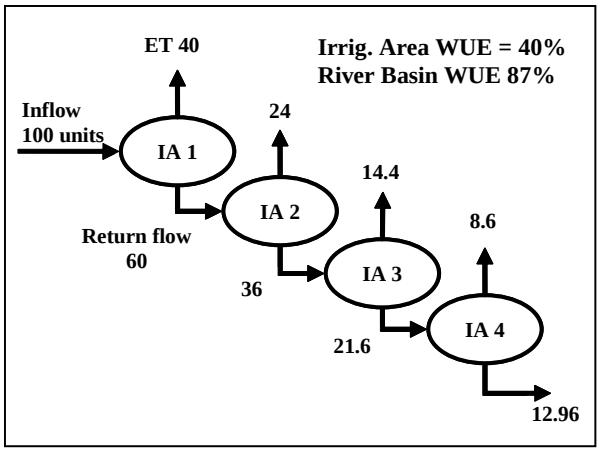
Irrigation and IWRM

43. Irrigation is a major user of water (with much of the water being consumed through evaporation) and this affects other water users in a river basin by reducing the amount of surface and groundwater water available; changing river flows thereby affecting the environment; and non-point source pollution through the use of agri-chemicals. In some cases, irrigation may contribute to the raising groundwater levels causing groundwater discharge, waterlogging and concentrating salts in soils and drainage waters but in many areas irrigation is a major consumer of groundwater resulting in over-abstraction.

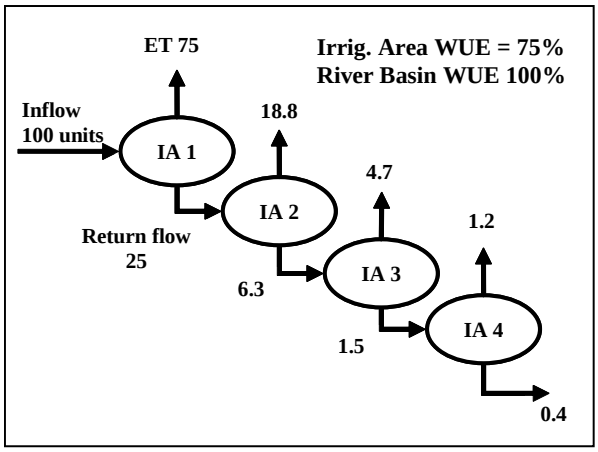
44. In river basins where there are water shortages, clear plans, rules and regulatory arrangements are required if water supply and security of access is to be sustained for water users and businesses. It is only with this security that water users will be willing to make investments to increase their returns from their water supply and to use available water most efficiently.

45. Without these plans and rules, a significant component of the supply to water users further down a river system tends to be a return flow from upstream irrigation areas. With time, it is common for upstream water users to improve the net consumption of water thereby reducing return flows and downstream water availability. This is illustrated in the following diagrams.

46. The first diagram shows the water available from return flows to a series of irrigation areas that are operating with water use efficiency (WUE) of 45%. A series of 9 such irrigation areas would effectively close the river basin meaning that no (or very little) water would leave the basin. A substantial part of the water used for irrigation is lost as evaporation / evapotranspiration while run-off and percolation are available for reuse. Maximization of agricultural production (yields, crop value) per unit of water evaporated must be an objective.

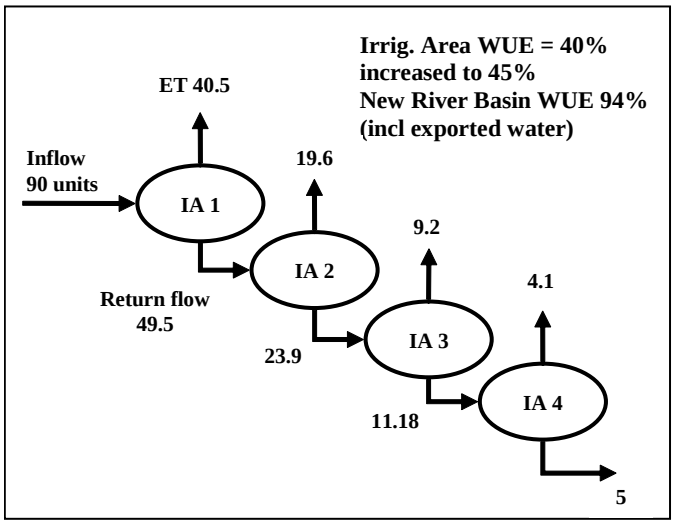


47. Provided water and not land is limiting irrigation farms inevitably become more and more efficient as better technologies become available and as cost pressures drive efficiency gains. The second diagram shows the results of irrigation areas increasing WUE to 75 %. Water availability for successively lower irrigation areas is much reduced so that the fourth irrigation area is only receiving 7% of inflows previously received when upstream areas were at 40% WUE. The river basin is effectively closed after only 4 such irrigation areas.



48. Governments or industries in the search for water under conditions of scarcity will sometimes fund measures in irrigation areas to raise efficiency and then transfer the water elsewhere. The third diagram

shows this scenario when investment is made in each irrigation area to raise efficiency by about 10% and also transfer 10% of the inflowing water ('entitlement) elsewhere; in effect a double penalty for downstream areas. The lower most irrigation area only receives 42% of the water received previously.



49. An IWRM approach if fully implemented would aim to control these unintended consequences of 'improved water management' by having a strict water entitlements system for the river basin and each of the irrigation areas. This would be based on a river basin plan and a detailed assessment of the water resource (surface and groundwater) and the seasonal and annual variability; environmental water requirements; a bulk water entitlements system; measurements of flows and water deliveries; reservoir regulation that uses the water efficiently as well as managing multiple uses of reservoirs such as for flood control, fisheries and recreation; as well as an operational plan drought conditions of varying magnitude. Water users and administrations would be closely involved in developing and implementing this IWRM system.

50. The IWRM approach within irrigation areas would include water entitlements/permits to an appropriate level (eg. WUCS) and including groundwater where there is a stressed groundwater system; measurement of flows and deliveries; volumetric water charges to provide for system operation and maintenance as well as to provide an efficiency incentive for water users; and awareness raising of the approaches and benefits of more efficient water management systems. Water entitlements need to be specific about whether the entitlement is for full consumption of the amount of whether it has a return flow component. Control is best achieved by water regulators if the amount is the consumptive entitlement is the delivery can be measured whereas return flows can only be measured with difficulty and at additional cost.

The KISWRMIP and IWRM

51. The KISWRMIP will take an IWRM approach to implementation that involves:

- Studies of water policy approaches and their adaptation to Karnataka,
- Studies of the water balance and river basin planning so that water is used within the limits of water availability and to ensure that any water savings are real rather than being water that is already being used by an existing user or the environment,
- An approach to water sharing so that water users are aware of their entitlements under the range of seasonal conditions including drought and thereby have the knowledge and security to make sound business decisions,
- Measurement of water deliveries to a WUCS level consistent with water entitlements to ensure that water deliveries are consistent with entitlements,
- Measurement and control of groundwater abstractions so that groundwater use is sustainable and water users have the knowledge and security of water access to make sound business decisions,
- Establishment and strengthening of dam operator, river managers and Irrigation and Drainage Authorities and their planning and management systems for operating and maintaining their infrastructure and to achieve a service orientation,

- Involvement of water users to operate and maintain local irrigation systems as well as to use water more efficiently and productively,
- Capacity building of farmers to sustainably manage water as well as reduce the environmental impacts from agro-chemical use and salinity,
- Financing arrangements so that irrigation systems are financially sustainable.

3.2 Water Use Efficiency Improvement

52. The SGOK has[7] 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, crop yield enhancement, adopting practices that are environmentally sustainable and economically viable, closing the gap between the demand and supply of water and maintaining the quality of water.'

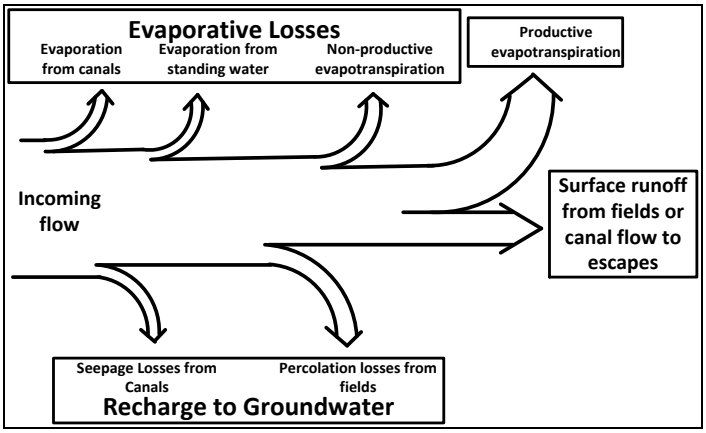
53. Using a lesser quantity of water or in other words improving water use efficiency in irrigation is possible by saving and conserving water through efficient water conveyance, distribution and application; reducing losses; adopting better on-farm and crop management technologies; and shifting to crop varieties that use less water while giving higher productivity (either yields and/or financial returns per unit of water used). Crop management strategies to improve water use efficiency will reduce use of irrigation water by individual crops and at the same time it should increase productivity and overall agricultural production through use of the saved water elsewhere in the basin. With water, and not land, limiting irrigation area development in Karnataka, measures to increase irrigation efficiency and crop water productivity (increased farm household revenues per unit of water used) are central to the modernization 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.

54. Water use efficiency and "crop per drop" in the agricultural context involves emphasizing economic efficiency whereby farmers' crop choices are driven by maximizing their revenues and livelihoods within the constraint of diminishing water availability.

55. Improving irrigation water use efficiency would thus include improving reservoir management and performance and the optimum delivery of water at canal head to meet indented demands while reducing evaporation and seepage losses; reviewing operation policies and plans within overall water availability and basin allocations; plugging leakages, controlling unauthorized diversions and other unaccounted use; improving reliability of supply to avoid the farmers' tendency to over-irrigate; improved conveyance and distribution; improved field application efficiency that optimizes soil moisture, reducing evapo-transpiration from weed growth and using water efficient crop management practices; and, improved drainage.

[7] Results Framework Document for Government of Karnataka (Department of Water Resources) (2011-2014)

Figure 9: Schematic Distribution of Irrigation Inflow



56. Figure 9 shows schematically the distribution of water entering an irrigation system. For a surface irrigation system, the productive evapotranspiration (ie water actually used by the crops) is typically around 40% of the inflow. This is the headline irrigation efficiency. The balance of the water is split between other evaporation, surface runoff and percolation to groundwater. Unless the groundwater is saline or very deep, the percolation is effectively recharged which can be reused. Surface runoff can also be reused (although water quality may progressively deteriorate) but water that evaporates is lost to the system. Reuse will also sometimes occur within schemes, particularly where percolation to groundwater is reused for well irrigation.

57. Reducing field demand will translate into reduced system demand. The amount of water to be supplied to the field can be reduced through changes such as:

(i) better response in reducing irrigation supply after rainfall
(ii) promoting crops with equal or better farm incomes but lower water demands
(iii) deficit irrigation at times when it does not affect yields
(iv) adopting agronomic measures such as system of rice intensification (SRI), sustainable sugar initiatives and anaerobic rice cultivation
(v) improved soil quality management techniques can also improve field water use efficiency.

58. More timely irrigation will raise yields to nearer the maximum potential. Increased reliability of irrigation supply is also needed to ensure that farmers are willing to move away from keeping their field moisture contents close to capacity in order to provide a buffer against supply interruptions.

4. SOCIO- ECONOMIC ASSESSMENT

4.1 Approach

59. The overall goal and objectives for the investment programs strongly warrants for developing a cross-sectoral policy approach, designed to replace the traditional fragmented approach for effective water resource management in the project region, wherein maximizing economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. In order to explore the plausible ways of percolating the social and economic benefits at the grass root level, the investment program aims to evolve social development strategies and safeguard frameworks under the PPTA, which makes the investments towards modernization works feasible and accessible for the people for whom these initiatives are being made.

60. The social assessment for the investment program has been carried out at the backdrop of ADB's overreaching goal of achieving poverty reduction[8], the Millennium Development Goal[9], its strategic agenda on inclusive growth and India's mandate on adopting a comprehensive strategy for faster and inclusive growth as emphasized in its 11th & Draft 12th Five Year Plan. In addition, the framework of enhanced poverty reduction strategy (EPRS) requires ADB support to be focused on pro-poor sustainable economic growth, inclusive social development and good governance and in comprehending how the social elements influence poverty, inequality, and vulnerability. At this backdrop, the social assessment for the subprojects of the Tranche 1 aim to provide effective steps through systematic government interventions towards attaining sustainable and positive impact in enhancing the living standard and livelihood of the project beneficiaries with increased agriculture production, improved accessibility, social inclusion, capacity building and research.

61. While taking into account the project interventions in terms of modernization and improvement in the irrigated agriculture of the Gondhi canal system, the envisaged socio-economic benefits, primarily entail (i) improvement in farm income (ii) enhanced rural livelihoods (iii) reduction in rural poverty through improved irrigation service delivery, (iv) enhanced agricultural practices, crop diversification and strengthened water resources and environmental management to increase the productivity of irrigated agriculture in region and (v) social inclusion and participation.

62. As highlighted in Indigenous Peoples Social Assessment (IPSA) report, the targeting classification of this project requires a GI (general intervention), which indicates that the poverty level of the project area is lower than the national average, with only selected areas of high poverty incidence where there's irrigation deprivation due to poor infrastructure. Under Gender and Development, the classification covers effective gender mainstreaming, which requires preparation of a Gender Action Plan for the project. Further, integration of social dimensions/parameters within the institutional frameworks, implementation arrangements, capacity development programs, service delivery mechanisms and M&E and safeguard procedures will also be executed.

63. The approach for social assessment for the PPTA has been developed on the basis of focus group discussions (FGD) and sample baseline socio-economic household surveys conducted in the subproject area. The FGDs were represented by various strata of the society such as small/marginal farmers, women cultivators, tribal families, village Panchayat members / sarpanch (head of Panchayat), officials of the Water Resource Department,

[8] ADB. 2004. Enhancing the Fight Against Poverty in Asia and the Pacific: The Poverty Reduction Strategy of the, Asian Development Bank. Manila;

[9] ADB. 2008. Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008-2020. Manila

anganwadi workers, and representatives of community based organizations, women groups and so on, and the participatory techniques used for the social assessment have been elucidated in the ensuing Table.

64. The estimated population size of the command area was abstracted from Census 2001 with an approximate 97.2 percent representation of all the villages. A village information schedule (VIS) was used for collecting information of the 10 selected villages, three villages from the head, and four each from middle and three from tail reach of the of the canal. These were supplemented by transect walks, informal discussions and interaction with villagers, so on.

Table 3: Location of the Sample Villages on the Gondhi Channel System

Village names	Division	Location on the Canal	Distributary Details and Chainage		Sample HH	District	Taluka/ Block
*Bale Maranahalli	Sub-Division 3 (LBC)	Head	DPO 1-9	Km 3.50-Km8.40	12	Shivamogga	Bhadravati
*Doddagopenahalli	Sub-Division 3 (LBC)	Head	DPO-4	Km 9.10-Km11.90	9	Shivamogga	Bhadravati
*Barandoor	Sub-Division 3 (RBC)	Head	16h DPO	Km 4.00-Km 9.60	17	Shivamogga	Bhadravati
Baballi	Sub-Division 3 (RBC)	Middle / Head	5th Branch-DPO 2	27.00Km	7	Shivamogga	Bhadravati
Kage Kodamogi	Sub-Division 3 (RBC)	Middle	VII Branch DPO -4	Km 33.70-Km 34.00	12	Shivamogga	Bhadravati
Nagathi Belagalu	Sub-Division 3(RBC)	Middle	Xth Branch DP0-2	Km 42.10-Km 44.40	16	Shivamogga	Bhadravati
Thiplapura	Sub-Division 3(RBC)	Middle	VIth Branch DPO-2	Km 28.65 to 30.00	6	Shivamogga	Bhadravati
Danayakapura	Sub-Division 2 D.B Halli (RBC)	Tail		km 66.00 to 74.00	5	Shivamogga	Bhadravati
Tallikatte	Sub-Division 3 (RBC)	Tail	IXth Branch DPO-2	Km 58.800 to 59.635 KM	5	Shivamogga	Bhadravati
Dasarakallahalli	Sub-Division 2 D.B Halli (RBC)	Tail	Distributory No. 11	53.650 KM to 55.850 KM	11	Shivamogga	Bhadravati
Total Sample Households *the LBC villages has be taken as head reach as its channel length is only 14.5 km and water availability remains same throughout the channel					100		

65. The baseline socio-economic survey (BSES) for 100 households was carried out in the 10 selected villages to establish the existing baseline situation. The social survey team collected and compiled the information, employed through an NGO. It may be noted that the villages selected for the detailed study reflects similar characteristics to those of the subproject and may be considered as representative of the entire command area. An approximate of 3.6 percent sample households to the total households of the command area was taken up for the study. Though the selection of households has been done on a random sample basis, utmost care was taken to ensure coverage of the various social groups (SC, ST, OBC and General) and Landholders/Landless households. (Large, medium, small farmers and landless).

Table 4: Sample Households based on Social Stratification/Landholding Size

Category	General	OBC10	SC	ST	Grand Total
Large Farmers (more than 2 ha)	11	6	2		19
Marginal Farmers (less than 1 ha)	21	23	9		53
Small Farmers (between 1-2 ha)	12	1	7		20
Landless				8	8
Grand Total	44	30	18	8	100

Table 5: Participatory Techniques used for Social Assessment

Method	Tools and Technique	Stakeholders	Quantity
Household survey	Structured format - Household Questionnaire	Project beneficiaries from command area	100 Households
Focus Group Discussions & Public Consultation	Checklist and semi-structured formats	Villagers, Gram Pradhan/Sarpanch, CADA officials, concerned stakeholders Women and SC/ST (WUC members) Vulnerable & poor, land less agricultural labour,	4
Village level Information (primary and secondary data)	Checklist	Gram pradhans/Sarpanch, Anganwadi worker, taluka /Block level officials, Gram Panchayats etc.	For all the 10 sample villages

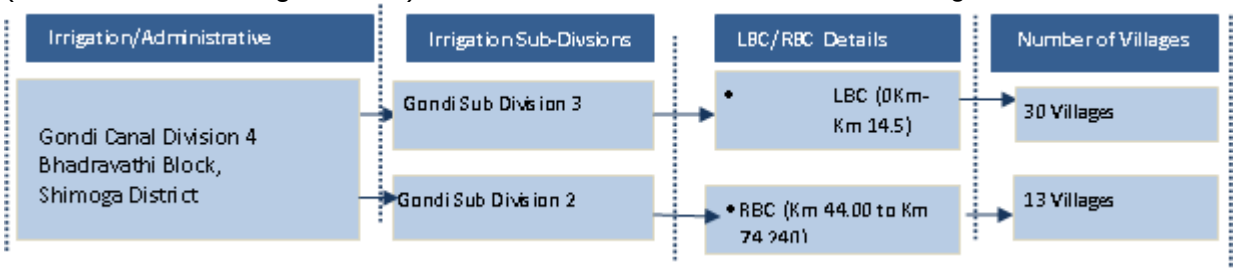
4.2 The Gondhi Sub-Project Area

Regional Setting

66. The Gondhi Irrigation system, presently an unlined canal, has been proposed for upgrading in terms of provision of canal lining to suit the future water delivery requirements and repair/ replacement of all canal structures. The project interventions also entail modifications of online storage where feasible to become actively managed offline storage and provision of night storage reservoirs where land can be made available, capacity development of system operation staff and water users, training on agriculture extension and on farm water management training to equip the farmers the skill to use water more efficiently.

67. Hence, while considering the above in mind, it is imperative to analyze and comprehend the regional setting, demographic characteristics, cultural patterns and socio-economic profile of the selected project area in order to have realistic and planned interventions. The Gondhi subproject falls under the administrative jurisdiction of Bhadravathi block in Shivamogga district, which is amongst the most developed districts in the state (ranked 5 out of the 27 districts as per Karnataka HDR, 2005) and accounted for a Human Development Index of 0.67, which is above the national (0.5) and state level average (0.6).

68. The Gondhi canal comprises a Right Bank Canal (RBC) and a Left Bank Canal (LBC). The RBC, older of the 2 canals (commissioned during 1926-27) encompasses an area of 4,253 hectares, has a canal length of 74.240 kms and the LBC on the other hand (commissioned during 1953-54) has an area of 212 hectares and canal length of 14.5 Km.



[10] Other Backward Community

Population

69. The subproject command area comprises an approximate population size of 67,057 in 12,861 households and the average family size is 5.2 with a ratio of 970 females per 1,000 males. (Census 2001). An estimated variation of 5-10 percent in population/household size (based on field interaction and discussions with local officials) may occur as the administrative and CA boundaries differ.

Table 6: Village Details of Gondhi Subproject

Name or No of the Channel	Block	District	Name of the villages in Gondhi Irrigation system
Gondhi Left channel Division 3	Bhadravati	Shivamogga	Bale Marana halli, Dodda Goppenahalli, Ujjineepura & Anekoppa
Gondhi Right channel Division 3	Bhadravati	Shivamogga	Gowrapura, Barandoor, Bommena Halli , Goni Naraseepura, Bhadravathi, Kodi Halli,Gopala Masara Halli, Devara Naraseepura, Baballi, Majjena Halli, Gowdara Halli, Kabali Katte, Veera pura, Seege Bagi, Kana Katte, Nagathi Belagalu, Hosa Halli, Kalpana Halli, Sunnada Halli, Erehalli, Thalli Katte, Seetha Rampura, Kage Kodamggi, Thiplapura and Bhadra Colony
Gondhi Right channel, Division2- D.B Halli	Bhadravati	Shivamogga	Arabilachi, Arathotlu , Dasarakallahalli , Agansanahalli, Thatihalli, Kannekoppa, Danayakpura, Koppa, Jambara Ghatta Mualavitalapura, Holebyranahalli, Yammehatti & Keereberanahalli

Source: WRD, 2012

70. The command area has 43 villages and constitutes 6.47 percent area of the Bhadravathi block and 18.11 percent of its population. The Scheduled Caste and Scheduled Tribe (Indigenous People-IPs) of the command area to the total command area population accounts for 18.8 percent and 3.3 percent respectively.

Table 7: Demographic Profile of the Gondhi Command Area

	Total	Male	Female	Females per '000 males	Percentage to total CA population
Households	12,861				
Population	67,057	34,034	33,023	970	
Percentage (%)		50.8	49.2		
Mean Family Size	5.2	2.4	2.33		
Literates	36,668	20,816	15,852		
Literacy Rates (All groups)	59.74	66.86	52.41		
Scheduled Caste	12,627	6383	6,244	978	
Percentage (%)		50.5	49.5		18.8
Scheduled Tribe	2,219	1,123	1,096	976	
Percentage (%)		50.6	49.4		3.3

Source: Census, 2001

4.3 Village Infrastructure and Services

71. The infrastructure status in the villages suggests that 90 percent of the sample villages are well connected by metalled road, with very limited inaccessible areas in the tail reach. However, the local community demanded strengthening of rural road infrastructure as one of their priority needs.

72. The other details include, 9 of the 10 sample villages do not have common land within the village, 2 have health centers in the village, 7 have health centers up to 5 kms and only 1 village is located at more than 10 km distance from a nearest PHC.

Table 8: Village Infrastructure and Services ***

Sl. No.	Village Name	PHC	School	Sanitation	Fair Price Shop	Tube Well/Drinking water	Common land	Metaled Road	Agriculture Market	Panchayat Bhavan	Agriculture .Credit	Subsidized Fertilizer	Improved Seeds
1	Dasarakallahalli	2	1	1	1	1	2	1	3	1	3	2	2
2	Danayakapur	2	1	1	2	1	4	1	1	2	2	2	2
3	Tallikatte	1	1	1	1	1	4	1	3	2	1	1	1
4	Nagatibelagalu	2	1	1	2	1	4	1	3	1	2	2	2
5	Barandoor	1	1	1	1	1	4	1	3	1	1	1	1
6	Baballi	2	1	1	1	1	4	1	3	2	2	2	2
7	Kagekodamagge	2	1	1	1	1	4	1	2	1	2	2	2
8	Bale Marana halli	3	1	1	2	1	4	1	1	2	3	2	2
9	Dodda Goppenahalli	2	1	1	2	1	4	1	3	4	2	2	2
10	Thiplapura	2	1	1	1	1	4	1	3	2	2	2	2

*** 1. In village 2. Up to 5 Km 3. Up to 10 Km 4. None

73. The issues highlighted by the project beneficiaries mainly related to lack of proper drainage and seepage water of Bhadra Canal (middle and tail reach villages), which has led to waterlogging in their areas. This was further resulting in weakening of the residential structures of the rural households. Due to prolonged waterlogging these villages have been facing unhygienic living conditions and prevalence of waterborne diseases like malaria, diarrhea, and typhoid are common in these areas. All the sample villages reported access to a school, sanitation, and tube well facility for drinking water within the village.

74. It may be noted that all the sample households/villages are covered under various drinking water supply schemes of the government (Department of Rural Development and Panchayati Raj) with piped water supply being the major source of drinking water in the subproject. While, approximately 70 percent of the rural households are covered under the piped water supply scheme, the rest depend on public stand post and other sources of water are of little importance. Differences between farmer category and caste are not very large.

Table 9: Physical Infrastructure Status (percentage of households)

Category	Landless	Large	Marginal	Small	General	OBC	SC	ST
Sample Household (nos.)	8	19	53	20	44	30	18	8
Piped Water supply	50.00	84.21	60.38	85.00	77.27	63.33	66.67	50.00
Public stand post	50.00	15.79	39.62	15.00	22.73	36.67	33.33	50.00
Cooking gas used	50.00	73.68	49.06	75.00	61.36	56.67	61.11	50.00
Fuel wood	50.00	26.32	50.94	25.00	38.64	43.33	38.89	50.00
Electrified	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Household toilets	62.50	68.42	77.36	80.00	79.55	73.33	72.22	62.50
Distance of water supply source from house								
less than 25 m	87.50	100.00	92.45	100.00	97.73	96.67	88.89	87.50
25-50 m	12.50	0.00	7.55	0.00	2.27	3.33	11.11	12.50

Note: all household total weighted distribution by household distribution of 10 sample villages

75. All the sample households reported 100 percent electric connections during the household survey. In terms of assessing the usage of cooking fuel used by the rural households, it may be observed that 73.68 percent of large famers have gas connection, which is higher than the other categories. The general caste farmers (61.3 percent) in comparison to other caste use cooking gas. Further, approximately 72 percent of the sample households have individual toilets and are covered under the Toilet Sanitation Campaign (TSC) scheme of the government. On the whole, the differences between large, marginal and small farmer category and general, SC and OBC are not very large. However, the coverage of sanitation facilities, cooking fuel, and piped water supply amidst the landless farmers and ST caste are comparatively lower than the others.

4.4 Social and Economic Profile

Education

76. Then socio-economic pattern of the sub-project district suggests that the region has shown good progress in human development sectors in comparison to the other neighboring districts in the last decade. The literacy rate of Gondhi subproject, accounted for 59.7 percent, (Census 2001) which was at par with the state rural literacy rate (59.33 percent) but lower than the district average of 68.9 percent. The male and female literacy rates of the subproject area accounted for 66.86 percent and 52.41 percent respectively with a gap of 14.5 percent between both. It may be observed that as per Census 2011, the overall state's rural literacy level has increased to 68.8 percent and the district literacy level has increased by 7.7 percent and a similar trend may be considered in the subproject area as well.

Land Distribution, Social Classification and Vulnerable groups

77. The distribution of agriculture landholding size in the project block of the command area reveals that about 89 percent farmers fall under the category of marginal and small farmers (land holding less than 2 ha), 8 percent in semi medium farmers (land 2-4 ha), 2 percent medium (land 4-10 ha) and the balance 0.07 percent in the large farmer category (> 10 ha). (District Census Handbook, 2009-10). The average land holding size for the Gondhi system accounts for 0.9 Ha. The landless agricultural laborer ranges between 20 to 25 percent in the Gondhi Channel area. It may be observed that the subproject area reflects a similar distribution pattern as well.

Table 10: Distribution of Agricultural Landholdings and Area for Project Block (Percent)

	Marginal (>1 ha)	% Marginal (>1 ha)	Small (1-2ha)	% Small (1-2ha)	Semi Medium (2-4 ha)	%Semi Medium (2-4 ha)	Medium (4-10 ha)	% Medium (4-10 ha)	Large (<10ha)	% Large (<10ha)	Total
Number	25147	70.04	7145	19.90	2876	8.01	710	2.0	25	0.07	35903
Area	12150	36.13	9737	28.96	7660	22.78	3684	11.0	393	1.17	33624

Source: Agriculture Census 2005-06; DCH, 2009-10

Occupations

78. With a Worker Female Participation Ratio (WFPR) rate of 45 percent, the command area accounts for 84.7 main workers and 15.3 percent marginal workers. The male workers constitute 68.3 percent of the total workers, while female workers account only for 31.7 percent of the total workforce. A similar pattern may be observed in agriculture and allied sectors activities with male and female participation accounting for 49.3 percent and 25.8 percent respectively.

79. The estimated rural households engaged in agriculture and allied activities in the subproject villages entails 4,010 households (based on the census 2001). It may be inferred that 75 percent of the command area villages are engaged in primary sector activities, however, the rural households/settlements adjoining or forming a part of the urban area/fringes comprises households engaged in tertiary sector activities as well.

Table 11: Command Area Villages under Gondhi Channel System

Worker	Male/ Female	Primary	Primary %	Secondary	% Secondary	Tertiary	Tertiary %	Total
Main	Male	226724	43.8	5774	1.1	65197	12.6	297740
	Female	92809	17.9	2710	0.5	14903	2.9	110440
Marginal	Male	23912	4.6	657	0.1	5309	1.0	29883
	Female	72972	14.1	1901	0.4	5088	1.0	79975
District Total		416417	80.4	11042	2.1	90497	17.5	518039
Main	Male	36683	47.7	926	1.2	10682	13.9	48340
	Female	13068	17.0	648	0.8	2919	3.8	16653
Marginal	Male	3659	4.8	105	0.1	1003	1.3	4772
	Female	5719	7.4	337	0.4	1132	1.5	7196
Block Total		59129	76.9	2016	2.6	15736	20.4	76961
Main	Male	12409	44.2	362	1.1	4168	16.4	16984
	Female	5157	18.9	271	0.8	980	3.4	6428
Marginal	Male	1381	5.1	32	0.1	501	1.8	1919
	Female	1907	6.8	89	0.4	306	1.1	2309
Sub Project Total		20854	75.0	754	2.4	5955	22.6	27640

Source: Census 2001

80. Hence, whilst agriculture remains the primary livelihood activity for most of the households in the subproject area, there exists a diversity of household livelihood strategies due to the differences in land and other resource endowments and different opportunities. For example, the villagers enjoying good access to urban areas are engaged in a variety of economic activities whereas a major section of the farmers in the tail reaches are confined to growing crops. Approximately 5-10 percent of the younger generation in the subproject area (in tail reach and villages adjoining to urban settlement) are either migrating or commuting to nearby towns/cities for job opportunities in government sector or in trade and business activities. (Based on FGDs and field discussions).

81. The irrigated agriculture (more than 95 percent household) is dominant in the subproject and the main crops grown are paddy, sugarcane and garden (arecanut) /semidry crops. The project beneficiaries also rely heavily on channel water for non-agriculture purpose like meeting their domestic needs such as washing, bathing, health and hygiene and keeping livestock etc. Besides agriculture, the secondary occupation in the project villages entails dairy development and milk production with 30-35 percent of households engaged in such activities as revealed during the FGDs and field discussions. There are various incentives being provided by the Animal Husbandry Department in this regard and Shivamogga District is well known for its dairy development and milk production activities.

Household Assets and Wealth Distribution

82. The housing quality as detailed in Table reflects that the houses in the subproject mainly range between semi-pucca and pucca condition accounting for 88 percent and 12 percent respectively. The percentage distribution of pucca houses amidst the various strata of the society suggests that the large farmers have maximum pucca houses accounting for 26 percent followed by small and marginal households accounting for 20 percent and 6

percent respectively. The average house area of a large farmer is 71.05 square meters and the value of the house increases from landless households (INR 44,200) to large farmers (INR 56,842) as might be expected, there are smaller differences by caste, with scheduled caste having the lowest.

Table 12: Housing Quality (percentage of households)

Category	Landless	Large	Marginal	Small	General	OBC	SC	ST	All Household
Sample Household	8	19	53	20	44	30	18	8	100
Pucca houses	0	26	6	20	11	13	17	0	12
Semi Pucca	100	74	94	80	89	87	83	100	88
Covered Area (Sqm.) per HH	55.25	71.05	67.17	59.75	74.89	64.67	48.33	55.25	65.47
Total Value per Household	44,200	56,842	53,736	47,800	59,909	51,733	38,667	44,200	52,376

Note: all household total weighted distribution by household distribution of 10 sample villages

Table 13: Livestock Inventory of the Sample Households (percentage of households)

Category	Land less	Large	Marginal	Small	General	OBC	SC	ST	All H'hold
Sample Household	8	19	53	20	44	30	18	8	100
Cow (INR 20000)	38	68	60	55	59	67	56	38	59
Ox (INR 15000)	0	5	15	30	16	10	28	0	15
Buffalo (INR 30000)	13	26	9	15	11	13	22	13	14
Sheep (INR 3000)	13	16	15	5	2	20	28	13	13
Hen (INR 200)	0	21	13	25	18	10	28	0	16
Mean nos. / households									
Cow (INR 20000)	1.3	2.3	2.2	2.3	1.7	3.0	2.3	1.3	2.2
Ox (INR 15000)	0.0	2.0	1.8	1.7	1.9	1.7	1.6	0.0	1.7
Buffalo (INR 30000)	1.0	2.0	1.8	2.0	1.6	2.5	1.8	1.0	1.9
Sheep (INR 3000)	3.0	3.7	1.5	1.0	1.0	2.3	1.8	3.0	2.1
Hen (INR 200)	0.0	12.8	4.0	7.2	6.4	15.0	3.8	0.0	7.2
Total Value / Household (INR)	14,875	51,221	36,634	42,010	30,186	53,533	45,600	14,875	38740

Note: all household total weighted distribution by household distribution of 10 sample villages

Household Income/Expenditure and Poverty Levels

83. The head count rate of BPL (Below Poverty Line) households in the subproject area (based on BPL card owners as per gramvikas.nic.in, 2009-2010) to the total households is 33.3 percent in the Gondhi subproject area. However, these BPL estimates may not necessarily reflect the ground conditions as many households possess these cards in order to avail the facilities of government fair price shops and cannot be treated as actual representation of head count poverty estimate of the region.

84. The overall poverty estimate of (head count rate) Shivamogga district accounted for 8.1 percent[11] as against the state average of 20.1 percent during 2001, wherein reflecting that the district in comparison to its neighboring districts is well developed. Based on Planning Commission, 2012 the rural poverty estimates of the Karnataka state accounts for 26.1 percent[12].

85. The household survey results reveal that (weighted average) approximately 5 percent household in the subproject area fall below official poverty line (i.e. having an annual income below INR 17, 500).

Table 14: Distribution of Household Income (percentage of households)

Category (INR)	Landless	Large	Marginal	Small	Grand Total
Sample Households	8.00	19.00	53.00	20.00	100
<20,000	25.00	0.00	9.43	5.00	8.00
20,001 to 40,000	37.50	10.53	39.62	5.00	27.00
40,001 to 80,000	25.00	10.53	43.40	60.00	39.00
80,001 to 120,000	12.50	31.58	7.55	25.00	16.00
>120,001	0.00	47.37	0.00	5.00	10.00

Note: all household total weighted distribution by household distribution of 10 sample villages

86. The average annual household income in the subproject area accounts for INR 72,134 and ranges between INR 132632 amidst large farmers to INR 42375 for landless. The household expenditure pattern shows higher for large farmers and general caste households as might be expected. Majority of households reported expenditure on food items, social functions and transportation as revealed during the FGDs.

Access to Credit

87. The credit details of the subproject households exhibits that on an average 87 percent households have taken loans from various sources, of which loans from banks are most common (more than 80 percent HHs). The loans taken by households are mainly for agricultural purpose accounting for 84 percent of the total share and this pattern may be observed across various caste and categories of farmers.

Table 15: Distribution of Household Income (percentage of households)

Category	Landless	Large	Marginal	Small	General	OBC	SC	ST	All Household
Sample Household	8	19	53	20	44	30	18	8	100
Education	0	0	2	0	0	0	6	0	1
Agriculture purpose	88	74	83	95	86	83	78	88	84
Others	0	5	2	0	0	3	6	0	3

Note: all household total weighted distribution by household distribution of 10 sample villages

Major Observations of the subproject community and key stakeholders based on FGDS and field interactions

88. More than 95 percent farmers felt that lining and modernization work of canals must be taken up by the government, which will solve their water problems. The villagers also

[11] Measuring Poverty in Karnataka; Economic and Political Weekly January 25, 2003

[12] Planning Commission Press Note on Poverty Estimates (March 2012) for Karnataka state is INR 629.4 monthly per capita rural income and all India average per capita monthly rural poverty estimates is INR 672.8

expressed that a lined canal system will have a direct and indirect positive social and economic impact on their well-being and livelihood pattern.

89. The farmers were sensitized about the proposed agriculture interventions during the FGDs viz crop diversification by introducing short duration and market value added crops such as vegetables, flower cultivation, introducing and increasing the area under SRI Paddy cultivation etc. 85-90 percent farmers were receptive to the new ideas and supported the interventions and expressed their keenness towards training/skill enhancement in these areas.

90. The issues flagged by subproject households mainly related to the insufficient and inconsistency of channel water reaching the tail end farmers, especially in villages falling within the Canal Subdivision 2 D.B.Nalli.

91. The villagers expressed that though efforts were being made by WRD officials to meet their water problems by draining the seepage water from Bhadra Canal into the Gondhi Anicut and through interceptions in Gondhi canal, they (villagers) strongly feel that more concrete, systematic and permanent solutions needs to be explored by the government.

92. The issues relating to waterlogged villages due to seepage water has increased the woes of rural households, in terms of weakening of their residential structures and giving rise to other unhygienic living conditions, so on.

93. Through interaction with the local people (Doddagoppenhalli and Kage Kodamaggi) it was revealed that though there are 2-3 NGOs in the development sector in this subproject, but they felt that such initiatives and sensitization /livelihood generation programmes must be further explored and scaled up.

94. The other concerns that were brought out during the interaction with farmers included aspects such as: strengthening rural road infrastructure, government incentives for promoting direct access to market facilities and reducing the dominance of middle-men, provision of better storage facilities for crops, and provision of health facilities.

95. In Gondhi subproject, the conditions of project beneficiaries in terms of their accessibility to basic services like safe drinking water and sanitation facilities (coverage more than 70 percent) was good with the attitude of farmers being progressive.

96. Though the farmers are progressive and receptive to new ideas in the subproject, their awareness level related to various government schemes, health /hygiene practice etc. ranged between low to medium.

97. The lining/modernization works were strongly supported by all the reaches of the farmers; head, middle and tail reach as well as across various sections of the society.

98. Minimal social risks are anticipated with only temporary disturbances expected during the construction phase. On the whole there has been positive response from the local community regarding the modernization work.

99. In general the field discussions reveal unanimity among all section of rural communities regarding the positive impact of the project interventions on raising their living standards. It was felt that through modernization, sustainable multiple cropping patterns will be made possible leading to increased crops yields, improvement in agricultural income and alleviating poverty in the region. Further, with assured water availability other related income generating activities such as animal husbandry, poultry so on can also be developed manifold.

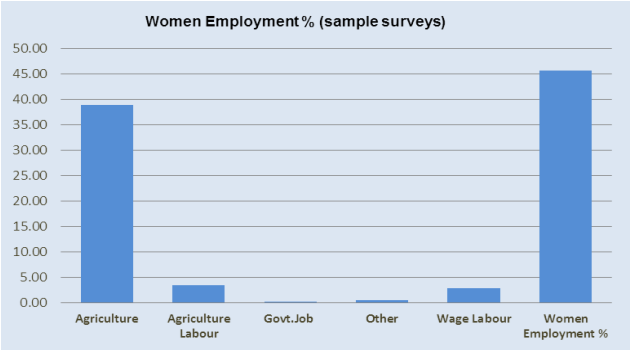
4.5 Gender Concerns

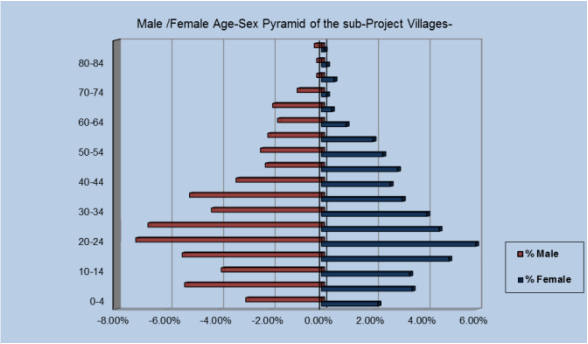
Demographic Pattern of Women

100. Women constitute 49.30 percent of the population of Gondhi subproject area and have a low literacy rate of 52.41 percent, (Census 2001), in comparison to their male counterpart (66.86 percent). While comparing, the inter district Gender Development Index, the project region falls under the best GDI ranked districts (with 0.66 GDI and ranked 5 out of the 27 districts as per HDR-2005).

101. Based on the sample surveys, the age-sex composition reveals that nearly 55 percent of the total population fall under the working age-group of (24-60 years) across both male/ female population in the subproject area. The concentration of illiterate women above 35 years as depicted in the following figures:

Table 16: (a) Women Employment Pattern (b) Male /Female Age Distribution in Sample Villages





Role of Women in agricultural activities

102. In the subproject, the women play an important role in carrying out the economic activities of the rural households, especially in the agriculture and related sectors. They constitute approximately 37 percent of the workforce in the primary sector (Census 2001). In general women are involved directly in agricultural and its allied activities, animal husbandry, poultry, and other related pursuits. In typical agricultural households, women participate in production and have sole responsibility for household activities. Further, the occupational pattern of the vulnerable women groups comprising scheduled tribe and landless reveals that they are mainly tied to land owners for their livelihoods. Women are also engaged in unskilled jobs, as agriculture laborers, whereby their agriculture wages ranges between INR 80 to 100 and for male workers it range between INR 150 to 180, thus reflecting the disparity in wage patterns.

Status of Women in the subproject area

103. The main observations related to socio-economic profile and gender participation in the subproject may be summed up as:

Table 17: Distribution of Women Literates/Illiterates (percentage of households)

Education level	Women Literacy Pattern of the subproject (sample surveys)				
	8 to 14years	15 to 24 years	24 to 33 years	above 33 years	Overall Female Literacy rate
Literate %	12.5	26.7	13.7	30.4	83.3
Illiterate %	1.3	0.5	0.8	14.1	16.7

Source: sample household survey, 2012

104. The field discussions exhibits that approximately 85 percent men are the main decision makers of households and manage the household finances and 80 percent possessed legal house/land ownership in their names.

105. The fertility rate of women in the subproject accounts for 2.13 (based on sample surveys), which is lower than the national average (2.7) and similar to the state average (2.1). The average age of marriage of women in the subproject ranged between 17 to 22 years and males between 20 to 26 years. The Infant Mortality Rate (based on field interactions and discussions) in the subproject accounts for approximately 40 as against national average of 55 and state average of 47. (SRS, 2007). The sex ratio of the subproject villages was 970 (Census 2001) as against state average of 968 (Census 2011). Hence, the gender development patterns in the subproject area may be rated more developed than the national and state average.

Women's Participation in WUCS and Self Help Groups (SHGs)

106. The participation of women in WUCS range between 10-15 percent in the subproject area. Though, it may be noted that the WUCS in the project area follow the procedures laid down as per SGOK Act requirements13, by filling the positions of SC, ST and women (one each) within the WUCS executive members (ranging between 8-9 members), but their active participation remains a concern.

107. However, women play a role in water distribution to farmers' fields. The reason for non-inclusion of women in WUCS is due to fewer women being landowners and lack of awareness about of the Act, roles and responsibilities. It was also indicated that there have been a few training programmes and exposure visits conducted for WUCS members in the sub-project by CADA, but the women representation was very minimal and as such no separate training has been conducted for women members.

108. Considering the importance of women in terms of their number and the significant contribution they make to the agriculture labor force, it's been recognized that they should play an important role in the WUCS. Interestingly it was noted during field interactions that women had equally good knowledge about land preparation, raising seedlings, cleaning, harvesting etc. as compared to their male counterparts, but are never recognized for their knowledge and the valuable contribution that they can make in this area.

109. While the poor status profile, land ownership and various other factors inhibit women participation in WUCS in the subproject, good examples from better performing states like Chhattisgarh (Chhattisgarh Irrigation Development Project, under ADB's assistance) may be adopted/replicated. The provisions within Chhattisgarh Participatory Irrigation Management Act, provides for more inclusive and equitable Water Users' Association, especially with increased representation of women and the landless. It also allows membership to the Wife/ spouse of the land holder and allows any person who is in lawful possession and enjoyment of the land under a water source, on proof of such possession and such enjoyment in a crop year, may claim membership not withstanding whether he is recorded land holder or not, in which case the Water Users' Association shall not refuse the membership of such person for the purposes of the Act. Such person shall be liable to pay the water charges and the fees as may be prescribed as if he is the water user; In addition, the wife / wives of such land holder, who do not hold land, shall deemed to be the landholders for the purpose of this act.

110. The other good initiative being undertaken in India is Madhya Pradesh (Sinchai Prabandhan Me Krishkon Ki Bhagidari Adhiniyam) and Chhattisgarh, which ensures all farmers, be they men or women can be rightful members of the outlet committee. It also

13 The Act requires at least one of the 9 Directors to be female

allows the women to attend meeting along with their spouses. The current program, may hence explore options for establishing an increased and minimum acceptable level of participation for women without foreclosing options of further participation.

111. In line with the above, though the gender status in the Karnataka and the subproject area is good, entry points for women in water management needs to be explored by examining other government programmes where women are performing well. For example, in the project area on average, there are 4-5 Stree Shakti Sanghas (SHGs) in each village formed under the Department of Women and Child Development. (based on interactions with aganwadi workers, women and secondary data sources). The loan taken by these women SHGs are mainly for pursuing agriculture/ floriculture and dairy activities accounting for 29.8 percent and 54.6 percent respectively. Hence, possible linkage of these SHGs to water management process and WUCS could be explored.

Women's Needs Assessment

112. Women's perceived needs were identified in focus group discussions undertaken in the 10 sample villages, and have been prioritized below. These needs were scored (3 points for 1st priority, 2 points for 2nd, and 1 point for 3rd or lowest priority). Improved animal husbandry, skilled employment opportunities in farm and non-farm activities and roads were accorded a high priority by the majority of villages, followed by health, improved agriculture technology etc.

Table 18: Needs and Priorities of Women

	Priority 1	Priority 2	Priority 3	Overall Score
Animal Husbandry	6	3	3	9
Health Centre	4	4	3	8
Improved agriculture technology	4	4	3	8
Drinking water	4	3	4	7
Employment	5	4	3	9
Road	4	4	4	8
Higher Education	5	4	4	9
Electricity	1	0	2	2
Poultry	3	4	4	7
Agro-forestry	0	1	2	1
Communication	4	3	4	7
Water for Kitchen Garden	4	4	3	7
Sanitation	4	3	3	7

Source: Focus Group discussions in 10 Sample villages

4.6 Vulnerable Groups

113. As listed in the Constitution (Scheduled Tribes) Order, 1950 (Part III— Rules and Orders under the Constitution) and Karnataka Gazette Notification No BC 12016/34/76 SCT, 1977, there are 50 scheduled tribes in the state. The main scheduled tribes residing in the subproject villages are the Nayak Tribes. The percentage of scheduled tribes in the subproject villages is very low, accounting for 3.3 percent of the total command area (Census 2001). The spatial distribution of the STs in the subproject villages further highlights that 39.5 percent villages do not have ST populations.

114. Based on the sample surveys, all the scheduled tribes were landless and literacy rates were low. However Census 2001 suggests that agriculture remains the mainstay activities of the scheduled tribes in the sub project villages, wherein these groups are engaged as cultivators and agriculture laborers like other rural households. It was revealed

during the transect walks and discussions with farmers that 80-90 percent of the ST families mainly reside with other rural households in the village with exceptions in some villages, where they live at the entry points of the villages or beside canals.

115. The interaction with the WUCS president and members in Doddagoppenhalli and Kage Kodamaggi revealed that the procedures followed for the inclusion of SC/ST were being adhered as per the SGOK Act, but the ST representation was comparatively lower than other caste in the WUCS and their participation in the WUCS meetings was quite low.

4.7 Beneficiary Contribution Assessment

Beneficiary Project Contribution Assessment

116. Based on FGDs and field interactions, the rural households expressed their support towards the interventions and more than 70 percent expressed willingness to participate in construction related activities and were willing to provide contribution in form of cash, labor as well as both, provided they got assured water supply and government commitment. Majority of the households also expressed their willingness to participate in extension and demonstrations and in WUCS development activities.

Awareness of the Government Welfare Schemes

117. There are number of welfare and employment generation schemes being run under various government departments (Department of RD&PR, Women and Child Development, Agriculture Department etc.) in the project villages and the awareness level of the villagers ranged between low to medium. It is noteworthy to mention here that the majority of the government schemes/programmes have an inbuilt pro-poor inclusion approach, wherein special/ substantial benefits are extended to vulnerable and women groups.

118. The most popular schemes in the project villages include the Antodaya, MGNREGA, SGSY, Stree Shakti Sanghas etc. Of the various ongoing women development programmes, the Stree Shakti scheme for self-help group (SHG) formation has reaped very good results in organizing women groups in the project villages. The women also felt that over the years, through these SHGs, it has been able to curb domestic violence against women, promote girl child education, and in preventing child marriage, etc.

119. In the subproject, the SC and ST farmers expressed their views that very limited CADA /WRD are being undertaken under the Special Component Plan and Tribal Sub Plan. The beneficiaries felt that these support activities need to be further scaled up.

4.8 Social Development Constraints, Needs and Opportunities

120. The social development constraints, needs and opportunities are summarized below:

Table 19: Social Development Constraints, Needs and Opportunities

Constraints	Perceived Needs Project	Other Opportunities
Irrigation Supply and Management		
Limited disaggregated ground level information of the subproject area.	Development of an updated and consolidated information base of the subproject area Development of baseline data disaggregated by sex for future M&E and impact monitoring required	
Lack of general awareness related to new agriculture technologies/ inputs and government programs /benefits etc.	Conduct sensitization programs at grass root level related to proposed agricultural interventions, crop diversification, technologies and, government subsidies. NGOs'/SST's participation in awareness	

Constraints	Perceived Needs Project	Other Opportunities
	generation, community mobilization, credit plus and participatory irrigation management	
From Focus Group Discussions and Household surveys farmers expressed their problems related to unlined canal.	Modernization of irrigation canals so that tail end, small and marginal farmers have equal access to water The WUCS and CADA to carry out on-farm works that will address poor Infrastructure and assured /equitable water supply and with gender sensitive irrigation designs/schedules to promote women's security by avoiding night schedules etc.	
WUCS though formed need to be effectively operational. As per FGDs, approximately 70 % of households expressed willingness to participate in WUCS development.	Awareness campaigns, training of WUCS Members and support to establish WUCS Planning and management. Ensure women's increased involvement in project management, leadership and monitoring activities in WUCs. Ensure proactive participation of women, small marginal farmers, landless and the vulnerable are included in WUCS.	Consolidated list of WUCS members' details. Development of sex-disaggregated data such as number of trainings conducted, TNA, women participation, feedback etc.
With few initiatives from CADA, the on-farm activities are limited	Increase budget for CADA activities and initiatives of pro-poor approaches to be scaled up by broadening the income base of the landless, small, marginal farmers, tailenders and women by aiming to secure skilled jobs in the irrigation and/or water resources management sector.	.
Flooding and water logging causing seepage and Weakening of residential structures, crop failure and diseases.	Drainage improvements through CADA works organized by WUCS Ensure lining of canal, which will stop the problem from worsening	Main canal lining work required Community initiatives in canal cleaning (with /without government support must be encouraged.
Agriculture		
Based on FGDs, even though currently less than 10% of the younger generation migrates outside for higher income, this trend may increase in coming years, if planned interventions not taken.	Improvement in agriculture and incomes through proposed agriculture interventions like crop diversification, on-farm training, soil testing, SRI etc. Ensure women's participation in improved and environmentally friendly agriculture practices, agriculture extension services and capacity development Improve canal water supplies to tail end farmers	
Changes in land-use and cropping patterns reducing value of production	Extension, training and demonstrations to improve crop husbandry WUCS undertaking marketing, input supply, machinery hire etc.	
Limited extension services by the Agriculture Department. 70-80% of households expressed willingness to participate in crop extension and demonstrations	Identification of extension activities that Have broad based support for WUCS micro-planning. Increased extension and training through WUCS to farmers to increase water saving, agricultural production, farmer profitability and environmental sustainability	
Women's Development		
Participation of women in WUCS management is less than 15 percent as very few own land	Promote participation of women in WUCS, Take into consideration mobility constraints etc. and by adopting Madhya Pradesh model of women participation in WUCS along with their spouses Conduct specific training programs for women	Linkage with women SHGs in the subproject area

Constraints	Perceived Needs Project	Other Opportunities
Lack of awareness related to income generating opportunities amidst vulnerable group	Establish Self Help Groups for income generating activities: agriculture related activities like vegetable gardens, dairy, farming, pisculture, small stock, etc. Organize extension, demonstrations and training. Social mobility will be taken into account in formulating SHG activities with focus on women/men from women headed households, and other vulnerable households in relation to water resources, irrigation, farm–based and off–farm livelihood opportunities and dovetailing with national programmes of employment generation and skill development	
Unhygienic conditions related to unlined canals, impact women's health and livelihoods as women are the main users of canal water for non-agriculture (domestic) purpose	Lining of canal will have direct and indirect impacts on health and hygiene of all , especially women NGOs'/SST's participation in awareness generation related to improved health /hygiene practices	
Limited Health Centers and poor rural road infrastructure	Overall infrastructure development, like small rural roads construction/maintenance can be made self–reliant with contribution of labor, cash and time from local communities, including vulnerable groups/women. Improved access to health centers and higher education facilities for women	
Development of Indigenous People		
Very few (3.3%) in the subproject	Ensure that Scheduled Tribe members are given priority in training and extension programs	

5. AGRICULTURAL ASSESSMENT

5.1 Water and Land Use

121. The soils in Gondhi area are acidic in nature (pH is less than 7.0), poor in nitrogen, and with medium phosphorous and high potash levels. A zinc micro-nutrient deficiency is present in the area. There is waterlogging on 1,318 ha[14] with some soil salinity and alkalinity. A small amount of drainage works are conducted through the Watershed Department using perforated clay pipes buried at 1m and covered with coir, sand and mud.

122. From household survey data (100 households in 10 villages, 2012) (Table 20), mean farm size is 1.18 ha and there is a decline in farm size from the canal head (1.7 ha), middle (0.92 ha) and tail (0.75 ha), 29% of farms in the head reach were medium size, just 2% in the tail reach. The majority, 53%, of farms in the sample were marginal (under 1 ha), only 3 farms were over 4 ha. Households below the poverty line were mostly landless, 18% or marginal, 73%. Distribution of farm size by caste was generally similar, except that all of the Scheduled Tribe households were landless.

Table 20: Gondhi Scheme Survey Farm Category by Canal Reach

(percent by canal reach)

	Landless	Marginal (<1ha)	Small (1-2ha)	Medium (2-10ha)	Total percent	Households
Canal Reach						
Head	*3*	*45*	*24*	*29*	***100***	**38**
Middle	*10*	*56*	*20*	*15*	***100***	**41**
Tail	*3*	*13*	*3*	*2*	***100***	**21**
Poverty Level						
Above PL	*0*	*38*	*32*	*30*	***100***	**56**
Below PL	*18*	*73*	*5*	*5*	***100***	**44**
Caste						
General	*0*	*48*	*27*	*25*	***100***	**44**
OBC	*0*	*77*	*3*	*20*	***100***	**30**
Scheduled Caste	*0*	*50*	*39*	*11*	***100***	**18**
Scheduled Tribe	*100*	*0*	*0*	*0*	***100***	**8**
Households	**8**	**53**	**20**	**9**		**100**

123. In addition to canal water, Kharif season cropping makes use of monsoon rainfall, while Rabi season cropping, though assisted by rainfall, makes use of residual soil moisture following Kharif. There were three irrigation pump sets reported in the household survey (3% of households). Pumped river water is utilized by farmers in the middle and tail reaches to supplement canal supplies. Small electric pumps are used to lift river water for all crops, but especially arecanut, during scheme closure (1 month in late November and December), and in the lower part of the scheme (below km 44 on the right bank canal) during the closure of Bhadra canal in May to July, when seepage water inflows into the Gondhi canal cease. River water is available year round. Pumps are electric, around 10hp, and electricity is provided free of charge, but is only available 6 hours per day. Installation costs are about Rs 30,000 and connection charges Rs 20,000. Water may be pumped several kilometers from the river using small plastic pipes, and is distributed in existing field channels. There are small areas of drip irrigation for arecanut. The area served by pumped water is not known, but may be 20% to 30% of the crop area. Groundwater currently has limited use for agriculture, and water yields are low.

124. Early irrigation is required if rice crops are to be established early in the Kharif season, which requires planting and nursery establishment in early June. Irrigation allows optimal yields to be obtained from Kharif crops in drought years. Canal closure periods

[14] Bhadra CADA office, Shimoga and Joint Director, Department of Agriculture, Shimoga

make supply of water at this time difficult but are also timed for the period when the river flow is likely to be at a minimum.

125. Household cropping from the survey are shown in Table 21. Paddy is the main seasonal crop in both Rabi and Kharif and sugar cane and arecanut are the perennial crops. 60% of households grow paddy rice, usually in both seasons, and 62% grow at least one perennial crop.

Table 21: Gondhi Scheme Cropping (2012 household survey)

Crop	Percent Households Growing	Percent of Farm Area
Kharif		
Paddy	*60*	*43*
Other (sorghum/millet)	*2*	*1*
Rabi		
Paddy	*60*	*39*
Jowar	*1*	*1*
Subtotal Seasonal	***65***	***84***
Perennial		
Sugar Cane	*30*	*16*
Arecanut	*46*	*26*
Coconut	*6*	*4*
Banana	*2*	*1*
Subtotal Perennial	***62***	***47***
Total	***92***	
Farm Holding (ha)	1.18	
CI (overall) %	131	
CI (seasonal) %	160	
Cases	100	

Notes: Areas based on revised household survey data, 7/11/2012
Perennial crop areas are lower than reported from satellite imagery,

126. Sharecropping is not practiced and tenant farming are uncommon, with just a few cases, and is declining. Lease rates are between Rs 8,000 to 10,000 per acre per year, usually paid in output.

5.2 Agricultural Practices

Crop Calendar

127. The cropping calendar for the main crops is shown in Table 22. The Kharif season is June to December, and Rabi cropping starts in December to January, after the canal closure period, though paddy nurseries may be planted earlier.

Table 22 Cropping Calendar

Crop	Sowing Period	Harvest Period
Paddy - Kharif	Jun-July	Nov-Dec
Paddy- Rabi	Jan	Apr-May
Kharif Field crops	Jun-Jul	Nov-Dec
Arecanut	Jun-Jul	Aug-Dec
Sugar Cane	Aug-Nov (bienn.)	Aug- Feb
Banana	monsoon	All year
Coconut	monsoon	Aug- Feb

Crop Inputs

128. The use of fertilizers in Karnataka State has increased steadily to over 2 million tonnes in 2011-12, with an average growth rate of 5 percent per year. The per hectare consumption in Karnataka is higher than India average, during 2010 - 11; it was 171 kg/ha (of nutrient) compared to 145kg/ha for India. Over half the total is N, mainly as urea, Table 23, with a ratio of N2.6:P1.7:K1, where balanced use is taken as N4:P2:K1. Fertilizer use on Gondhi scheme is considerably higher than the state average (which includes rainfed crops) at about 500kg/ha, with quite high inputs of P & K.

Table 23: Karnataka State Fertiliser Consumption

('000 tonne nutrient)

Nutrient	2007-08	2008-09	2009-10	2010-11	2011-12	Annual Compound Growth (%)
N	790	864	963	1,016	1,030	5
P^2O^5	387	558	630	696	643	9
K^2O	330	409	466	398	337	-
Total	**1,507**	**1,832**	**2,058**	**2,110**	**2,010**	**5**
Kg/ha	121	148	166	171	165	

Source: Report of The Working Group on Fertilizer Industry for the Twelfth Plan (2012-13 to 2016-17) Government of India Ministry of Chemicals & Fertilizers Department of Fertilizers
Department of Agriculture. Economic Survey of Karnataka 2011-12

129. There is no soil testing or mapping and the organic content and nutrient status is not known. The use of organic manure is low and farmers are applying small and reducing amounts of farm yard manure, farmers apply inorganic fertilizers at nearly twice recommended rates. Presently around 173 kg of nitrogen per ha, 87 kg of phosphate and 70 kg of potash is applied per hectare rice. There is a little vermi-compost production. Crop rotations and green manure crops are not adopted, as seasonal cropping is almost all paddy rice. Farmers rely on inorganic fertilizers to maintain crop productivity, and report declining soil fertility. Reduced organic matter in the soil requires ever higher doses of artificial fertilizer to maintain fertility, and it is likely that micro nutrient deficiencies are increasing as a result of heavy production.

130. The application of pesticide has also become common among the farmers in the project area with nearly all paddy farmers and arecanut growers having to use pesticides.

131. Household survey result show low uptake of improved practices, Table 24, though a high proportion of households use inorganic fertilizer (80%), pesticides (83%) and organic fertilizer (54%). There is some adoption of high cost technologies such as drip or sprinkler

irrigation, which have a 75% government subsidy. Given the high adoption of pesticides, use of IPM is not being used by most households.

Table 24: Gondhi Scheme Improved Practices

Practice	Percent of HH Adopting
Drip or sprinkler irrigation	*13%*
Mulching	*11%*
Organic fertiliser	*54%*
IPM (Integrated Pest Management)	*1%*
INM (Nutrient)	*10%*
Improved crop varieties	*12%*
Inorganic fertiliser	*80%*
Pesticides	*83%*
SRI (System for Rice Improvement)	*18%*
Others	*14%*

Source: Survey of 100 households in Gondhi, 2012

Mechanization

132. Farm labor costs are increasing, and this trend looks likely to continue as relatively well educated young people tend towards urban living and employment. Farmers are increasingly, and rapidly, adopting mechanized agriculture, with tractor ploughing and transport and contract combine harvesters. Rice transplanters are not yet in use but contract planting is common. The cost of cultivation are typically:

- ploughing and puddling costs around Rs 2,500;
- transplantation Rs 2,000;
- harrowing, weeding, sprays, and 20 kg of seed Rs 1,500; and
- harvesting by combined harvesters is Rs 2,000 per hour with 3 to 4 hours per hectare.

133. Tractor rotovators are becoming common for weed control at Rs 600 per hour, and cultivators are also used, costing Rs 500 per hour. Two wheel tillers are used, as transport and small cultivators costing Rs200-300 per hour. There are local owners of tractor equipment and small and marginal farmers hire services. Combine harvesting is all carried out by outside contractors using small (2.4m) machines, some rubber tracked. Combining is organized by agents. The use of bullock power has mostly vanished but they are still used for levelling fields after puddling (planking) and for sugar cane weeding. Household survey shows 12 % of the households owned a tractor (value about Rs 450,000), and 82% households rented a tractor, with an average annual rental cost of Rs10,390 per renting household. Some farmers owned seed planters. Twenty-three percent of households owned a sprayer and 59% rented them.

5.3 Current Cropping Pattern, Yields and net Returns.

134. Land use on Gondhi was estimated using satellite imagery[15], which showed 76% of the gross command area was cropped land, the rest built up and farmstead area, river, roads, non-crop trees, land out of command and open water. Allowing 5% for bunds and channels the plot area (CCA) would be 4,786ha, which is close to the reported CCA of 4,600ha. 37% of the cropped area was under seasonal crops, 49% under tree crops and 12% under sugar. 23% of the tree crop area was new (6 years or less) arecanut plantations (unmistakable, with open canopy planted on a 2.7m by 2.7m grid). The household survey reported rather more seasonal crops (44% of farm area / compared to 37% from satellite imagery) fewer tree crops (31% / 49%) and more sugar (16% / 12%). Given the sampling errors, and errors in identifying crops on satellite imagery, these findings are remarkably consistent, and young sugar would be hard to identify on the satellite image. According to

[15] Google earth images from 2011. Two grids, of 532 dots, at 500m centers were used (one grid offset by 250 meter) and land use at each point reported. Both grids gave similar results. Tree plantation was easy to identify.

the household survey cropping intensity in the area is 131% overall and about 160% on land with no perennial crops. Gondhi scheme is fully developed, with almost 100% cropping in both Kharif and Rabi seasons. Official data show 60% of area under seasonal crops 7% under tree crops and 7% under sugar, and are clearly not representative of current conditions.

135. Household survey results show perennial crops cover 47% of the sample farm area (Table 25), with seasonal crops covering around 44%. Cropping intensity increases from 124% at the head to 141% in the tail reach reflecting the lower proportion of perennial crops there. There is a drop in perennial crops in the tail reach, from around 50% to 36% of the farm holdings. Seasonal cropping (nearly all paddy rice) increases in importance in the lower canal reaches, 69% of the farm holding is seasonally cropped in the head reach, 88% in the middle reach and 100% in the tail reach. This is related to smaller farm holdings, which require a higher proportion of the land for subsistence, and to less reliable water supplies required for perennial crops.

Table 25: Gondhi Scheme Survey Satellite Data and Household Survey Crop Area

	% of Cropped Area	**% of Cropped Area from Household Survey**	**Detailed Project Report (% of CCA)**
Kharif		*44*	*60*
Rabi		*40*	*34*
Area of Seasonal Crops	*37*	*44*	*60*
Tree Crops	*49*	*31*	*7*
Sugar	*12*	*16*	*7*
Total	***100***	***131***	***126***

Table 26: Gondhi Scheme Survey Cropping Pattern by Canal Reach

	Kharif (ha)	**Rabi** (ha)	**Perennial** (ha)	**Total** (ha)	**Farm Holding** (ha)	**CI %**	**Kharif** (% farm area)	**Rabi** (% farm area)	**Perennial** (%farm area)
Head	25.4	24.2	30.9	**80.5**	64.7	*124*	*32*	*37*	*48*
Middle	17.6	15.5	19.0	**52.1**	37.8	*138*	*47*	*41*	*50*
Tail	8.6	8.0	5.6	**22.1**	15.7	*141*	*55*	*51*	*36*
Total	**51.7**	**47.7**	**55.2**	**154.6**	**118.3**	***131***	***44***	***40***	***47***
Cases	38	41	21	**100**					

136. The cropping pattern is dominated by paddy rice with around 40% of the area in both Kharif and Rabi seasons. Most sample households (92%) had some crop and 84% grew at least one seasonal crop, mostly paddy rice. Perennial crops were grown by 62% of sample households, tree crops were grown by 48%, most of which was arecanut, and sugarcane by 30% of households. There are small areas of other semidry crops and other tree crops, such as banana and coconut (5% of sample area). There is little potential for increasing cropping intensity, due to the large area of perennial crops.

Table 27: Assumed Project Cropping Pattern and Yields

	Current Area (ha)	Area (ha)	Current Yield (kg/ha)	Yield PY25 (kg/ha)
Command Area	4,600	4,600		
Kharif Season				
Paddy	1,400	450	5,450	7,000
SRI Paddy	0	450	-	8,000
Other	350	350	5,500	6,600
Rabi Season				
Paddy	1,000	100	5,500	6,600
SRI Paddy	0	400	-	7,000
Other Rabi	750	750	5,500	6,600
Perennial Crops				
Sugarcane	550	550	85,000	100,000
Arecanut	2,300	2800	15,000	18,000
Total Area & Cropping Intensity	**6,350**	**5,850**		
Cropping Intensity	***138***	**127**		

Paddy Rice

137. Paddy production methods are typical for the crop in India, with fairly high use of inputs and high yields, over 5,000 kg/ha. Most of the area uses HYV with annual seed replacement. Mechanization is universal, and half the crop is combine harvested, and half harvested by contract labor. The latter is more expensive, but makes the hay crop available. Rice manual harvest contracts are Rs 10,000 to Rs 12,500 per ha compared with Rs 7,500 to 8,000 per ha for machine harvesting. Most rice is sold off the field, the trader providing transport and sacks. Aftermaths are grazed by sheep brought in from outside the scheme, and local cattle. Pesticide use is quite high, mainly for insect pests, but also fungal diseases. Land preparation and harvesting are mechanized and transplanting is by contract labor. It is envisaged that mechanized transplanting will be introduced in the medium term.

Maize

138. Maize is grown for livestock feed, and is currently a small area, but expected to increase under the project. HYV varieties are planted with fairly high levels of inputs, land preparation and harvest are mechanized.

Sugar

139. Karnataka had 421,000 ha of sugar and produced 38 million tonnes of cane in 2010-11, about 11% of the national crop. Both area and production are fairly stable, with a compound growth rate of under 2%. Yield rates in Karnataka, 89 t/ha, are typical of the tropical region, where the crop has a 14 month rotation, yields on Gondhi are a bit higher (100t/ha). Sugarcane is generally grown as a perennial crop, with a single ratoon if first year yields are considered adequate. Planting is carried out in ploughed and levelled land, (three passes normally), then ridged, using cut cane planting material, usually as a contract operation. The crop is weeded with herbicides (glyphosphate) three times in the first three months, then by animal draught, until the canopy closes. High levels of inorganic fertilizer (2,500 kg/ha product) are used, but there are fertility issues due to lack of FYM. Use of inputs in the ratoon crop are lower, and yields are less, but land preparation and planting costs are avoided. The crop is harvested under contract, according to schedules imposed by the factory, and transport is organized by the factory, but paid by the producer. Current prices are Rs 2,400 per tonne cane, out of which transport and moving cane to the road are paid. There are marketing issues and payments due at 15 day can be delayed by months, forcing producers to borrow for new plantings at high interest rates. Sugar area is declining, and being replaced with arecanut.

Arecanut[16]

140. Karnataka is a significant arecanut (betel nut) producer, with about 46% of the total for India, Table 28. Annual growth in demand is around 5%, in Karnataka area has grown from 70,000 ha in 1991 to 180,000 ha in 2011, production is 230,000 tonne (dry nut). Arecanut is harvested every 40 days during the harvest period. Spraying of arecanut is required (fungicides), which requires specialized skill, as the operator has to climb the trees. In Gondhi the cropping pattern was originally all paddy rice, moving to 50/50 sugar and paddy, after the sugar factory opened. Marketing issues led to adoption of arecanut, which has increased from almost nothing to about half the area since 1990, and expansion is continuing.

Table 28: Arecanut Area and Production 2010

	Area (ha)	Production (t)	Percent of World
Karnataka	180,000	230,000	*26*
India	475,000	490,000	*55*
World	**730,000**	**867,000**	***100***

141. Establishing arecanut involves a considerable investment by farmers (over Rs 300,000 per ha) over the seven years before production begins, and positive cash flow takes around 12 years. Intercropping of young arecanut is practiced but only on around 25% of the crop area, and the returns are small. Intercrops include banana, cocoa (both of which provide shade to young trees), ginger, floricrops (marigold, jasmine and roses), beans, fodders and green manures. Old arecanut plantation are also intercropped with new arecanut for succession at about 25 years. Tree seedlings are produced locally and planting is on a 2.7 meter grid (1300 trees/ha), generally aligned SW/NE. Arecanut are planted in pits about 0.5 meter deep, which are backfilled with compost, FYM, a high potash fertilizer and red clay brought if from rainfed areas. Resupply of trees is required annually to replace poor performers, typically 60 trees /ha/year. Yellow leaf disease is increasing losing 150 trees/acre. Large quantities of inorganic fertilizers and FYM are used, despite which farmers are reporting soil fertility issues, probably shortages of micro nutrients, which need to be investigated and corrected. Farmers practice marling with red clay soils from nearby rainfed areas, presumably to improve nutrient availability, applications are made every second year, alternating with inorganic fertilizers. Production starts in year 6, and takes a further 6 years to reach full yield. There are four harvests a year as overripe nuts are not marketable.

142. Arecanut is a flexible crop and does not require precise timing for cultural operations. It is a relatively light user of water. Arecanut marketing is mainly carried out prior to harvesting, and local processers (often also farmers) buy the crop on the tree. Processing requires harvest, transport, shelling, boiling the nuts (using by-products as fuel) and drying, most of the output being red boiled nut in the scheme area. There are numerous small processers in the scheme. Dry nuts market at about Rs 150 per kg.

Other Tree Crops

143. There are small areas, less than 5%, of banana and coconut. Coconut is planted on a 9m by 9m grid (120 trees/ha), or more commonly as a plot boundary, and sometimes within arecanut plantations. Water nut is consumed locally and copra made for sale for oil extraction. Banana is grown as a sole crop but mostly as an intercrop in arecanut. It provides shade to young trees, and can go on producing in mature plantations, but yields are low at about 4t/ha. Two or three year ratoons are grown, with a year between plantings.

[16] Information on arecanut is taken from: Arecanut at the Crossroads, Dr TN Prakash Kammardi, Department of Agric. Econ. University of Agricultural Sciences, Bangalore. 2012

5.4 Livestock and Fisheries

144. The Gondhi household survey reports cows owned by 59% of the sample households, with an average of 1.3 per sample household ranging from 1 to 8 cows per household, Table 29. Other livestock ownership is minimal, including draft animals. Sixteen percent of sample households own one or more chickens up a maximum of forty. There is no relationship between canal reach and livestock ownership. Farmers mostly depend on dry fodder, aftermath grazing and grazing common areas. Green fodder is not common, as land for fodder is not available as nearly all the non-plantation area is used for paddy rice and semidry crops. Farmers expressed willingness to adopt growing green fodder, which could be an intercrop with arecanut.

145. There are no fish farms in the scheme, but some fishing is undertaken in the river.

Table 29: Gondhi Scheme Livestock Ownership

	Percent HH Owning	Mean Owned per Sample Household	Maximum Owned per Household
Cows	*59*	1.3	8
Ox	*15*	0.3	2
Buffalo	*14*	0.3	2
Sheep & Goats	*13*	0.3	6
Chicken	*16*	1.2	40

5.5 Agricultural Incomes and Expenditure

146. Mean agricultural income from the household survey was Rs 54,000 per household per year, ranging from Rs 5,000 to Rs 330,000. Other income was small. In addition, livestock benefits were valued at Rs 6,000. Household expenditure was Rs 56,000, so income and expenditure was broadly in balance.

5.6 Agriculture Extension and Training

147. The Department of Agriculture provides extension services through the following agencies:

- Raitha Samparka Kendra (RSK)
- Technical Units
- Indian Council of Agricultural Research (ICAR)
- State Agricultural Universities (SAUs) networks
- Agriculture and Technology Management Agency (ATMA)
- Command Area Development Authority (CADA)

Raitha Samparka Kendra (RSK)

148. RSK network was launched in 2000, with objectives of:

- providing information on production and marketing
- provision of agricultural inputs
- testing agricultural materials
- Providing a public and private sector interface

Department of Agriculture Technical Units

- Horticulture (implementing the GOI National Horticulture Mission since 2000)
- Sericulture,
- Animal Husbandry
- Fisheries

Indian Council of Agricultural Research (ICAR)

149. Major programs are:

- Operational Research Projects (ORPs) that identify technological and socio-economic constraints and develop extension modules.
- Lab-to-Land programme to transfer low cost technologies.
- Krishi Vigyan Kendra (KVK) (Farm Science Centre) at district level conduct need based training programmes and demonstrations.

State Agricultural Universities (SAUs)

- transfer of technologies to farmers
- extension and training services
- extension publications in local languages

150. There is an agricultural research station and training college based in Shivamogga, part of University of Agricultural Sciences, Bangalore. The facilities include:

- Arecanut Research Centre (2001) which studies varieties, pest management, value added products, marketing and is partially funded by farmer co-operatives;
- Organic Farming Research Centre, developing composting, green manure, development of bio-fertilisers and biological pest control and developing organic production modules;
- Plant Health Clinic under the National Horticulture Mission providing identification and control services;
- Agricultural research into varieties (140 local rice and 40 brinjal varieties are being studied), intercropping and crop technology packages;
- Irrigation research;
- Training of input suppliers as crop advisors.

151. The project could use the research station as a resource base, and assist in undertaking testing and extension of identified packages, especially bio-fertilizers and biological pest control.

Agriculture and Technology Management Agency (ATMA)

152. ATMA is a GOI initiative at District level which emphasizes coordination between key stakeholders (farmers, departments, non-government organizations, input dealers, mass media, agri-business). Every district prepares a Strategic Research and Extension Plan.

Command Area Development Authority (CADA)

153. CAD activities include:

- development of command areas;
- prevention of land erosion and water logging;
- improving soil fertility and regulation of cropping pattern;
- maintenance of field channels and drains by farmers;
- supply of inputs and services;
- set up rural growth centres;
- developing marketing, processing and storage facilities;
- arrange credit;
- organize Co-operatives and Associations;
- constructing field channels and drains;
- manage conjunctive water use;
- determine compensation;
- agricultural demonstrations and extension activities.

154. CADA activities are generally restricted to field channels and drainage, due to serious skills limitations and lack of resources.

Overview

155. Extension services lack agricultural skills and resources and activities are limited. Extension and farmer training are weak, and adoption of new technologies is low, though use of inorganic fertilizers, pesticides and mechanization is universal. SGOK extension is targeted towards subsidy distribution and extension officers are occupied mostly in administration. Farmers depend on private input dealers, often with limited knowledge, for advice. NGO's provide agriculture assistance on a small scale but lack suitable production modules.

5.6 Project Development Opportunities

156. Despite the high current yield rates in Gondhi there is potential to improve yields for most farmers and crops (Table 30)[17], by up to 40%, though project impacts will be less than the potential. Costs of cultivation can be reduced and increase the net returns.

Table 30: Current and Potential Yield in Gondhi

	Low Yield	High Yield	Potential Yield
Paddy			
Percent of farmers	*42*	*58*	
Yield rate (kg/ha)	4,500	6,250	8,750
Arecanut			
Percent of farmers	*75*	*25*	
Yield rate (kg/ha)	11,250	17,500	20,000
Sugarcane			
Percent of farmers	*80*	*20*	
Yield rate (kg/ha)	100,000	125,000	150,000

Crop water management

- improved crop water management, based on real water requirements and crop stage (flowering and filling) can considerably increase crop production and water productivity.
- improved water management at the WUCS level.
- Promotion of SRI for more water-efficient paddy production with potential for increased yields
- improve water use efficiency by promoting micro irrigation and fertigation. SGOK subsidises equipment by 75%.

Crop Diversification

- dependency on a single cash crop is risky, and the project can assist in identifying alternatives, and increase crop diversification, reversing the current trend of increased arecanut.
- develop suitable modules and introduce demonstrations of short duration high value crops such as vegetables, flower cultivation, banana, Rabi pulses (etc.)

Arecanut

- inter cropping of young arecanut to increase incomes
- promotion of vermicomposting, as a nutrient provider (6 tonnes of by-product/ha/year)
- identify and promote alternate high value crops

[17] Op cit., JalaSpandana-DHV p19

- testing and promotion of soil fertility enhancers (microorganisms for fertility enhancement, nitrogen fixers and green manuring)
- test and promote plant protection (Yellow Leaf Disease), packages and biological control modules, especially fungal control of nuts
- Promote the Multi Story Cropping System, which may double net returns.
- promote improved arecanut varieties and high quality planting material
- mechanisation of spraying, harvesting and post-harvest operations (de-husking)
- promotion of co-operative processing through WUCs.

Sugarcane

157. Sugarcane is a declining crop and no project interventions are envisaged.

Rice, SRI Cultivation

158. SRI/modified SRI one of the water saving and yield enhancing measure for paddy would be adopted as part of modernization program. The main characteristics of SRI rice cultivation are:

Table 31: Characteristics of SRI Rice

Practice	Conventional	SRI
Nursery		nutrient-rich un-flooded nurseries.
Seed rate	50-60 kg/hectare	5 kg/hectare
Transplanting	30 days	8-12 days
Stand density	40/m^2	16/m^2
Seedlings per stand	3	1
Inputs	chemical fertilisers pesticides herbicides	organic fertiliser blend with inorganic fertiliser non-chemical weed control pesticides usually not needed
Water management	continuous flooding	moist conditions mulching
Weed management	weeds manually removed	weeds buried by cono weeder frequent weeding

159. Introduction of SRI would reduce water use, increase the yields by 25%, whilst operating costs only increase 2.5%, and increase incomes. Gondhi has a surplus of suitable mulching and composting materials from perennial crops. SRI improves the productivity of land, labor, water and capital used in rice cultivation. SRI, labor requirements are higher, but manageable.

Drainage

- fund survey of drainage requirements
- promote field drainage as required, including tile drainage

Soil Fertility Management

- Despite high levels of chemical fertiliser application, soil fertility is said to be declining.
- test and promote bio-fertilisers developed by local agriculture research
- support mass production and marketing of bio-fertilisers
- promote green manure crops and legumes
- promote Integrated Nutrient Management to reduce fertiliser inputs
- introduce soil testing at plot level to identify nutrient requirements

- test and develop modules for micro nutrients, and support demonstrations and marketing

Pest Management

- test and promote bio-pest control products (insecticide and fungicides) developed by local agriculture research
- test and promote fungal rot control in arecanut (replacing use of heavy metals)
- promote Integrated Pest Management, especially in rice

6. ASSESSMENT OF IRRIGATION SYSTEM

6.1 Crop Water Requirements and Design Discharge

160. A detailed description assessment of the crop water requirements is included in Annex 7 and is summarized below.

Reference Evapotranspiration

161. Reference evapotranspiration (ETo) is calculated from climate data using the FAO ETo calculator[18] which uses the Penman-Montieth formulae which was recommended to be adopted by an expert consultation in 1990. The method overcomes the shortcomings of the previous FAO Penman method and provides values that are more consistent with actual crop water use data worldwide.

162. In the absence of a full dataset of agro-climatic near the project area the values used in the DPR, which are for standard agro-climatic zones, have been used. This assumption could have significant impact on the overall water requirements.

Irrigation Efficiencies

163. The overall efficiency for an irrigation scheme is built up from the efficiencies of the separate steps in the water distribution and application process. The components normally used[19] are:

164. **Conveyance efficiency:** This takes account of both operational losses and hydraulic losses (evaporation and seepage) in the main distribution system. The DPR proposes 90% on account of the proposed lining of the canal system but very effective management will be needed to achieve this.

165. **Distribution efficiency:** This takes account of the losses between the main system and the field. The DPR proposes 80% efficiency which is reasonable for an open channel network but this could be improved to 90% if a gravity-supplied piped distribution system, proposed to be piloted under the project, is provided.

166. **Application efficiency:** Application efficiency reflects the proportion of the water supplied to the field which is actually used by the crop. Some water will run off, some will evaporate (from bare soil and open water) and some will percolate beyond the root zone. Crop water calculations for flooded paddy provide for deep percolation as a separate loss because it is independent of the crop water requirement and this results in a higher value for application efficiency to reflect the other losses.

167. Application efficiency will depend on both irrigation type and soil conditions: For flooded paddy and for non-flooded crops. It is assumed that flooded paddy will be only grown on the less permeable black cotton soils for which 85% efficiency + 4mm/day percolation loss is assumed. Other crops are assumed to have application efficiency between about 65% (red soils) and 75% (black cotton soils).

Overall Efficiency

168. The overall irrigation efficiency is calculated as conveyance efficiency x distribution efficiency x application efficiency. The application efficiency will depend on whether the crop

[18] http://www.fao.org/nr/water/eto.html

[19] http://content.alterra.wur.nl/Internet/webdocs/ilri-publicaties/publicaties/Pub19/pub19.pdf

is flooded paddy or other non-flooded crops. The overall efficiency for three cropping conditions noted in paragraph 167 using canal distribution are:

(i) Flooded paddy 90% x 80% x 85% = 61.2% (+ percolation loss)
(ii) Non-flooded crops on black cotton soil = 90% x 80% x 75% = 54%
(iii) For non-flooded crops on red soils: = 90% x 80% x 65% = 46.8%

169. If a piped distribution below the outlet is used then the corresponding overall efficiencies would become:

(i) Flooded paddy 90% x 90% x 85% = 68.9% (+ percolation loss)
(ii) Non-flooded crops on black cotton soil = 90% x 90% x 75% = 60.8%
(iii) For non-flooded crops on red soils: = 90% x 90% x 65% = 52.7%

170. This represents about a 6% improvement in the system efficiency provided by the piped system. However, the extent of adoption of piped distribution is unknown at this stage and this is not reflected in the calculations.

Crop Water Requirements

171. Water requirements have been computed for following crops:

- Arecanut
- Banana
- Dry (ie non flooded) field crops in kharif and rabi
- Flooded paddy in kharif and rabi
- SRI[20] paddy in kharif and rabi
- Sugarcane

172. While implementation of the full suite of potential improvements for SRI paddy is reported to reduce water consumption by up to 50%, a more modest saving equivalent to about 25% has been assumed since the technique is new to the project area and requires adoption by a whole group of irrigators in order to save water. It is not possible for one farmer to stop flooding his field if surrounding fields are still using flood irrigation.

173. Gross water requirements at the headworks for each crop, including allowance for irrigation efficiency and rainfall are presented in the following Table.

Table 32: Gross Water Requirements for Selected Crops

Crop name	Diversion at headworks	Water consumed[21]
	m³/ha	m³/ha
Arecanut (includes other tree crops)	14,491	7,303
Banana	22,119	11,148
Dry (non-paddy grains and pulses) kharif	3,490	1,634
Dry (non-paddy grains and pulses) rabi	8,604	4,646
Paddy kharif	18,328	6,131
Paddy kharif SRI	13,838	5,877
Paddy rabi	20,741	7,699
Paddy rabi SRI	16,628	7,310
Sugarcane	19,796	10,690

174. Scheme water requirements have been calculated for 3 scenarios selected to represent both agro-economic changes and pressure to reduce scheme water usage:

[20] SRI (System of Rice intensification) is an alternative method of paddy cultivation using different agronomic practices preferably without flood irrigation. See http://sri.ciifad.cornell.edu/index.html

[21] "Consumed" is water lost to the basin, ie evaporation / evapotranspiration

(i) The existing cropping pattern based on evaluation of satellite imagery but with the improved efficiencies anticipated under the project
(ii) A 500 ha increase in arecanut with corresponding decrease in paddy plus partial adoption of SRI paddy production and a reduction in the rabi paddy area
(iii) No increase in the current area of arecanut and the cultivation of semi-dry crops instead of paddy

Table 33: Water Requirements for Selected Cropping Patterns

	Current Cropping Pattern			Future Cropping Pattern			No Paddy Cropping		
	Area	Peak Flow	Water Vol	Area	Peak Flow	Water Vol	Area	Peak Flow	Water Vol
Crop	ha	m^3/s	Mm^3	ha	m^3/s	Mm^3	ha	m^3/s	Mm^3
Arecanut	2,300	2.083	33.33	2,800	2.536	40.57	2,300	2.083	33.33
Semi-dry Kharif	350	0.239	1.22	350	0.239	1.22	1,750	1.193	6.11
Semi-dry Rabi	750	0.951	6.45	750	0.951	6.45	1,750	2.219	15.06
Paddy Kharif	1,400	3.011	21.01	450	0.968	6.75	0	0.000	0.00
Paddy Kharif SRI	0	0.000	0.00	450	0.767	4.46	0	0.000	0.00
Paddy Rabi	1,000	2.774	20.13	100	0.277	2.01	0	0.000	0.00
Paddy Rabi SRI	0	0.000	0.00	400	0.975	6.36	0	0.000	0.00
Sugarcane	550	0.668	10.89	550	0.668	10.89	550	0.668	10.89
Total area	6,350	5.801	87.36	5,850	4.896	72.11	6,350	4.971	59.70

175. It can be seen that the gross water requirement (at the headworks) is 87.4 Mm^3 for current cropping pattern and reduces to 72.1 Mm^3 for the assumed future cropping pattern. Cessation of paddy cultivation would reduce the gross water requirement to 59.7 Mm^3. The net water requirements will be less than this because of return flows. These water requirements exclude the demands of the perennial crops during the canal closure periods (assumed to be June and December). These demands would need to be satisfied by either stored surface water or groundwater or pumping from the river.

Design Discharges

176. The water requirements presented in Table 33 are for the total CCA of 4,600ha. This will be shared between the left and right bank canals in proportion to their command areas as shown in Table 34.

Table 34: Flow Requirements for Canals

	Left bank canal	Right bank canal	Total
Original design flow (m^3/s)	0.56	7.50	8.06
Net command area (ha)	220	4380	4600
Current Cropping Pattern			
Peak flow at headworks (m^3/s)	0.28	5.54	5.82
Future Cropping Pattern			
Peak flow at headworks (m^3/s)	0.23	4.66	4.89

177. Canal design should include provision for some excess flow if required for operational reasons. The 10% excess for “rush irrigation” that is normal practice is appropriate and would, if the canals are designed for the future cropping pattern, provide capacity of the current demands.

6.2 Conjunctive Use

178. The project area has considerable potential for conjunctive use of water resources. There are effectively three sources that may supplement the canal water:

(i) Groundwater
(ii) Surface water tanks
(iii) Runoff from the Bhadra irrigated area

179. The Bhadra runoff is inherently unreliable and is least likely to be available when supplies for the Gondhi canal are short although, at present, water is deliberately released through the Bhadra system to compensate for the poor condition of the Gondhi right main canal.

180. There is considerable potential for more active management of the surface water tanks within the Gondhi command area, particularly those that are currently in-line storage along the main canal. However, for this to be achieved the tanks will need to be physically separated from the main canal because, at present, they act as dampers on more responsive operation.

181. Groundwater is already being used within the Gondhi command area, most notably for drip irrigation of arecanut although the socio-economic survey and field visits the use of groundwater to be small. Neither the groundwater potential nor the current abstraction rates have been accurately quantified but are understood to be modest. There will be potential for reuse of percolated water from surface irrigation either for land that is locally out of command or during periods of water scarcity. However, pumping from groundwater (and also pumping direct from the river) incurs an energy cost which should be avoided if a gravity supply of surface water is available.

6.3 Command Area Water Balance

182. Water balance of any closed hydrological system for a given period of time is expressed as:

$I - O = \Delta S$, where

I	=	Inflow into the system
O	=	Outflow from the system
ΔS	=	Change in storage

183. A water balance for the Gondhi command area involves five components:

- Rainfall
- Surface water in via the canal system (including runoff / return flows from the Bhadra command areas)
- Surface water out via the drainage system
- Evaporation / evapotranspiration
- Change in groundwater (recharge less abstractions)

184. In the absence of data on groundwater extraction and trends it is not clear whether the hydrological system within the command area is currently in balance while there is the risk that increasing development of groundwater to compensate for inadequate surface water supplies can create an imbalance in the current situation unless there is a corresponding increase in the recharge. The proposed change in the scheme allocation of water is shown in Table 35.

Table 35: Proposed Change in Scheme Water Allocation

Subproject	CCA (ha)	Water Allocations, Mm³		Depth over CCA, mm	
		Original*	Revised	Original	Revised
Gondhi	4,600	87.80	73.64	1,906	1,600

185. However, the extent to which a change in allocation represents a change in supply is unknown because of lack of data on the current quantity of water either supplied or being returned to the river.

186. An indicative water balance for the command area after system modernization and assuming the current cropping pattern is presented in
187. Table 36.

Table 36: Command Area Water Balance

	Current Cropping		Future Pattern		Reduced Water	
	Mm³	TMC	Mm³	TMC	Mm³	TMC
Total diversion =	87.361	3.085	72.109	2.546	59.702	2.108
Crop water consumption	44.030	1.555	36.343	1.283	30.090	1.063
Assume water for non-irrigated land =	10.000	0.353	10.000	0.353	10.000	0.353
Allow for other evaporation	7.500	0.265	7.500	0.265	7.500	0.265
Closure water requirement	5.679	0.201	6.609	0.233	5.679	0.201
Return flow =	20.152	0.712	11.657	0.412	6.433	0.227
Scheme area water consumption =	67.209	2.373	60.451	2.135	53.269	1.881
Saving from current cropping pattern			6.757	0.239	13.940	0.492

188. It can be seen that the change from the current to the anticipated future cropping pattern will result in a reduction of about 15.25 Mm³ in the gross diversion but only about 6.76 Mm³ in the net water consumption. An alternative cropping pattern without paddy production would result in a reduction of about 27.66 Mm³ in the gross diversion but only about 13.94 Mm³ in the net water consumption, relative to the current cropping pattern.

6.4 Assessment of Existing Infrastructure

189. The Gondhi irrigation system comprises two canals supplied from the Gondhi Anicut (weir) on the Bhadra river about 14 km downstream of Bhadra dam. The anicut and the right bank canal are reported to have been completed in 1926 and the left bank canal was completed in 1954. The main canals are contour canals and the height above the river increases with distance downstream. As contour canals, the alignments are not straight: The tail of the right main canal is less than 30km from the anicut. The main details of the scheme are summarized in Table 37 below[22] :

Table 37: Summary of Canal Details

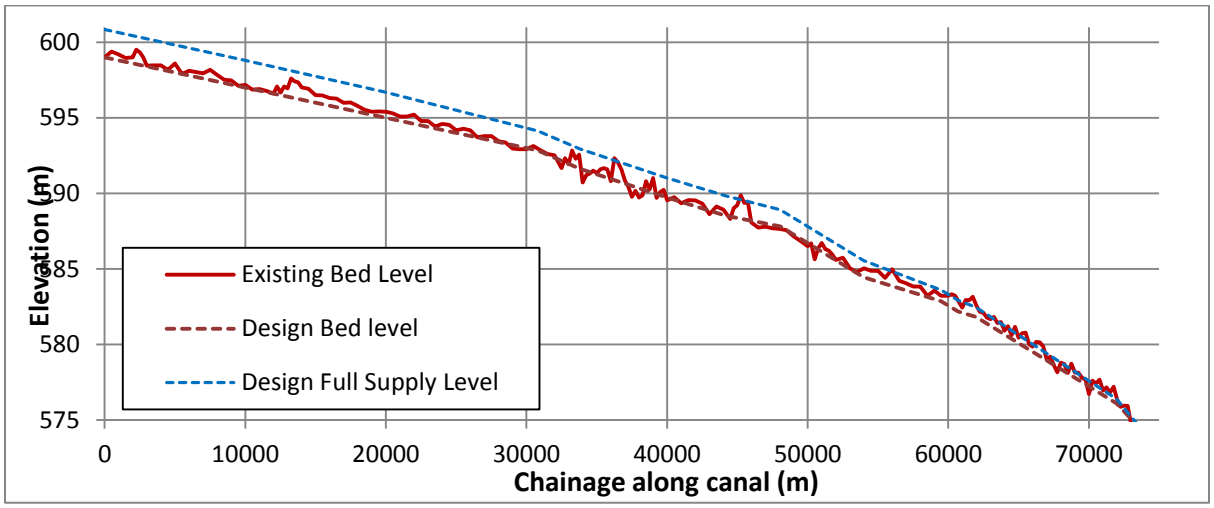
	Left Bank Area	Right Bank Area	Total
CCA (ha)	220	4380	4600
Main canal length (km)	14.7	74.4	89.1
Distributaries	0	16 No. / 34km	16
Cart bridges	20	86	106
DPOs on main canal	20	130	150
DPOs on distributaries		52	52

[22] Data from Detailed Project Report (DPR) by 3G Consultants, 2010-12

Drainage inlets	2	51	53
Relieving weirs	3	22	25
Escape sluices	0	6	6
Aqueducts	0	3	3
Tanks	0	20	20

190. The system is in poor condition, most notably the right main canal where water is reported to be unable to pass from head to tail. The current canal bed profile is shown on Figure 10.

Figure 10: Right Main Canal Profile



191. High points in the bed can be observed at several locations on the profile and will be sufficient to substantially affect performance because raised water levels will result in excess flow spilling from the canal over the relieving weirs which are provided to discharge any excess water entering through the drainage inlets. The provision of the drainage inlets, while desirable to make maximum use of available water resources, is also an unwelcome source of sediment. This sediment, if not regularly removed, results in lost capacity relative to more normal canal designs because of increased spillage over the relieving weirs instead of maintenance of capacity but encroachment on freeboard. There are three aqueducts on the right main canal where it crosses over major drainage channels. All other drainage flows enter the main canal.

192. There are 20 tanks within the right bank command area. Some of these are in-line storage where the canal crosses a valley on an embankment but most are within the command area. One of these tanks, Koppa Dodakere, commands about 260ha and has gated outlets to enable active management of supply to its command area.

193. There are about 150 pipe outlets directly from the main canals. Some of these have gates but they are never operated. The others have no gates at all. The result is uncontrolled release of water which may be in excess of irrigation requirements. There is an access track on the side the canal adjacent to the command area.

6.5 Drainage System

194. There is no engineered drainage system for Gondhi. The command areas slope towards the river (typically 1% to 3% slope) and contain a natural drainage system. As noted above, most drainage flows crossing the main canals enter them and are then spilled out over relieving weirs. There are some reports of waterlogging within the command area but precise details are unknown. The cause may be over-irrigation.

6.6 Command Area and on-Farm Water Management

195. Each outlet typically serves an area of 20 to 30 ha. The command area is extensively terraced into basins with the width depending on the prevailing ground slope. Channels serve blocks of basins which are usually irrigated as a group with water passing through from the upstream to the downstream.

196. CADA have constructed some concrete field channels although the network requires further improvement. Some subsoil drainage is also reported to have been provided.

6.7 System Operation Assessment

197. The inability of the right main canal to pass water along its length has resulted in alternative operational practices being adopted by the operating staff, who are also responsible for the adjacent Bhadra canals. It is reported that the canal cannot pass water beyond about km 45 (which is consistent with a high point in the bed at km 45.5) and water for the Gondhi command area downstream of this point is supplied via Bhadra right bank distributaries 20 to 22 which, at some points, are within a few hundred meters of the Gondhi right bank canal. However, this operational practice depends on overall operation of the Bhadra system for which closure periods are longer than for the Gondhi canal.

6.8 Constraints and Opportunities

198. The Gondhi system provides an opportunity to re-use some of the return flows from the Bhadra system as well as making use of water entering the Bhadra river in the reach downstream of the Bhadra dam. However, the Gondhi canals are vulnerable to water shortage during the periods when the Bhadra system is not operating and the return flows are minimal. In such circumstances either deliberate releases to the river will need to be made from Bhadra reservoir, subject to there being water available to release, or the tanks within the Gondhi command area are managed to provide water during such periods.

7. INSTITUTIONAL ASSESSMENT

State-wide Responsibility for Irrigation

199. Large and medium irrigation schemes fall under the Water Resources Department (WRD) which consists of five major groups of agencies:

- Those concerned with the construction and modernization of irrigation projects (the 3 Nigams);
- Those concerned with the operation and maintenance of existing irrigation projects (the 14 irrigation zones);
- Those concerned with hydrological data collection and management and planning and investigation of irrigation projects (the Water Resources Development Organization);
- Those concerned with command areas development (the 6 CADAs); and
- Those concerned with water management research and training (KERS and WALMI)

200. The WRD implements the construction of new irrigation projects and modernization of the existing ones through the 3 Nigams headed by their respective Managing Directors. The Nigams are established as public corporation registered under the Indian Companies Act, 1956. The Krishna Bhagya Jala Nigam Limited (KBJNL) is responsible for the construction of the Upper Krishna Projects; the Cauvery Neeravari Nigam Limited (CNNL) is responsible for construction of projects in the Cauvery River Basin; and the Karnataka Neeravari Nigam Limited (KNNL) is responsible for construction of projects in the remaining parts of the State. The Nigams execute the works through the various irrigation zones that fall within their respective jurisdiction.

201. Post construction the Nigams manage the operation and maintenance and irrigation services. The Nigam implements these activities through the concerned irrigation zones headed by their respective Chief Engineers. There are currently 14 irrigation zones in the state headed by Chief Engineers.

202. The Irrigation Zones are headed by a Chief Engineer. Each zone is divided into Irrigation Circles with a Superintending Engineer in charge. The Irrigation Circle themselves comprises of a few Irrigation Divisions with an Executive Engineer in charge. The Irrigation Divisions are further divided in to a few Sub-Divisions under the charge of an Assistant Executive Engineer. At the field level (Section) are the Assistant Engineers and Junior Engineers. The Irrigation Zones and its various sub-levels are supported by a team of administrative and ministerial staff.

203. The Water Resources Development Organization (WRDO) is in charge of planning and investigation of all major and medium irrigation projects in the State and provides all information to the Government of Karnataka in respect of inter-state water disputes like Cauvery, Krishna, Godavari and Mahadayi. It acts as a data bank for all hydrological data of the State and provides information regarding completed, ongoing and proposed irrigation projects of the State, prepares catchment area maps, digital maps of all hydro meteorological stations of the State and command area maps of completed, ongoing and proposed irrigation projects. The work of monitoring and evaluation of existing and ongoing projects and safety aspects of dams are also monitored by the WRDO. In addition, the establishment matters of the irrigation zones regarding postings, transfer of staff, etc. is also attended to by it. The WRDO is led by a Chief Engineer and comprises of 6 units:

- Inter State Water Dispute headed by a Chief Engineer;
- Planning and Investigation Unit headed by a Superintending Engineer;
- Hydrology Unit headed by a Superintending Engineer;
- Geomatics Centre headed by a Director;

- Irrigation Investigation Circle, Mysore headed by a Superintending Engineer; and
- Irrigation Investigation Circle, Yermarus, Raichur District headed by a Superintending Engineer

7.1 Government Institutions in Project Area

204. Responsible agencies for carrying out functions relevant to the irrigation of the Ghondi Area are summarized in Table 38.

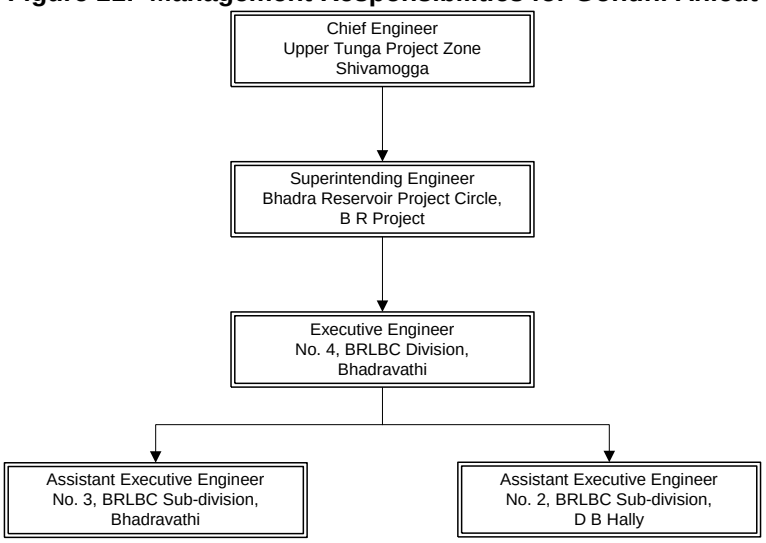
Table 38: Operations and Responsibilities for Irrigation in the Gondhi Area

Operation	Responsible Organization
Operation and Maintenance (O&M) of Bhadra Reservoir	KNNL – Upper Tunga Project Zone
O&M of main canal	KNNL – Upper Tunga Project Zone
O&M of off takes to distributaries	KNNL – Upper Tunga Project Zone
O&M of distributaries	KNNL – Upper Tunga Project Zone
O&M of off takes from distributaries	KNNL – Upper Tunga Project Zone
O&M of minor canals and off takes	Bhadra CADA, WUCS becomes responsible after construction
Formation and support of WUCS	Bhadra CADA
Agricultural extension to farmers	Bhadra CADA and Shivamogga District Agriculture Department Office
Training of students in Agriculture	University of Agricultural Sciences, Bangalore, College of Agriculture, Shivamogga

Irrigation

205. The responsibility of operation and maintenance of the Gondhi Anicut Project lies with the Karnataka Neeravari Nigam Limited (KNNL) through its field office of Chief Engineer, Upper Tunga Project Zone, Shivamogga. The project is under the jurisdiction of the Superintending Engineer, Bhadra Reservoir Project Circle, B R Project and the Executive Engineer, No. 4, BRLBC/BRRBC Division, Bhadravathi, which consists of two sub-divisions, namely Bhadra Reservoir Left & right bank Canal (BRL/RBC) Sub-division, Bhadravathi and Bhadra Reservoir Right Bank Canal (BRRBC) Sub-division, D B Hally under Assistant Executive Engineers No. 3 and 2, respectively as is shown in Figure 11.

Figure 11: Management Responsibilities for Gondhi Anicut



206. The staffing structure of the BRLBC Sub-division, Bhadravathi and BRRBC Sub-division, D B Hally are is shown in Table 39:

Table 39: Staffing Structure of BRLBC and BRRBC Sub-Divisions

Posts	Sanctioned	Vacant
BRLBC Sub-division, Bhadravathi		
Assistant Executive Engineer	1	
Assistant Engineer	3	1
Junior Engineer	3	2
First Division Assistant	1	
Second Division Assistant	2	1
Typist	1	
Peon	2	
BRRBC Sub-division, D B Hally		
Assistant Executive Engineer	1	
Assistant Engineer	3	
Junior Engineer	2	1
First Division Assistant	1	
Second Division Assistant	2	1
Typist	1	
Surveyor	1	1

207. In addition to the sanctioned staff there are unsanctioned staff, in particular the sowdies 23 who do the hands-on canal operation. Such staff are usually hired on annual contracts without security of tenure.

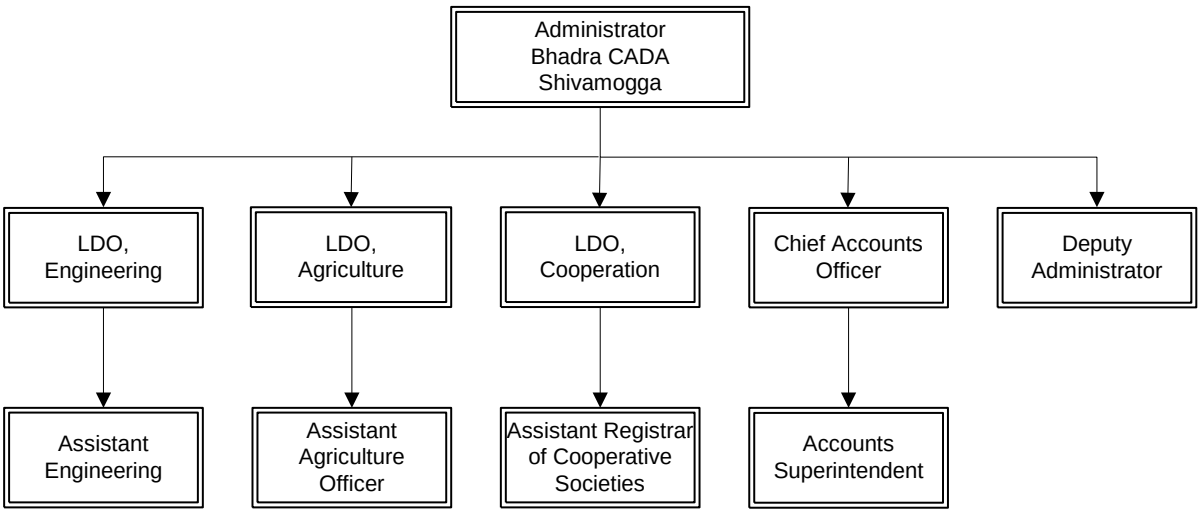
Command Area Development

208. The Gondhi Anicut Project lies within the jurisdiction of the Bhadra Command Area Development Authority, Malavagoppa, Shivamogga. The Bhadra Command Area Development Authority (CADA) has jurisdiction over 30 major and medium irrigation projects spread over 11 districts of the State. The total command area under Bhadra CADA jurisdiction is 157,323 ha that include 348 WUCS of which 310 WUCS covering 122,571 ha have been established.

209. The Bhadra CADA is administratively headed by an Administrator supported by a Land Development Officer, Engineering, a Land Development Officer, Agriculture, a Land Development Officer, Cooperation, a Chief Accounts Officer and a Deputy Administrator. They are further supported by additional Group B and C office and field staff as shown in the following Figure 12.

[23] The local name for water bailiffs

Figure 12: Administration of Bhadra CADA



210. In all, Bhadra CADA has a sanctioned post strength of 38 posts of which currently 28 are filled.

Table 40: Staffing Bhadra CADA

Sl. No.	Name of Post	Sanctioned Post	Filled Post	Vacant Post
Group A				
1	Administrator	1	1	
2	LDO, Engineer	1	1	
3	LDO, Agriculture	1	1	
4	LDO, Cooperation	1	1	
5	Chief Accounts Officer	1		1
6	Deputy Administrator	1	1	
Group B				
1	Assistant Registrar of Cooperative Societies	1	1	
2	Assistant Engineer	1	1	
3	Accounts Superintendent	1	1	
4	Assistant Agriculture Officer	1	1	
Group C				
1	Senior Inspector of Cooperative Societies	1	1	
2	First Division Accounts Assistant	1	0	1
3	First Division Assistant	6	5	1
4	Second Division Assistant	3	2	1
5	Stenographer	1	1	0
6	Typist	2	2	0
7	Driver	6	5	1
8	Group D Employees	8	3	5
	Total	38	28	10

211. The Bhadra CADA is currently implementing CAD works under Central and State schemes including construction of field irrigation channels and drains, command roads, reclamation of saline, alkaline and water logged soils and formation and support to WUCS.

Agriculture & Horticulture

212. Agricultural support services in the form of government schemes and subsidies are being provided to the farmers of Gondhi Anicut Project through the Shivamogga District Agriculture Department Office under a Joint Director, Agriculture.

213. The main agriculture support schemes being implemented by the Shivamogga District Agriculture Department Office in the district are integrated cereals development programme, National pulses development programme, oil seeds production programme, maize development programme, integrated cotton development programme, CSS for coarse cereals minikits, natural farming and green manure and compost schemes and plant protection schemes.

214. Horticulture support services in the form of government schemes and subsidies including under the National Horticulture Mission and Micro irrigation Project are being provided to the farmers of Gondhi Anicut Project through the Shivamogga District Horticulture Department Office under an Assistant Director, Horticulture.

215. The main horticulture support schemes being implemented by the Shivamogga District Horticulture Department Office in the district are drip irrigation for horticulture crops, oil palm cultivation, nursery maintenance and seed procurement for coconut, integrated farming in coconut for productivity improvement and integrated control of pests and diseases in horticultural crops.

College of Agriculture, Shivamogga

216. The University of Agricultural Sciences, Bangalore has established a College of Agriculture in Shivamogga in 1990 for imparting graduate and post graduate courses in agriculture. Since 2000, the College has been running a Krishi Vigyan Kendra[24] in the district, an Areca Research Centre since 2001 and an Organic Farming Centre in agriculture, horticulture & plantation crops since 2006. Starting 2007, the College is also offering a Diploma in Agriculture Extension Services for agricultural input dealers.

217. The main mandate of the College is to impart basic knowledge and updated techniques of agriculture and related sciences to the students and to gain first hand practical knowledge and experience on agricultural practices in the area to provide extension services to the farmers.

7.2 CSO Activities in Project Area

218. There are about 33 CSO that work on various issues related to community empowerment in rural and urban areas in Shivamogga District[25]. The review of the list of CSOs (Table 41) shows that most of the CSOs are working for the causes of physically handicapped, rehabilitation, women empowerment, agriculture, child welfare, education, watersheds, and arts. There are three CSOs engaged in Participatory Irrigation Management in canal irrigation including in the Gondhi Sub Project. The three CSOs predominantly working in the area in canal irrigation are Sri Kshethra Dharmasthala Rural Development Project (SKDRDP), JalaSpandana and Adavi Sidheshwara Rural Development.

219. ***Sri Kshethra Dharmasthala Rural Development Project*** by Sri Dharmasthala Kshethra has its office in Shivamogga and in most villages in the region. It provides support

[24] Agriculture Science Centres: GoI along with regional Agriculture University/NGO have set up such KVKs in each district of India to provide farmers with research and extension support

[25] www.indiamapped.com/ngo-in-karnataka/shimoga

services to the farming community. During the WUCS Pilot Strengthening Study carried out in Gondhi Sub Project, it was found that the Project supported one of the sample WUCS Kagekodamage with Rs 25,000 for the construction of a Godown cum Office for WUCS.

220. ***JalaSpandana:*** South India Farmers Organization for Water Management is formed by the representatives of Water Users Associations and Farmers from South India and is working with WUCS in canal irrigation in Bhadra and Gondhi sub project over 9 years. The organization has is facilitating WUCS participating in PIM policy formulation and implementation. In addition, the organization has carried out studies in Krishna Basin including Bhadra and Tungabhadra Sub Basins. This organization has carried out the WUCS Pilot Strengthening Study in Gondhi Sub Project Area for TA-KISWRMP (43253-012)[26].

221. ***Adavi Sidheshwara Rural Development.*** The organization was engaged in conducting social economic survey for the TA for TA-KISWRMP (43253-012).

Table 41: Community Service Organisations in Shivamogga

Name	Address
Shivamogga District Physically Handicapped Welfare Sangha	Behind Court, Balraj Urs Road, Shivamogga
Aasare Social Service Society	Janatha Typing Institute Building, Opp. Church, B.H Road, Shivamogga
Bhagwan Mahaveer Jain Foundation	Bhagwan Mahaveer Jain Foundation (R.) J S Sakriya Health Centre S M Lunawat Diagnostic Centre Dr. S P M Road
Jeevana Charitable Trust	Jeevana Charitable Trust Behind National Stores, Opp Vijaya Bank, Marnamikatta Circle, Jeppu Mangalore - 575 001
Sri Sharada Devi Andhara Vikasa Kendra	Sri Sharada Devi Andhara Vikasa Kendra (A Free Residential School For Blind) Paramahamsanagara, Anupinakatte Road, Gopala, SHIVAMOGGA - 577204
Azad Educational and Welfare Society	AZAD Educational and Welfare Society Kasimavina Koppalu,
Aranya Vikasa	Aranya Vikasa, 5th Stage, 5th Cross, Vinobha Nagar, Shivamogga - 577 204
Chaithanya Rural Development Society	Chaithanya Rural Development Society Red No 22 Near S M Circle Savalanga Road Shivamogga 577201 Karnataka
Parivarthana	Parivarthana, Rural Development Society Near Govt. Hospital, H K Road, SHIRALAKOPPA 577428, Shikaripura TQ, Shivamogga District Karnataka State, India
Navachetana Handicapped Welfare Soiety	Praveen Kumar G Patil 1063,Near New Primary School, A.K.G.Colony, Opp M.V.J. Eng College,Channasandra,Bangalore-560067
Aavi Rural And Urban Development Organisation	Aavi Rural And Urban Development Organization (Arudo) Kodur -Post Hosanagar - Taluk Shivamogga - Dist Karnataka -State 577 445
Sri Kala International Institute Of Fashion Technology	Keerthana, 1st Floor, 8th Cross, Tank Mohalla, Shivamogga - 577 201
Academy for Sustainable Development	Academy for Sustainable Development (R), Sarvashree, Near NGO Building, Balraj Urs Road, Shivamogga - 577 201, Karnataka. India.
Mahila Samaja Basavani	Mahila Samaja Basavani Basavani Post Thirthahalli Taluk Shivamogga Dist Karnataka State Pin : 577432
Patanjaliyogaandprakruthisamsthe	Patanjali Yoga & Prakruthi Samsthe (R), Seegehatti Javaraiah Gowda Complex, Shanthi Nagara, Ragigudda Main Road, Shivamogga-577202, Karnataka, India. Admn.Office: Sri Beeralingeshwara, Hosamane, 4th Cross, Shivamogga-577201, Karnataka, India
Shree Channappaswamy Vidya Peetha	Shree Channappaswamy Vidya Peetha, Hirekalmatha, Honnali - 577 217, Davanagere Dist.
Agriculture Research Education Extension Development Society	AREEDS Near Vittala temple Sharavathi nagara Shivamogga Pin-577201
Karnataka Sangha Shivamogga	Karnataka Sangha, B.H. Raod, Shivamogga - 577 201. Karnataka State, India.
Madeena Education Society	Mohammed Shafi Ahmed Secratary Madeena Education Socerity (R) & Madeena Primary School. Tank Mohalla,Shivamogga District, Karnataka.

[26] See Annex 10

Sharavathi Valayabhivridhi Samithi	Sharavathi Valayabhivruddhi Samiti Maradavalli Circle, Post : Sasaravalli Sagar, Shivamogga Dist 577 401
Srivijaya Kalanikethana Trust	Srivijaya Kalanikethana trust Rajendra nagar,6TH CROSS.
Srusti Samaja Seva Samsthe	Ramesh T H secratery, srusti samajaseva samsthe(R), Thattikere, hosakoppa(V), Hosahalli(P),
Vikasam R Bhadravathi	Vikasam(R) Bhadravathi 2nd Cross Kittur Chennamma Block Jannapura Bhadravathi=577302 Shivamogga District
Surabhi Mahila Samaja	Surabhi Mahila Samaja S.I. Nilaya, 7th Cross, Annanagar, Shivamogga
Samudaayashivamogga	Samudaayashivamogga, "Surabhi", Kote Post Office Road, Shivamogga 577201.
Kutumba Shikshana Samsthe	Kutumba Shikshana Samsthe (R) Kallahalli, Vinobanagara, Shivamogga-577204.
Kshema Trust	2nd Floor, Sridhar Nursing Home,1st Main Road, Rajendranagar, Shivamogga - 577 204
Lead	Lead (R) Nandishwara Nilaya Behind Apmc Yard 60ft Road, Vinobhanagara Shivamogga-577204 Karnataka India
Karnataka Civil Society	Karnataka Civil Society Opp: Kanaka Vidhya Samasthe Main Road Cross R M L Nagar
Natamitraru	Natamitraru C/O Trupthi Sweets Azad Road Thirthahalli - 577432
Sri Kshethra Dharmasthala Rural Development Project	Near Hole, Shivamogga
JalaSpandana – South India Farmers Organisation for Water Management	Project Office: Beeranahalli, Shivamogga Taluk, Shivamogga District
Adavi Sidheshwara Rural Development Society	Baihongala, Belgaum District, Karnataka

Irrigation Operation and Maintenance

222. The operation of the Gondhi main canal falls under two sub-divisions: BRLBC Sub-division, Bhadravathi and BRRBC Sub-division, D B Hally as described in paragraph 0. The main workload of these sub-divisions is managing other adjacent canals of the Bhadra reservoir system and staff take advantage of the shared operational responsibility and interlinkages between the systems to mitigate the poor functioning of the Gondhi canals. The boundary of responsibility between the two sub-divisions is km 44 of the Gondhi right main canal.

223. Table 42 provides details of overall O&M expenditure by KNNL[27]. For operation there are two major sub-heads: (i) salaries of the staff and (ii) travel cost. For maintenance, data are available separately for (i) expenses on canal and distributaries, (ii) lift irrigation, (iii) dams and reservoirs and (iv) maintenance expenses on vehicles.

224. It can be seen that the major portion of O&M expenditure (ranging from 70-80%) is spent on operation especially on staff salaries and only about 20-30% on actual maintenance works. However, much of the KNNL staff costs will be for personnel engaged in KNNL's primary task of completing the construction of ongoing irrigation schemes. As regards maintenance, a major part of it (about 70%) is spent on maintenance of canal and distributaries. It can be noted that a significant portion of the expenses (about 10-15%) also incurred on maintenance of vehicles which is in fact more than expenditure on Dams and Reservoirs. A significant (40%[28]) of the maintenance expenditure on canals is actually spent on the non-sanctioned staff (see paragraph 0) who are primarily involved in operation. As such, the maintenance budget includes much of the field operations cost.

[27] Source: KNNL Annual Reports

[28] From verbal discussion with engineers

Table 42: Operation and Maintenance expenses of projects under KNNL (Rs lakh) (figures in brackets in lakh USD)

Operation		**2007-08**	**2008-09**	**2009-10**	**2010-11**
Salaries		6693 (122)	7048 (128)	8219 (149)	9552 (174)
% of operation		96.6%	96.5%	97.2%	96.6%
Travel		233 (4)	255 (5)	237 (4)	337 (6)
% of operation		3.4%	3.5%	2.8%	3.4%
Total operation		6926 (126)	7303 (133)	8456 (154)	9889 (180)
Operation as % of total O&M		79.9%	72.6%	70.7%	73.9%
Maintenance		**2007-08**	**2008-09**	**2009-10**	**2010-11**
Canal & Distributaries		1230 (22)	1863 (34)	2440 (44)	2466 (45)
% of maintenance		70.%	67.5%	69.6%	70.5%
Lift irrigation		139 (3)	525 (10)	253 (5)	382 (7)
% of maintenance		8.0%	19.0%	7.2%	10.9%
Barrages		66 (1)	13	370 (7)	84 (2)
% of maintenance		3.8%	0.5%	10.6%	2.4%
Dams& Reservoirs		31 (0.5)	57 (1)	116 (2)	232 (4)
% of maintenance		1.8%	2.1%	3.3%	6.6%
Vehicles		274 (5)	304 (6)	325 (6)	333 (6)
% of maintenance		15.8%	11.0%	9.3%	9.5%
Total Maintenance		1740 (32)	2762 (50)	3504 (64)	3497 (64)
Maintenance as % of total O&M		20.1%	27.4%	29.3%	26.1%

225. KNNL does not get regular maintenance grants but only Capital Grants from the state for completion of ongoing projects .However this grant is used by KNNL for maintenance of assets already created. Presently KNNL follows the norm of Rs 600 (11 USD) per irrigated hectare / year as recommended by the 12th Finance Commission (for the period 2005-10) for estimating the requirements of funds for the maintenance[29] of the major and medium projects. The revised norm of Rs.1175 (21USD) with 5 per cent annual increment as recommended by the 13th Finance Commission (for the period 2010-15)[30] has not been yet adopted and is reported to be under discussion with the Government. However the actual allocation of funds by the state for maintenance works in a year is generally based on the fund availability and the priority of the works as decided by the state government under its budget.

226. Total maintenance expenditure of Rs 3497 lakh for the 5.89 lakh ha under KNNL represents an average expenditure of Rs 593/ha which is similar to the recommendation of the 12th Finance Condition. Given the poor state of repair of many irrigation systems much higher expenditure is needed to bring the infrastructure to a condition where maintenance expenditure will conform to budget norms rather than the greater cost of addressing the dilapidation caused by many years of inadequate maintenance.

227. Establishment of WUCS is being undertaken as described in paragraph 271 with the objective of devolvement of operation and maintenance of the minor canal system. Where an O&M transfer MOU with a WUCS exists, the WUCSs is charged by KNNL at Rs12/1000m^3 for bulk water supply. The WUCS then collects water charges from farmers at the normal rates with the balance used for WUCS expenditure.

[29] The term “maintenance” as used in the Finance Commission reports is assumed to include operational costs other than staff on the government payroll

[30] http://fincomindia.nic.in/writereaddata%5Chtml_en_files%5Coldcommission_html/fincom13/tfc/Chapter7.pdf

228. Where O&M transfer has not taken place then water charges are levied on farmers according to crop and season currently Rs 250/ha paddy, Rs 1000/ha sugar and Rs 150/ha for garden (tree) crops. It is proposed that collection of water charges is undertaken by the WUCs, and used for O&M, 30% being passed on to WRD for overheads. Currently collection, such as it is, is made by the Revenue Board and funds are subsumed into general revenue. Even at 100% collection the water charges are only about 30% of the total O&M cost, with no contribution to capital replacement.

8. PROPOSED PROJECT

8.1 Project Components

229. Tranche 1 project components are consistent with overall Program Impact of "Enhanced access and security of water supply in selected river basins of Karnataka" and Program Output 2: Management of Bhadra and Gondhi sub-projects is modernized.

230. Activities comprise:

Project 1: Modernisation of Bhadra Canal Control and Gondhi Command Area
- Sub Project 1-1: Canal System Infrastructure Upgrading
- Sub Project 1-2: Command Area Development

Project 2: Improved Operation and Maintenance at all levels of the system
- Sub Project 2-1: Improved Operation and Maintenance at all levels

Project 3: Strengthening of KNNL and CADA System Management
- Sub Project 3-1: Institutional and Management Systems Strengthening
- Sub Project 3-2: Assessments of Tranche 2 and 3 projects

Project 4: WUCS and Agricultural Development
- Sub Project 4-1: WUCS Institutional Development & Capacity Building
- Sub Project 4-2: Agricultural Development and Livelihood Enhancement

231. Developing the institutional arrangements and building the capacity WUCS is essential for effectively planning and implementing water management, agriculture and minor system O&M as well as building the capacity for more efficient and effective main system operation.

232. Agricultural development is also included in the project implementation because this is a supporting pillar of the overall objective of agricultural livelihood enhancement.

9. IRRIGATION MODERNIZATION AND IMPROVED OPERATION

9.1 Improvement Strategy

233. With water, and not land, limiting irrigation area development in Karnataka, measures to increase irrigation efficiency and crop water productivity leading to increased farm household revenues per unit of water used are central to the modernization 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 to improve crop yields and profitability.

234. Flexibility of irrigation supply is often central to increased productivity, allowing water applications to be adjusted to meet crop demand as well as enable 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.

235. A surface irrigation supply will be the main pillar in the irrigation system but will be supported by possible groundwater use and local storage of surface water where possible. 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 modernization plans will promote sustainable use of groundwater use where possible, to meet seasonal / periodic shortages in the command area including canal closure periods.

236. The technical assessment identified constraints and opportunities to be addressed by:

(i) Infrastructure upgrading
(ii) Improved system operation and maintenance including management information systems (MIS), staff capacity and facilities, equipment and communications

9.2 Infrastructure Upgrading

237. The following interventions are envisaged to upgrade this system with a command area of about 4,600ha:

- Repairs to the Gondhi anicut and canal headworks.
- Improvement of main canals and distributaries including provision of concrete canal lining to improve water delivery efficiency and equity and upgrading of canal access roads. Lining may be a combination of slipformed channel and large precast units in order to minimize the duration of canal closures.
- Repair / replacement of all canal structures including bridges and crossings, drainage inlets and relieving weirs, pipe outlets and provision of new structures such as cross regulators where necessary to support the future operational objectives. Ramps into canals for laundry and animal drinking will be provided.
- Modification of current on-line storage tanks where feasible to become actively managed off-line storage and enhancement of existing off-line tanks for more pro-active management.
- Where feasible, remodelling of the drainage inflow and relieving weir arrangement to avoid water (and associated sediment) entering the main canals unless the supplementary flow is required.
- Command area development works comprising lined channels, low pressure gravity-supplied pipe distribution where technically feasible, and improved drainage where required.

- Provision of electronic flow measurement with telemetry at about 20 locations on the main canal and drainage system and flow measurement with recorders at all outlets.
- Capacity development of system operations staff and water users to enable them to effectively use the flow measurement system and provide a more efficient and equitable water distribution service more closely aligned with farmers' needs.
- Agricultural extension and on-farm water management training to equip the farmers with the skills to use water more efficiently and conduct of community-based water audits to confirm that distribution equity has improved.

238. It is also envisaged to develop managed conjunctive use of canal water, water stored in tanks and pumped groundwater and undertake small pilots of pressurized irrigation using gravity supply from the main canal with possible interlinking to existing drip irrigation that uses groundwater.

239. These interventions are described in more detail below. The interventions all provide potential to improve system operation and water use efficiency.

Repairs to the Gondhi anicut and canal headworks

240. The anicut and headworks are in overall sound condition but provision is made for structural repairs as needed to extend the working life. Water control gates will be maintained as necessary to ensure fully-functional operation.

Lining of Canals

241. It is planned to provide concrete lining to the main canals and distributaries in order to reduce seepage losses, provide hydraulically stable sections and enable more responsive operation. Canals with a bed width of 1.2m or larger will be lined using slipform paving equipment. Small canals will be lined using either hand-placed concrete or precast concrete units.

Replacement of Canal Structures

242. It is proposed to replace all structures on the canals[31] to ensure that they are not an impediment to improved operation. Bridges will be upgraded to accommodate modern width and traffic loading requirements. All outlets will be provided with gates for effective water control and flow measurement will be provided downstream of each outlet. Cross regulators will also be provided along the main canal to enable better control of water levels and reduce flow variability through the outlets.

Improved In-scheme Storage

243. Gondhi irrigation system contains at least 20 tanks. Some of these are along the main canal and were formed where the canal cuts across small side valleys. Others are within the command area. One of these tanks, Koppa Dodakere, commands about 260ha and has gated outlets to enable active management of supply to its command area. The tanks along the main canal are on-line, which mean that their water levels fluctuate with the main canal. As such, they reduce the responsiveness of the system to flow changes. It is therefore recommended that tanks are modified to enable active management of the stored water.

[31] See Table 37 for a summary of structure numbers

Main System Flow Measurement

244. Improved flow measurement will provide information to support better operation of the irrigation system both in terms of day-to-day flow management and quantification of flow volumes supplied. Main canal flow measurement will use electronic flow measurement devices with telemetry to enable real time data acquisition to guide system operation. Likely measurement points are at boundaries of WUCSs, at major inflows and possibly at selected command area outflow points.

245. In addition, flow measurement using flumes with water level and flow volume recorders is proposed for all outlets so that water provided to each WUCSs can be quantified.

Command Area Development

246. For achievement of the overall objective of improved water use efficiency it is necessary to improve the entire distribution system between headworks and the crops. This involves improving the distribution system in the command area and, if necessary, supporting measures such as land levelling and drainage. There is considerable potential to upgrade the command area distribution system in Gondhi. Normally, concrete channels are used and some have already been provided by CADA. However, it is recommended that a gravity-supplied piped distribution using uPVC or HDPE pipes is provided in areas with moderate slopes. Final distribution of water from the fixed pipe outlets could be undertaken using flexible hose. A piped system will provide several benefits including: (i) negligible land take; (ii) negligible conveyance losses; (iii) reduced opportunity for water to be drawn from points between the agreed outlets; and (iv) a clearly defined rotation system for sharing the use of the pipe outlets.

Night Storage Reservoirs

247. Night storage reservoirs may be provided if the farmers are willing to make land available. These would be located downstream of outlets so that, although water can flow continuously through the outlets, irrigation in the command area would be only undertaken in day-time, when water can be managed more efficiently, safely and wastage reduced. Such reservoirs, however, will require land which will need the support of the beneficiaries which may not be immediately forthcoming. Planned use of night storage will require increased capacity of the downstream works.

Gravity-Fed Pressure Irrigation

248. Part of the command area has slopes greater than 1% with land more than 15m below main canal level. This provides opportunity to mobilize sufficient pressure for micro sprinklers or drip irrigation with associated increase in water use efficiency. There may be potential for interlinking of the pressure supply from the canal system with the drip irrigation systems provided for some arecanut plantations to enable conservation of groundwater supplies for periods when insufficient surface water is available.

Reuse of Drainage Flows

249. At present the Gondhi main canals intercept drainage flows (both runoff from rainfall and excess flow from irrigation) from the Bhadra canal command areas. However, with better water management within the Bhadra system the return flows from irrigation are expected to diminish with drainage inflows mainly occurring after rainfall which is when water may not be needed. Inflows also carry sediment which will tend to collect in the main canal. The current arrangement of drainage inlets + relieving weirs should therefore be modified to enable unwanted drainage flows to cross the canals without entering.

250. Within the Gondhi command area there is also potential to intercept runoff for re-use further downslope (the tanks within the command area probably do this) which raises the water use efficiency within the system. The existing situation needs to be mapped and further potential for water reuse identified.

9.3 Improved Operation and Maintenance

Support to System Operation

251. The investment in improved infrastructure will not alone achieve the expected improvements in agricultural production and water use efficiency. System operators will need support to enable them to make best use of the system.

252. Capacity building of the KNNL/WRD staff is required to enable them undertake more efficient and effective operation and maintenance of the irrigation distribution system. Specific training of system operations staff will be provided to enable them to benefit from the flow measurement and information system to achieve more responsive and equitable operation with minimal wastage and to support the WUCSs.

253. Capacity building of the WUCSs is required to enable them undertake more efficient and effective operation and maintenance of the irrigation distribution system. Attention must be given to ensuring that vulnerable groups such as women are included in this activity.

Support for Improved Maintenance

254. Inadequate maintenance has been a contributory factor in the progressive deterioration of the irrigation system. Achievement of the expected performance of the modernized system will depend upon improvement in the maintenance regime to maintain full functionality. Effective maintenance requires not only improved asset management but also ensuring that sufficient financial resources are mobilized to meet the cost.

Operation and Maintenance Planning

255. A comprehensive operation and maintenance manual will be prepared with the support of the project implementation consultants. The manual will include:

- Scheme description (physical features / resources, command areas, infrastructure, WUCS status)
- Background data pertinent to the scheme
- Appraisal of current O&M practices
- System operation guidelines including use of flow measurement to inform improved operation
- Basic data needed for preparation of seasonal operational plans in conjunction with the WUCS
- A methodology for preparation of the seasonal operational plans
- System maintenance guidelines
- A methodology for prioritizing maintenance and preparation of annual maintenance plans
- Guidelines on administration

256. The key objectives of improved operation and maintenance are:

(i) Operation

- Provide the agreed volumes of water to the WUCSs at the agreed times
- Ensure equity of distribution
- Prompt changing of flows in response to events such as rainfall or emergency conditions
- Maximize efficiency of water use and minimize losses

- Keep and disseminate information about water delivery to WUCSs and other stakeholders

(ii) Maintenance

- Maintain the system in a suitable condition to meet the operational objectives
- Efficient expenditure of maintenance funds
- Minimize interruptions to irrigation flows due to maintenance or damage

Proposed Training

257. Proposed training is set out in Table 43 below and will involve both formal training courses and on-the-job support and capacity building. On-the-job training will also be carried out to support improved system operation and maintenance as set out in the O&M manual.

Table 43: Proposed Irrigation O&M Training

Stakeholder	Capacity Building Objective	Planned Activities	Training Content (in addition to general capacity building[1])
KNNL / WRD	Improved water management and delivery and effective maintenance	• Study tours • Training courses • On-the-job training / mentoring	• Introduction to IWRM and water use efficiency • Management of irrigation systems • Flow measurement • System losses and inefficiencies • Water Resources Information Systems • Asset management • Gender issues in irrigation planning and operation • Preparation of operational plans • Feedback and operational improvements • Maintenance planning • Introduction to irrigated agriculture • Participatory irrigation management • Benchmarking performance indicators
CADA / Dept. of Agric.	Improved capacity to deliver support to farmers	• Study tours • Training courses	• Introduction to irrigated agriculture • Participatory irrigation management • Benchmarking performance indicators
WUCSs	Beneficiary operation and maintenance	• Training courses • Technical support and guidance	• Introduction to irrigated agriculture • Preparation of operational plans • Participatory irrigation management • Maintenance planning

Institutional Change

258. Substantial and sustainable improvement of system O&M will need changes at the institutional level to support the capacity building of the staff. Part of the change is through the development of the WUCS (see section 10.3 WUCS Strengthening) but, for this to be fully effective, there has to be change at the main system level. The following interventions are envisaged:

259. Review and modification of the KNNL mandate to increase emphasis on the irrigation system management and overall water use efficiency. This may entail creation of a new organization specifically for operation of completed irrigation systems with a strong focus on service delivery. IFPRI has proposed[32] that irrigation reforms should be based on six principles:

- the irrigation agency must be financially autonomous;
- irrigation staff salaries must come from the fees charged for irrigation water;
- the irrigation agency must be accountable to user groups;
- third-party intervention in the form of an Independent Regulatory Commission for Canal Irrigation (IRCCI) may be necessary to prevent a deadlock between the irrigation agency and farmers when it comes to costs and incentives;

[32] Institutional Reforms In Indian Irrigation, 2005. http://www.ifpri.org/sites/default/files/publications/fps42.pdf

- the primary tasks of the IRCCI should be to ensure transparency in contracts, obtain technical help, and act as a dispute settlement body; and
- the pricing of water should be related to consumption to keep costs low.

260. Such reforms will require political support and the agency may require a diminishing subsidy until service and payment mechanisms are fully functioning and water charges have reached a level which covers the cost of operation and maintenance of the water delivery service and infrastructure. In addition, there has to be a strong appreciation that irrigation is a service for agriculture and unreliability of supply can have a major impact on the agricultural production and profitability. WUCS formation with transfer of O&M responsibility for the minor and field canals is one step towards alignment of irrigation supply with farmers' needs but this change will also need to be addressed higher up the system.

261. In the case of Gondhi, where the command area of the main canals is less than the distributaries in many other systems, one mechanism for improved operation should be the establishment of a WUCS federation that is responsible of operation of the whole system. The proposed flow monitoring system will enable the sharing of real-time flow data which will (i) enable the KNNL / WRD staff to monitor whether the diversions from the river are within the agreed limits and (ii) enable the individual WUCS to see if they are getting their share of the flow. Inequities in allocation would then be managed at the WUCS federation level. The WUCS federation would need to employ O&M staff. Most likely these would be the non-sanctioned staff currently hired by KNNL for the hands-on operation and the close linkage between their employment and the service delivery will provide motivation for the best possible service delivery. Implementation of this devolvement in Gondhi will provide a pilot for devolvement of O&M at the distributary level in other systems.

262. However, management of irrigation supply based only on demand does not take account of the supply constraint which, for Gondhi, depends on rainfall in the catchment, return flows from the Bhadra canal system and the water in the Bhadra reservoir. This constraint means there will always be a need for careful planning and consultation about how to best use the available resource and the users made increasingly aware of the supply constraints with progressive introduction of IWRM principles for overall basin-wide water management.

10. ON FARM WATER MANAGEMENT & CAD

10.1 Improving Water Use Efficiency

263. Water use at the farm level can make a significant difference to overall project water use efficiency. Reliability of supply is one pre-requisite for enabling farmers to improve their water usage and adoption of more productive crops particularly perennial plantings. Unless they have certainty of supply when water is needed they will be reluctant to adopt a practice of only irrigating when necessary instead of irrigating whenever water is available. More responsive main system operation, as discussed in Section 9.3 is therefore an essential supporting pillar for better water efficiency at the farm level.

264. Improved flexibility in supply is another supporting pillar for improved water use efficiency so that farmers can have only the water they need and when they need it. Bulk water charging to the WUCS may be reflected in each WUCS by volumetric charging of water, not necessarily the full cost of supply, to farmers who will thus be encouraged to use water less wastefully.

265. Agricultural extension and capacity building will be provided to support farmers achieve more frugal use through guidance on activities such as irrigation scheduling and the application of more precise irrigation technologies.

266. Demonstrations will be undertaken for the SRI process for paddy production which offers the potential to reduce water consumption by paddy because it does not utilize sustained flooding of fields. It also offers scope for improved yields.

10.2 Physical Interventions

267. For achievement of the overall objective of improved water use efficiency, it is necessary to improve the entire distribution system between headworks and the crops. This involves improving the distribution system in the command area and, if necessary, supporting measures such as land levelling and drainage. There is considerable potential to upgrade the command area distribution system in Gondhi. Normally, concrete channels are used and some have already been provided by CADA. However, it is recommended that a gravity-supplied piped distribution using uPVC or HDPE pipes is provided in areas with moderate slopes. Final distribution of water from the fixed pipe outlets could be undertaken using flexible hose. A piped system will provide several benefits including: (i) negligible land take; (ii) negligible conveyance losses; (iii) reduced opportunity for water to be drawn from points between the agreed outlets; and (iv) a clearly defined rotation system for sharing the use of the pipe outlets.

268. Where topography permits, the use of gravity-supplied micro-irrigation (drip and micro sprinklers) will be piloted.

10.3 WUCS Strengthening

269. ***Participatory Irrigation Management in Karnataka:*** The Karnataka Irrigation Act of 1965 was amended in the year 2000 to accommodate Water Users in main stream irrigation management through formation of WUCS at primary, distributary, project level and apex level. The WUCS are also formed under Karnataka Cooperative Societies Act of 1959, and as a result WUCS are guided by two statutes namely the Irrigation Act and the Cooperatives Act. In addition, the state also forms project level water users' cooperatives federations which primarily address issues pertaining to main system management.

270. ***Analysis of PIM and Pilot Study:*** The TA analyzed Karnataka PIM policy and the support system to WUCS including Acts, Rules and Regulations in the context of formation

of WUCS; conditions for Memorandum of Understanding (MOU) between WUCS and WRD on water management; and WUCS administration covering auditing and water charge collection. The analysis is supported by the Pilot WUCS study analyzing the formation of WUCS, internal administration, water management, operation and maintenance and agricultural productivity in Gondhi Channel. The study carried out detailed analyses for two sample WUCS namely Barandur and Kagekodamage out of the nine WUCS in Gondhi Channel[33].

271. ***WUCS in Gondhi Channel:*** The Bhadra CADA records show that there are 9 Water Users Cooperative Societies in Gondhi Right Bank Channel including the Koppa Doddakere tank which is fed from the Gondhi Channel. On the left bank there is potential to form one WUCS. At the outset there are three WUCS that have entered into Memorandum of Understanding (MOU) with KNNL on water management and have benefited from a one time functional grant which is kept in the Bank as fixed deposit. The interest from this amount is being made use for WUCS administration costs.

Table 44: WUCS formed under Gondhi Anicut Project

Sl. No	Name of WUCS	River Bank	Area Irrigated	MOU
1	Barandur	Right Bank	510.52	
2	Baballi	Right Bank	491.09	
3	Seegebagi	Right Bank	387.04	
4	Kage Kodumagi	Right Bank	324.73	20-07-2002 / Renewed on 2012
5	Tallikatte	Right Bank	453.44	09-09-2003
6	Hollehonnur	Right Bank	340.08	
7	Dasara Kallahalli	Right Bank	458.82	
8	Nagathi Belagallu	Right Bank	485.82	
9	Koppa- Doddakere	Right Bank	278.87	03-05-2012 / There is confusion among CADA whether this is part of Gondhi Channel or not.

Source: Bhadra CADA, Shivamogga and KNNL, Bhadravathi

272. ***Formation and Farmers Enrolment:*** One of the findings of the WUCS pilot study is that the process of formation of WUCS was target rather than process oriented. This has resulted in the payment of membership fees by others for farmers who were not informed or aware of their membership in the WUCS. The membership has not crossed 80 % even after one decade of formation in any of the WUCS in Gondhi Channel.

273. ***Water Management:*** Water continues to be managed in the same way after establishing the WUCS as it was before. It is common for the MOU between KNNL and WUCS not to mention the volume of water to be supplied except in a few cases where a volume of water is specified. Further, there is no attempt to assess how much water is actually delivered to a particular WUCS. In this way the issue of volumetric supply as required by the Karnataka Irrigation Act is not being implemented and there is little effort to move towards a volumetric supply by either KNNL or the WUCS. In this whole process the Bharda CADA does not play any significant role. In the interest of better coordination and water management in the Gondhi Channel it is important that the Gondhi WUCS be made part of the Bharda Project Irrigation Coordination Committee. The committee makes the decisions on scheduling irrigation and Bhadra reservoir and main canal operation. A thorough capacity building of WUCS and KNNL and engagement of WUCS as per the PIM policy in Karnataka including volumetric supply is anticipated to bring change in the water management.

33 Similar studies of WUCS under the PPTA are carried out in 2 WUCS and 4 channels in Vijayanagara Channel, 9 WUCS under Bhadra Reservoir Project and 6 WUCS under Tungabhadra Left Bank Canal.

274. ***Accountability for Water Management:*** As per rules, one of the directors of the governing council of a WUCS is a KNNL representative. This is a positive step as it creates a joint platform to deal with all technical irrigation issues and leads to close interaction between the WUCS and KNNL assisting WUCS in participatory irrigation management. The study, however, reveals that there is no participation of the KNNL representatives in WUCS meetings leading to a lost opportunity for closer coordination among them. It was also observed that most provisions of the MOU related to irrigation management and governance are yet to be made operational although the MOUs have been in existence for nearly a decade.

275. ***Action Plan for water indenting, crop plans, O&M and water rate and charges:*** One of the basic requirements for judicious use of irrigation water is to have a practicable action plan that includes the crop plan, water requirement, operation and maintenance needs, monitoring of water use efficiency during cropping seasons, and a future course of action utilizing identified gaps in canal operation. It is worth mentioning here that the Karnataka Irrigation Act requires WUCS to (i) prepare the crop plan and water budget, (ii) operate and maintain canals, (iii) equitably distribute water to members and (iv) promote efficient and economic use of water. The Act also empowers WUCS to procure water in bulk from the Nigams and collect water charges from water users in its jurisdiction. Currently, no systematic procedures and actions to operationalize these WUCS functions were observed in Gondhi Channel. However, during the pilot WUCS study, a micro planning exercise was undertaken in one of WUCS to prepare a WUCS action plan on water management using a work book approach. The exercise showed encouraging results indicating that with proper facilitation WUCS Action Planning can be done successfully.

276. ***CAD Works:*** According to Bhadra CADA annual report 5,688 ha in Tunga and Gondhi projects are affected by water logging, salinity and alkalinity due to the lack of a drainage system. To address this in 2009-10, 891 ha and in 2010-11, 389 ha of reclamation works were carried out (the reclaimed area were in Tunga, Gondhi, Jambadahalla, Anjanapura and Ambligola projects under Badra CADA). These drainage works are carried out by the Watershed Department under the state budget. The drainage system technology used is installation of perforated pipes in the ground at a depth of 1 m covered with coir[34], sand and mud. There are also a series of chambers provided to check the drainage flow. The drainage water drains out to the river or nala (natural drain). It was reported that similar work was taken in Kagekodamage WUCS area by the Watershed Department without any discussion and involvement of the WUCS. The WUCS representatives believe that any works related to soil and water conservation should be carried out with the involvement of the WUCS. This helps WUCS to participate and understand in the works constructively, improves maintenance and also builds confidence in the WUCS by its members.

277. ***Financial Sustainability:*** Financial Sustainability is the key to better functioning of WUCS. The financial resources for a WUCS is from its membership fee in the form of share capital; annual contribution from the farmers; interest amount accrued from the functional grant received from the government; savings from contract works; water charges after remitting the KNNL share; and income generating activity such as the godown (warehouse) and other service charges.

278. ***Godown:*** Construction of a godown has been taken up by a WUCS in Gondhi Channel with financial support from the CADA. But the godown is being used as the WUCS office and is not being used to provide storage services to its members. WUCS in Gondhi Channel currently are not carrying out any other income generating activity including farm support services.

[34] Fiber extracted from the husk of coconut

279. ***Support Services:*** The WUCS in Karnataka were given assistance to establish forward and back market linkage through construction of godowns to generate income through storing of food grains and also to establish WUCS offices. In some parts, this provides income to meet the administration cost of the WUCS. Similarly, the WUCS were given the task of carrying out farm road works called 'Our Farm Our Road' (Namma Hola Namma Dhaari) and fertilizer sales, etc. It would be worthwhile to assist sustainability of Gondhi WUCS to explore the feasibility and opportunity for such activities as well as by extending their role into livelihoods and other relevant activities.

280. ***Collection of Water Charges:*** A core element of sustainable water management is collection of water charges from the farmers to pay for the irrigation eservices. The Karnataka Irrigation Act of 1957 and its amendments empower the WUCS to collect water charges from its members. The KNNL currently sends the water charge demand to a WUCS based on crop area rates, which is contrary to the MOU provisions which requires KNNL to raise the charge on a volumetric rate basis of actual water delivered. However, as measurement of volumes of water actually delivered is not measured due to lack of any measuring system, KNNL is uses the crop area rate basis.

281. The WUCS pilot study shows that farmers are willing to pay and the WUCS express willingness to collect water charges as long as they receive their share of the water. One of the WUCS studied has made a small attempt towards collecting water charges from its members and remitted it to the KNNL.

282. ***Agricultural Productivity:*** Although, there is a clear mandate for CADA to carry out farm demonstrations to enhance crop productivity, the agriculture wing of CADA is more involved in activities like land reclamation and drainage systems executed through the Department of Watershed. At present farmers carry out farming practices, especially input applications such as fertilizers and pesticides; routinely, and by learning from neighboring farmers. Currently WUCS and farmers are not assisted to improve crop productivity levels or in diversifying due to lack of any extension services either from CADA or the Agriculture Department. During the study, WUCS representatives said that they need information on improved agriculture inputs including optimum application rates for fertilizer and pesticides. They also requested Farmers Field Schools to train and demonstrate crop intensification and diversification.

283. ***Training and Capacity Building:*** Training on WUCS registration processes under the Karnataka Cooperative Act, book keeping, internal administration and auditing is carried out by the Regional Institute of Cooperative Management (RICM), Bangalore. Bhadra CADA as per its regular training plan brings representatives of WUCS to RICM for a three days training program. As a result, WUCS in Gondhi Channel have fair knowledge of WUCS management procedures. Discussion with the RICM faculty members revealed that, though a substantial amount of knowledge has been generated at the WUCS level on cooperative society management, there is an urgent need to evolve effective strategies and support mechanisms to operationalize this. . On the other hand, internal governance matters such as accountability and transparency still remain major issues to be addressed.

11. AGRICULTURAL DEVELOPMENT & LIVELIHOOD IMPROVEMENT

11.1 Agricultural Productivity Improvements

284. Agricultural interventions are to be introduced consistent with the KISWRMIP's sub-output of increasing farmer's incomes and livelihoods as well as the outcome of improving water resources management. The implication here is that as well as approaches to improve farmer incomes, interventions are required that will save water consistent with the project's water savings targets and also to reduce the water pollution and environmental risks of irrigated agriculture.

285. Based on the agriculture assessment, the following interventions have been designed for improvement of agricultural productivity under the Program. The agricultural interventions for Tranche-1 comprise:

Focus 1: Enhance Water Productivity and Improve Agriculture Business

286. **Agriculture 1**: Soil Fertility: This will improve soil fertility including carbon levels through: (i) full coverage of the area by soil testing as required and supplemented by plant tissue analysis; (ii) balanced and reduced use of fertilizers and micro nutrients to increase crop productivity, reduce the costs of cultivation, improve soil health, and reduce the contamination of surface and groundwater. Soil and plant samples will be collected and results shared and interpreted participatively with farmers.

287. **Agriculture 2**: Irrigation Water Savings and IWRM: Understanding of the concepts and local application of IWRM by farmers will be increased. Issues include water availability in a river basin-sub-basin-irrigation area perspective, water sharing, water pollution from agriculture, environmental water needs, groundwater and surface water interactions, etc. In particular measures to meet the project's water savings targets will be addressed as well as strategies for coping with drought and climate change. Technologies including irrigation scheduling and addressing water saving and use efficiency, raising water productivity, conjunctive use of groundwater and surface water to overcome times of surface water shortage, matching crop to land capability and water availability, management of waterlogging and proper drainage will be introduced to increase agricultural productivity, ease pressure on canal water and meet project water saving targets, as well as increase family incomes and sustainable growth in the region.

288. **Agriculture 3**: Cropping Patterns, Diversification and Intensification: Alternative crops, cropping patterns and crop intensification will be introduced to increase the income of the farmers with limited land holding and to benefit commercial farming. As well, cropping patterns and diversification would be considered to address and adapt to drought and climate change. Approaches include increasing the proportion of paddy under SRI cultivation which will save water and increase paddy productivity as well as introduction of short duration and market value added crops such as vegetables, and flower cultivation, etc. It is planned to introduce rice (Kharif) followed by pulses (Rabi) cultivation to 20% of the paddy cultivated area and horticulture crops to 25% of the area to reduce water use, increase the farmer incomes and enhance soil fertility.

289. **Agriculture 4**: Farm Mechanization: Farm mechanization and post-harvest technologies are needed in the project area due to the intense labor shortage and rapid increase in the farm labor wages which is resulting in non-remunerative agriculture enterprise. Rice transplanters should be demonstrated to the project area and WUCS and local businesses could be promoted to provide services. Processing of arecanut is undertaken manually and available technologies could alleviate labor shortages and costs.

290. **Agriculture 5**: Chemicals and Pest Management: Responsible use of chemicals and the introduction of Integrated Pest Management address and reduce: (i) input costs, (ii) health risks from handling and storing hazardous chemicals, (iii) surface and groundwater pollution risks, (iv) damage to flora, fauna and beneficial insects, (v) residual chemicals in food, and (vi) the build up of chemical resistance. Aspects that would be introduced include: IPM systems, selection of chemicals, health risks, toxicities and handling, transporting storing, equipment management, spraying conditions, protective equipment, mixing, cleaning up, records, storage and disposals including of containers. IPM would be introduced for paddy and arecanut as a priority.

Focus 2: Effective Research & Extension Services to the Farmers:

291. **Agriculture 6:** Agricultural Extension and Communications: Transferring advanced technologies on farming through training and capacity building is an important intervention for improving agriculture productivity. An effective method developed for such transfer of technologies is the Farmers Field School (FFS) Method. However, this requires skilled manpower exclusively focused on the task available to the farmers whenever they are in need of demonstration and advice. Hence, it is proposed to implement the interventions through dedicated resource persons mobilized from Agriculture Universities, Colleges, Research Institutes and relevant Civil Society Organizations. There are also many government research and extension projects in or near the study area. However, local farmers are mostly not aware of these activities. This project will link these activities with the project's farmers and activities. Information material kits, based around training workshops on good and improved irrigation and water saving practices, cultivation practices, handling of chemicals, etc., for various crops will be prepared and circulated among farmers. Kits could include wall writings, posters, pamphlets, handouts, short video films, etc., to be used extensively to reach out to the farmers and support farm demonstrations.

292. **Agriculture 7:** Research and Demonstration: Research linked to demonstration projects will be undertaken on water saving irrigation and technologies (irrigation scheduling, Regulated Deficit Irrigation); agriculture and water productivity; and conjunctive water management.

Proposed Activities

293. The activities proposed for the project are as follows:

Sl. No	Proposed Activities for Improved Agriculture in Gondhi Sub Project
Soil Fertility	
1	Workshop on Soil Quality Aspects (1x4x10)
2	Soil and Plant Testing at WUCS level (full area coverage as required)
Irrigation Water Savings and IWRM	
3	Workshops on IWRM and Irrigation (surface water, groundwater, quantity and quality)
4	Workshops and training on crop water demands, responses to water, and irrigation scheduling
5	Workshops and training on irrigation water saving technologies and practices including cropping patterns
6	Workshops on groundwater and conjunctive use
7	Propagation Workshop on Micro Irrigation (Drip and Sprinkler) 1x4 season
8	Micro Irrigation FFS (Demonstration of 5 FFS/WUCS) 10x4x10
9	Micro Irrigation FFS (25 farmers x 4 crops x 10 WUCS)
10	Propagation of Gravity pipe distribution at tertiary level Workshop (1x4)
11	Gravity Pipe Distribution (Demonstration of 5 sluices/WUCS) 5x4x10

12 Gravity Pipe Distribution (25 farmers x 4 crops x 10 WUCS)

Cropping Patterns, Diversification and Intensification

13 SRI propagation workshop (1per season x 4 seasons)

14 SRI Farmers Field School (Demonstration of10 FFS/WUCS)10x4x10

15 SRI Farmers Field School (25 farmers x 4 crops x 10WUCS)

16 Propagation Workshop on Mixed Cropping in Garden Crops 1x4 season

17 Mixed Cropping Field School (Demonstration of 5 FFS/WUCS) 10x4x10

18 Mixed Cropping Farmers Field School (25 farmers x 4 crops x 10 WUCS)

19 Propagation Workshop on Horticulture, Floriculture and Sericulture 1x4 season

20 Horticulture and Floriculture Crops FFS (Demonstration of 5 FFS each /WUCS) 10x4x10

21 Horticulture and Floriculture FFS 25 farmers x 4 crops x 10 WUCS)

Farm Mechanisation

22 Organizing campaigns on technology and practices for use of seed and fertilizer 1x4

23 Training Farmers on post-harvest processing (25 farmers x 100)

24 Demonstrations on farm equipments, machinery, post-harvest technologies 1 x 4 season

25 Vermi-compost, Green manure and bio-fertilizers workshop

26 Demonstrations on vermi-compost, green manure and bio-fertilizer 5 FFS x 4

Chemicals and Pest Management:

28 Workshops on the hazards and risks of agri-chemicals

29 Training courses in the safe usage agri-chemicals

30 Integrated Pest Management (25 farmers x 4 crops x 10WUCS)

Agricultural Extension

31 Dissemination of information on relevant State and Central Government activities on crop production and water saving

32 Preparation and circulation of information materials in Kannada

33 Training on computer application - agriculture market information

Research and Demonstration

34 Trials demonstrating and researching water saving technologies

35 Research and trial of conjunctive use of groundwater

36 Trials demonstrating and researching fertilizer usage

37 Trials demonstrating and researching IPM

12. INITIAL ENVIRONMENTAL ASSESSMENT

294. District Shivamogga is partially in the Western Ghats, a fragile ecosystem which covers a variety of forest and other ecosystems and is also the origin of a number of the significant rivers of South India. The project area, however, does not fall in the Western Ghat forest areas, though there is some animal movement from forests which are nearby. From available information it is expected that there is likely to be no adverse impact from project activities on these areas or these animals. Nonetheless, some issues which are not necessarily related to the Western Ghat's ecosystem have been identified that will need to be addressed though the Environmental Management Plan (EMP) and are discussed below. Based upon existing information the Gondhi modernization sub-project is a Category B project and therefore an IEE has been conducted for it (Annex 2). The Bhadra flow measurement and control sub-project is a Category C project and therefore no IEE or EIA is required for the project.

12.1 Assessment

Gondhi Modernization sub-Project

295. The main detrimental environmental impacts from the project are likely to be during the construction phase – where the canal lining and other structures are to be put in place; and, agriculture intensification activities take place for which there is a project design plan. These agricultural impacts are expected to happen spontaneously once the project is implemented; and, include increased efficiency of water use, drainage, and increased use of agri-chemicals. Expansion of agriculture to areas currently not used for agriculture such as grazing lands and pastures and wetlands is not thought to be an issue as the area of command is already irrigated based on survey and satellite assessments. Nevertheless this potential impact needs to be considered. During the design phase consideration needs to be given to the risks and their mitigation of people and animals (wild and domestic) falling into the lined canals and being unable to escape. As a result of the assessment, the sub-project is classified as Category B.

296. There are likely to be a number of positive impacts from project activities such as improved drainage resulting in better soil health, increased agricultural productivity and reduced habitat for certain disease vectors.

297. Impacts have been identified as a part of the assessment available in Annex 2 *'Initial Environmental Assessment and Environment Safeguards'*.

298. The major construction related activities of concern are the procurement of material, transport routes and the various sites including quarries and borrow pits, material storage, labor camps and the areas. The major concerns related to construction activities are (i) safety of the workers and local population, (ii) waste disposal, (iii) impact to local ecosystems due to degradation or destruction, (iv) reduced access to the local population dependent upon the sites, (v) long term degradation of sites such as erosion or waterlogging due to inadequate rehabilitation of sites, (vi) damage to local infrastructure, and (vii) health risks from poor site management or safety and labor management – such as waterborne diseases due to inadequate provision of sanitation facilities for labor.

299. Tanks, currently connected to the canal system and which collect catchment runoff, overland flow from an upstream irrigation area and water from the canal system may be separated and then regulated as a part of the canal system. This will affect the seasonal behavior and to some minor extent, tank functions as an ephemeral wetland. It is likely the tanks won't dry out to the current extent that occurs whenever the canal are close (twice a year). During the irrigation season, storage levels in the tanks are expected be slightly more

variable than now as water is held and then released when needed. The environmental impact of this however is likely to be minor.

300. Agricultural interventions and intensification; especially with assured irrigation, is likely to result in higher use of agrichemicals. This would introduce greater toxicity to the environment with potential to impact human health and the ecosystems adversely. Furthermore, the disposal of agrochemical waste will also increase as an issue considering that at present there is no system for its disposal. While some waste is burnt or buried other, such as plastic containers are reused, potentially introducing contaminants into the human food chain directly. Furthermore, increased hydraulic loadings as a result of more intensive irrigated agriculture may also increase waterlogging and salinity, and this would have an adverse impact on soil health and agriculture productivity. Increased waterlogging may also result in an increase in vector-borne diseases like malaria, or waterborne diseases due to existing low levels of sanitation. Overall however and on balance, these environmental impacts are likely to be minor.

301. Increased irrigation efficiency is another potential concern for the environment. While increased irrigation efficiency and lower overall hydraulic loadings in some areas is likely result in reduced waterlogging and salinity, it may also result in reduced return flows to the river. This may impact existing ecosystems adversely although the river ecosystem is already thought to be affected with very low dry season flows.

Bhadra sub-Project Activities

302. The Bhadra subproject has only a few and very limited set of activities involving improved electronic flow measuring devices at selected points along the existing canal and possibly at major canal outlets and selected command area outflow points to provide information and operation of the canal and water delivery system. There are no other engineering interventions or agriculture related activities planned for the sub-project.

303. Discussion with various government officials noted that while the canal network does not pass through the parks or reserves, it does pass through and in places adjoin protected forest areas.

304. There are expected to be few impacts, beyond those already experienced and these would occur mainly during the construction period. There could be a few minor impacts during O&M of the devices.

305. Expected construction related impacts are: (i) dust and noise from machinery involved in transporting equipment materials, (ii) waste from construction related activities and sites; (iii) disturbance of wildlife especially in any migration areas, and (iv) disturbance of the local population near the construction sites. During O&M the only concern would be the need for proper maintenance of the site and for disposal of any waste created.

306. Ongoing impacts from the current canal could include, (i) possible disturbance to local wildlife by stretches of canal that pass through forested areas, and (ii) damage to infrastructure due to animal movement especially during the dry season when wild animals use the canal for drinking. Maintenance of the equipment will require occasional access and visits that may disturb wildlife.

307. For all impacts, details of possible impact management are given in the project's Environmental Assessment and Management Framework (EARF). This should be used to guide all work. Briefly, design related management should include appropriate siting or location to ensure minimum disruption to wildlife due to site location or the need to access the site, and a design that neither creates a problem nor is damaged by animals. During construction, site management, safety of workers and local population, waste management

and rehabilitation of sites, are the major issues that need to be considered. During O&M appropriate waste management and site management should be planned.

308. Considering that these are the only planned activities, this sub-project is considered a Category C project. Therefore, no IEE or EIA is required for the project. Greater details of possible environmental impacts and their management are given in Annex 3.

12.2 Environmental Management Plan

309. The impacts of the sub-project are likely to be managed with appropriate interventions that need to be built within the project design and its activities, or in the case of construction related activities though appropriate contract clauses. The EMP for the Gondhi project (Annex 2) needs to be monitored, as also should the overall implementation of the project to ensure both appropriate EMP implementation. Any additional unforeseen issues and impacts should also be recorded and monitored.

310. In the case of construction related activities, good site management, consultative processes to ensure local populations are not adversely impacted, rehabilitation of sites and safety measures at all sites are the major management actions which will be required. Safety needs should not only include appropriate signage and warnings, but also safety equipment for workers and first aid in case of any accident and until the injured are able to be taken to appropriate medical center.

311. To ensure agriculture interventions do not have an adverse impact on human or ecosystem health a good extension service to provide both information and support for farmers is needed. This could include training on better water and environmental management, storage and disposal of agrochemicals and related waste (eg. containers), Integrated Pest and Nutrition Management knowledge and practice, soil health and drainage management, and support to implement identified strategies.

312. The maintenance of environmental flows and land use changes and patterns are likely to be beyond the immediate implementation actions of the project. Much of this can be more appropriately addressed in the overall IWRM framework and the river basin management activities of the Program. Local land use changes and environmental risks – such as conversion of tanks that function as ephemeral wetlands into semi-permanent and more stable water retention structures, and other reclamation processes, may be reduced though the project's WUCS and farm level education and communication process which would also address improved on-farm land and agriculture management. As well, guidelines for the operation of tanks that are integrated into the water distribution system would ensure increased multiple benefits (environment and socio-economic).

13. SOCIAL SAFEGUARDS

13.1 Resettlement Impacts

313. The field assessment for Vijay Nagar and Gondhi Irrigation Systems has been made for the likely social and Rehabilitation & Resettlement (R&R) impacts. Based on preliminary interactions with the WRD and CADA officials and observational field visits, no major resettlement issues are anticipated under the modernization works. The field assessment of a few canals and interaction with the beneficiary communities revealed that the right of way (RoW) for the canal system seems to be available.

314. The majority of the project interventions as part of the physical works on the distribution channels are envisaged within the cross sections of existing channels/ canals so there is unlikely demand for any land acquisition. The canals under the Channel Systems are primarily contour based canals with approach roads for maintenance and the fields under the command area at the lower level. The land availability along both the canal systems for the approach road ranges between 3.5-8 m at different sections which provides adequate pathways for vehicles for construction works. In some cases, the approach along the canal is available on both sides. In certain sections especially where canals are passing through urbanized / habitation areas, scattered temporary as well as permanent constructions occur along some canal banks. These are unlikely to affect the implementation of the project activities, however as increased cross sections are not envisaged under the project.

315. As part of the overall approach, the other activities anticipated include strengthening of the existing linkages between the different canal systems within the sub-basin including improvements in the tanks/ ponds. Gondhi irrigation system contains at least 20 tanks. Some of these are along the main canal and were formed where the canal cuts across small side valleys. Others are within the command area. One of these tanks, Koppa Dodakere, commands about 260 ha and has gated outlets to enable active management of supply to its command area. The tanks along the main canal are on-line, which mean that their water levels fluctuate with the main canal. As such, they reduce the responsiveness of the system to flow changes. It is therefore recommended that tanks are modified to enable active management of the stored water. The objective of tank modification interventions is to modify current on-line storage where feasible to become actively managed off-line storage and enhancement of existing off-line tanks for more pro-active management.

316. As per the technical assessment, the possibility of providing night storage reservoirs should be investigated. These would be located downstream of outlets so that, although water can flow continuously through the outlets, irrigation in the command area would be only undertaken in day-time, when water can be managed more efficiently and wastage reduced. Such reservoirs, however, will require land which will need the support of the beneficiaries which may not be immediately forthcoming.

317. Some of these ponds/ tanks areas have been encroached upon for the purpose of farming. In other cases changes to dam operation could increase water levels and therefore result in peripheral flooding. These could potentially have impacts on the livelihood issues.

318. During the field visit it was observed that water pipelines are crossing the canal sections and are laid on the canal bed, which would require special attention during the execution of lining works.

319. The other set of interventions envisaged under the project include command area development works comprising lined channels, low pressure gravity-supplied pipe distribution where technically feasible and drainage where required. To realize the overall objective of improved water use efficiency it is necessary to improve the entire distribution

system between head works and the crops. This involves improving the distribution system in the command area and, if necessary, supporting measures such as land levelling and drainage. There is considerable potential to upgrade the command area distribution system in Gondhi. It is recommended that this distribution system includes piped distribution where feasible using UPVC or HDPE pipes. Final distribution of water from the fixed pipe outlets could be undertaken using flexible hose. A piped system will provide several benefits including: (i) negligible land take; (ii) negligible conveyance losses; (iii) reduced opportunity for water to be drawn from points between the agreed outlets; and (iv) a clearly defined rotation system for sharing the use of the pipe outlets.

320. The assessment of the two sub-projects under consideration with regard to the projects interventions envisaged and the ground level situation clearly reveals that direct resettlement impacts are unlikely and a very minimal extent of temporary impacts may be involved especially if there are establishment of construction camps although this is not envisaged at this stage. This will be confirmed with detailed planning.

321. Given the overall nature of the project, the project is likely to fall under Category C with regard to resettlement impacts. However based on the final set of design interventions especially if the night storage reservoirs are planned or water levels in tanks are thought to increase peripheral flooding, the project could be transferred to Category B and assessed only once the design interventions are firmed up. Given the existing set of interventions the project is likely to fall under Category C for which only a resettlement framework incorporating the Indigenous People (IP) issues is proposed to be developed under the current TA. The resettlement framework would guide the safeguards that would be followed while the exact project interventions are made under the project.

13.2 Indigenous People

322. Indigenous people constitute a very small proportion of the command area population (3.3 percent are Scheduled Tribes, ST), and nearly 40 percent of the project villages do not comprise any ST population (Census 2001).

323. Considering the sub-project interventions (modernization and lining works), their likely impact on the ST is expected to be minimal. Hence, as per ADB's Safeguard Requirements 3: Indigenous People; Category C will be applicable for the project (Safeguard Policy Statement, June 2009).

324. Further, the project also envisages strengthening of WUCS constituted as per the provisions of Section 62 of the Karnataka Irrigation Act, 1965. As part of the Participatory Irrigation Management approach for sustainable O&M of the lower tiers of the canal system, the inclusion of vulnerable groups needs to be encouraged. The project will need to take steps to ensure that the vulnerable groups have full, and preferential, access to project support and services, including raising awareness and ensuring they have opportunities for training.

14. FINANCIAL AND ECONOMIC ANALYSIS

14.1 Background

325. The Karnataka Integrated and Sustainable Water Resources Management Investment Program (KISWRMIP) aims to manage and sustain the increasingly scarce water resources in the selected water scarce river basins in the State of Karnataka (the State) in India. It will establish and strengthen state and basin level institutions, adopting the principle of integrated water resources management (IWRM) by initiating in the Tungabhadra sub-basin (of the Krishna basin). With water for agriculture utilizing over 80% of the State's water resources, investment support will be provided for sub-basin wise planning to modernize and improve irrigation service delivery while strengthening relevant institutions–state departments and irrigation water user cooperative societies (WUCS). Technological advancements–such as micro irrigation and decision support systems will also be implemented and options for innovative financing modalities like public-private partnerships will be explored. The Program proposes a multipronged approach for IWRM and water use efficiency particularly for irrigation service delivery improvements as follows:

(i) Improved sub-basin and basin planning and monitoring based on an IWRM roadmap, specifically: (a) strengthening of the recently State established Advanced Centre for IWRM (AC-IWRM) which will be pivotal to the program as a regional center of excellence for advancing policy research in IWRM and supporting basin level institutions for water resources planning; (b) improved water resources monitoring (quantity, quality, and utilization); and (c) preparation and implementation of river basin management plans to provide long-term strategies and set directions for water resource management.
(ii) Increased water productivity in irrigated agriculture through (a) holistic system improvement planning, and (b) modernized irrigation infrastructure on Gondi and Vijaynagara medium subprojects and Tungabhadra Left Bank Canal major subproject;
(iii) Improved irrigation service delivery by strengthening management, operation and maintenance capacities of relevant institutions and WUCS.

326. As a result of the Project, water management will be improved and utilization of the water resource optimized. The project will:

- enhance access and security of water supply in the TB sub-basins;
- improve access to irrigation;
- increase farm incomes and improve water management;
- provide defined bulk water deliveries for major water users, including drought water management;
- implement water monitoring systems;
- improve productivity of water;
- promote irrigation management by WUCS with improved service quality for users.

327. The economic rationale for the Project is that economic benefits of improved water supplies are not likely to be obtained without GOI/SGOK investment, as cost effective mechanisms for recovery of water charges at commercially viable rates are unavailable, and private sector investment is therefore precluded. Introduction of river basin planning and volumetric monitoring of water flows in the sub-basin and irrigation subproject will contribute to a better understanding of resource availability, efficient utilization and improving water productivity for agriculture by increasing net benefits per unit of water. The aim will be to strengthen WUCS and improve their agricultural practices for increasing crop production by maximizing utilization of available water.

Gondhi Subproject

328. Gondhi Subproject was commissioned in 1926 and consists of a weir diversion (anicut) feeding into two channels, on the right and left bank of the Bhadra river. See scheme details in other sections. The subproject has a gross command area of 5,060 ha and the current CCA is taken as 4,600 ha. It is located in Bhadravathi Taluk, Shivamogga District (30º 46'N, 75º 41'E), comprising of 9 WUCs, which are not currently functional. According to satellite interpretation (2011) about 60% of the CCA 3,076 ha is under perennial crops (arecanut 49%, sugar 12%) and most of the remaining area is cropped to Kharif and Rabi paddy rice (38 % of the command area). In the sub project marginal farmers dominate the farmer's distribution 60% to 70%, see Table 1. There are no large farms. It is likely that the household survey over represented larger farms, so the Block level data are used in the analysis. Over 90% of land is cultivated by tractors, and combine harvesters are being introduced due to rising labor costs. Cropping is dominated by paddy rice, areca nut orchard and sugar cane.

Table 45: Distribution of Households by Farm Holding

	Marginal under 1 ha	**Small** 2 to 4 ha	**Medium** over 4 ha
Household survey, Gondhi scheme, 2012 (100 households)	*58*	*22*	*19*
Block level data, Agric. Census 2005	*70*	*20*	*10*

329. Pumped water for conjunctive use is utilized by farmers in the middle and tail reaches. Small electric pumps are used to lift river water for all crops, but especially arecanut, during scheme closure (1 month in late November and December), and in the lower part of the scheme (below km 44 on the right bank canal) during the closure of Bhadra canal in May to July, when seepage water inflows into the Gondhi canal cease. Pumps are electric, around 10hp, and electricity is provided free of charge, but is only available 6 hours per day. Installation costs are about Rs 30,000 and connection charges Rs 20,000. Water may be pumped several kilometers from the river using small plastic pipes, and is distributed in existing field channels. There are small areas of drip irrigation for arecanut. The area served by pumped water is not known, but may be 20% to 30% of the crop area. Pumping costs are small, unknown, and are not included in the analysis.

330. Sharecropping and leasing are uncommon, under 1% of area, and are not considered in the analysis.

331. The financial analysis for Gondhi subproject is undertaken to assess the impact on the farm incomes of intended beneficiaries and their ability to contribute to O&M requirements. The economic analysis is conducted to quantify the economic benefits and costs as a basis for assessing the Subproject's economic viability and sustainability in the long-term. The Project will generate benefits from support to WUCs and PIM, institutional strengthening of irrigation planning and management, and management of the State's water resources. These non-quantifiable benefits are not included in the economic analysis but are expected to be substantial and will have a significant impact on the performance of the Subproject.

332. Annual operating and maintenance costs are estimated at Rs 3.7million, or Rs 800 per hectare, based on engineers' estimate of funding required for sustainable irrigation system management, excluding capital cost recovery.

14.2 Financial Analysis

Methodology

333. The financial analysis used late 2012 values. The exchange rate of the US$ was Rupees 55. GOI administered prices (crop outputs and fertilizers, in particular), are below world price levels, but output market prices are above the administered price (Minimum Support Price).

334. Project outputs were modeled with and without the project using crop budget models developed in FARMOD 4.02. No livestock or fisheries models were developed, but crop residue and forage crops were valued to represent livestock benefits.

335. Labor costs are increasing very rapidly in the scheme area, at 20% to 30% per year, and well above inflation rates. This is the result of increased availability of urban employment and the improved education levels of young entrants to the work force. Wage rates were around Rs 210 per day (Rs 250 for men and Rs 150 for women) in 2012. This increase is expected to continue and makes returns to low value crops negative. Farmers are being forced to adopt increasing mechanization and low labor technologies. Most land preparation is by tractor, over half of grain harvesting uses small combine harvesters (some rubber tracked to cope with wet conditions), weeding is increasingly undertaken by tractor rotovators or cultivators, and, where possible, use of herbicides. Mechanization is likely to increase, for example adoption of rice transplanters, currently uncommon. High labor costs have led to reduction in livestock ownership and use of animal draught. These potential impacts are noted, but future trends have not been included in the models.

336. Gondhi scheme is fully developed, with almost 100% cropping in both Kharif and Rabi seasons (overall cropping intensity is about 138%, due the large area of perennial crops). Use of HYV and high levels of fertilizers and crop chemicals are universal, see detailed crop budgets. Yield rates are comparatively high and the potential for increasing yields is expected to be by 20% to 30%.

Sources of Data and Limitations

337. A socio-economic survey was conducted in late 2012, on 10 villages and 100 households on Gondhi sub project, which provided some information on farmer distributions, area and yields. Production data appeared nominal, with very low coefficients of variation, and were not used. Crop budgets were based on secondary data and farmer discussions.

338. Crop area estimates are based on household survey data, and, mainly, analysis of 2011 satellite imagery. Reported official area data were not representative and do not reflect the rapid increase in perennial cropping.

339. Farm numbers and distributions were based on survey data, WUC records and Block level data from the Agricultural Census 2005. Final estimates were derived by the consultant.

340. Scheme development costs are based on the Detailed Project Report estimates, and are subject to revision.

Scheme Background and Cropping

341. Gondhi scheme was developed for paddy rice production, but low returns and opening of the local Mysore sugar and paper factory in 1984 led to the introduction of sugarcane as a cash crop. Poor marketing and late payment for sugar led to experiments with arecanut in the 1990’s and the crop has increased from zero to around 50% of the

cropped area in 2012[35], and the area continues to increase, replacing sugar cane and paddy rice.

342. Establishing arecanut involves a considerable investment by farmers (over Rs 300,000 per ha) over the seven years before production begins, and positive cash flow takes around 12 years. Intercropping in young arecanut is practiced but only on around 25% of the crop area, and the returns are small. This makes the financial (and economic) returns to new arecanut very low (well below the discount rate), and farmers clearly have long term objectives and are prepared to defer gratification, possibly as a form of pension planning. Discounting investment costs and the value of full production provides a valuation of about Rs 1.2 million per ha of fully developed arecanut. Large quantities of inorganic fertilizers and FYM are used, despite which farmers are reporting soil fertility issues, probably shortages of potash and micro nutrients, which need to be investigated and corrected. Farmers practice marling with red clay soils from nearby rainfed areas, presumably to improve nutrient availability, applications are made every second year, alternating with inorganic fertilizers, though average annual applications for both are included in the model.

343. Arecanut is popular as the crop is flexible, and does not require precise timing for cultural operations. It is a relatively light user of water. Local demand for the output is strong and growing more rapidly than production. There are currently substantial tariff barriers to imports (duty of 108%) which keep local prices artificially high. Arecanut marketing is mainly carried out prior to harvesting, and local processers (often also farmers) buy the crop on the tree for a fixed price, or payment by yield. Current prices for wet nut are Rs15/kg on the tree. Processing costs are Rs 20,000 to Rs 30,000 per ha, for harvest, transport, shelling, boiling the nuts and drying, most of the output being red boiled nut in the scheme area. Dry nuts market at about Rs 140 per kg.

344. Sugarcane is generally grown as a perennial crop, with a single ratoon if yields are considered adequate. Use of inputs in the ratoon crop is lower, and yields are less, but land preparation and planting costs are avoided. The crop has been modeled as an annual crop using average inputs and outputs. Herbicides are used extensively during the first three months after establishment. Full growth may take 14 months, but the crop has been assumed to be an annual harvest[36]. The crop is mainly marketed to the local factory, only a few kilometers from the scheme, though there are also local brown sugar producers inside the scheme. The crop is harvested under contract, according to schedules imposed by the factory, and transport is organized by the factory, but paid by the producer.

345. Paddy production methods are typical for the crop, with fairly high use of inputs and high yields. Mechanization is universal, and half the crop is combine harvested, and half harvested by contract labor. The latter is more expensive, but makes the hay crop available. Aftermaths are grazed by sheep brought in from outside the scheme, and local cattle.

346. Crop production costs are based on farmer group surveys, crop budget publications[37] and data provided by a local NGO[38] working in the scheme. Crop budgets with the project are based on consultants' assumptions. Scheme construction costs were taken from current engineer's base estimates, and are subject to updating.

[35] This area includes small areas of other tree crops such as coconut, often grown as a plot boundary, or intercropped with arecanut, and also banana. Perhaps 5% of the cropped area.

[36] Mainly to preserve the economists failing sanity

[37] Report on Regionwise Cost of Cultivation of Crops 2006-07. Karnataka State Department of Agriculture

[38] JalaSpandana South India Farmers Organisation for Water Management. Personal communication.

14.3 Development Costs

347. Gondhi certified command area (CCA) is 4,600 hectare. Gondhi subproject operating and maintenance costs are based on engineer's estimates and include: direct and indirect costs, labor, equipment, materials, services, and overheads. Construction costs exclude the taxes paid by contractors, who are paid net of tax, with the tax due paid into State budgets as a paper transaction between WRD and the Revenue Department.

348. Construction and CAD development works are assumed to start in 2014, and will be completed in 2016. CAD works will be undertaken totaling Rs 190 million. Sub project costs are shown in the following Table. Estimated channel lining costs are 55% of the total for earthworks and lining, or Rs 386 million.

Table 46: Gondhi Sub-project Engineering Base Costs

Item	Rupee million	US $ million
Preparatory Work	0	0
Dam	0	0
Main Canal earthworks and lining	701	12.75
Main canal structures	208	3.78
Distributaries	57	1.03
Command area development	190	3.45
Flow measurement	28	0.5
Contingencies (10%)	118	2.15
TOTAL	**1,301**	**23.66**

349. Other sub-project costs include project management overheads based on 10% of total project management of Rs 88 million. Institutional strengthening costs are excluded from scheme costs. Physical contingencies of 10% are added to scheme costs. Construction is assumed to take three years. Estimated social support and agriculture costs are included, and are subject to revision.

Table 47: Gondhi Base Cost

Item	Cost (Rupees million)	Cost ($ million)
Irrigated Agriculture Management Systems		
WUC Support	18	0.33
Irrigation and Associated Infrastructure		
Irrigation Infrastructure	1083	19.71
CAD Works	190	3.45
Agriculture & livelihoods	26	0.47
Institutional Development		
Project Management	9	0.16
Physical Contingencies	132	2.40
Total Scheme Cost + Physical Contingencies	**1,460**	**26.52**

Subproject O&M Costs

350. O&M costs were estimated from the CCA at Rs 800 per hectare per year, both with and without the project. If channels are not lined it is assumed that O&M costs for the unlined percentage of the channels increases by 25%.

351. No pumping costs are included in the model, but they are fairly small.

352. Water charges are paid by farmers according to crop and season currently Rs 250/ha paddy, Rs 1000/ha sugar and Rs 150/ha for garden (tree) crops. It is proposed that collection of water charges is undertaken by the WUCs, and used for O&M, 30% being passed on to WRD for overheads, currently collection, such as it is, is made by the Revenue Board and funds are subsumed into general revenue. Water charges are included in the crop budget models, but even at 100% collection the water charges are only about 30% of the total O&M cost, with no contribution to capital replacement.

14.4 Benefits

Agriculture, Markets and Prices

353. The ***Feasibility Studies Supplementary Report, Financial & Economic Analysis Markets and Prices*** details the prices used in the analysis, and the production and marketing background for the Project, and should be read as an integral part of this report, attached as an Annex.

Crop Budgets and Production Costs

354. The cropping calendar for the main crops is shown in Table 48. Sugar cane is planted biennially or possibly with two to three ratoons, and harvest takes place between August and September according to permits issued by factories that are supply based. Similarly the harvesting of coconuts takes place between August and September according to factory permits. Arecanut is harvested every 40 days during the harvest period.

Table 48: Cropping Calendar

Crop	Sowing Period	Harvest Period
Paddy - Kharif	Jun-July	Nov-Dec
Paddy- Rabi	Jan	Apr-May
Kharif Field crops	Jun-Jul	Nov-Dec
Arecanut	Jun-Jul	Aug-Dec (40d)
Sugar Cane	Aug-Nov (bienn.)	Aug- Feb
Banana	monsoon	All year
Coconut	monsoon	Aug- Feb

355. Crop budgets were prepared for Kharif & Rabi rice, other semi dry crops (maize) sugarcane and arecanut (betel nut). Key inputs, fertilizer and harvest labor were related to yield rates in the model to reflect input costs. A typical physical budget of irrigated paddy is shown as Table 5. Yield rates with the project increase from 5,450 to 7,000 kg per hectare (20%), over three years (not shown) and by-products are directly linked to yield. Inorganic fertilizers and harvest labor are linked to the yield rate. A summary table of physical crop budgets is attached as an Annex Table.

356. The paddy rice budget shows a very high output and input crop compared to the norm for Karnataka state, with yield rates about twice the average and crop inputs also about twice the average, and high labor inputs. These levels were confirmed in the field, and the scheme is well developed. Yield rates can be increased, mainly by introduction of SRI, by 20 to 25%. Labor costs are assumed to fall, with increased mechanization, probably rather more than modelled. Other crop models are included in Annex tables.

Table 49: Physical Budget for Kharif Irrigated Paddy Rice

	Unit per ha	Existing Technology	New Technology
Outputs			
Grain	kg	5,450	7,000
Straw and Stalks	kg	8,175	10,500
Inputs			
Paddy Seed	kg	73	66
Nitrogen	kg	130	150
Phosphorous	kg	80	100
Potassium	kg	70	90
Contract transplanting	each	1	1
FYM	kg	3400	5000
Pesticide	kg	14	17
Herbicide	kg	-	0.3
Animal Hire		20	5
Tractor Hire	hour	19.0	30
Combine hire	hour	4	5
Labour	person-day	105	100

Note: Contract planting and harvesting are excluded from labour data

357. The financial budget of irrigated paddy rice is shown below, Table 50, for current and new technology for PY 25. The budget shows income before labor costs (which are retained by the farm family) and after. Income after labor costs are quite low and the budgets are sensitive to the assumed price of rice, which are currently, locally, well above the MSP. If MSP are used the returns, after labor, are frequently negative, as are economic price crop models.

358. There are five factors effecting rice budgets: subsidies; home consumption; household labor; market prices; and time:

- Farmers face financial prices at the subsidised rate, and have no interest in true costs at economic rates. This specifically encourages high fertiliser utilisation, which may not be economic at world prices.
- Households value home grown subsistence crops above market prices as they avoid marketing costs, they avoid having to pay retail prices of food, and they avoid most transport costs. This could easily be 30%, or more, of the market price the farmer would receive for their crop.
- Marginal and small farmers do not pay the full costs of labour, as much of it will be undertaken by family members, and they will be prepared to do the work if the value of their labour is higher due to producing their subsistence needs, and also if their alternative employment opportunities are limited.
- There is evidence that farmers are obtaining prices 20% above the current MSP, in other words the market price is adapting to reality quicker than the support price system. Using a market price of Rs14/kg paddy (rather than the MSP of Rs 12.5/kg) transforms the budgets to profitability. Local market prices in Gondhi are quite high.
- Farm labour costs have increased at a very rapid rate in the last five years, up to 30% per year, and are now about four times higher than they were (at around Rs 210, compared to Rs5 0 per day). There is evidence that farmers are reacting to this by increasing mechanisation (tractor land preparation and seeding, introduction of mechanised planting and combine harvesting with small locally produced equipment) and adoption of chemical weed control. However there has not been time for this to be completed.

359. Summary financial budgets by crop are attached as Annex tables. These show that the perennial crops have positive financial, (and usually economic), returns at current prices.

New arecanut plantation starts producing six years after planting, and reaches positive cash flows in about year 12. To obtain economic returns the crop must be intercropped during establishment (typically with banana, though a range of crops are used), though this is not always practiced (possibly 25% to 50% of new areca nut is intercropped). Households with alternative sources of income (quite often productive arecanut plantation), appear to be prepared to accept deferred gratification, possibly to secure future pension income, and increase their arecanut area gradually.

Table 50: Financial Budget for Kharif Irrigated Paddy Rice (INR/ha)

	Existing Technology	New Technology
Revenue		
Paddy Rice	76,300	98,000
Straw and Stalks	7,358	9,450
Sub-total Revenue	83,658	107,450
Input costs		
Paddy Seed	2,628	2,340
Nitrogen	2,470	2,850
Phosphorous	3,680	4,600
Potassium	1,820	2,340
FYM	8,500	12,500
Pesticide	1,200	1,500
Fungicide	3,000	3,600
Herbicide	-	75
Animal Hire	6,000	1,500
Contract transplant rice	-	3,250
Tractor Hire	11,400	18,000
Combine Harvester	8,000	10,000
Irrigation Fee Paddy	500	500
Sub-total Input costs	**49,198**	**63,055**
Income (Before Labour Costs)	**34,460**	**44,395**
Labour costs	**22,050**	**21,000**
Income (After Labour Costs)	**12,410**	**23,395**

360. SRI rice is being adopted in Karnataka, and it is envisaged that this will be introduced into Gondhi subproject through the ADB investment program. Data is scarce but research[39] suggests that in Karnataka adoption of all four key SRI methodologies (young seedling under 15 days; single seedling; square planting at 25 cm spacing; cono weeding) will increase yields by 25%, whilst operating costs only increase 2.5%, and there are significant water savings, as water is kept shallow and the crop is mulched. Gondhi has a surplus of suitable mulching materials from the perennial crops.

Farmer Distribution and Farm Models

361. There are about 3,900 farming households in the Gondhi Subproject area, distributed shown in Table 51. There are a reported 3,582 members of the 9 WUCS (CADA data), and 4,010 famers in the 2001 Population Census. A CCA of 4,600ha with a mean farm holding of 1.18ha implies 3,900 farmers. The study assumes a total of 3,900 faming households, distributed as shown. It is assumed that the household sample survey overrepresented the

[39] IWMI-Tata Water Policy Research 7 2012. Impact of the System for Rice Intensification in 13 States of India, K Palanisami, KR Karunakaran Upali Amarasinghe

medium farm households somewhat, as no rigorous household sampling was reported, so these numbers were reduced.

Table 51: Benefiting Households for Gondhi Canal Command by Farm Size

	Agric. Census (%)	Household Survey 2012 (%)	Model Assumption (%)	Household Numbers Assumed
Marginal Farmer (up to 1ha)	*70*	*58*	*60*	2,340
Small Farmer (1 to 2 ha)	*20*	*22*	*25*	975
Medium Farmer (over 2ha)	*10*	*20*	*15*	585
Farming Households				**3,900**
Landless				300
Grand Total	***100***	***100***	***100***	***4,200***

Source: Agricultural Census 2005 at Block level

362. Farm models were prepared for marginal, small and medium farmers using the average farm size for each (Table 52). The farm sizes were: marginal farm area of 0.4 hectare; small farm area of 1.4 hectare; and a medium farm area 3.9 hectare, with an average size of 1.18 hectare. Numbers are rounded, and it is assumed there are no large farms.

Table 52: Farmer Distribution and Areas (2012)

Farm Type	Households	Mean Farm Size (ha)	Total Area (ha)	Percent of area
Marginal (up to 1 ha)	2,340	0.4	935	*20*
Small (1 to2 ha)	975	1.4	1,365	*30*
Medium (over 2ha)	585	3.9	2,300	*50*
Total	**3,900**	**1.18**	**4,600**	***100***

363. Farm family labor was assumed to be 1.6 persons, available 25 days per month for all households.

Present Situation (Without Project)

364. The main Kharif season crop is Paddy (45% of farm holding), Rabi season crop is Paddy (40%). There are large areas of sugar (15%) and tree crops, mainly arecanut (35%). There are small areas of other semidry crops (under 1%) and other tree crops (banana and coconut (5%) which are not included as separate crops in the analysis. Overall cropping intensity is about 138%, and there is little potential for increasing cropping intensity, due to the large area of perennial crops.

365. Without project crop yields are typical for the State. Yield rates are assumed to decline by 20% without the project, due to restrictions in the available water supply.

Table 53: Without Project Cropping Pattern Production and Yields

Crop	Area (ha)	Percent of Area	Yield kg/ha)
Command Area	***4,600***		
Kharif Season			
Paddy	1,400	*30*	5,450
Other	350	*8*	3,500
Rabi Season			
Paddy	1,000	*22*	5,500
Other Rabi	750	*16*	3,500
Perennial Crops			

Sugarcane (cane)	550	*12*	85,000
Arecanut (wet nut on tree)	2,300	*50*	15,000
Total Area & Cropping Intensity	**6,350**	***138***	

Future Situation (With Project)

366. The CCA with project remains at 4,600 hectare, though a reduction in area is likely as built up area increases.

367. Conservative adoption rates were used for the analysis. No benefits were assumed in PY1, and full uptake of the new crop technologies was completed in PY 5. The direct benefits of the sub project are derived by avoiding a decline in yields due to water shortages and improved yields resulting from better irrigation and crop management.

Table 54: Gondhi, Area under Existing and New Technology (ha)

Year	Existing Technology	New Technology	Cropping Intensity (%)
1	6,350	0	*138*
2	5,381	733	*133*
3	3,175	2,925	*133*
4	970	5,120	*132*
5 on		5,850	*127*

368. Farmers are expected to continue cultivating paddy as the major crop during Kharif and Rabi seasons, taking up SRI, and expand new arecanut. Yield rates are assumed to increase with new technology by only 20% in a sigmoid pattern over three years from the without project yield levels.

Table 55: With Project Cropping Pattern and Yields

Crops	Area (ha)	Percent of Area	Current Yield (kg/ha)	Yield PY25 (kg/ha)
Command Area	4,600			
Kharif Season				
Paddy	450	*10*	5,450	7,000
SRI Paddy	450	*10*	-	8,000
Other	350	*8*	5,500	6,600
Rabi Season				
Paddy	100	*2*	5,500	6,600
SRI Paddy	400	*9*	-	7,000
Other Rabi	750	*16*	5,500	6,600
Perennial Crops				
Sugarcane	550	*12*	85,000	100,000
Arecanut	2800	*61*	15,000	18,000
Total Area & Cropping Intensity	**5,850**	***127***		

Production Levels and Output Marketing Constraints

369. There will be an increase in the production of most crops, around 17 to 43%, but paddy rice is replaced with perennial crops, so production declines.

Table 56: Production with and without Project (tonnes)

Crops	Without Project	With Project Full development	Increase (%)	Karnataka State production 2005-06	Sub Project as % of Karnataka
Rice (paddy)	13,130	10,210	*(25)*	6,000,000	-
Sugarcane	46,750	55,000	*17*	19,650,000	-
Arecanut (dry nut)	3,500	5,000	*43*	215,000	2
Other (semi dry crop	3,850	4,620	*17*	-	-

Source: Report on area, production, productivity and prices of agricultural crops in Karnataka, 2005-2006. Directorate of Economics & Statistics, Bangalore

370. Scheme production is a fraction of the total for Karnataka State except for arecanut, which reaches about 2%. No marketing issues are likely to develop as a result of the project. GOI policy is to phase out arecanut consumption, which, if successful, would reduce the market, in which case farmers would replace the crop with an alternative tree crop such as coconut or banana. Arecanut markets account for a large percentage of production on Gondhi, and the scheme will always be subject to market shocks or other threats, such as disease problems. The project can take steps to mitigate this potential problem by exploring and promoting alternative high value products, such as orchard crops or floriculture.

Farm Crop Area and Production

371. The following table shows the area of crops for marginal, small and medium farmers with and without the project. These are based on the area assumptions at scheme level, with a minimum of 0.2 ha of rice for subsistence requirements (half the area of a marginal farm). Area of perennial crops is reduced for marginal farms to allow subsistence, and no new arecanut is added. Farm areas are rounded so resemble but do not exactly match scheme area assumptions. Total crop area per season does not exceed farm size. The models are intended to show household income effect of the project.

Table 57: Crop Area by Farmer Category With and Without Project (ha)

	Without Project			With Project		
	Marginal (up to 1 ha)	Small (1 to2 ha)	Medium (over 2ha)	Marginal (up to 1 ha)	Small (1 to2 ha)	Medium (over 2ha)
Arecanut	0.15	0.75	2.05	0.15	0.75	2.05
New Arecanut				0.00	0.15	0.55
Sugarcane	0.01	0.20	0.50	0.01	0.20	0.55
Other Kharif (Maize)	0.04	0.10	0.30	0.04	0.10	0.30
Other Rabi (Maize)	0.09	0.20	0.50	0.11	0.17	0.55
Paddy Kharif	0.20	0.35	1.00	0.09	0.08	0.25
Paddy Rabi	0.10	0.25	0.85	0.00	0.05	0.10
SRI Paddy Kharif				0.10	0.10	0.20
SRI Paddy Rabi				0.12	0.08	0.10
Total	**0.59**	**1.85**	**5.20**	**0.62**	**1.68**	**4.65**
Kharif	0.4	1.4	3.9	0.4	1.4	3.9
Rabi	0.4	1.4	3.9	0.4	1.4	3.9

372. Cropping patterns for head, middle and tail reach farmers are not known, but household survey data indicates that farm size reduces in the lower reaches of the command, so small and marginal farmers will form a larger proportion of the total.

Farm Financial Income

Marginal Farms

373. Retained farm income is expected to increase by 53% for marginal farm households, as shown below. This includes the value of family labor retained by the family, the models show that a typical household with 1.6 people available for farm work would not need to hire labor, though in practice some households would do so, either because they have other employment, or less than the assumed labor able to work.

374. Income levels remain low, at about Rs 30 per person per day, which is well below the poverty threshold, but the return to family labor is attractive, due to low labor requirements resulting from mechanized operations and use of contract harvesting. These increases are adequate to provide incentive to participate in the Subproject, but marginal farmers will need to find alternative employment. A high proportion, about 40%, of the paddy output will be consumed by the household. Cash incomes are likely to be low and mainly used to finance bought crop inputs.

Table 58: Annual Farm Income, with and without Project (Rupees)

Without Project	**Unit**	**Marginal**	**Small**	**Medium**
Output Value	Rs	66,624	268,481	742,319
Operating Costs	Rs	28,534	115,418	323,846
Family Labour	day	44	143	371
Hired Labour	day	0	0	26
Retained Income	Rs	38,090	153,063	418,473
Return per family labour day	Rs	866	1,070	1,128
With Project		**Marginal**	**Small**	**Medium**
Output Value	Rs	85,570	334,128	925,520
Operating Costs	Rs	27,625	119,036	336,929
Family Labour	day	49	131	296
Hired Labour	day	0	0	51
Retained Income	Rs	57,945	215,092	588,591
Return per family labour day	Rs/day	1,183	1,642	1,988
Annual O&M Cost	Rs	320	1,120	3,432
Increase of Output Value	*%*	*30*	*25*	*25*
Increase of Retained Income	*%*	*53*	*41*	*41*

Without Project	**Unit**	**Marginal**	**Small**	**Medium**
Output Value	Rs	66,624	268,481	742,319
Operating Costs	Rs	28,534	115,418	323,846
Family Labour	day	44	143	371
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Annual O&M Cost	Rs	320	1,120	3,432
Increase of Output Value	*%*	*30*	*25*	*25*
Increase of Retained Income	*%*	*53*	*41*	*41*

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Retained Income	Rs	57,945	215,092	588,591
Return per family labour day	Rs/day	1,183	1,642	1,988
Annual O&M Cost	Rs	320	1,120	3,432
Increase of Output Value	*%*	*30*	*25*	*25*
Increase of Retained Income	*%*	*53*	*41*	*41*

Note: Operating Costs EXCLUDE family labour

Small Farms

375. Retained farm income is expected to increase by 41% for small farm households, as shown in Table 14. This includes the value of family labor retained by the family, the models show that a typical household with 1.6 people available for farm work would not need to hire labor with the project. In practice some small farm households do hire some of their labor. The models assume that arecanut and sugar are harvested by contractors, in practice small farmers may prefer to use their own labor, so family labor would be higher than reported.

376. Production of paddy rice averages 1.2 kg per person per day, which allows marketing, and there are substantial marketable arecanut and sugar. Sales should be adequate to finance crop inputs.

377. Income levels with the project are about Rs 133 per person per day, which is above poverty level. The return to family labor is attractive, at Rs 1,642 per day with the project. These increases are adequate to provide incentive to participate in the subproject. Cash incomes are likely to be sufficient to allow small farmers to pay for O&M, which is only 0.5% of their total income.

Medium Farms

378. Retained farm income is expected to increase by 41% for medium farm households, as shown in Table 14. This includes the value of family labor retained by the family, the models show that a typical household with 1.6 people available for farm work would need to hire about 51 days of labor per year. In practice most medium farm households hire some or most of their labor. Rice production is well above subsistence requirements.

379. Income levels with the project are about Rs 310 per person per day. These increases are adequate to provide incentive to participate in the subproject. Cash incomes are likely to be sufficient to allow medium farmers to pay for O&M, which is only about 0.6% of their total income.

Head, Middle and Tail Farmers

380. There is little information on returns to head, middle and tail reach farmers. On most subprojects impact of the project will be greatest for the tail reach farmers, as project interventions can be expected to bring their low area and yields into line with those further up the system. However on Gondhi current cropping patterns are fairly similar, with a high cropping intensity for the subproject overall, and relatively small areas with drainage constraints, so the effect is likely to be small.

Capacity and Willingness to Pay for O&M

381. Annual O&M costs are estimated at Rs 800 per ha per year. The incremental benefits from the increased crop production are considerably larger, so all farmers are able and, provided service is reasonable, likely to be willing to pay for O&M.

382. Medium and small farmers generate a marketable surplus, over and above their subsistence requirements, and to cover the cost of bought inputs. O&M charges are under one percent of farm income and a tiny proportion of other crop production costs.

383. Marginal farmers produce a marketable surplus, as yield rates for grain crops are very high. Marginal farmers should be able to pay for O&M, as it is a small percentage of their income or crop production cost. Average income of Rs 30 per family member per day, including the value of retained output, is well below poverty levels. Marginal farmers without alternative incomes will remain poor, and may be unwilling to pay full O&M costs without off farm employment, possibly undertaking the work required by the WUCs.

14.5 Economic Analysis

Methodology and Assumptions

384. The economic viability of the Subproject is assessed by estimating its economic internal rate of return (EIRR) and benefit-cost ratio over an expected scheme life of 25 years. Sensitivity analysis was undertaken for the key perceived risks of increased costs or reduced or delayed benefits. An assessment of the impact of the subproject on poverty reduction is also undertaken. The social discount rate for NPV is assumed at 12%, which is quite high compared to other investment opportunities in the current economic climate, but is the rate normally assumed for development project in India.

385. Land below kilometer 44 of the Gondhi right bank canal is supplied almost entirely by intercepted seepage flows from the Bhadra Canal, and water supply stops completely when the Bhadra canal is closed. There are plans to improve the water management in the Bhadra scheme by introducing water monitoring systems and volumetric water management. When these are implemented the area below km 44, totalling 1,762 ha (38% of the scheme), would cease to have any effective irrigation water. Farmers might respond to this by increasing pumping activity, but this would be costly, required year round, and possibly exceed current power availability without a substantial investment in new power lines and connections. It is

more likely that perennial cropping would largely cease, and farmers would be forced to revert to rainfed cropping. This would be socially and politically unacceptable and measures are required to protect the irrigation supplies for this area, by modernization of the Gondhi system. Precise estimates of the reduction of returns if no mitigation was undertaken are not really possible, as the water management implications have not been studied. The analysis assumes that 20% of the total production for Gondhi would be lost without the project, and restoring the irrigation supply allows this to be claimed as a direct benefit.

386. The project will promote the use of water saving crops such as semi dry field crops and SRI paddy, and support limited introduction of new arecanut plantations. Without the project it is assumed that the area of arecanut would increase by around 20% of the cropped area, to about 70%, and rice production would be restricted to subsistence need and areas not suitable for perennial crops (low and wet land).

387. The Detailed Project Report[40] indicates that the proposed modernization of the canal system will release 0.5 TMC (thousand million cubic feet) or 14 million m^3 of water which will be used to provide new irrigation in the proposed Upper Bhadra scheme, which is about 100km to the east of Gondhi, and would be supplied directly from the Bhadra reservoir using water savings not released to Gondhi. The value of this water has been estimated at Rs 21 per cubic meter, based on crop returns and cropping patterns on Gondhi scheme at full development. This value is added to the with scheme benefits[41], where appropriate, assuming that a proportion of the value of this water is required to pay for water delivery to and distribution on the new scheme, and allow for current crop production value. The net value added is taken as 25%.

Table 59: Valuation of Irrigation Water on Gondhi Scheme

Crop	m^3/ ha (@80% efficiency)	Gross Margin (with project)	Rs/m^3	Percent area	Rupee per m^3
Arecanut	9,129	172,390	18.9	*50*	9.5
Sugarcane	13,362	37,590	2.8	*12*	0.3
SRI paddy (kharif)	2,408	56,200	23.3	*30*	7.0
SRI Paddy (rabi)	6,496	58,830	9.1	*22*	2.0
Semi dry Kharif	2,042	36,610	17.9	*8*	1.4
Semi dry Rabi	5,813	36,610	6.3	*16*	1.0
Total				***138***	**21.2**

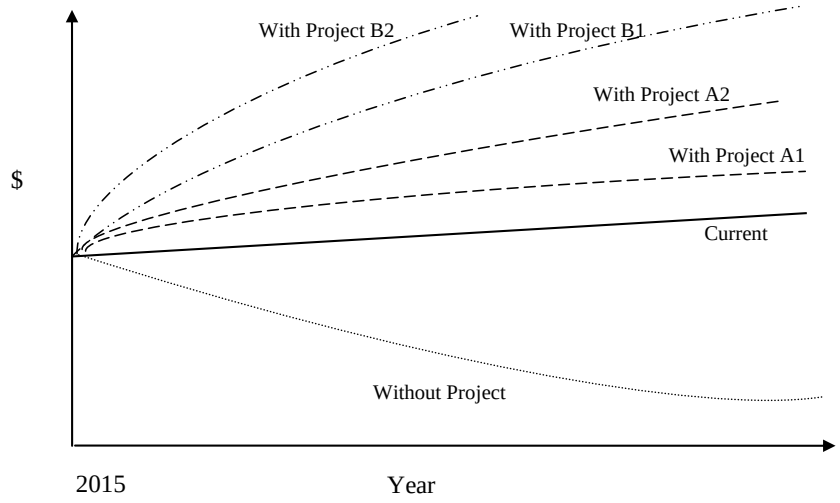
388. Based on the DPR summary cost table the cost of lining is estimated as 55% of the total cost of channel rehabilitation with lining. Canal reconstruction earthworks costs (cleaning canal, importing fill, reforming and profiling canal) are 45% of the concrete lining option. Cost of structures (bridges, weirs, outlets, drops, escapes) remains the same in both options. Canal lining costs of Rs 386 million are removed from project costs where appropriate.

389. The various scenarios used in the economic analysis are summarized in the figure below. The line slopes are schematic and do not represent the actual financial differences between scenarios.

[40] Modernisation of Left Bank Canal and Right Bank Canal of Gondhi Anicut in Bhadravathi Taluk, Shimoga District, DPR, September 2012, 3G Consultants, Mysore

[41] The alternative is to value current (mainly rainfed) production in Upper Bhadra, and value future irrigated production with the project. The rainfed crop model has been developed in FARMOD, but not used, as there are not sufficient data on current areas, water requirements, irrigation efficiency and distribution costs to finalise the model.

Figure 1: Schematic of Scenarios Tested



390. The descriptions of the scenarios tested are as follows.

Scenario	Characteristics
Current	• Current cropping pattern with increasing arecanut area (20%) replacing paddy, based on reported farmer intentions. • No increase in base yield rates assumed during project life. (simplifying assumption) In practice yield rates increase 2% per year both with or without the project, that is on both sides of the model, so no net effect. • Yield increments due to project (+20%).
Without Project	• Bottom 38% of Gondhi loses irrigation supply (tailwater) from Bhadra system • No replacement supply from Gondhi as left canal blocked at 'km 44' • Cropping pattern adjusts to this (end of Gondhi production falls by 20% overall) • Perennial plantings lost due to lack of Rabi water (half of mature arecanut (400ha) with NPV of about Rs 1.2 million per ha). Rest uses pumped river water.
With Project A1a (lined canal)	• Canal lining 100% • Water supplied along length of canal • 'Limited' irrigation supply (tailwater) from Bhadra • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project A1b (lined canal)	• Canal lining 100% • Water supplied along length of canal and 20% production loss at end of system avoided • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project A2	• Add net value of 0.5 TMC (14 Mm³) of water transferred to Upper Bhadra scheme
With Project B1a (no canal lining)	• Canal earthworks re-construction only (no lining) • O&M costs increase by 25% • Water supplied along length of canal • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project B1b (No canal lining)	• Canal earthworks re-construction only (no lining) • O&M costs increase by 25% • Water supplied along length of canal and 20% production loss at end of system avoided • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project B2	• Add net value of 0.5 TMC (14 Mm³) of water transferred to Upper Bhadra scheme

Economic Prices, Taxes and Duties

391. The economic price estimates and Conversion Factors (CF) used for the analysis are detailed in the *Feasibility Studies Supplementary Report, Financial & Economic Analysis Markets and Prices.* This annex includes details of current levels of duty and local taxes relevant to the project and should be read as an integral part of this report. A summary of the financial and economic prices and CF are attached as an Annex table.

392. Traded commodities (paddy CF 1, oil crops CF 1.7, and fertilizers, CF 1.4 to 3) economic prices are based on farm gate values at border parity pricing in 2012 prices. Transfer payments such as taxes and subsidies are excluded. Financial values of non-traded goods and services are adjusted to economic values by the standard conversion factor of 0.9. Individual CF were estimated for crop chemicals (0.8) and mechanized operations (1.2, due to fuel subsidy). Unskilled and agricultural labor are adjusted by a shadow wage rate of 0.9, skilled labor (including project management) was assumed to be correctly valued, (CF 1.0).

393. A Construction Conversion Factor (CCF) (0.8) is applied to subproject construction costs, at 2012 values, based on the weighted CF for materials, fuel and equipment, labor and overheads. Other costs and O&M costs are adjusted by the standard conversion factor (SCF) of 0.9.

394. Remaining items were converted at the SCF.

Inflation and Exchange Rates

395. Constant 2012 prices were assumed so US$ and domestic inflation rates were not included in the economic analysis.

396. The exchange rate assumed for the analysis was US$1 = Rs 55. The analysis assumes Constant Purchasing Power Parity for the Rupee, that is the nominal exchange rate will change so that the real value of the Rupee stays constant in US$ terms[42]. This means the assumed 2012 exchange rate can be used throughout the analysis.

Excluded Costs

397. There were no excluded costs for the subproject, but only a proportion of the project management costs were attributed to the scheme.

398. A nominal overhead for project management was included, 10% of total costs. The majority of project management costs is for State level institutional development, and is not directly related to the scheme.

Project Cost

399. Financial project costs adjusted by the CF above give the assumed costs tabulated below. Pumping costs for conjunctive use of river water are not included in the model. O&M costs are continued. Construction contracts will include provision for continued water supplies for perennial crops, so cropped areas are assumed to be maintained during construction.

Table 60: Gondhi Subproject Economic Costs (2012 Rupees million)

Activity	Costs
Irrigated Agriculture Management Systems	
PP & PIM Support	16

[42] Say the current exchange rate is 55:1, with 20% local inflation and 5% international inflation, then in PY2 the nominal exchange rate would be 55*1.2/1.05= 63:1

Irrigation and Associated Infrastructure	
Irrigation Infrastructure	866
CAD Works	113
Agriculture & livelihoods	21
Sustainable Infrastructure O&M	80
Institutional Development	
Project Management	9
Physical Contingencies	108
Total Project Cost + Physical Contingencies	**1,213**

Project Benefits

400. Crop production benefits result from increased yields from irrigation and improved agricultural practices, as detailed above, and a small shift to higher value crops, see economic budget Annex table.

401. Loss of water to the tails of Gondhi without project is modelled by reducing the without project outputs and production costs by 20%[43], to represent reduced cropping. Additional pumping costs for remaining perennial crops, if any, are ignored, so the reduction in value is conservative.

402. Use of water saved by the scheme modernization is modelled assuming a value for water for crops on a new scheme, based on crop returns to Gondhi (see above), where crops are converted from rainfed to irrigated production. The net value of water saved allows for delivery costs and net value of current production by assuming a percentage of the gross value, which can be adjusted in the EIRR spreadsheet. More sophisticated modelling of with and without scenarios was precluded by lack of suitable information (though rainfed crop models were prepared as part of the FARMOD file).

403. The sensitivity of the economics to concrete canal lining is tested by removing the estimated lining costs from the project costs, and increasing the O&M costs by 25% from Rs800 to Rs 1,000 per ha, as earth channels cost more to maintain. Any percentage of lining can be modelled, and the O&M costs are calculated proportional to unlined channel.

404. Institutional strengthening of WRD, other concerned agencies, and farmers, including PIM, will result in improved water management and security. Expected yield reductions due to declining water availability will be avoided. Agricultural support programs which include farmer training and farm demonstrations are included in the economic model as assumed yield and production increases.

405. Economic benefits are calculated from the incremental value of crop production generated by the subproject, net of production cost at economic input and output prices. Livestock benefits are included by valuing fodder and crop residues.

406. Project benefits excluded from the analysis include small fishery developments, and health benefits from improved nutrition, better water management and drainage.

Results of the Economic Analysis

407. The baseline analysis assumes the CCA of 4,600 hectare and a cropping intensity of 138%.

[43] The model allows this percentage to be adjusted within the EIRR spreadsheet, as required.

408. The economic returns are shown in Table 17 the detailed EIRR tables are attached as an Annex table. Gondhi scheme, with channel lining, and assuming no downstream crop loss, is not economic, as a stand-alone project, with an EIRR of 9%, base, but is acceptable at 15% with the costs of concrete lining removed. Assuming that there will be loss of production in lower Gondhi without the project improves the expected returns to EIRR 17% with lining and 26% with no lining.

409. Adding the value of water saved and diverted to new irrigated areas, assuming 25% of the water value is retained as net income, improves returns considerably to an EIRR of 22% to 32%. However, given that there is a lack of detailed bulk flow, water allocation and water balance information available there are some doubts that the level of savings proposed can be achieved, as they are a considerable proportion of the total current water supply to scheme.

Table 61: Economic Returns to Gondhi Scheme

Scenario	Without Yield Reduction (%)	Saved Water Net Return (%)	EIRR (%)	NPV (Rs million)	B:C ratio
With Lining					
A1a: Gondhi scheme, 100% lining	*0*		*9*	-138	0.8
A1b: Add avoided end of Gondhi loss	*20*		*17*	274	1.2
A2: Add diverted water value	*20*	*25*	*22*	631	1.4
Without Lining					
B1a: Gondhi scheme, no lining	*0*		*15*	102	1.2
B1b: Add avoided end of Gondhi loss	*20*		*26*	514	1.4
B2: Add diverted water value	*20*	*25*	*32*	871	1.7

Sensitivity Analysis

410. Sub project sensitivity analysis is tested on scenario A2, that is crop production reduced by 20%, full lining and no value to saved water, with a base EIRR of 17%. Including value of saved water tends to “swamp” the returns, and the model becomes insensitive to changes in assumptions on Gondhi scheme itself. Parameters tested were: (i) increased investment costs; (ii) delay in achieving full benefits; (iii) shortened Subproject life; (iv) reduced benefits (crop output or price); (v) increased crop production costs; and (vi) shortfall in projected crop yields with project.

Table 62: Sensitivity Analysis (Scenario A1, with 20% reduced production)

Change	EIRR[44] (%)	Switching Value[45] (%)	Sensitivity Indicator[46]
Base (Gondhi scheme)	***17***	-	-
Construction and CAD Costs Increased by 10%	*15*	*35*	1.0
Project Benefits Delayed by 2 Years	*11*	-	-
Project Life Reduced by 5 Years	*17*	-	-
Incremental Benefits or Crop yields or Price Reduced by 10%	*14*	*15*	1.9
Crop Production Costs Increased by10%	*16*	*40*	0.8
Crop Yield with Project Decreased by10%	*4*	-	7.7

411. Incremental benefits to the subproject were not very sensitive to construction cost increases, but are sensitive to construction delays. Reducing production value (yield rate increases or prices) by 10% reduces EIRR to 14%, and the switching value is a 15% reduction, so the project is sensitive to prices and yield rates, mainly because the existing yield rates are high and the assumed improvement due to the project are relatively small. Increased production costs are less sensitive, as net returns are generally high. The project is very sensitive to overall yields with the project reducing, as the assumed increases with project are small.

14.6 Benefit Distribution & Poverty Impact Analysis

412. The distribution of incremental financial benefits to poor households is shown in Table 62 and 63. Sub project level (undiscounted) annual financial incomes with and without the project, at full development, provide the incremental output to sub project farmers, and similarly for total production costs (before any labor hiring). These benefits and costs are distributed in proportion to the total farm area of large, small and marginal farmers. The value of contract planting and harvesting, including arecanut harvesting (assuming 50 days a ha) are included in hired labor, which does not change greatly due to the project, but would reduce significantly without the project, due to lost crop area. Production, operating costs and labor are assumed to be reduced 20% in the without project scenario, due to loss of supply below km 44 of the right bank canal, as discussed above. The table presented is not the normal ADB poverty analysis, based on economic surplus distribution (this can be provided if required). Most readers find this analysis easier to follow, and as the economic surplus for irrigation projects is not very large, the estimated proportion of benefits to the poor are similar, but a little lower.

[44] The EIRR is the discount rate that reduces the NPV of the net annual cash flow to zero during the project lifetime (in this case 25 years).

[45] The Switching Value is the percentage change in the tested parameter that reduces the NPV to zero at the assumed discount rate of 12% (or the EIRR to the assumed discount rate). A high Switching Value indicates that the project is relatively insensitive to the tested parameter.

[46] The Sensitivity Indicator is based on the ratio of the base EIRR and the tested change EIRR, divided by the percentage change in the tested parameter. If the EIRR changes at the same ratio as the change in the tested parameter the SI is 1 (for example if the base EIRR is 20% and the tested parameter is changed 10%, a resulting change in the EIRR of 2% (that is 10% of the EIRR) would give a SI of 1). An SI of less than 1 indicates the EIRR is relatively insensitive to the parameter, the higher the SI the more sensitive the project is to the tested parameter.

Table 63: Distribution of Incremental Financial Farm Incomes

	Financial Farm Incomes		
(Rupees million)	**Without Project**	**With Project**	**Incremental Income**
Benefits and Costs			
Project Output	(1,003) 802	1,088	286
Production Costs (excluding labour)	(350) 280	327	-47
Total Farm Labour Value	(153) 122	154	-32
Hired Labour (%)			
Hired Labour Cost			
Benefits			**207**
HH Labour Value			
Proportion of poor (%)			

Notes: Sums rounded and presented in millions.
Without Project figures in brackets are the current levels. The second figure, assuming 20% reduction, is used.
Net benefits INCLUDE the value of household labour, retained by the household.

Table 64: Distribution of Incremental Incomes

	Distribution of Incremental Income				
(Rupees million)	**Medium Farmers**	**Small Farmers**	**Marginal Farmers**	**Labour**	**Total**
Benefits and Costs					
Share of Benefits (% of area)	*50*	*30*	*20*	*0*	*100*
Project Output	143	86	57		
Production Costs (excluding labour)	-24	-14	-9		
Total Farm Labour Value	-16	-10	-6		
Hired Labour (%)	*50*	*20*	*0*		
Hired Labour Cost	*-8*	*-2*	*0*	10	
Benefits	**95**	**60**	**42**	**10**	**207**
HH Labour Value	8	8	6		
Proportion of poor (%)	*11*	*11*	*60*	*100*	
Net benefits and costs to poor (Rupees mill.)	**11**	**7**	**29**	**10**	**57**
PROPORTION OF BENEFITS TO POOR HOUSEHOLDS					**28%**

413. Total farm financial labor values (total labor days used, at Rs 210 per day) are shown in the table, but are retained by the farm family, except for the estimated labor hiring. It is assumed that medium farmers hire 50% of the incremental labor requirement. Small farmers are assumed to hire 20% of the incremental labor requirements and marginal farmers do not hire. The costs of net labor hired are removed from the benefits retained by the farmers and added to benefit of labor.

414. The benefits flowing to poor households are based on the proportion of poor in each category, using the percentage of below poverty line (BPL) households found in the household survey. It is assumed all labor is poor.

415. This model shows 28% of the total farm financial benefits are captured by poor households, lower than usual as labor inputs do not increase very greatly, and a large proportion of the scheme area belongs to larger farmers. It does not show the additional flows to poor households and GOI from scheme construction, and from the subsidized O&M costs. It does not show the net taxes and subsidies flowing to GOI, but the benefits and costs to other groups are included in the model as part of the financial price structure, in particular fertilizer subsidies.

15. IMPLEMENTATION

15.1 Project Institutional Arrangements

Institutional Framework

416. KISWRMIP constitutes of two components: Component 1: Institutions, Policies and Systems for IWRM and Component 2: Priority Investments and Institutional Strengthening for Irrigated Agriculture Development. Under Tranche 1, Component 1 activities include policy and institutional arrangements for IWRM, and integrated river basin management activities including river basin organizations, river basin plans, information and knowledge systems for integrated water resources modelling, and, Component 2 activities include Gondhi Channel irrigation scheme modernization, automated water flow monitoring system in the Bhadra canal system, capacity building of irrigation water supply institutions and agricultural staff and mapping and assessment of irrigation areas.

Project Steering Committee

417. Through a Government Order, a Steering Committee was constituted to coordinate the activities of key stakeholders related to activities associated with Integrated Water Resources Management. KISWRMIP involves the same key stakeholders as those associated with IWRM and so the IWRM Steering Committee will also serve to coordinate activities and resolve issues for this Project.

418. The Chairman of the Steering Committee is the Chief Secretary to Government and the Principal Secretary, WRD is its Secretary and Member. Other Committee members include representatives from the Urban Development Department, Rural Development and Panchayati Raj Department, Agriculture Department, Commerce and Industries Department, Forest Ecology, and Environment Department, Minor Irrigation, Karnataka Urban Infrastructure Development and Finance Corporation, Karnataka Urban Water Supply & Drainage Board, Bangalore Water Supply & Sewerage Board, WRD. In addition there are special invitees from ADB.

Executing Agency – KNNL

419. The Executing Agency for KISWRMIP will be the Karnataka Neeravari Nigam Limited. And the key implementation roles will be carried out by the Advanced Center for Integrated Water Resource Management (Component 1) and the Upper Tunga Project (UTP) Zone, Shivamogga and Bhadra Command Area development Authority, Shivamogga (Component 2).

Advanced Center – IWRM

420. The State has established an Advanced Center-IWRM as a society registered under the Karnataka Societies Registration Act. The Center will act as a think tank for the Water Resources Department helping to define improved water management and regulatory functions and institutions through policy research and analysis, knowledge development and serving as a platform through WRD for coordination among main departments and other agencies dealing with water in implementation of IWRM principles in the State. While KISWRMIP, will provide technical support to establish this Centre it is expected that the Centre will provide support to the project by supporting the government in carrying out pilot river basin planning, establishing

pilot river basin organizations, establishing a State IWRM information system, and providing training to staff associated with KISWRMIP in IWRM related concepts and activities.

Upper Tunga Project Zone, KNNL

421. The UTP Zone, KNNL will have responsibility for construction work related to modernization of Gondhi Channel main and branch canals. In carrying out this mandate, UTP Zone, KNNL will contract the construction work to private contractors. The work will be supervised and quality checked through the offices of the Chief Engineers, UTP Zone, KNNL in the field while the PMU will overall monitor work progress.

Bhadra Command Area Development Authority

422. For this project, the Bhadra CADAs will construct on-farm infrastructure in the Gondhi project area including the proposed pipe distribution systems, promote the organization of farmers into WUCS, provide long-term support to these groups and coordinate with the Agriculture Department to ensure that farmers receive extension services.

Project Management Unit

423. The Project Management Unit (PMU) will be responsible overall for delivering the KISWRMIP. The PMU will have full authority to execute the project and to liaise with ADB. Specifically, the PMU will: (i) coordinate with other agencies concerned, (ii) prepare an overall implementation plan and annual project budget; (iii) review and approve subproject feasibility studies, (iv) monitor the activities of the Subproject Implementation Office (SIO) (iv) maintain project financial records and accounts; (v) prepare periodic reports on implementation progress, (vi) establish and maintain a project Management Information System, and (vii) monitor overall project progress and assess social and environmental impact and project benefits. The PMU, working with the Project Consultancy Team, will monitor overall project execution with respect to agreed procedures and compliances. The organization structure for the PMU is presented in Figure 13.

424. The PMU will be located in Munirabab within the Karnataka Neeravari Nigam Limited with Chief Engineer, Irrigation Central Zone, Munirabad as the Project Director. The PMU staff will be working from its Project Director's Office. The Project Director will operate under the overall guidance and with the support of the Managing Director, KNNL and the Principle Secretary, WRD. The Principle Secretary, WRD will be responsible to:

- Process and coordinate inter departmental matters related to KISWRMIP activities;
- Correspond with the Government of India, the Central Water Commission and ADB on project-related matters; and
- Review and guide the project's overall implementation plan and progress.

425. For project administrative matters, the Office of the Project Director will have two Cells that report directly to him; a Monitoring Cell and a Budget and Administration Cell. It will be necessary to recruit full-time, project-related staff for these positions (Table 65):

Figure 13: KISWRMIP Implementation Framework (Tranche 1)

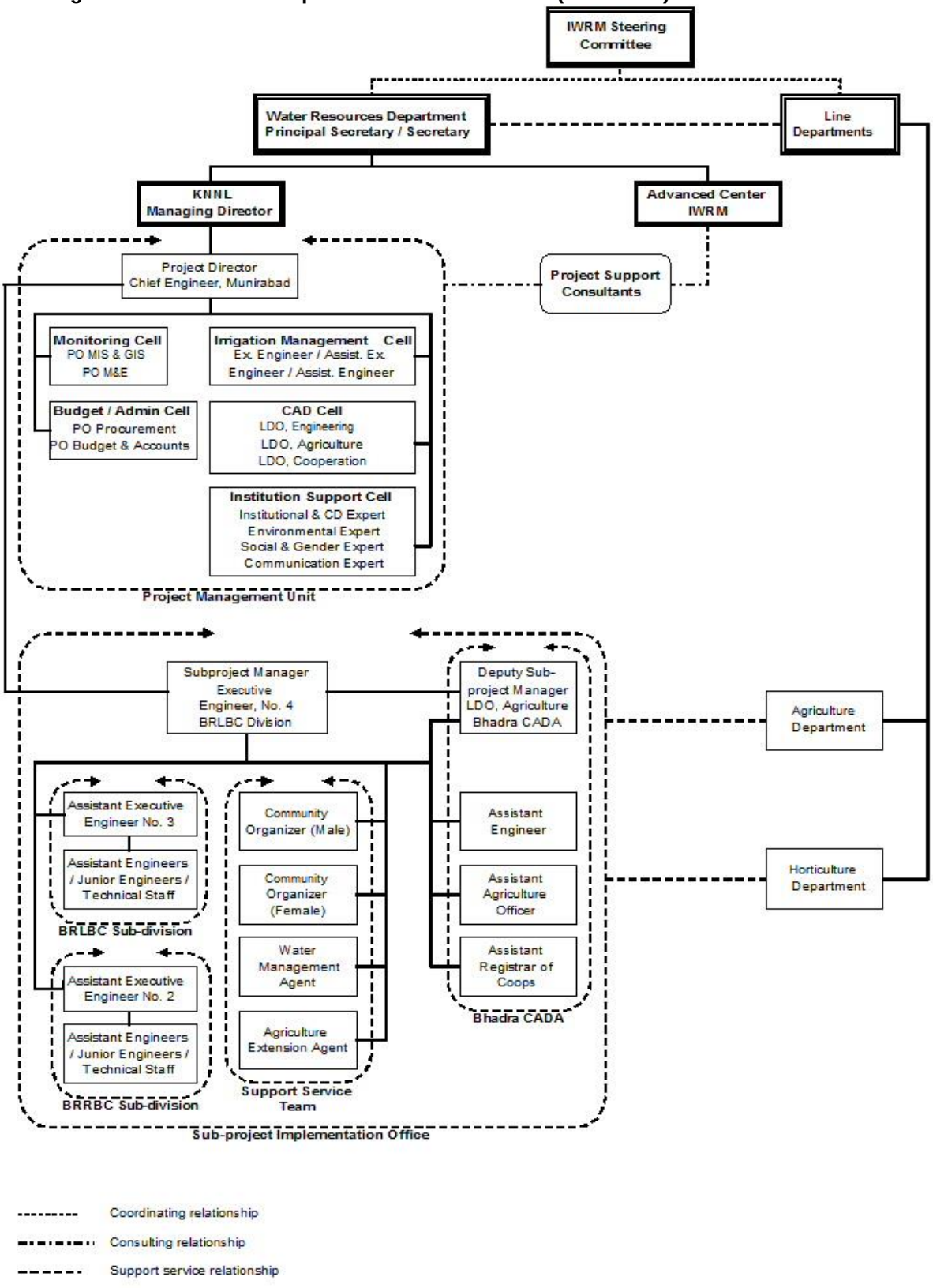


Table 65: Staffing of PMU for Administration and Monitoring

Staff Position[47]	Source
Monitoring Cell	
1 Project Officer MIS and GIS	Departmental
1 Project Officer Monitoring and Evaluation	Departmental
Budget and Administration Cell	
1 Project Officer Procurement	Departmental
1 Project Officer Budget and Accounts	Departmental

426. For technical matters related to project management, reporting to the Project Director will be three additional Cells, namely the Irrigation Management Cell, the CAD Cell and the Institutions Support Cell. To deliver the KISWRMIP related services specified below, each of these Cells will have the following personal that will either be filled through internal staff transfers or with new recruits. The Institutional & Capacity Development Expert in the Institutions Support Cell will be located with AC-IWRM in Bangalore in order to be involved in and assist the institutional aspects of the project.

Table 66: PMU Staffing for Technical Matters

Staff Position	Source
Irrigation Management Cell	
1 Executive Engineer, Irrigation	Departmental
1 Assistant Executive Engineer, Irrigation	Departmental
1 Assistant Engineer, Irrigation	Departmental
CAD Cell	
1 Land Development Officer, Agriculture Engineering	Departmental
1 Land Development Officer, Agriculture Extension	Departmental
1 Land Development Officer, Cooperation	Departmental
Institutions Support Cell	
1 Institutional & Capacity Development Expert	Outsource
1 Social, & Gender Expert	Outsource
1 Environment Expert	Outsource
1 Documentation & Communication Expert	Outsource

427. The KISWRMIP related services that are provided through these Cells include:

- Ensuring that project activities are adequately coordinated, and budgets are placed in an appropriate and timely manner;
- Ensuring headquarter-level coordination with the activities of KNNL, CAD Directorate, AC-IWRM and any complementary government schemes that might be available from departments such as agriculture, horticulture, etc.;
- Assisting in identifying requisite staff and placing them in the Subproject Implementation Office (SIO) to ensure that a full complement of staff is maintained;
- Providing guidance and direction to the SIO;

[47] The positions and number mentioned against them is for Tranche 1 of KISWRMIP only. For further project Tranches there may be a need to revise both the composition and the numbers corresponding to the Tranche scope and size.

- Conducting regular meetings with SIO to monitor, coordinate, and guide their activities and to assist with any specific problems that may arise;
- Monitoring, through a purpose designed MIS system, the activities of the project. This will involve establishing the data input and retrieval systems and producing outputs for servicing the needs of the SGOK, GoI, ADB, project offices and other concerned stakeholders;
- Preparing newsletters for distribution among the WUCS and other interested people highlighting project related issues, experiences, learning and successes;
- Supporting any other project management related needs of SGOK, GoI and ADB.

Project Support Consultancy

428. It is anticipated that technical consultancy support will be required by the Advanced Center for IWRM, the KNNL and the CADA in implementation of the project. The Project Support Consultancy (PSC) Team will consist of International and Domestic Specialists in the areas of IWRM, irrigation management, irrigation operation, water institutions, PIM, agriculture, social, gender and environment. The Project Support Consultancy will be contracted through a single contract using a QCBS process of 90% technical and 10% financial weight. The detailed terms of reference for the Tranche 1 PSC Team is given in the Aide Memoire of the ADB Mission Leader / Project Officer.

Field Level Implementation Arrangements

429. At the field level, the KISWRMIP will be implemented through the Chief Engineer, UTP Zone office working under KNNL; the Bhadra CADA; and the WUCS Support Service Team.

430. The aim is twofold: rehabilitate and renew the infrastructure so that a fully functioning irrigation system is left in place and WUCS that are independent self-sustaining entities capable of fulfilling their responsibilities including irrigation management; equitable distribution of water to farmers; O&M of minor canal system and collection of irrigation water charges; and, capable of interacting with service agencies including KNNL / CADA, Agriculture Department, Horticulture Department and other Departments to ensure that they receive necessary services. The goal is a significant improvement in water use efficiency coupled with an increase in agricultural productivity which in turn should lead to substantial improvement in the income of farmers.

431. For project implementation, a Subproject Implementation Office (SIO) will be established for the Gondhi subproject in the Office of the Executive Engineer No. 4, BRLBC Division, Bhadravathi. The SIO will be built on the existing establishment at the field level. The SIO will consist of UTP Zone engineering / technical staff of the Assistant Executive Engineer No. 3, BRLBC Sub-division, Bhadravathi and the Assistant Executive Engineer No. 2, BRRBC Sub-division, D B Hally to oversee the implementation of the canal system rehabilitation and modernization works. The Bhadra CADA staff will oversee the implementation of CAD and on-farm development works and Support Service Team (SST) will directly support the process of strengthening the WUCS, manage the PIM process, and provide agriculture support. The SST will be mobilized through a Service Provider (Civil Society Organization) comprising four persons with expertise in community organization (one male and one female), participatory on-farm water management (one person), and agriculture extension (one person) who work closely with the WUCS and the irrigation / CAD counterpart staff. The Executive Engineer No. 4, BRLBC Division, Bhadravathi will be the subproject manager and the deputy subproject manager will be the Land Development Officer (Agriculture) assigned by Bhadra CADA.

432. Under the support and guidance of the PMU provided through regular PMU-SIO meetings, the SIO will (i) coordinate with the field staff of the concerned line departments; (ii) prepare an annual work plan for approval by PMU; (iii) implement the work plan; and (iv) establish reporting systems to provide information on physical and institutional progress and impacts. The SIO will work closely with WUCS and establish participatory decision making system through regular meetings at minor canal and on farm levels.

433. Within this framework, the specific tasks of the SIO will include: (i) provide inputs to subproject planning and design process; (ii) undertake WUCS strengthening and micro-planning for CAD and agriculture development; (iii) implement safeguards actions following the relevant plans; (iv) execute civil works; (v) coordinate for and/or implement support services for agriculture and livelihoods; (vi) support subproject operation, and maintenance in collaboration with WUCSs while ensuring the capacities and resources for the latter; (vii) arrange training programs for the staff including service providers, and WUCS.

434. As mentioned above, to support the WUCS, the project will provide a Support Services Team (SST) comprised of two community organizer (one male and one female), a participatory on-farm water management agent, and an agricultural extension agent. The SST working with the WUCS will be provided with a series of milestones to be met within a specified schedule as a basis for evaluating their performance. It is expected that the support provided by the SST will be required for about 36 months.

435. A suitable Service Provider (CSO) will provide the Support Services Teams. Recruitment of the Service Provider will be the responsibility of the PMU Project Director. The contracted Service Providers will be responsible for recruiting, fielding, and maintaining the Support Services Teams. However, the teams will be responsible to the subproject manager. In selecting the Service Providers, the following basic criteria will apply:

- Work experience: Experience should be relevant to irrigation, irrigated agriculture, participatory irrigation management, community mobilization and capacity building. The Service Provider should have a proven track record in PIM and be non-political in the conduct of its field activities;
- Geographic location: Ideally the Service Provider should be locally based. If nationally-based, any field staff that is engaged should be local with local language skills;
- Legal status: Registration of the Service Provider under the statutory Act it is registered should be up-to-date;
- Age related experience: The Service Provider should have been operating for a minimum of 10 years and have worked with PIM related activities for a minimum of three years;
- Audits, accounts, and annual reports. Records must be maintained as per statutory requirements and up-to-date; and
- Accountability and transparency principals: The Service Provider will agree to adhere to principles of accountability and transparency as defined by the PMU.

Coordination

436. Coordination at headquarters (Bangalore) will be the responsibility of the Project Director. For interagency coordination, the Project Director will have the support of the KNNL / WRD and the IWRM Steering Committee.

437. Coordination in the field will be undertaken through the sub-project manager. For interagency coordination, the subproject manager will have the support of the Administrator, Bhadra CADA, the Chief Engineer, UTP Zone and the Chief Executive Officer, Zilla Panchayath.

Procurement

To be completed

Fund Disbursement and Project Financial System

To be completed

15.2 WUCS Development & Implementation of Interventions

Responsibilities of WUCS

438. The Karnataka Irrigation Act, 1965 (amended 2000 & 2002) sets the functions of the Water User Cooperative Societies as:

- To assist the Irrigation Department and Command Area Development Authority in implementing irrigation and drainage works;
- To implement or execute on-farm development works;
- To procure water in bulk on a volumetric basis from the Irrigation Department or Krishna Jala Bhagya Nigama or Karnataka Neeravari Nigam and distribute it to the land holders in accordance with the principles laid down by the General Body for equitable distribution of water;
- To prepare water budget and financial budget for each irrigation season;
- To operate and maintain canals situated within its jurisdiction;
- To levy and collect water charges and service charges from the land holders;
- To resolve disputes that may arise among land holders; and
- To educate and train land holders in the efficient and economical use of water and adoption of new technology as well as to implement necessary programmes.

439. The responsibility to operationalize this mandate lies with the concerned CADA and the concerned irrigation authorities (Nigam-Irrigation Zones) of the irrigation projects. The formation, registration and capacity building of WUCS on society administration, water management, land reclamation and crop demonstration rest with the CADA. The usual practice followed by CADA in formation of WUCS and on the basis of whole distributaries of the main canal, is to identify a chief promoter who initially mobilizes 50 farmers as members with the collection of Rs. 5,300 as member fee (share capital at the rate of 106/share). This allows for the registration of the WUCS as a cooperative society under the Karnataka Cooperative Societies Act.

440. Subsequently, the WUCS mobilizes more members to meet the criteria specified in the Irrigation Act, 1965[48] to enter into a Memorandum of Understanding (MOU) with the Nigam on irrigation services. The MOU specifies the terms and conditions of the irrigation service to be received by the WUCS from the Nigam and include sections on the rights of the members of the WUCS, water rights of the WUCS, water rates and assessment, recovery of water charges, maintenance and repairs on the minor canals, maintenance and repairs of the field channels

[48] At least 51 percent of the command of the minor canals (of the WUCS distributary) must come under the jurisdiction of the society or 60 percent of the respective land holders must become members of the society.

and field drains, special incentives and rights of government officials. The stated objectives of the MOU is that the WUCS will take water from the government on a volumetric basis and distribute it among members and non-members on crop / area basis; it would maintain and repair the minor canals, the field irrigation channels and drains and other structures of the physical system in its jurisdiction; and it would make available to the members modern technology for water use for ensuring water economy and prescribing appropriate applications to the relevant crops.

441. After signing of the MOU between the WUCS and the Nigam, the minor canal and CAD system within the jurisdiction of the WUCS is handed over by the Nigam to the WUCS for operation and maintenance. However, after signing the MOU, but before the resumption of water supplies a joint inspection of the minor canal and CAD system is carried out jointly by the Nigam and the WUCS and the required repairs are carried out at the Nigam cost to ensure that the actual discharges at various points are to the design capacities.

442. On handing over, the WUCS is responsible for maintenance and repairs of the physical system of the minor canal in its jurisdiction. Maintenance and repairs of the minor canal include desilting, maintenance of the service road and inspection path in proper condition, removing trees, shrubs and grass from canal embankments, maintaining structures in good condition including outlet gates and measuring devises. For this purpose the WUCS is entitled to receive a grant of Rs. 10,000 only annually reviewed after every two years of implementation of the MOU. Similarly, the WUCS is also responsible for the proper maintenance and repair of the field irrigation channels and field drains and the structures thereon. However, no grant is given to the WUCS by the government for this purpose and it is expected that the maintenance cost will be met by the farmers themselves.

443. The MOU also is required to specify the water allocation on volumetric basis the WUCS is entitled to receive at the head of its minor canals on crop season bases (Kharif and Rabi). However, this entitlement is subject to the provisions that if there is less water available of in storage in any year, the volume sanctioned would be proportionately reduced as per the government policy with advance notification of the WUCS before the beginning of the cropping season. Further, the water allocation is subject for review and suitable modification after two years in mutual consultation between the WUCS and the Nigam. Finally, at the end of each cropping season, the Nigam would prepare demand statements for water charges on the basis of the total quantity of water supplied and at the volumetric water rates indicated in the MOU. This would be submitted to the WUCS for collection from the farmers and remittance to the Nigam accounts.

444. Hence, between the Karnataka Irrigation Act, 1965 and the MOU the mandate of the WUCS in irrigation water management and the procedures to be followed is clearly delineated. However, observations made during WUCS pilot study in Gondhi Channel showed that a number of these procedures are yet to be fully operationalized:

- Most WUCS are yet to increase their membership to 60% of the water users for irrigation in their jurisdiction;
- Only 3 out of the 9 WUCS formed have signed a MOU with KNNL and minor and CAD system has been handed over for O&M to only 1 WUCS among the 3;
- The MOUs do not specify the water allocation on volumetric basis the WUCS is entitled to receive;

- The procedure of repairing at Nigam cost the minor canal and CAD system to ensure that the actual discharges at various points are to the design capacities before handing over to the 3 WUCS was not followed;
- The water charges demand made by the KNNL to the WUCS is not on volumetric supply basis but on the crop area rate basis.

Establishment of Effective WUCS

445. The task involved in establishing active and effective WUCS is intensive and time consuming and in practice, the current staff composition and available staff in Bhadra CADA is insufficient. The Bhadra CADA, which has 30 irrigation projects and 157,323 ha that include 348 WUCS under it, has only 3 staff to work on formation and strengthening of WUCS – a Land Development Officer (LDO), Cooperation, an Assistant Registrar of Cooperative Societies and a Senior Inspector of Cooperative Societies. The situation with the engineering and agricultural technical staff is no better with current staffing being – a Land Development Officer (LDO, Engineer); a LDO (Agriculture); an Assistant Engineer; and an Assistant Agriculture Officer. Consequently, for field implementation of its CAD works, Bhadra CADA is currently almost depending entirely on line departments such as UT Project Zone, Agriculture Department, Watershed Department, etc. However, for establishment and strengthening WUCS, Bhadra CADA does not have any line department to assist it and it is entirely dependent on its staff to do the job.

446. Enrolment of farmers as active members of WUCS is the basic requirement for the successful emergence of empowered and functional WUCS. This is crucial in terms of ensuring transparency, accountability and democratic functioning of the WUCS and requires rigorous community awareness and mobilization effort followed with well-structured training and hand holding support. Currently, there are 9 WUCS registered on the right canal of the Gondhi Channel project. Out of these, 3 WUCS have signed MOU with the KNNL and handing over process has been completed with only 1 WUCS. No WUCS has yet been established in the left bank command area of the Gondhi Channel Project.

447. Hence, the WUCS institutional action to be accomplished under the project in Gondhi Channel command includes:

- Establishment of a WUCS for the left bank command area of the Gondhi Channel Project;
- Signing of MOU with 7 WUCS (6 in the right bank command and 1 in left bank command)'
- Handing over process for minor canal and CAD system to 9 WUCS (8 in the right bank command and 1 in left bank command); and
- Capacity building 10 WUCS to effectively function and perform its responsibility of water management, minor canal and CAD system O&M, water charge collection and remittance to KNNL and support agriculture development among the farmers.

WUCS Institutional Strengthening Strategy

448. To achieve these results in the Gondhi Channel it is proposed that the Project adopt a WUCS institutional strengthening strategy that is divided into 4 sequential steps:

Phase 1	WUCS Mobilization	3 Months
Phase 2	Planning Modernization	3 Months
Phase 3	Executing Modernization Plan	18 Months

Phase 4	Irrigation Management	12 Months

449. The activities and method and tools proposed to be used in each step are given in Figure 14 and the sections below.

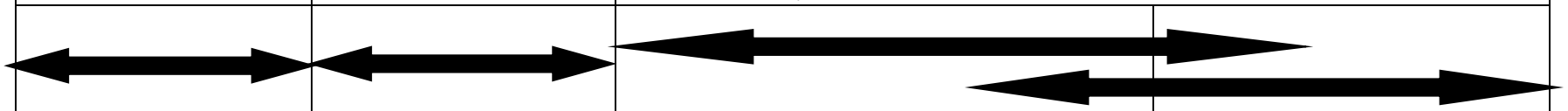
450. As discussed above, with the current staff composition and strengthen of Bhadra CADA and its work load it is very unlikely for it to be able to provide the intensive inputs and time required to facilitate emergence of functionally effective WUCS. Therefore, it is proposed to augment the Gondhi Channel Subproject Implementation Office under the Executive Engineer, No. 4, BRLBC Division, Bhadravathi (Subproject Manager) with a WUCS Support Service Team (SST).

451. The SST is proposed to be comprised of two community organizers (one male and one female), a participatory on-farm water management agent, and an agricultural extension agent. A suitable Service Provider (CSO) will be contracted to provide the SST. Recruitment of the Service Provider will be the responsibility of the PMU Project Director. The contracted Service Providers will be responsible for recruiting, fielding, and maintaining the SST. However, the team will be responsible to the subproject manager.

452. In selecting the Service Providers, the following basic criteria will apply:

- Work experience: Experience should be relevant to irrigation, irrigated agriculture, participatory irrigation management, community mobilization and capacity building. The Service Provider should have a proven track record in PIM in canal irrigation and be non-political in the conduct of its field activities;
- Geographic location: Ideally the Service Provider should be locally based. If nationally-based, any field staff that is engaged should be local with local language skills;
- Legal status: Registration of the Service Provider under the statutory Act it is registered should be up-to-date;
- Age related experience: The Service Provider should have been operating for a minimum of 10 years and have worked with PIM related activities in canal irrigation for a minimum of three years;
- Audits, accounts, and annual reports. Records must be maintained as per statutory requirements and up-to-date; and
- Accountability and transparency principals: The Service Provider will agree to adhere to principles of accountability and transparency as defined by the PMU.

Figure 14: WUCSS Institutional Strengthening Strategy

Phase 1 (8 Months)	**Phase 2 (6 Months)**	**Phase 3 (18 Months)**	**Phase 4 (16 Months)**
Mobilization	Modernization Planning	Executing Modernization Plan	Irrigation Management
		These two phases may overlap	
			
Build awareness, mobilize & build capacity of WUCS and farmers for strengthening organization, increasing membership, WUCS level information generation, equipping with necessary records & information & participation in minor canal modernization, CAD work & agriculture development planning. Assist and facilitate WUCS to discuss, understand and agree to MOU including modernization, CAD works, crop and water management, water charge collection.	Assist and facilitate WUCS to prepare participatory plans for CAD and on farm development works	Assist and facilitate WUCS to execute CAD and on farm development work including monitoring and supervising (in collaboration with KNNL/CADA). Assist and facilitate WUCS to prepare and implement plan to enhance agriculture production, introduce agricultural innovations, agriculture support services, training and extension.	Assist and facilitate WUCS to plan, execute and monitor effective minor canal O&M, crop & water management to match irrigation supply with planned cropping pattern, distributing water to farmers & managing conflicts, collecting & remitting water charges to KNNL. Continue implementing agriculture development plan. Continue WUCS strengthening & capacity building for effective administration and accountability. Gradual withdrawal of project inputs.
Village meetings, folk theatre, exposure visits, formal training sessions	Walk through, transect, cadastral based resource map	CAD and on farm development plan Agriculture development plan	Work book exercise based Action Plan for O&M, crop & water management & water charge demand, collection and remittance, Quantitative Participatory Assessment tools for WUCS performance monitoring & management

Phase 1 – Mobilization (8 Months)

453. WUCS institutional strengthening process under the project will start with the WUCS Mobilization Phase. Under this phase the following activities will be implemented:

- Establishing and registering a WUCS for the Gondhi Left Bank command area;
- Creating awareness among farmers about the role and function of WUCS in irrigation service delivery including crop water planning, water management, minor and CAD system O&M, water charge collection and remittance;
- Creating awareness among WUCS / members on project objectives and activities and their role in it;
- Mobilizing non-member farmers to become members of their WUCS and ensuring that women and landless irrigators are involved;
- Training all WUCS office bearers on internal administration of WUCS as per Cooperative Societies Act;
- Establishing WUCS Office, equipping WUCS with relevant information and records and updating their records to current status;
- Discussing and signing of MOU between all WUCS and KNNL; and
- Participatory bench marking of WUCS on its current level of functioning related to internal administration and irrigation management with its members.

Establishing and registering a WUCS for the Gondhi Left Bank command area

454. Bhadra CADA has a well-established process of forming and registering WUCS as discussed above. Following the same process the WUCS will be established and registered in the left bank command area of Gondhi Anicut. The process will commence with awareness generation activity in the WUCS area carried out by the SST. This will include awareness on the objectives for forming a WUCS, its functions and the benefits to its members under the Irrigation Act. During the awareness campaign the farmers will also be informed about the project, its objectives and their benefits. The SST will mobilize and motivate the farmers to become WUCS members by paying their share capital contribution. After the awareness and mobilization campaign the Bhadra CADA cooperation staff will initiate the process of forming and registering the WUCS.

Creating awareness among farmers about the role and function of WUCS

455. To create awareness among farmers about the role and function of WUCS, the WUCS managing committee with support of the SST, will hold village meetings (during evenings) in which they will hold discussions with the members and nonmembers on the roles and responsibilities of WUCS as per the provisions of the Karnataka Irrigation Act, 1965 and Karnataka CADA Act, 1980. The meeting will also hold discussions on the internal administrative procedures of the WUCS as per the provisions of the Karnataka Cooperatives Societies Act, 1959. The relevant sections of these Acts will be distributed among the farmers in Kannada language. The discussions will focus on the benefits to farmers of becoming WUCS members and the longer range vision and objectives of farmer managed irrigation programme being promoted by the government.

456. During the meeting folk art forms such as folk songs and folk theatre may be used to create awareness. The PMU will identify some Bheedhi Nataka Groups (folk / street theatre) in the subproject area and work with it to develop these performances. Other awareness generation methods such as wall writing slogans, posters, leaflets and banners in Kannada language may be developed by the PMU for use in the subproject villages.

Creating awareness on project objectives and activities

457. There will also be a need to create awareness on project objectives and activities among the WUCS members, the expected benefits and their role, in order to motivate the farmers to actively participate through their WUCS. Similar awareness generation methods as described in the section above will be used. The PMU will prepare awareness generation material like posters, leaflets, etc. which will be used by the SST in village meetings with farmers. It is expected that by this means, information about the project will be disseminated to all the farmers and an understanding of the project components and activities will grow among them.

Mobilizing non-member farmers to become members of their WUCS

458. Following the awareness generation meetings, it is expected that the still non member farmers will become motivated to be members. Landless and female irrigators will be included in this process. The WUCS Secretary along with the SST will follow up by meeting these farmers in groups and individually answering their queries and apprehensions and encourage them to become members. The membership procedure will be as per the provision in the Karnataka Cooperatives Societies Act, 1959. It is anticipated that increasing the membership of the WUCS to the proposed 90% of the farmers will take time and the effort will need to continue into the subsequent phases. The mobilization phase will result in at least 51% of farmers as members of WUCS.

Training WUCS office bearers on WUCS administration

459. The internal administration of WUCS is governed by the clauses of the Karnataka Cooperative Societies Act, 1959. Currently, Bhadra CADA is providing training to the WUCS office bearers (managing committee members and secretary) on administration of WUCS through the Regional Institute for Cooperative Management (RICM), Bengaluru. RICM has developed a detailed training module/programme on this and is experienced in providing the training. The PMU will make arrangement with the RIMC to provide this training to the office bearers of all Gondhi Anicut WUCS. Since the number of WUCS is few, all office bearers could be trained in a single training programme.

460. Post training, the SST will assist the WUCS office bearers in updating the WUCS records and bring the administration of the WUCS to current status. Henceforth, the WUCS office bearers would be responsible for maintaining and keeping all WUCS records up to date.

Establishing WUCS Office and equipping WUCS with updated information / records

461. The WUCS will be promoted to establish an office in a convenient place which is easily accessible to all members without any social or legal restriction. The office place should also be selected that a change in office bearers does not require a change in location of the office. The WUCS Secretary would set up his working office there and conduct all WUCS administration work from the premises including maintaining all WUCS records and conducting WUCS managing committee meetings.

462. The minimum information and records to be maintained by the WUCS are:

- WUCS registration records – WUCS bylaws, registration certificate, membership list, WUCS map[49]
- Meeting records - meeting notice file, general body minutes register, managing committee meeting register
- Communication records – letter head, letter file, inward and outward register
- Accounts records - cash book, ledger book, receipt book, asset register, accounts register, annual audit report, bank book

49 WUCS map based on digitized cadastral map will be prepared by the PMU with assistance of KNNL / CADA and supplied to the WUCS.

- Water management records – MOU, minor canal and CAD system design layout map, O&M works register, water charges register, annual action plans, participatory bench marking records

463. The SST will assist the WUCS Secretary to set up these records. Some of these records such as the WUCS and minor canal and CAD system design layout maps will have to be prepared and supplied by the PMU, while the other records registers and files will have to be created by the WUCS itself. Some WUCS may already have some of these records, which the SST will assist the WUCS Secretary to update. Other records will be freshly created by the WUCS Secretary assisted by the SST.

464. The WUCS will require a bank account into which project funds may be transferred to pay for activities being executed by them. Those WUCS that already have a bank account which can be used. But for those WUCS that do not yet have a bank account, the SST will assist the WUCS managing committee to open a bank account in a local nationalized or cooperative bank with the President and the Secretary as joint operators.

465. Additionally, all WUCS will be provided with Kannada language copies of the Karnataka Cooperative Societies Act, 1959 and Rules, Karnataka Irrigation Act, 1965 and Rules, Karnataka CADA Act, 1980 and rules and a compendium of government orders relevant to WUCS functioning.

466. By the end of the mobilization phase it is proposed to establish the office of all Gondhi Anicut WUCS with their updated records.

Discussing and signing of MOU between all WUCS and KNNL

467. Currently, KNNL has signed MOU with 3 WUCS in the Gondhi Anicut project and MOU with the remaining 6 existing WUCS and the proposed left bank WUCS are yet to be made. Once these WUCS have achieved the required membership level of 51% of farmers, the process of signing the MOU will be started. A MOU with all required information including the bulk water allocation, volumetric water rates, etc. will be prepared by the Executive Engineer, No. 4, BRLBC Division, Bhadravathi and will be drafted and given to the concerned WUCS. The KNNL staff / SST will discuss in detail the MOU with the WUCS general body to explain all the clauses of the MOU and address all their queries. Based on the discussion, an agreement will be arrived on the MOU including the bulk water allocation, volumetric water rates, etc. After this the MOU will be signed between the WUCS and the KNNL.

468. During the pilot WUCS study, it was found that there were some information gap in the MOU already signed between the KNNL and the 3 WUCS. Through mutual discussion and agreement between the WUCS and the KNNL these information gaps in the MOUs will be filled and if necessary a new MOU prepared and signed.

Participatory bench marking of WUCS

469. Before commencing implementation of project activities related to system modernization, CAD works and agriculture development, it is proposed to benchmark the WUCS on its current level of functioning related to internal administration and irrigation management to create a baseline. The benchmarking will be carried in a general body meeting of the WUCS using a participatory process. The PMU will identify the benchmarking indicators and tools based on a quantified participatory assessment approach in consultation with the WUCS. The benchmarking tool will be a Quantified Participatory Assessment chart designed such that WUCS can make objective self-assessment of its current performance standards against identified indicators. The SST will train and assist the WUCS in carrying out the benchmarking exercise. The benchmarking exercise will be repeated at regular

intervals (annually or semi-annually to the end of the Tranche period and afterwards) to assess the change in the performance level of the WUCS. Comparative analysis of the benchmarking results of different WUCS will provide understanding of improvements achieved, the remaining gaps in the level of performance, and lead to remedial action for the WUCS action plan.

470. By the end of the mobilization phase all Gondhi WUCS will have a working office, updated records, trained office bearers and agreed and signed complete MOUs with KNNL.

Phase 2 – Modernization Planning (6 Months)

471. The next phase of WUCS institutional strengthening strategy is the modernization planning that will be executed over a period of 3 months. The Gondhi canal system modernization planning and execution will be carried out by KNNL and contractors in which the WUCS are expected to play no role other than via consultation. However, the WUCS will have a major and direct role to play in CAD system improvement and agriculture development planning and execution. Therefore, under this phase the following activities will be implemented:

- Preparation of WUCS CAD system improvement plan; and
- Preparation of the WUCS agriculture development plan

Preparation of WUCS CAD system improvement plan

472. The CAD system improvement interventions are already detailed in an earlier section of the report. Within this the actual layout of the field irrigation channels, field drains and other on-farm-development works will have to be finalized with the WUCS and farmers. The Bhadra CADA staff assisted by the SST will hold discussions with the WUCS on the required CAD works within their jurisdiction. For this, a joint walk through will be carried out by the farmers, the CADA staff and the SST. A cadastral based resource and transect map will be prepared identifying the required CAD works. Based on the works identified, the CAD staff will prepare the design and layout plans. These layout plans will be discussed with the WUCS for final endorsement as agreement may be required from individual farmers to allow works across or along their fields. The SST will assist the WUCS Secretary to convene these meetings with the farmers.

Preparation of the WUCS agriculture development plan

473. Similarly, agriculture development plan for each WUCS needs to be prepared in consultation with the farmers. The proposed project agriculture strategy and interventions is detailed in an earlier section of the report. Based on this and the current cropping practice in the WUCS area and in discussion on desired / willingness to change by the farmers, the SST will prepare a detailed agriculture development plan with the WUCS. A walk through and a cadastral based resource mapping exercise jointly conducted by the farmers (including women and landless farmers) and the SST will help identify the potential for improved agriculture practice with reference to field characteristics such as soil type, land level, etc. The plan would propose the seasonal cropping pattern, the improved agronomic practices to be implemented, the training and demonstration programme (Farmer Field Schools, etc.) for the farmers on the new practices, the improved agricultural inputs and their possible sources for farmers to purchase from, etc.

474. By the end of the modernization planning phase, a CAD system improvement and an agriculture development plan will be prepared and endorsed by the WUCS for implementation.

Phase 3 - Executing Modernization Plan (18 Months)

475. After the preparation of their CAD system improvement and agriculture development plans the WUCS will start implementation of these plans. This will happen during phase 3 when the following activities will be implemented:

- Implementation of the WUCS CAD system improvement plan;
- Implementation of the WUCS agriculture development plan; and
- Continued training of WUCS on various topics

Implementation of the WUCS CAD system improvement plan

476. Given the short periods between standing crops in the field in Gondhi Anicut command it is expected that the CAD work implementation will take about 18 months. It is proposed that the CAD works be implemented by the WUCS themselves using the current procedure being followed by Bhadra CADA under its CAD & Water Management (GOI) scheme. The CADA engineering staff will supervise the implementation process with regular field assistance from the SST while the WUCS Secretary will maintain the works records such as the measurement book and the muster role. For supply of materials like pipes and cement, etc. bulk procurement may be done by the SIO and then distributed to the WUCS who would maintain its asset register to account for the material received. For labor work payment, the SIO Manager will transfer the amount to the WUCS account from which the WUCS Secretary will make payments based on the muster role and the measurement book. The SST will assist the WUCS Secretary in this task.

Implementation of the WUCS agriculture development plan

477. The 18 month execution phase will give 3 cropping seasons for the farmers to implement the WUCS agricultural development plan. It should be noted, however, that implementation of the WUCS agriculture development plan will continue beyond this phase into the next phase and perhaps beyond. The farmer training and demonstration programmes will be implemented by the SST with resource person support from the agriculture department, the local Krishi Vigyan Kendra and the College of Agriculture in Shivamogga. Purchase of agriculture inputs may be carried out as bulk procurement by the WUCS assisted by the SST. In this way, quality agriculture inputs at competitive costs may be made available to the farmers.

Continued training of WUCS on various topics

478. This phase will also be used to continue systematic training of WUCS and farmers on a range of topics that would support future sustainable O&M of their irrigation system. This will include training on crop water budgeting, irrigation scheduling, equitable distribution of water to farmers, on-farm application, asset management plan based on minor canal operation and maintenance, etc. There will be additional agricultural development related trainings that may arise during implementation of the WUCS agriculture development plan. Additionally, some refresher training on WUCS administration may be required for the office bearers and as well as member awareness campaigns. The PMU will be responsible for designing the modules and preparing the training material for these trainings. It will also conduct the training of trainers (ToT) of the SST for these trainings.

479. By the end of this phase all Gondhi WUCS will have an improved CAD system in place. The WUCS agriculture development plan would be at an advanced stage of implementation with clear indication of achieving the agriculture development result indicators identified in the Project DMF. Also all the Gondhi WUCS would have been provided with the requisite training to take over the responsibility of irrigation management in their command areas along with the minor canal and CAD system operation and maintenance.

Phase 4 – Irrigation Management (16 Months)

480. It is anticipated that modernization of minor canal works in Gondhi Anicut project will coincide with the end of the phase of WUCS institutional strengthening strategy of the Project (execution period of 24 months).

481. Under this phase the following activities will be implemented:

- Handing over of minor canal and CAD system to WUCS
- Preparation of minor canal and CAD system Assets Register and Management Plan
- Participatory benchmarking of WUCS
- Preparation and implementation of participatory WUCS action plan
- Constitution of Gondhi Anicut Water User Project Level Federation

Handing over of minor canal and CAD system to WUCS

482. On completion of modernization of the minor canal system and the CAD system, the KNNL / Bhadra CADA will be in the position to hand over the restored systems to the WUCS for future O&M as per the clauses of the MOU. From this point onwards it will become the responsibility of the WUCS to operate and maintain the system and provide irrigation service to its members. To facilitate the handing over process, the KNNL / Bhadra CADA will prepare a detailed record and layout map of the minor canal and CAD system in the WUCS command including structural specifications such as design flow and discharge levels of canal, weirs, outlet points, channels, drains, etc.; the design standards to be maintained of included structures; and other technical details as necessary. This record, layout map will become the basis for preparation of the WUCS minor canal and CAD system Asset Management Plan.

Preparation of minor canal system Assets Register and Management Plan

483. On completion of the minor canal system modernization, KNNL engineers and the SST will assist the WUCS in preparing an Assets Register and Management Plan for operation and maintenance of the minor canal system as well as for the CAD system. The PMU will develop the process and formats and train the KNNL / CADA staff and the SST in its use. The minor canal and CAD system Assets Register and Management Plan will then become the basis for the WUCS to carry out on-farm water management and maintain the system structures.

Participatory bench marking of WUCS

484. The WUCS will continue its regular participatory benchmarking exercise as described earlier to self-assess and monitor its performance. The SST will assist the WUCS in this.

Preparation of participatory WUCS action plan

485. To formalize the process of operation, maintenance and management of its irrigation system, each WUCS will to trained to prepare its action plan covering all its responsibilities mandated under the MOU including receiving bulk water from KNNL on volumetric basis, preparing irrigation plan for the command area, managing irrigation service to its members, equitably distributing water to farmers, improving on farm water application, collecting and remitting water charges to KNNL and maintaining the minor canal and CAD system to design standards.

486. To facilitate preparation of the WUCS action plan preparation, the PMU will design a work book with simple and standard formats for requisite data collection of seasonal crop planning and water demand estimation, irrigation scheduling and rotation supply to outlets and irrigation channel, farmer crop area estimation for raising water charges, and the

maintenance plan derived from the Asset Management Plan. The work book will incorporate the participatory benchmarking format to include WUCS performance monitoring and planning. Additionally, actions for flood management and conjunctive use of canal and groundwater may be included. The PMU will also develop the training module for use of the work book for plan preparation and train the KNNL / Bhadra CADA and SST on it. The PMU will prepare the work book and the training material in Kannada language.

487. Post training, the KNNL / Bhadra CADA and SST will facilitate the WUCS in preparing their crop season plans on the items listed above and with the use of the work book. They will also support the WUCS in implementing it. At the beginning of each cropping season the WUCS will self-assess their performance using the participatory benchmarking tool. The results of the bench marking assessment will feed into the action planning for the next season.

488. For each round of seasonal planning, using the work book, a WUCS will prepare in consultation with its farmers, the season's crop plan and estimate the irrigation water required before each cropping season (kharif and rabi). The WUCS will indent this bulk amount for supply to KNNL making certain that it generally does not exceed its allocated volume agreed in the MOU. The WUCS will also submit its desired irrigation supply schedule for the season. The SST will assist the WUCS in preparing the crop water plan, the indent and the irrigation supply schedule.

489. The water indent and the supply schedule will be presented to the Bhadra Irrigation Consultative Committee for discussion and finalization. The Gondhi WUCS should be made members of the Bhadra ICC to facilitate their representation and participation in discussions when the operation schedule of Bhadra Reservoir is finalized. This is necessary as Gondhi command is not only receiving inflows from the Bhadra main canals but also the operation of Gondhi Anicut depends on the Bhadra reservoir operation. In the ICC, the seasonal water allocation for each Gondhi WUCS and its supply schedule will be finalized and agreed depending on the farmers and hence WUCS seasonal water request (indent) and the availability of water in the reservoir and expected inflows. In case a WUCS indents more bulk water supply than its allocated volume, the ICC will decide on whether it could be sanctioned and supplied. The decision made in the ICC will become the seasonal volume of bulk water to be supplied by KNNL to a WUCS.

490. Subsequent to this agreement, the KNNL will supply irrigation water to the WUCS at its bulk supply point from where the WUCS will take and distribute supply water to its farmers on its agreed rotational schedule. KNNL and WUCS will keep records of the actual bulk water supplied to the WUCS at its supply point based on monitoring of the measuring devices installed at these points (refer to irrigation modernization project). At the end of each cropping season KNNL will raise the water charge from the WUCS determined by a volumetric rate agreed in the MOU and the actual bulk water supplied. The WUCS will apportion the water charge among its farmers according to mutually agreed criteria, collect the charges and deposit of the funds to the KNNL bank account.

491. For maintenance of the minor and CAD system within its command, the WUCS will prepare an annual maintenance plan using the Asset Management Plan and a walk through. The SST will assist the WUCS in identifying the maintenance works required and in preparation of the work estimates according to KNNL / CADA schedule of rates. The KNNL / Bhadra CADA engineers will review the estimates and make any necessary corrections.

492. Implementation of the minor canal system maintenance work will be carried out with the water charge apportioned to WUCS as per the recent decision of the Government of

Karnataka in its 2012-13 Budget.[50] The cost of maintenance of the CAD system works will be met directly by the farmers through their contribution.

493. The irrigation management phase, being of 12 month duration, will allow the SST to hand-hold the WUCS through a complete annual operational cycle covering two cropping seasons. It is expected that during this period sufficient training will be received by the WUCS to be able to continue the workbook based annual planning and implementation process with minimal support from the KNNL / Bhadra CADA staff even after withdrawal of the SST at the end of this phase.

494. From this point onwards the WUCS will continue to receive the irrigation service form KNNL as per the provisions of the MOU and manage its irrigation system using the Asset Management Plan, participatory benchmarking and workbook based annual planning process.

Constitution of Gondhi Anicut Water User Project Level Federation

495. Once all the 10 Gondhi WUCS have reached a level of functional effectiveness, the process for formation of the Gondhi Anicut Water Users Project Level Federation may be started by the SST. However before this, the AC-IWRM under the KISWRMIP project, should review the experience of the functioning of Project Level Federations in Karnataka, nationally and internationally to design a well-structured strategy for formation and institutional strengthening of Water Users Project Level Federations in the State. This would include the guidelines, procedures and tools for Federation functioning, training modules for the Federation members and facilitators, training material for these trainings, etc. The AC-IWRM will then train the KNNL / Bhadra staff and the SST on this strategy which they will implement in Gondhi Anicut for the Water Users Project Level Federation for this project.

496. Therefore at the end of this phase Gondhi Anicut project will have 10 WUCS with membership level of 90%; MOUs with KNNL; a functional office with updated records; a modernized minor and CAD system; an operational minor and CAD system Asset Register and Management Plan; regular annual plans for WUCS functioning; regular participatory benchmarking of its performance and an agriculture development plan in implementation. The end result of this will be improved agriculture production and farm household income.

15.3 Main System Construction Works

497. The anticipated scope of modernization works for the Gondhi irrigation system includes:

- Repairs to the Gondhi anicut and canal headworks
- Concrete lining of 74.7km of right main canal, 14.5km of left main canal and 34km of distributaries (small canals serving two to four outlets) and upgrading of canal access roads
- Reconstruction of canal structures including:
  - 12 head sluices for distributaries and 206 outlets
  - 102 cart bridges and 52 pipe culverts
  - 61 drainage inlets
  - 31 relieving weirs and 8 escape sluices
  - 9 main canal drops and 107 distributary drops
  - 89 washing points and cattle ramps
  - Repairs to 3 aqueducts

50 In the Agriculture Budget 2012-13 Government of Karnataka has declared its intention to make available to the WUCS 70% of the water charge collected by a WUCS for O&M works within its command. It is expected that WRD will soon order the procedure for this apportionment.

- Modification of current on-line storage where feasible to become actively managed off-line storage and enhancement of existing off-line tanks for more pro-active management.
- Command area development works over 4,600ha comprising lined channels, low pressure gravity-supplied pipe distribution where technically feasible and drainage where required.
- Provision of electronic flow measurement with telemetry at about 20 locations on the main canal and drainage system and flow measurement with recorders at all outlets.

498. The main construction activities are expected to involve:

- Clearance of vegetation along the canal rights of way to provide access and working space for the construction activities.
- Excavation where necessary within the existing canals. Suitable excavated material may be re-used within the construction works and unsuitable material (too silty) may be placed on fields to improve soil quality. The total excavation volume is estimated at about 250,000m³.
- Filling of about 350,000m³ to restore the canal cross section and access track. Fill material will either be suitable material from excavation or from borrow areas.
- Gravel surfacing of canal roads using material from suitable quarries or borrow areas.
- Concrete lining using mechanised paving equipment, precast concrete units or hand-placed concrete. Concrete for paving equipment would be supplied by ready-mixed concrete but concrete for hand-placed lining will probably be mixed on site.
- Reconstruction of canal structures using reinforced concrete. Most structures will be cast in place although some works may use precast concrete. Rebuilding of larger structures may take a month or more and will probably follow after the lining works.
- Command area improvements will involve provision of either concrete field channels or pipes within the command area which will require temporary access over fields and subsoil drainage may be required for waterlogged areas (although this problem may be reduced by better irrigation management).

15.4 Subproject Implementation Schedule

499. The anticipated timescale of project activities is discussed below and shown on Figure 15.

Project Start-up

500. There is likely to be a start-up phase containing activities such as establishment of a project management unit and completion of procurement of consultants and construction contracts. This could potentially take up to one year but should be less if these activities are progressed prior to loan effectiveness. Once the consultants are in place then capacity development activities can commence.

Gondhi System Modernization – Construction

501. If construction takes place over 30 months then it is likely that the working period will encompass two longer closures (assumed as two months) and two shorter closures (assumed to be one month). Activities during closure periods needs to be focused on specific sections with the objective of completing all work within a section during a closure to avoid the risk of unfinished work having to be redone (for example, if earthworks are undertaken but lining is not completed during a closure then earthworks will likely have to be repeated).

502. The overall division of construction activities could be:

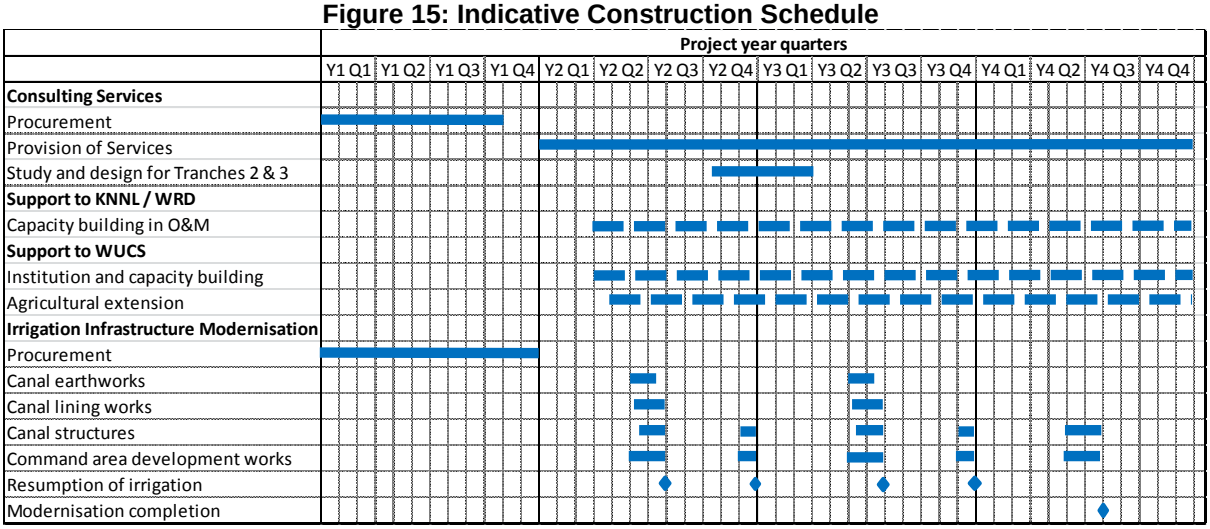
- **Longer closure periods**: Canal earthworks and lining; some canal structures; command area development works.

- **Shorter closure periods**: Canal structures; command area development works.
  An indicative schedule for a 30 month construction period is shown in Figure 15. This shows two each of long and short closure periods will be available. A further closure period may be available depending on the exact timing of the contract.

Support Activities

503. A range of activities are required to support the investment in system modernization. These activities can commence once the consultancy services are functioning. While it is anticipated that the bulk of the work will be completed during Tranche 1, some further aftercare will be provided during Tranche 2.

Figure 15: Indicative Construction Schedule



15.5 Monitoring and MIS

504. The project will be monitored according to the Project Design and Monitoring Framework attached as Annex 1. The DMF lays out the proposed results to be achieved by the project for its different components and the indicators to be used to measure the achievement of these results. While the DMF lays down the overall results to be achieved under the Tranche 1 of the project, the Project Annual Plans will disaggregate and specify the results to be achieved on an annual basis.

505. The PMU will establish a Project MIS linked to project indicators outputs and outcomes within 6 months of initiation of Tranche 1. The MIS and the M&E Officers in the PMU will be responsible for design of the Project MIS under the supervision of the Project Director. The Project MIS design will be based on the Project DMF consisting of modules for physical, financial and performance monitoring of all the different components and activities implemented under the Project. The MIS will be made operational in the PMU and the SIO and the relevant staff in both offices will be trained in its use by the PMU MIS Officer. Subsequent to this all, project progress monitoring and reporting will be supported by this MIS.

506. Project implementation progress will be monitored monthly by the project implementing offices that will include the PMU, SIO, the AC-IWRM and other offices of WRD involved in implementation of project activities. The various offices will compile their monthly

progress information and upload it into the Project MIS. The PMU will be responsible for coordinating this exercise and ensure that regular monthly updating is done by the concerned offices.

507. Based on the information loaded into the Project MIS, the PMU will generate the Monthly Progress Reports for the various users such as the WRD, SGOK, GoI and ADB. Quarterly and annual progress reports will also be generated from the MIS by the PMU.

508. The MIS will monitor the physical and financial progress of the project against its Annual Plan and Procurement Plan to assess the timeliness of project implementation. Additionally, the MIS will also monitor the project against the result indicators listed in the DMF and the Annual Plan to assess the performance of the project against its outputs and outcomes. A review of the progress and performance monitoring reports will become the basis of guiding decisions for improving project planning and implementation.