PRESENTATION ON

IMPROVEMENT IN WATER USE EFFICIENCY
BACKGROUND FOR NWM/WUE STUDIES

• Government of India has launched National Water Mission as a part of National action plan for climate change
• The main objective of National Water Mission is “Conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within states through integrated water resource development and management”
• One of the major goals of National Water Mission is “increasing water use efficiency by 20%”
BACKGROUND FOR KARNATAKA

• The Government of India through Central Water Commission is extending grant under AIBP for ERM (Extension, Renovation and Modernization) works by identifying projects taken up for rehabilitation works.

• As a sequel to the policy of the Indian Government, the Karnataka State has identified modernization of Narayanpur Left Bank Canal under Upper Krishna Project which aims at rectifying the deficiencies and in turn improving water use efficiency by about 25%.
A COMPREHENSIVE STRATEGY PLAN WORKED OUT BY KBJNL TO IMPROVE WATER USE EFFICIENCY BY 25% THROUGH TOTAL SYSTEM IMPROVEMENT
THE PROJECT UNDER CONSIDERATION IS NARAYANPUR LEFT BANK CANAL SYSTEM OF UPPER KRISHNA PROJECT
HOW TO ACHIEVE 25%?

• THROUGH ERM AND ITS COMPONENTS

• THROUGH MICRO IRRIGATION
GIS Map Of NLBC Network & Command Area
## SALIENT DETAILS OF NLBC SYSTEM

<table>
<thead>
<tr>
<th>No.</th>
<th>Particulars</th>
<th>Length of Main Canal</th>
<th>Length of Distributaries</th>
<th>Length of Laterals</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Narayanpur Left Bank Canal</td>
<td>77.5</td>
<td>240</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hunasagi Branch Canal</td>
<td>11.5</td>
<td>80</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Shahapur Branch Canal</td>
<td>76</td>
<td>375</td>
<td>752</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Indi Branch Canal</td>
<td>64</td>
<td>173</td>
<td>280</td>
<td>Part considered</td>
</tr>
<tr>
<td>5</td>
<td>Jewargi Branch Canal</td>
<td>40</td>
<td>41</td>
<td>127</td>
<td>Part considered</td>
</tr>
<tr>
<td>6</td>
<td>Mudbal Branch Canal</td>
<td>50</td>
<td>170</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>319.0 Km</strong></td>
<td><strong>1079.0 Km</strong></td>
<td><strong>2079.0 Km</strong></td>
<td></td>
</tr>
</tbody>
</table>
DEFICIENCIES IN EXISTING NLBC SYSTEM

- The canal system not lined in some reaches resulting in leakages
- Lined reaches of the canal damaged with slippage and chair formation thereby loosing its designed section
- Expansion joints loosing mastic filler and sealant resulting in its capability to arrest leakage
- In some reaches, formation of bed level not according to the designed bed level resulting in overtopping and insufficient quantity reaching the tail end
- Slippage/sinking of embankment leading to leakage of water
- Pooling due to excessive siltation and damaged sluices, outlets etc
- Erosion of canal banks
DEFICIENCIES

• Presence of Jungle growth due to lack of maintenance activities
• Main canal in deep cut reaches are silted up
• Deteriorated Service roads/Inspection path leading to inadequate communication
• Unauthorised offtakes/Syphons/lifting of water leading to insufficient supply to tail end reaches
• Violation of rotational system /Warabandhi
• Lack of adequate operators for canal operation/maintenance
• Ineffective/Defunct WUCS’s
• Absence of proper surface and subsurface drainage
• Absence of proper water regulatory system
• Excess irrigation resulting in water logging, salinity/alkalinity
• Violation of cropping pattern
RESULTING SCENARIO IN NLBC

The deficiencies have resulted in the following:

• **Suffering atchkat** of 1,05,623 Ha

• About 37,000 ha of **water logged, saline /alkaline** affected areas

• **Poor Water Use Of Efficiency (WUE)** Of 31.75% against **Design Efficiency Of 51%**
FRAMEWORK OF OVERALL SYSTEM IMPROVEMENT

• In formulating the overall WUE proposal, including the ERM component, there is a paradigm shift in the approach from a supply-based system to a availability-efficiency management based sustainable system.

• To enable the realization of this scenario, it is necessary to adopt the latest available technological resources. For NLBC System the following measures are proposed as tools for Total Canal System Management:
  - Automated Canal System Management using Telemetry & SCADA
  - Database System
  - Geographical Information System (GIS), including utilization of Satellite Imagery
Telemetry, SCADA & Automation
FRAMEWORK FOR AUTOMATION

• The objective concept of automation is enabling a demand based system.

• For a system of the size of NLBC, the automation required is of the level of Computer Directed control.
COMPONENTS

- Automated Gates (3000)
- Sensors
- Communication Network (10 towers)
- Main SCADA Server
- Monitoring Stations (70)
SCADA FEATURES

• MIMIC diagrams
• Setpoint command
• Alarm Generation.
• Report generation
• Recording & storage of data
• Multiple Viewing Stations
EXPECTED BENEFITS

• Paradigm shift in service to water users
• Efficient water conveyance (control on wastage)
• Real time Water accounting
• Reduction in operating costs
• Providing the fundamental mechanism for ensuring sustainability
GIS IN IRRIGATION PROJECTS

GIS In Irrigation Projects has four main aspects:

• GIS as a Mapping Tool
• GIS and Database Integration
• GIS as a Planning/Management Tool
• GIS and Modeling

• The GIS includes remote sensing, which has become a powerful source of spatial data as an input for GIS through which a detailed map can be generated with the help of other collateral data derived from several other sources.
FRAMEWORK OF GIS FOR NLBC SYSTEM

The GIS is proposed to be used as a tool to collect & organize data, understand the spatial relationship & enhance understanding to aid the decision support system.

The GIS platform shall aid in various aspects:

• To specify location base (geo-reference)
• To integrate the various irrigation related information
• To update the dynamic changes occurring in time & space
• Comprehensive tool for irrigation management
• To provide user friendly information on real time basis
• To generate value added reports time to time for special purposes, for easy & enhanced understanding.
INPUT – STATIC & DYNAMIC DATA

Static (One-time)
- SOI 0.5 m contour data
- Cadastral Map
- GPS survey
- Canal Details

Dynamic
- Groundwater Data
- SCADA Data
- Other data
• The GIS is built on a foundation of spatial and attribute data, and that users can access the database to conduct analyses and generate visualizations of data and analyses.

• Practically, the volume of the pyramid devoted to the database is indicative of the time and effort required to build a successful GIS. Hence the necessity of development of database system
DATABASE FOR IRRIGATION SYSTEMS

SPATIAL DATABASE

ATTRIBUTES OF THE FIELDS THEME

CROP. FIELDS THEME

ID_FIELD | ID_SUC. | (…)
----------|--------|------
1         | 1      |      
2         | 2      |      
3         | 1      |      
4         | 2      |      

CROP SUCCESIONS TABLE

ID_SUC. | ID_WCROP | ID_SCROP | ID_WIRRIG | ID_SIARIG
--------|----------|----------|-----------|-----------
1       | 6        | 3        | 1         | 2         
2       | 5        | 4        | 1         | 1         
(…)     |          |          |           |           

ATTRIBUTES OF THE SOILS THEME

SOILS THEME

ID_SOIL | (…)
--------|------
7       |     
8       |     
9       |     

CROPS TABLES

ID_CROP | NAME | (…)
--------|------|------
1       | CORN |      
2       | WHEAT|      
(…)     |      |      
7       | COTTON|      

IRRIG. METHODS TABLE

ID_IRRIG | NAME | (…)
---------|------|------
1        | PRECIPIT. | 
2        | SPRINKLER | 
3        | TRICKLE | 
4        | FURROW | 

ATTRIBUTES OF THE METEO THEME

METEO. THEME

ID_METEO | (…)
---------|------
1        |     
2        |     
3        |     

ASCII Related Files

(.,ETO, .,PRE, …)

SOILS TABLE

ID_SOIL | NAME | (…)
--------|------|------
7       | SILT |      
8       | SILTY_CLAY | 
9       | CLAY | 

OBJECTIVES OF RDBMS FOR NLBC

• The objective of the RDBMS component is to establish an Integrated Irrigation Network Management Information System together with all associated support systems that will enable the KBJNL to improve its business processes and work practices.

• Closely monitor the performance in all areas of operations and management.

• Provide improved levels of operations and efficient service delivery to its internal and external customers – assisting in decision making.
GENERAL SPECIFICATIONS

• The platform shall be open source
• Servers shall be leased.
• No ERP aspects are to be incorporated in the package development.
• IP based
• Compatible with websites of KBJNL, WRD & CWC (WRIS)
• Should provide the information interchange platform for Decision Support System, including upto the level of the Information Kisoks for farmers
Field Investigations
Reconnaissance Survey & Establishment of Control Points Using GPS
LiDAR Survey
Discharge Measurements
Existing Canal Conditions
NARAYANPUR Left Bank Canal

Canal Breach In Several Reaches

Dilapidated Structures

Leakages In Structures
HUNASAGI Branch Canal

Breached Canal

Side Wall Of Regulator Damaged

Trough Side Walls Damaged
SHAHAPUR Branch Canal

Canal Breach

Damaged Canal Lining

Structures Needing Repairs
JEWARAGI Branch Canal

Canal Breach

Dilapidated Distributary Offtake

Road Bridge Requiring Repairs
MUDBAL Branch Canal

- Structure Needing Repairs
- Damaged Lining
- Canal Breach
INDI Branch Canal

- Damaged Lining
- Structure Needing Repairs
- Deteriorated Bridge
NECESSITY OF EXTENSION, RENOVATION & MODERNIZATION

- NLBC with an ICA of 5.4 lakh Ha has failed to supply required quantum of water to envisaged ICA
- PCC slabs used for lining slipped and sunk at several reaches
- Cross sections not conforming to the designed cross sections
- Leakages noticed at embankment reaches
- Unsatisfactory performance of lining
- Deteriorated condition of canal system resulting in frequent closure for maintenance/repairs
Remodeling activity planned addresses the following:

• Rectify design defects if any in the canal system and structures there on

• Restore design canal parameters by remodeling wherever necessary and carrying out repair works

• Strengthen the embankments ensuring no slips and bank failures and effectiveness of lining
ERM PROVISIONS FOR CANALS

• Jungle clearance
• Earthwork Excavation and Embankment
• Formation of Service Road and Inspection Path
• Desilting and provision of CNS layer through out the canal for stabilization purpose
• Lining for Canal Bed and sides using Mechanical Paver
• Provision of LDPE/LLDPE Sheets in full banking and partial banking reaches to avoid seepage
• Provision of GI Pressure relief pipes in cutting reaches to avoid breaching of lining
• Provision of expansion joints to avoid cracks in the lining
• Provision of nominal reinforcement for canal lining in partial and banking reaches
• Provision for Chainage stones, Hectometer stones, Kilometer stones
ERM PROVISIONS FOR STRUCTURES

- Jungle clearance
- Jointing and plastering to Head walls, parapet walls and abutments
- Protection works for MCPC and Box culverts on upstream and downstream side
- Guniting for entire pipe length in MCPC
- Desilting of pipes and boxes
- Dismantling and reconstruction of damaged portion of structures
- Construction of new structures wherever required
Agricultural Measures & WUCSs Initiatives
PROVISIONS FOR AGRICULTURAL MEASURES

• Dissemination of Information and knowledge base to farmer community.
• Water auditing, volumetric pricing and demand-based supply to be a reality after system automation.
• Reclamation of water logged / salinity affected land
• Land leveling in potential areas
• Soil Fertility Management & Providing GPS-based Soil Health Cards
• Mechanization Facilitation Center
• Implementation of Warabandi
• Enhanced Training & Action Research
PROVISIONS FOR WUCS

• Revival of Awareness and Proposals in ERM through IEC activities
• Rejuvenation of the defunct WUCSs
• Formation of new WUCSs
• Establishment of Facilitation Centers & Information Kiosks
• Training and Capacity Building Activities
• Incentives to WUCSs - with checks to ensure performance based disbursements to WUCSs
• With assurance of Demand-based supply and interactive exchange of information through Automation, WUCSs will be on a sound platform to carry out their assigned role
**ERM COST ESTIMATE**

<table>
<thead>
<tr>
<th>No</th>
<th>Particulars</th>
<th>Estimated cost (Rs. Crores)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Remodeling of NLBC system</td>
<td>3250.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Introduction of Telemetry for proper measurement and automation of regulators for equitable distribution of water</td>
<td>490.00</td>
<td>GIS compatible</td>
</tr>
<tr>
<td>3</td>
<td>Reclamation of water logged, saline area in command area of NLBC by providing sub surface drainage system</td>
<td>227.50</td>
<td>GIS compatible</td>
</tr>
<tr>
<td>4</td>
<td>Cost towards agricultural aspects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Land levelling, soil fertility managements ( Soil/water health cards, training and research activities)</td>
<td>30.00</td>
<td>GIS compatible</td>
</tr>
<tr>
<td>4.2</td>
<td>Formation of new WUCS and rejuvenation of existing WUCS and capacity building</td>
<td>106.00</td>
<td>GIS compatible</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4103.50</strong></td>
<td></td>
</tr>
</tbody>
</table>
Micro Irrigation
OBJECTIVE

• Providing the beneficiary with a new technology tool in the form of Drip irrigation which will help in efficient, easier, professionally managed system to achieve maximum potential

• Aiding in covering large area with the available water by way of savings achieved through adoption of Drip irrigation system

• Enhancing water productivity resulting in increase in agricultural production and water use efficiency in NLBC system by more than 20%.
AREA COVERAGE

Keeping in view the goal of National Water Policy and National Water Mission of India, KBJNL plans to introduce the modern drip irrigation system in about 1,00,000 Ha in the command of NLBC in order to increase the water use efficiency and consequent increase in Agricultural production.
MODELS FOR MICRO IRRIGATION

Feasible Models:
- Model 1: Drip system with pumping system using electric power
- Model 2: Drip system with pumping system using solar power
- Model 3: Gravity pressure drip system using topographical advantage

The above models can be further classified with either 1.22 m drip line spacing or 1.52 m drip line spacing.

In the present proposal, gravity drip system and drip system with solar based pumping has been considered with a drip line spacing of 1.52 m.
Models For Micro Irrigation

Model 1

Model 2

Model 3
# Proposed Cropping Pattern

<table>
<thead>
<tr>
<th>Season</th>
<th>Crops</th>
<th>% area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Khariff</strong></td>
<td>Maize</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Groundnut</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Bajra</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Sunflower</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Green gram/pulses</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Horticultural crops</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>57.50</strong></td>
</tr>
<tr>
<td><strong>Bi seasonal</strong></td>
<td>Tur</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Chilli</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Cotton</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>22.50</strong></td>
</tr>
<tr>
<td><strong>Rabi</strong></td>
<td>Rabi Jowar</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Wheat</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Bengal gram</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sunflower</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Horticulture crops</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>35.00</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>115.00</strong></td>
</tr>
</tbody>
</table>
The total cost towards adopting Micro Irrigation for NLBC system in about 1,05,623 Ha with proposed cropping pattern and selected models works out to **Rs. 2368.00 Crores** inclusive of 5 years O&M cost.
BENEFITS EXPECTED

- Restores conveyance efficiency by Remodelling of the canal system by about 15%
- Bringing the suffering command area of 1,42,580 Ha under irrigation.
- Avoid seepages in the canal system thereby avoiding salinity/alkalinity of the area
- Reducing the O&M cost and achieving equitable distribution of water
## IMPROVEMENT IN WUE

<table>
<thead>
<tr>
<th></th>
<th>Achievable Limits as per CWC Guidelines</th>
<th>Existing Efficiencies</th>
<th>Efficiencies After Implementation of ERM and MI</th>
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</thead>
<tbody>
<tr>
<td><strong>Reservoir Efficiency</strong></td>
<td>95% - 98%</td>
<td>92%</td>
<td>92%</td>
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<tr>
<td><strong>Conveyance Efficiency</strong></td>
<td>70% - 75%</td>
<td>60.02%</td>
<td>75%</td>
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<tr>
<td>Fully Lined System</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partially Lined System</td>
<td>60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlined System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>On Farm Field Application</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprinkler/ Drip Irrigation</td>
<td>90%</td>
<td>52.9%</td>
<td>71.25%</td>
</tr>
<tr>
<td>Basin/ Furrow Irrigation</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drainage Efficiency</strong></td>
<td>80%</td>
<td>70.9%</td>
<td>80%</td>
</tr>
<tr>
<td><strong>IPU/IPC++</strong></td>
<td>85%</td>
<td>65%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Overall WUE</strong></td>
<td>60% - 65% (46% - 50%)</td>
<td>31.75%</td>
<td>53.44%</td>
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</tbody>
</table>
## Salient Parameters

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>BCR</th>
<th>IRR</th>
<th>WUE</th>
<th>Absolute</th>
<th>Improvement</th>
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<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.75%</td>
<td>-</td>
</tr>
<tr>
<td><strong>ERM &amp; Other Measures</strong></td>
<td>4,103.50</td>
<td>1.74</td>
<td>17.92</td>
<td>48.75%</td>
<td></td>
<td>17.00%</td>
</tr>
<tr>
<td><strong>Micro Irrigation</strong></td>
<td>2,368.00</td>
<td>1.35</td>
<td>12.44</td>
<td>67.50%</td>
<td></td>
<td>35.75%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,471.50</td>
<td>1.60</td>
<td>15.91</td>
<td>53.44%</td>
<td></td>
<td>21.69%</td>
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</tbody>
</table>
Thank You