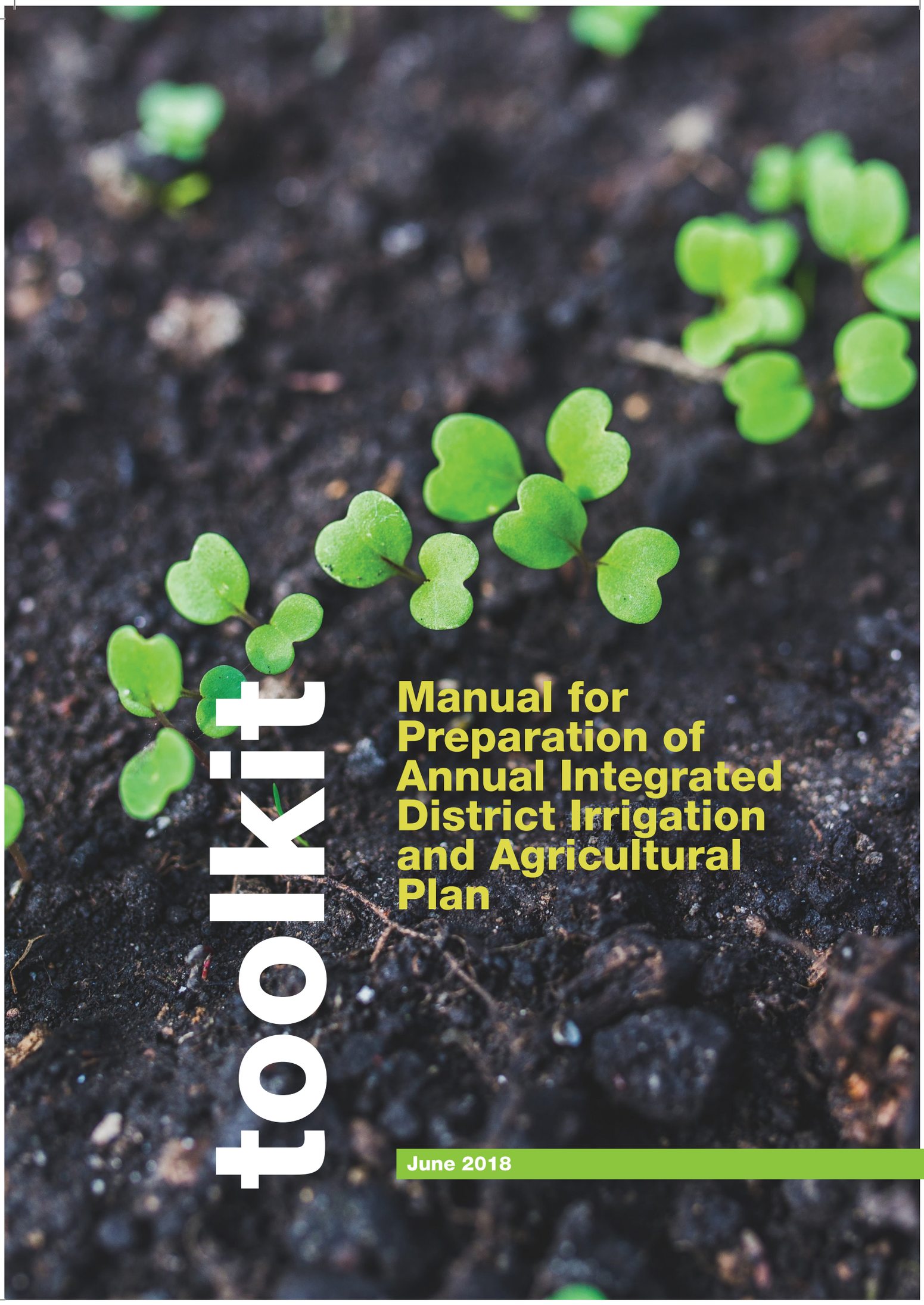

toolkit

# Manual for Preparation of Annual Integrated District Irrigation and Agricultural Plan

June 2018

Toolkit

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| **ACT** | Action on Climate Today |
| **ADB** | Asian Development Bank |
| **AE** | Assistant Engineer |
| **AO** | Agriculture Officer |
| **CADA** | Command Area Development Authorities |
| **CCA** | Culturable Command Area |
| **CR** | Cross Regulator |
| **DOAFE** | Department of Agriculture and Farmers Empowerment |
| **DAO** | District Agriculture Officer |
| **DDA** | Deputy Director of Agriculture |
| **DDH** | Deputy Director of Horticulture |
| **DFID** | Department for International Development |
| **DIAP** | District Irrigation and Agricultural Plan |
| **DLIC** | District Level Implementation Committee |
| **DoWR** | Department of Water Resources |
| **DRDA** | District Rural Development Agency |
| **DTW** | Deep Tube Well |
| **EAP** | Externally Aided Project |
| **EE** | Executive Engineer |
| **EIC** | Engineer-in-Chief |
| **ET** | Evapo-Transpiration |
| **FC** | Field Capacity |
| **GP** | Gram Panchayat |
| **HR** | Head Regulator |
| **IMD** | Indian Meteorological Department |
| **IPC** | Irrigation Potential Created |
| **IPCC** | Inter-Governmental Panel on Climate Change |
| **IPU** | Irrigation Potential Utilised |
| **IWRM** | Integrated Water Resources Management |
| **JE** | Junior Engineer |
| **KVK** | Krishi Vikash Kendra |
| **MASSCOTE** | Mapping System and Services for Canal Operation Techniques |
| **MGNREGA** | Mahatma Gandhi National Rural Employment Guarantee Act |
| **MOEFCC** | Ministry of Environment, Forests and Climate Change |
| **MIP** | Minor Irrigation Project |
| **MOWR** | Ministry of Water Resources |

| | |
|---|---|
| **NABARD** | National Bank for Agriculture and Rural Development |
| **NAC** | Notified Area Council |
| **NAPCC** | National Action Plan Climate Change |
| **NASA** | National Aeronautics and Space Administration |
| **NDC** | Nationally Determined Contributions |
| **NIR** | Net Irrigation Requirement |
| **NITI** | National Institution for Transforming India |
| **NRRI** | National Rice Research Institute |
| **OAIC** | Odisha Agro Industry Corporation |
| **ODI** | Overseas Development Institute |
| **OFD** | On Farm Development |
| **OIIAWMP** | Odisha Integrated Irrigated Water Management Project |
| **OIIPCRA** | Odisha Integrated Irrigation Project for Climate Resilient Agriculture |
| **OLIC** | Odisha Lift Irrigation Corporation |
| **O&M** | Operation and Maintenance |
| **P&D** | Planning and Design |
| **PMKSY** | Pradhan Mantri Krishi Sinchayee Yojana |
| **PP** | Pani-Panchayat |
| **RLIP** | River Lift Irrigation Project |
| **SE** | Superintending Engineer |
| **SLEC** | State Level Executive Committee |
| **WAC** | Water Allocation Committee |
| **Warabandi** | System of distribution of water allocation to water users by turn |
| **WR** | Water Resources |

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# RATIONALE AND PURPOSE

## Background

Climate change is a compelling challenge. National Aeronautics and Space Administration (NASA) has reported that, the planet's average surface temperature has risen a little more than one degree Celsius during the last century. According to NASA report, year 2017 was warmest non-El Niño year and was[1] marked by extreme weather events around the globe. Intergovernmental Panel on Climate Change (IPCC) report states that rising temperatures will be accompanied by a change in rainfall patterns and increase in the frequency and intensity of extreme weather events around the world.[2]

Developing countries have a limited capacity to deal with the impacts of climate change and are highly vulnerable. The requirement of financial resources is quite high which has to be met from mainstreaming climate change in the state's activities and budgetary provisions besides taking all proactive action to mobilise external resources through climate financing available from many multi-lateral agencies and donors such as World Bank. Estimates stated in climate action plan or the Nationally Determined Contributions (NDC), indicate that India will require a whopping $2.5 trillion to deal with the impacts of climate change by 2030.[3]

Govt. of Odisha has proactively initiated action for aligning programs in key sectors to climate change. Department of Water Resources (DoWR) is a leading department in the State Government and has taken many innovative actions for formulating programs and provisioning financial resources/funds towards this purpose. At the national level, there has been a policy change by Govt. of India. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been launched by Central Government as an umbrella scheme from which DoWR can access funds for irrigation development to ensure access to irrigation by farmers.

In this background, DoWR decided to undertake a project on prioritizing water use mechanisms for sustainable usage of water and development of integrated district irrigation and agriculture plans (DIAP). Climate Change Innovation Programme (CCIP) funded by Department of International Development (DFID), Government of UK was requested to assist the Government of Odisha in designing the DIAP for two pilot districts of Cuttack and Subarnapur. The activity was selected as one of the priority activities for the state. Under this activity, the management practices of DoWR for its existing irrigation assets for providing irrigation services to vulnerable farmers was closely looked at to make them climate sensitized and to cater to sustainable development goals of the state. DIAP is an important step in this direction.

1 National Aeronautics and Space Administration, Long-Term Warming Trend Continued in 2017: NASA, NOAA, available at https://www.giss.nasa.gov/research/news/20180118/.
2 Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5), 2014
3 Ministry of Environment and Forests and Climate Change (MOEFCC), 2015, India's Intended Nationally Determined Contribution

The project has developed a procedure for a transformative planning process for management of existing irrigation schemes through operational plan and development of additional irrigation facility through new command plan aligned to climate resilient agriculture in Odisha. This process was developed in close consultation with officials working on the ground in the two pilot districts. As part of the process of transformative planning, consultations were carried out in the two districts with officials of DoWR, Department of Agriculture and Farmers' Empowerment (DAFE), Government of Odisha, office bearers of Water Users Associations (WUAs) locally called as Pani Panchayats and farmers in irrigation project command areas. The activity resulted in three reports:

1. Water use report for Cuttack and Subarnapur District
2. Strategy report for formulation of transformative Integrated District Irrigation and Agriculture Plan conceptualized based on assessment of current scenario of water use in Cuttack and Subarnapur
3. Operational Plan and New Command Plan for Integrated District level management of Irrigation and Agriculture

While these three reports are specific to Cuttack and Subarnapur, the lessons learnt from the activity have been collated in the form of the present toolkit, which is the fourth part of the process, that will enable govt. planners in both agriculture and water resource department to formulate a cohesive plan for climate resilient water resource and agriculture planning.

At the present juncture, World Bank is also keen in funding a project to develop climate resilient irrigation and agriculture practices. Negotiations are in the advanced stage by the Govt. of Odisha with World Bank for funding a project titled "Odisha Integrated Irrigation Project for Climate Resilient Agriculture (OIIPCRA)". In this background, rolling out of DIAP in all districts has become very important. This will mean that there will be year to year assessment of prevailing irrigation and agricultural scenario and integrated planning of irrigation and agriculture activities with supervision and control of the District Collector. There will be nodal officer in the districts notified by DoWR who will be responsible to coordinate with all concerned and develop an integrated district irrigation and agricultural plan and get it approved by Collector.

DIAP Integrated Planning Process Roll out along with different components are described in this toolkit.

## WHAT IS THIS TOOLKIT?

This Toolkit is developed for integrated planning of irrigation and agriculture of a district on annual basis for each financial year. It is a type of manual which will provide guidelines to initiate the planning process and complete it with all essential components. This toolkit will also serve as a template for training engineers of DoWR and DAFE in DIAP.

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# **DIAP** INTEGRATED PLANNING PROCESS ROLL OUT

## 1.1 Initiation

This is the first step of commencement of formulation of the DIAP.

- Superintendent Engineer (S.E), DoWR, at present the Nodal Officer PMKSY for the concerned district will issue instructions to all divisions under DoWR, Odisha Lift Irrigation Corporation (OLIC), Odisha Agro Industries Corporation (OAIC), District Rural Development Agency (DRDA), and Head of the districts of Agriculture, Horticulture departments and Watershed mission three months before the last date of completion of plan. When the DIAP planning process is taken up in different districts of the state, the concerned Superintending Engineers will be issued directions by the State Government entrusting them to take concerted action on preparation and implementation of DIAP to develop climate change resilient practices.
- The instructions should contain updated data sets to be submitted along with time frame given in the flow chart at Figure 2 and 3 by the concerned division and district heads.[4]
- Convene the meeting of the district level team for collective review of the data and preparation of data needs to be further updated in the given format (annexure 1-10).

**KEY TECHNICAL ISSUES**

Facilitate matching of crop water requirement based on the cropping pattern finalized by agriculture department with water availability.

Facilitate between Pani Panchayat (PP) and Junior Engineer (JE) and Agricultural Officer (AO) for Pani Panchayat wise canal water supply (Flow Rate) and schedule of water release to each canal of the set of canals under PP.

## 1.2 Resources, Support and Supervision

### RESOURCES

- PP jurisdiction map
- Hydraulic particulars of canal system under PP
- Turn out position in the field channels
- Names of farmers and total area of farmers to be irrigated from the turnout

4 Section 1.3 and Annexures 1-10 may be referred

### SUPPORT

The support from different government officials is essential to carry out the DIAP process. The cooperation of Agriculture Dept. and the DoWR is vital in providing the materials and data required for DIAP. Certain fund provision may be kept for meeting travel and food expenses for a multidisciplinary team including honorarium for experts to work centrally in SEs office to expedite the DIAP preparation.

### SUPERVISION

The DIAP is a transformative planning process and is considered to be an alternative planning mechanism to the practices being followed at present. Therefore, there is a need for guidance, both for policy matters at the state level and planning aspects at the district level. Based on earlier consultations, it is suggested to set-up state level executive committees and district level implementation committees. Details about these committees are given below.

#### State Level Executive Committee (SLEC)

There is a National Executive committee for PMKSY5 with Vice Chairman of NITI Aayog as Chairman. PMKSY has goals to increase access to irrigation by farmers and increasing water use efficiency. Since the DIAP has similar goals, a SLEC chaired by Agriculture Production Commissioner, APC, Govt. of Odisha proposed to be formed to oversee the DIAP at state level. It is recommended that the SLEC is constituted as follows.

- Agriculture Production Commissioner - Chairman
- Engineer-in-Chief (WR) - Member
- Engineer-in-Chief (P&D) - Member
- Director of Agriculture and Food production - Member
- Director of Soil conservation - Member
- Secretary, Department of Panchayati Raj (In charge MNREGA) - Member
- Director (PPSU), DoWR - Member
- Additional Director, CADA, DoWR - Member
- Chief Engineer, MI - Member
- MD, OLIC - Member
- Chief Engineer, Monitoring, Office of EIC, DoWR - Member Secretary

#### District Level Implementation Committee (DLIC)

There is already a DLIC under PMKSY with Collector and District Magistrate as Chairman. Same committee will function for overseeing the preparation of integrated DIAP and giving approval. The DLIC is constituted as follows:

- Collector and District Magistrate - Chairman
- Deputy Director, Agriculture - Member
- Executive Engineers, DoWR, MI, OLIC - Members
- Deputy Director- Horticulture - Member
- Project Director Watershed - Member
- Executive Engineers, DRDA - Member
- District Level Nodal Officer, PMKSY - Member Secretary

## 1.3 Materials and Data

The materials and data required are given in Annexures (1-10)

### MATERIALS

Materials required

- District Irrigation Plan of the concerned district
- Rabi and Kharif agriculture Strategy reports
- State Annual Reports

### DATA

The formats for cropping pattern, new command plan and irrigation and agriculture related formats has been attached in annexures (1-10)

5 Pradhan Mantri Krishi Sinchai Yojana, PMKSY (Prime Minister's Irrigation Scheme)

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# CHAPTER OUTLINE

To maintain parity between the DIAP drawn out by different districts, it is proposed that the plan document should be drafted with chapters in accordance to the following template.

## CHAPTER MODEL TEMPLATE

A. Foreword (By District Collector)

B. Preface (District level nodal officer DIAP)

C. Contents

D. List of Tables

E. List of Annexures

F. Executive Summary

G. Chapter 1: Introduction
   i. Background
   ii. Vision
   iii. Rationale
   iv. Objective

H. Chapter 2: Operation Plan
   i. Background
   ii. Key strategies for operation plan in irrigation management
   iii. Mapping System and Services for Canal Operation Techniques (MASSCOTE)
   iv. Plan for 100% percent coverage of Cultivable Area under irrigation
   v. Assessment of gap between irrigation potential and actual utilization in a district
   vi. Bridging gap
   vii. Key Strategies for operation plan of Agriculture
   viii. Crop Water Budget
   ix. Use of CROPWAT for water budgeting and estimation of irrigation demand
   x. Canal operation Plan
      a. Govt. controlled Canals
      b. Canal operation Plan for Minor Canals (Pani Panchayat jurisdiction)
      c. Operation Plan for Field Channels (Outlet command area, chak)
      d. Water Security for Agriculture purpose
      e. Benchmarking
      f. Capacity Building

G. Chapter 3: New Command Plan

H. Chapter 4: Abstract of District Level Operational plan and new command plan for Integrated irrigation and agricultural plan

I. Chapter 5: Conclusion and Outcomes

J. List of Annexures
Annexure 1: Proposed Cropping Pattern
Annexure 2: Allocation of Water to Industries through WAC (Latest status available)
Annexure 3: Report for assessment of gap through PPs
Annexure 4: Compiled report on gap between irrigation potential and actual utilization in the assessment year
Annexure 5: Step by Step CROPWAT Calculation
Annexure 6: Template for rotational water distribution plan (among minors and distributaries) controlled by Govt.
Annexure 7: Template for rotational water distribution plan (among minors and distributaries) controlled by PP
Annexure 8: Template for Rotational Water distribution plan (among outlets) of PP
*Annexure 9: Template for* data to be used for preparation of Warabandi Schedule for Water Distribution in the field channel
Annexure 10: New Command Plan

## 2.1 Description and contents on different chapters

### CHAPTER 1

It is the introduction chapter, should be drafted highlighting different aspects of the district focusing on irrigation, agriculture and climate change. In this chapter, rationale or justification for preparing the DIAP is to be appropriately described. Key objectives should be formulated and put in this chapter. The objectives should include operational plan as well as new command plan.

### CHAPTER 2:

Provides information and analytical discussion regarding climate change, vulnerability and adaptive capacity. Vulnerability assessment of all PPs in existing command areas and all GPs in new command areas and rain-fed areas is to be made and reported in this chapter.

Climate change vulnerability can be incorporated in the DIAP by referring to the following.

- PRECIS simulations for 2020s, 2050s and 2080s indicate an all-round warming over the Indian subcontinent. Mean annual surface air temperature from 1961 (first year of model simulation) to 2098 (last year of model projections) as simulated by PRECIS, indicates that annual mean surface air temperature rises by the end of the century ranges from 3.5°C to 4.3°C.
- Greenhouse gas emission is an important cause to warming of climate and subsequent impacts on increased droughts and other hazards. Some analysis can be presented in DIAP by computing the emission for rice, which is the major crop in the state. India, on an average, cultivates rice on 43 million ha of land, of which 52.6% is irrigated, 32.4% is rain-fed lowland, 12% is rain-fed upland, and 3% is deep-water rice. The annual amount of CH4 emitted from a given area of rice is a function of the crop duration, water regimes, and organic soil amendments. The CH4 emissions were estimated by multiplying the seasonal emission factors by the annual harvested areas. In the Initial National Communications, it was highlighted that the eastern states of Bihar, West Bengal, and Orissa together account for more than 50% of the methane (CH4) emission from India from rice cultivation. The highest emitting category within these states was the continuously flooded fields. Greenhouse gas emission factor for different categories of paddy is given in Table 1.

**Table 1: Greenhouse gas emission factors used in the agriculture sector (Rice Cultivation)**

| Category | Sub-category | Emission factor | Source |
|---|---|---|---|
| Irrigated | Continuously flooded | 162 kg $CH_4$/ha | SNC Measurement[6] |
| | Single aeration | 66 kg $CH_4$/ha | SNC Measurement |
| | Multiple aeration | 18 kg $CH_4$/ha | SNC Measurement |
| Rain-fed | Drought prone | 66 kg $CH_4$/ha | SNC Measurement |
| | Flood prone | 190 kg $CH_4$/ha | SNC Measurement |
| Deep water | Deep water | 190 kg $CH_4$/ha | SNC Measurement |
| Upland | Upland | 0 | - |

Besides above, which will present some information on the district as whole, PP wise vulnerability assessment can be taken up using the following methodology. The methodology consists of assigning weightages to selected indicators and ranking the PPs in order of aggregate score obtained. Indicators are designed in four categories which is presented in Table 2. Weightage for different indicators finalised in consultations with district level planners and are furnished in Table 3, Table 4, Table 5 & Table 6.

**Table 2: List of indicators used for the vulnerability and capacity assessment**

| Vulnerability Categories | Indicators |
|---|---|
| **Socio-Demographic** | • Caste distribution (General, SC, ST & OBC)<br>• Economic category distribution (APL & BPL)<br>• Members in a family (number, young male, young female, old age male, old age female and children)<br>• Education<br>• Type of family<br>• Social network (friends, relatives) and kinship<br>• Population density |
| **Economic** | • Primary & secondary sources of livelihood<br>• Land (total land, cultivated land, irrigated land & fallow land)<br>• Source of irrigation (type & duration)<br>• Types of crop cultivated (type, area & income)<br>• Preferred market for sale of agricultural produce<br>• Land-based other livelihoods<br>• Livestock (type & number)<br>• Asset ownership at household level<br>• Income & expenditure (source & amount) - Debt (type & amount)<br>• Access to financial services<br>• Savings<br>• Source of credit |
| **Institutional** | • Membership of CBO (type & number of members)<br>• Access to facilities at village level<br>• Membership and activeness in Pani Panchayat<br>• Membership in FPO and benefit derived<br>• Access to services & information (training, value addition, market linkages, etc.)<br>• Benefits from government schemes (type) |

6 Kenya's Second National Communication (SNC) to the UNFCCC, which includes a GHG inventory for the agricultural activities 1995-2010

| Vulnerability Categories | Indicators |
|---|---|
| **Physical (Structural, Environment, local natural resources)** | • Type of structure of house (type & material of wall & roof)<br>• Source of lighting<br>• Availability of electricity<br>• Sanitation practices (toilet types, etc.)<br>• Type of cooking fuel used<br>• Availability of drinking water<br>• Status of connectivity (road)<br>• Status and type of CPRs<br>• Distance from river bank<br>• Distance from coast line |
| **Irrigation (water management and water scarcity)** | • Percentage of days scarcity is experienced out of total growing season of paddy and other non-paddy crops<br>• Type of Soil (Sandy, Loam, clay)<br>• Coping measures adopted by community<br>• Migration<br>- Where (Within same village, another village, Uphill, Nearby forest, urban area, etc.)<br>- How (on feet, local transport, bull cart, etc.)<br>- What (assets, livestock)<br>• Expenditure (during drought and water scarcity)<br>• Food security (during drought & after drought)<br>• Disease (during drought) - morbidity & mortality)<br>• Coping social structure – house structure, livestock, health, food security, etc.<br>• Coping – assistance (govt., NGOs, community of other villages, relatives, etc.)<br>• Agro-meteorological services preparedness, etc.)<br>• Access to info from govt. departments<br>• Access to financial assistance & insurance<br>• Awareness on drought relief measures and drought assessment procedure |
| **Irrigation project and distribution network's vulnerability** | • How the service responds to farmer's requirements, taking into account the limits imposed by policies and the resource availability<br>• Water use efficiency<br>• Type of water application method<br>• Reservoir filling factor[7] |
| **Irrigation management and irrigated agriculture** | • Participation of Pani Panchayats in irrigation water distribution<br>• Climate resilient crop planning and crop production practices |

7 It is computed as the ratio between net annual water inflow into the reservoir and maximum reservoir capacity (Cap MCM). The higher the net annual volume entering into the reservoir for a given reservoir capacity, the higher is the irrigated agriculture's resilience to climate change. On an equal net water inflow, reservoirs characterized by a smaller capacity show a higher annual inflow and thus a greater resilience.

**Table 3: Weightages assigned to indicators for Socio-demographic vulnerability**

| Socio-Demographic Vulnerability (50) | Weightage |
|---|---|
| Caste of the HH | 6 |
| Members in a family per HH | 6 |
| Male members per HH (age group wise) | 6 |
| Female members per HH (age group wise) | 6 |
| Education Status of members of a HH | 10 |
| Type of Family | 5 |
| Economic Category (APL / BPL) | 7 |
| BPL card holder | 4 |
| **Total** | **50** |

**Table 4: Weightages assigned to indicators for Economic vulnerability**

| Economic vulnerability (100) | Weightage |
|---|---|
| Livelihood portfolio | |
| Primary source of income | 8 |
| Secondary source of income | 5 |
| **Agriculture including Horticulture** | |
| Total Land owned | |
| Total cultivated land | 6 |
| Total Irrigated land | 6 |
| Source of Irrigation | 4 |
| Types of crops cultivated | 4 |
| Preferred market for sale | 4 |
| Land based activity pursued by the family | 5 |
| Livestock | |
| Type of livestock owned by the HH | 5 |
| No of livestock owned by the HH | 5 |
| **Assets** | |
| Assets owned by the HH | 5 |
| **Income and Expenditure** | |
| Earning members per HH | 8 |
| Average monthly Income per HH | 6 |
| Maximum monthly expenditure per HH | 4 |
| **Debt details of HH** | |
| Presence/Absence of debt in the HH | 5 |
| Total present debt in the HH | 4 |
| Financial Services | 6 |
| Access to financial services | 5 |
| Access to Savings | 5 |
| Access to sources of credit | 5 |
| Total | 100 |

**Table 5: Weightages assigned to indicators for Institutional vulnerability**

| Institutional vulnerability (50) | Weightage |
|---|---|
| Community Participation | |
| Members in Community based organisations/institutions | 10 |
| Access to local level facilities | 10 |
| Access to information and services | |
| Training / Exposure visits | 8 |
| Access to information/training related to Value addition methods | 8 |
| Access to information/training related to Market linkages | 6 |
| Access to information about the various benefits from government schemes | 8 |
| Total | 50 |

**Table 6: Weightages assigned to indicators on irrigation system**

| Irrigation infrastructure related vulnerability (100) | Weightage |
|---|---|
| Availability water in the reservoir/tank/system for growing two crops covering the designed CCA | 20 |
| Adequacy of the main system network for water conveyance and distribution to all outlets equitably to meet the demand | 20 |
| Adequacy of field channel network to supply water to all farmers in head, middle and tail reaches of the outlet command | 20 |
| Regular maintenance and upkeep of the minors, sub-minors and field channels by the PP | 10 |
| Sound written operation plan for regulation of water in main system | 10 |
| Warabandi plan well known to the water users/farmers | 10 |
| Measurement and monitoring of flow by Pani Panchayts | 10 |
| Total | 100 |

Considering four vulnerably categories and their respective weightages, area/villages under each PP will be assessed for vulnerability. Total weightage will be 300. For all PPs in major & medium projects and other projects above 40 ha of irrigation command, vulnerability assessment is required to be carried out once in five years. Priority should be given to more vulnerable PPs in terms of access to irrigation so that adaptive capacity is developed.

This chapter should ideally contain present scenario of irrigation and agriculture in the district. This should be done block-wise in the initial years. When the database for PPs/GPs are improved, data should be furnished under this scenario for micro level including physical aspects and institutional aspects for each PP/GP.

Action points and their purpose is described in nutshell in Table 7.

**Table 7: Action points, activities and scope for coverage**

| Action Points | Purpose/ Activity | Scope for Coverage |
|---|---|---|
| **River Basin Planning** | River basin planning will help in knowing the competing demands | Entire District and part of River basin |
| | a) Computation of present demand for industry | |
| | b) Computation of demand for industry in 2030 | |
| | c) Computation of present demand for agriculture | |
| | d) Computation of demand for agriculture in 2030 | |
| | e) Computation of present demand for drinking and other uses in 2030 | |
| | f) Computation of demand for drinking and other uses in 2030 | |
| | g) Preparation of district wise river basin plans for 2018 showing demand, availability and action plan for increasing availability | |
| | h) Preparation of district wise river basin plans for 2030 showing demand, availability and action plan for increasing availability | |
| **Cascade Planning** | Harness all water resources based on catchment area of streams by construction of different type of irrigation structures and interlinking among them | Blocks not having major and medium irrigation projects |
| | a) Identification of cascades and their catchment area | |
| | b) Marking of existing irrigation structures in the proposed cascade area | |
| | c) Preparation of cascade level plan | |
| **Crop water budgeting8** | For gaining understanding of water availability, requirement of water by Pani Panchayat and prepare crop planning and irrigation scheduling | Pani Panchayat Jurisdiction in all irrigation projects |
| | a) Preparation of Pani Panchayat wise soil type information | |
| | b) Computation of potential Evapotranspiration | |
| | c) Computation of crop Evapo-transpiration for crops grown in the Pani Panchayat area | |
| | d) Preparation of monthly crop water budget for the cropping period and annual crop water budget | |
| **Canal Operation Plans** | Distributing water on equitable basis | Major Project |
| **New Command Plan** | Creation of Additional Irrigation Potential by different means | All departments concerned |

## CHAPTER 3

It will cover data and discussion on the crop productivity, action plan of agriculture department for improving productivity and crop production for the year for which this plan is prepared.

## CHAPTER 4

This chapter should clearly describe all operational aspects of irrigation department at district level, sub-district level as well as the state level. First step in formulating the operation plan is to make assessment of irrigation scenario in the preceding year. The irrigation planning to be covered in this chapter consists of assessment of gap between irrigation potential and utilization, bridging the gap, crop water budgeting, CROPWAT calculation process, canal operation plan, new command plan, MASSCOTTE, cascade planning, river basin planning, benchmarking and flow monitoring.[9]

## CHAPTER 5

In this chapter, implementation of the DIAP for the concerned district should be discussed. Task should be specified at different levels in the hierarchical administration of the respective departments. Physical targets are to be fixed in consultation with the DLIC and SLEC.

03

# AGRICULTURAL PLAN

## 3.1 Crop Selection

Crop selection will be done on the basis of availability of water, soil and climatic conditions. Also, crop selection depends on market linkages and scope for value addition. The crop selection should also consider acceptability of the farmers. Pani Panchayat should discuss regarding crops that can be grown in the command area with the support of agriculture and irrigation departments. Proper training and capacity building should be organised for such stakeholders.

## 3.2 Project wise Irrigable Area for the proposed year

Project wise irrigable area is required for the district for which the DIAP is planned. The irrigable area is essential to know about the irrigation status of each project. Hence planning for increasing the area can be done based on it. Segregated information in the below format would be required.

**Table 8: Project wise Irrigable Area**

| Projects | Irrigable Area |
|---|---|
| Major & Medium | |
| Minor | |
| Lift Irrigation | |
| Ground Water (DTW) | |
| Other Sources | |

## 3.3 Project Wise Cropping Pattern and Crop Water Requirement

Cropping pattern for Kharif and Rabi season should be scientifically worked out. Because of robust PDS system and state government's policy to make certain quantity of paddy available to the BPL families at much subsidised rates of Rs. 1/kg, people are able to get their staple food through PDS. It should be attempted to bring change in cropping pattern and promote crop diversification by substituting paddy to other crops like groundnut, vegetables in Kharif and moong, groundnut, sunflower, chilly, and vegetables in Rabi. The net profit by cultivating pulses, oilseeds and vegetables are more compared to paddy. Besides net profit, these crops help to get more cash in hand by selling in the market whereas the harvested paddy is stored and not immediately sold by the small holder farmers.

Keeping crop diversification as a central idea and considering the gross irrigation requirements and water availability in the irrigation projects proposed, cropping should be worked out for each irrigation project as part of the agricultural plan. By changing paddy to other non-paddy crops which are remunerative, farmers will get more profit for agriculture, cover more area from the limited available irrigation water. For easy apprehension and understanding, an illustrative example of cropping pattern with total area cropped in each season, percentage increase in area and effect on water volume utilized in Kharif and Rabi is prepared taking Kusunpur Minor Irrigation Project MIP of Cuttack district as an example and given in Annexure 1.

The project wise cropping pattern and crop water requirement needs to be furnished as per the format in Table 9.

**Table 9:** *Project wise Cropping Pattern and Crop Water Requirement*

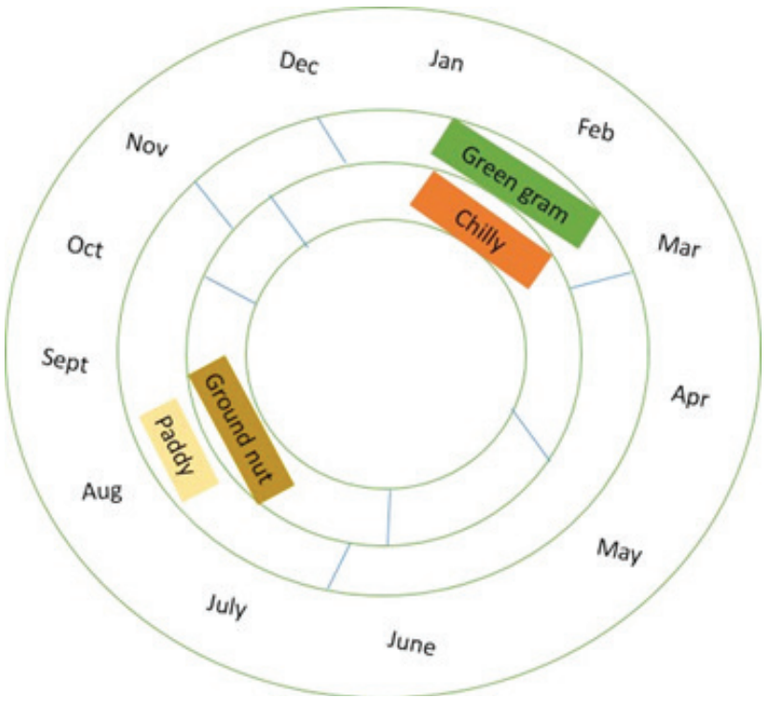
| Name of the project | Project | Kharif* | | | | Rabi* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Crop 1 | Crop 2 | Crop 3 | Total | Crop 1 | Crop 2 | Crop 3 | Total |
| | | | | | | | | | |
| | | | | | | | | | |

**Suitable rows and columns can be added under Kharif and Rabi according to the number of crops and projects under the irrigation scheme*

## 3.4 Crop Calendar with crops as per the selected cropping pattern

Based on the proposed cropping pattern, crop calendar should be prepared. Crop calendar consists of sowing time, harvesting time for different crops proposed to be grown in Kharif and Rabi season. For timely sowing of crops in the Rabi season, Kharif crop should be harvested early, i.e. by late October or early November instead of present practice of harvesting till January. An illustrative cropping calendar is given in Fig 1.

**Figure 1: Cropping calendar**



04

# IRRIGATION PLANNING

## 4.1 Assessment of gap between irrigation potential and utilization in the preceding year

In Major & Medium and bigger Minor Irrigation (commonly known as MI) projects, there exists a gap between the design irrigation potential and actual utilization in most projects. Assessment of gap should be conducted for each PP, as Pani Panchayats have been formed in Odisha. The operational procedure consists of sending formats to PP and obtain information from them regarding area not receiving assured irrigation. Report of assessment to be furnished in format given in **Annexure 3**. Thereafter, based on the information/data received, compile tables of whole district **(Annexure 4)** for each distributary (Major, Medium), each canal (MIP), each River Lift Irrigation Project (RLIP).

## 4.2 River Basin Planning

Factors governing industrial water requirement depends on several factors such as, type of industry, size of industry and number of industries for a particular district / water supply / irrigation project. Water requirement for a few industries located in a town may be taken around 60 litres/head/day but the demand may go as high as 500 litres/head/day depending on type of industry. The water allocation to industries through Water Allocation Committee (WAC) as of 31.03.2016, is given in Annexure 2. While computing water demand for industries in a district, source wise water already allocated should be taken care of besides new requirements that may come up during the planning process. The new allocations may be decided by DoWR based on the DIAP.

District Water and Sanitation Mission is interested to workout water requirements for drinking and sanitation at district level. Water requirement for drinking and sanitation is calculated using the norm 55 litres per capita per day (lpcd) for humans to meet the following requirements:

**Table 10: Water Requirement**

| Purpose | Quantity (lpcd) |
|---|---|
| Drinking | 3 |
| Cooking | 5 |
| Bathing | 15 |
| Washing utensils and house | 10 |
| Ablution/Toilets | 10 |
| Washing of Clothes and other uses | 12 |
| Total | 55 |

*Source: National Rural Drinking Water Programme Movement towards ensuring people's Drinking Water Security in Rural India Guidelines – 2013*

River basin plans may be prepared annually taking inputs from the DIAPs. Preparation of river basin plans may be entrusted to the Chief Engineer - Basin Planning and Climate Change, who has a set up with manpower and system of preparing river basin plans. There are 12 river basins in Odisha and river basin planning is essentially to revisit earlier plans with updated data and augmentation of new observations, strategy developments for the concerned basin.

### CASCADE PLANNING

Cascade concept is new to Odisha. It is a sub unit of river basin. Cascade are used as units in planning and development of minor irrigation in Andhra Pradesh, Tamil Nadu, Karnataka and Sri Lanka. It is very useful in rolling topography and hilly areas. In a district, cascades will have to be delineated which are synonymous to watersheds. In the delineated cascade, existing minor irrigation schemes, check dams, traditional water bodies and proposed development of small water storage and small irrigation scheme should be mapped. MI schemes and check dams will be linked either through natural channels or construction of linked canals.

*The team who will be preparing DIAP should also be entrusted with cascade planning as it will be a new introduction in Odisha. Executive Engineer, Minor Irrigation who has the mandate to work on tanks and check dams may be made the lead officer for cascade planning.* Cascade plans may be integral part of the DIAP, so that available surface water resources in numerous streams of Odisha can be utilized in a planned manner as well as environmental aspects such as depletion of ground water table can be tackled appropriately.

### GUIDANCE TO CASCADE PLANNING

Entire watershed of the catchment areas should be taken as a cascade for planning. This will include the command area and area beyond the command till the point of confluence of the stream to the next higher order stream/ tributary or river of medium or a cluster of minor irrigation projects. After delineating the watershed to be called as cascade, in context of the toolkit, all existing irrigation projects should be mapped in the cascade map. Thereafter, the water volume in each irrigation structure may be calculated. For complete utilisation of the available runoff, all irrigation projects should be operated and wherever possible, spills from one project should be used by other projects in down-stream in the cascade. Such cascade planning is useful as an adaptation measure to reduce impact of climate change and to maximize use of scarce water resources.

## 4.3 Bridging the gap

Bridging the gap between Irrigation Potential Created (IPC) and Irrigation Potential Utilized (IPU) is a priority operation as it can be considered as a low hanging fruit. Actions for bridging gap will emanate from the extent of gap and causes of gap found out from a systematic assessment involving the Pani Panchayats. Canals are already laid-out, but water is not reaching to the designed area due to constraints/bottlenecks that are potentially removable. Some of the operational steps/procedures are conscripted below. Some suggestions will be received from the water users/farmers contained in PP level report. Actions can be grouped in following categories categorized by level of institution:

- Individual land holder or chak committee
- Pani Panchayat
- Irrigation Department, DoWR
- Agriculture Department

**Table 11: Information regarding action at different levels for bridging gap**

| Level of Institution | | | |
|---|---|---|---|
| Individual land holder or chak committee | Pani Panchayat | DoWR | Agriculture Department |
| Cleaning the field channels upstream of the plot | Maintenance of field channels | Making the gates functional at HR and CR | Promotion of water saving practices and Crops |
| | Implementation of Warabandi Plans | Preparation of Warabandi Plans | |

## MASCOTTE

The Mapping System and Services for Canal Operation Techniques (MASSCOTE) has been developed by the Land and Water Division (AGLW) of FAO on the basis of its experience in modernizing irrigation management in Asia. MASSCOTE integrates/complements tools that enable a complete sequence of diagnosis of external and internal performance indicators. It will result in developing the design of practical solutions for improved management and operation of the system. This approach is being followed in Karnataka under ADB supported project on irrigation management improvement.

## PRESENTATION OF THE METHODOLOGY

The first steps of MASSCOTE are conducted for the entire command area of a minor/distributary canal system with the goal to identify homogeneous managerial units. Then, for each of these units, specific options for canal operation are further sought by running the various steps of MASSCOTE for each unit taken separately. Then, aggregation and consolidation is carried out at the main system level. Thus, the methodology uses a back-and-forth or up-and- down approach for the different nested levels of management.

**Table 12: MASSCOTE**

| MAPPING - PHASE A: BASELINE INFORMATION | |
|---|---|
| 1. The Performance Rapid Appraisal Process (Rap) | Initial rapid system diagnosis and performance assessment through the RAP: the primary objective of the RAP is to allow qualified personnel to systematically and quickly determine key indicators of the system in order to identify and prioritize modernization improvements. The second objective is to start mobilizing the energy of the actors (managers and users) for modernization. The third objective is to generate a baseline assessment, against which progress can be measured. |
| 2. The Capacity And Sensitivity Of The System | The assessment of the physical capacity of irrigation structures to perform their function of conveyance, control, measurement, etc. Assessing the sensitivity of irrigation structures offtakes and cross regulators, identification of singular points. Mapping the sensitivity of the system. |
| 3. The Perturbations | Perturbations analysis: causes, magnitudes, frequency and options for coping with. |
| 4. The Networks & Water Balances | This entails assessing the hierarchical structure and the main features of the irrigation and drainage networks, on the basis of which partition of the system into subsystems will be made. Water accounting should be undertaken, considering both surface water and groundwater, and mapping the opportunities and constraints related to them. |

| | |
|---|---|
| 5. The Cost Of O&M | Mapping the costs associated with current operational techniques and resulting services, disaggregating the different cost elements; cost analysis of options for various level of services with current techniques and with improved techniques. |
| **Mapping - Phase B: Improving Canal Operation, Service Oriented Management** | |
| 6. The Service To Users | Mapping and economic analysis of the potential range of services to be provided to users at various levels of the systems. The services should be based on a compromise between the water management strategies, the agriculture objectives and the willingness to pay by users. |
| 7.Partitioning Into Management Subunits | The irrigation system management should be partitioned into few level of management and the command area should be divided and subunits (subsystems and / or subcommand areas) that are held homogeneous and / or separate from one another by a singular point or a particular borderline. |
| 8. Assessing The Demand For Operation | Assessing the resources, opportunity and demand for improved canal operation at the different levels of management and within the local management units. |
| 9. Identifying Canal Operation Improvements | Identifying improvement options (service and economic feasibility) for each management unit for (i) water management, (ii) water control, and (iii) canal operation. |
| 10. Integrating And Consolidating Management | Integration of the preferred options at the system level, and functional cohesiveness check. Consolidation and design of an overall information management system for supporting operation. |
| A Plan For Modernization And M&E | - Finalizing a modernization strategy and progressive capacity development<br>- Select/choose/decide/phasing the options for improvements<br>- Plan for M&E of the project inputs and outcomes. |

## 4.4 Crop Water Budgeting

Crop water budgeting is important as it will provide quantitative information on monthly requirement of water for unrestricted supply of water from soil to the crop for proper crop growth and crop production. This quantitative information is not only important for the officials who will prepare canal operation plan and supply water through canal network, but also for the Pani Panchayats and individual irrigators for having an awareness on the scientifically computed need of water for the crops and area covered by them during different cropping seasons. Such awareness and proper regulation of irrigation water is likely to trigger reduction in wasteful use of irrigation water due to over-irrigation and run-off from the irrigated plots as well as flowing of canal water into drains subsequently to rivers without being used by the crops.

As generally understood from the word 'budget', the calculations performed in preparing a crop water budget will also have two components i.e. demand and supply. In a financial budget, money is the concern and receipt and expenditures are two major components and often attempt is made to match the demand with supply. In case of crop water budget, the requirement/demand will be for field preparation, consumptive use, special needs whereas the supply could be from irrigation through canals, irrigation from bore wells, tube wells and dug wells and soil moisture extraction including ground water extraction by the plant roots besides rainfall. An example is given in **Annexure 5**.

Step by step procedure for preparation of a crop water budget for irrigation for jurisdiction area of a Pani Panchayat is described below:

**Step 1**: Collect Meteorological data such as rainfall (mm/month), min max temperature (degree C), humidity (%), wind speed (km/hr), sun shine hours (hrs/day). The data for a representative agro-met station should be obtained from sources like Indian Meteorological Department (IMD), Agriculture University, Irrigation Department, National Rice Research Institute (NRRI), Krishi Vikas Kendra (KVK), and Agriculture Department. Long term average data may be used as these are all variable data and depends on the weather conditions.

**Step 2**: Find out the latitude and longitude of an approximate central location of the PP jurisdiction and obtain the solar radiation data corresponding to the latitude.

As an example, we will take the data for Cuttack and put it in CROPWAT to find out the above parameters. An example is given in **Annexure 5**.

**Step 3**: Calculate $ET_o$ using Penmann method.

FAO has developed a software where required data is inbuilt in the system and minimal location specific data is required to be entered. By entering Min Temp (°C), Max Temp (°C) Humidity (%), Wind (Km/day), Sun (hours) and rainfall, $ET_o$ and effective rainfall can be calculated by CROPWAT.

**Step 4**: Find out the crop coefficient $K_c$ for the concerned crop and month from the crop coefficient curve.

**Step 5**: Find out the $ET_c$ by multiplying crop coefficient with $ET_o$. This is evapotranspiration for the crop and is also called as consumptive use.

**Step 6**: Now we know the consumptive use which is also the crop-water requirement. Next, we should convert this into volume of water required by the PP to meet the crop water requirement. This is an easy process of multiplying the CWR in mm/month to hectares of area under jurisdiction of PP. By dividing the value by $10^{-6}$ we can calculate the volume required in Million cubic meters (Mcm).

**Step 7:** In this step we should list all possible sources of water that could be used by the PP or individual irrigators to meet the crop water requirement. Sources could be either one or more of the following:

a. Surface water from canals that can be delivered through outlet
b. Tube wells, bore wells constructed by individual irrigators or community
c. Ponds and tanks from which water can be brought to the PP area
d. Dug wells which should be preferably within the PP area
e. Rainfall
f. Pumping from natural drains
g. Contribution from ground water
h. Soil moisture storage

Crop water budget can be presented in terms of depth of water. An example of crop water budget is given Table 13.

**Table 13: Crop water budget in terms of water depth**

| Sl No | Component of Water in cropped fields | Water Depth in mm | Demand mm | Supply needed mm |
|---|---|---|---|---|
| 1. | Evapotranspiration (Consumptive use) | 505.7 | | |
| 2. | Water used in field preparation | 150 | | |
| 3. | Percolation loss | 513.7 | | |
| 4. | Net Irrigation | 1127.2 | | |
| 5. | Gross Irrigation | 1611.1 | | |
| | Total water demand | 1611.1 | 1611.1 | |
| 6. | Precipitation | 27 | | |
| 7. | Effective Rainfall | 25.2 | | 25.2 |
| 8. | Supply needed from irrigation project (S.I 5- Sl. 7) | 1585.9 | | 1585.9 |
| | Total | | 1611.1 | 1611.1 |

**Table 14: Crop water budget in terms of water volume (MCM) for a sample command area of 450 hectares under a Pani Panchayat**

| Sl No | Component of Water in cropped fields | Water Depth in mm | Water volume (mcm) | Demand Mcm | Supply needed Mcm |
|---|---|---|---|---|---|
| 1. | Evapotranspiration (Consumptive use) | 505.7 | 2.27 | | |
| 2. | Water used in field preparation | 150 | 0.675 | | |
| 3. | Percolation loss | 513.7 | 2.311 | | |
| 4. | Net Irrigation | 1127.2 | 5.07 | | |
| 5. | Gross Irrigation | 1611.1 | 7.24 | | |
| | Total water demand | 1611.1 | 7.24 | 7.24 | |
| 6. | Precipitation | 27 | 0.12 | | |
| 7. | Effective Rainfall | 25.2 | 0.11 | | 0.11 |
| 8. | Supply needed from irrigation project (Sl 7- Sl 5) | 1585.9 | 7.13 | | 7.13 |
| | Total | | | 7.24 | 7.24 |

Water rates for irrigation use in Odisha are levied on the basis of area irrigated and the types of crops grown separately for Kharif and Rabi crops. *Kharif crops are levied with a compulsory basic water rate on basis of class of irrigation (the total depth of water) that the project is designed to supply which is to be paid irrespective of its use. But the Rabi rate is not compulsory and payable on use. Obviously, this system leads to excess use of water and wastage.*

## 4.5 Project-wise soil data finalization

The agriculture department will furnish the soil data with particular emphasis on soil textures. Soil details may be given as any one of the following types for each of the Pani Panchayat command area.

**Table 15: Types of soil**

| Texture | Field Capacity (FC) | Wilting Point (WP) | Available Water |
|---|---|---|---|
| Coarse sand | 0.6 | 0.2 | 0.4 |
| Fine sand | 1.0 | 0.4 | 0.6 |
| Loamy sand | 1.4 | 0.6 | 0.8 |
| Sandy loam | 2.0 | 0.8 | 1.2 |
| Light sandy clay loam | 2.3 | 1.0 | 1.3 |
| Loam | 2.7 | 1.2 | 1.5 |
| Sandy clay loam | 2.8 | 1.3 | 1.5 |
| Clay loam | 3.2 | 1.4 | 1.8 |
| Clay | 4.0 | 2.5 | 1.5 |
| Self-mulching clay | 4.5 | 2.5 | 2.0 |

## 4.6 Meteorological Data Collection

The data related to meteorological parameters can be sourced from the meteorological department. The data for minimum and maximum temperature, rainfall, humidity, sunshine hours and wind speed are required to scheme supply calculation using CROPWAT.

## 4.7 Use of CROPWAT for water budgeting and estimation of irrigation demand

Assessing the crop water requirement is quite essential as this can help in optimising the water use efficiency. This will be done by using CROPWAT, a decision support system developed by the Land and Water Development Division, Food and Agriculture Organization (FAO) of United Nations, Rome for planning and management of irrigation.

The computation using CROPWAT will enable the irrigation managers whether at Govt. or at PP level to match the irrigation demand with irrigation supply. CROPWAT is meant as a practical tool to carry out standard calculations for reference evapotranspiration, crop water requirements and crop irrigation requirements.

- This tool is used worldwide for better management of irrigation schemes.
- Outputs from this tool gives an idea on irrigation demand during different time periods like month, week, ten daily periods. Based on computed demand canal operation plans can be prepared.

Example on use of CROPWAT is given in **Annexure 5**. From the computations, data on parameters like evapotranspiration, effective rainfall, and special needs can be obtained to be used in Crop water Budget.

## 4.8 Project-wise Water Allocation

Based on the project wise crop coverage data received from agriculture department and water availability assessment conducted by the divisions in charge of the project, project wise water allocation for each of the crops for the crop growing season is to be worked out and presented in a tabular format as per Table 16.

**Table 16: Project-wise Water Allocation**

| Name of the Project | Project CCA | Kharif* | | | | Rabi* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Crop 1 | Crop 2 | Crop 3 | Total | Crop 1 | Crop 2 | Crop 3 | Total |
| | | Water Allocation in CuM | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**If there are more than three crops then no of columns can be added.*

## 4.9 Canal Operation Plan

Equitable distribution of water, efficient water use, maximising irrigated area in each cropping season would require transformation in the regulation mechanism of canals particularly in Major & Medium and Minor projects having long canal system network and regulation structures. Rotational water distribution plans have been proposed to ensure equitable distribution among all the stakeholders. Rotational Water distribution plans are suggested to be prepared in the proposed strategy at three levels viz.

- Main canals and branch canals controlled by Government
- Minor canals to be operated by Pani Panchayats
- Field Channels to be operated by Chak Committee under the guidance of Pani Panchayat.

### GOVERNMENT CONTROLLED CANALS

- This is the main canal which comprises of a number of distributaries and subsequently each distributary has certain number of minor and sub-minor canals.
- Rotational water distribution schedule for main canal or branch canal will consist of discharge rate for distributaries/minors and duration for which the concerned canal will be opened and operated at full supply level.
- The format has been furnished in Annexure 6.

### PANI PANCHAYAT (PP) LEVEL CANALS

- To supply irrigation water to this command area falling under the jurisdiction of PP, certain portion of canal network is transferred to the PP by Government. Mostly these canal systems are minors and sub-minors. (Annexure 7)
- The rotation will be between minors or group of outlets in a particular minor. For irrigation water distribution among outlets in a minor, the time allotment for each outlet is to be computed and a rotational plan will be prepared as given in template in Annexure 8.
- After preparation of the rotational schedule among the outlets, next step is to prepare Warabandi schedule for distribution of water to individual farmer plots or to plots of a group of farmers from the turn out. For such Warabandi schedule, data has to be compiled in a template given in Annexure 9.

### FIELD CHANNELS

- Warabandi means the rotation of water supply amongst the individuals or a group of farmers below each outlet. 'Wara' means rotation and 'Bandi' means fixation.
- Under this system, allocations of available water are made on basis of irrigable area of holding of each farmer under an outlet with choice of crops left to him. The system ensures water to the cultivator of the area regardless of the position of his field in the outlet command or his social or economic status.
- It leads to more efficient irrigation practices by the farmers. It stands for equitable distribution of water to larger number of farmers in the command. This results in greatest overall production per unit of available water. (**See Annexure 9**)

## 4.10 District level irrigation planning for different seasons in various blocks

In section 3, crop planning in irrigation projects is described. After the preparation of crop plan, irrigation planning, i.e. how much area will be provided from all irrigation projects, needs to be prepared based on the water availability and crop water demand. The proposed area for Kharif and Rabi Season in different blocks of district for the concerned year should be furnished in the format given in Table 17.

**Table 17: Template for Proposed Irrigated Area for Kharif and Rabi Season in different blocks of District for 2018-19**

| Name of the Project/ Canal System | Name of District | Division | Block | Design CCA | Proposed Irrigation programme for Kharif 2018-19 | Proposed Irrigation programme for Rabi 2018-19 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

## 4.11 Flow Monitoring and Benchmarking

### GAUGE DISCHARGE MEASUREMENT

In major and minor irrigation projects, in all head regulators gauge discharge has to be measured at least once in a day regularly. It has to be documented by the respective irrigation divisions of DoWR.

## CROP PRODUCTIVITY DATA COLLECTION

Crop productivity data of different crops for last 10 years will be collected from the Department of Agriculture to analyse the impact of irrigation on crop productivity. As climate resilient agricultural practice and adaptation activity to climate change, introduction of new varieties, adoption of better water management and better cultivation practices should be promoted that will contribute to higher productivity. Farm mechanization can be introduced for timely ploughing, transplanting/sowing, harvesting operations leading to higher productivity.

## BENCHMARKING AND MONITORING OF SELECTED PARAMETERS

The operation of the canal system can be monitored in terms of measurement of flow, discharge at the outlet, minimum loss of water, water control mechanism, functioning of head and cross regulators, full supply depth for a longer period of time to assess the efficiency of irrigation system. In case of minor projects, water holding capacity of the tank needs to be assessed, water flow to the tail end needs to be ensured. Benchmarking Indicators taken from guideline of Ministry of Water Resources, Govt. of India are given in Table 18. At the district level, the indicators may be appropriately selected and furnished in the DIAP. The names of the schemes and their salient features while benchmarking will be carried out is to be incorporated in the DIAP.

**Table 18: Main Performance indicators of benchmarking of irrigation project**

| Sl. No. | Domain | | Performance indicator |
|---|---|---|---|
| I. | System Performance | 1 | Water delivery capacity Index |
| | | 2 | Total annual volume of irrigation water supplied/delivered ($m^3$/year) |
| | | 3 | Field application efficiency |
| | | 4 | Annual Relative Irrigation Supply Index |
| | | 5 | Annual Irrigation water supply per unit command area (Cum/ha) |
| | | 6 | Annual Irrigation Water Supply per unit irrigated area (Cum/ha) |
| II. | Agricultural Productivity | 7 | Output per unit command area (Rs/ha) |
| | | 8 | Output per unit irrigated area – Tons / ha crop-wise. (Rs./ha.) |
| | | 9 | Output per unit irrigation supply (Rs/Cum) |
| | | 10 | Output per unit crop water demand (Rs/Cum) |
| III. | Financial Aspects | 11 | Cost recovery ratio |
| | | 12 | Total O&M cost per unit area (Rs/ha) |
| | | 13 | Total cost per person employed on O&M Works (Rs/person) |
| | | 14 | Revenue collection performance |
| | | 15 | Revenue collection performance |
| | | 16 | Maintenance cost to revenue ratio |
| | | 17 | Staff numbers for O&M per unit area (persons/ha) |
| | | 18 | Total O&M cost per unit of water supplied (Rs./Cum) |
| IV. | Environmental Aspects | 19 | Average depth to water table (m) |
| | | 20 | Land Damage Index |
| | | 21 | Water Quality: Ph/Salinity/Alkalinity Index |
| | | 22 | Salt balance (tones) |

## 4.12 Water Availability Assessment

Water availability and use are a function of the total flow of water through a basin, its quality, and the structures, laws, regulations, and economic factors that control its use. Because water availability and water use are closely linked, "water availability" will be used for brevity in the following sections to include both water availability and water use.

**Table 19: Water Availability**

| Particulars | Indicators |
|---|---|
| Surface Water | • Assessments of long-term trends<br>• Reservoir storage, construction, sedimentation, and removal<br>• Storage in large lakes |
| Ground Water | • Changes in ground-water storage due to withdrawals, land drainage, and<br>• Number and capacity of supply wells and artificial recharge facilities |
| Other | • Total withdrawals by source (surface water and ground water) and sector (public supply, domestic, commercial, irrigation, livestock, industrial, mining, thermoelectric power, and hydropower)<br>• Reclaimed wastewater<br>• Conveyance losses<br>• Consumptive uses |

## 4.13 Maintenance Plan

Maintenance plan needs to be carried out by both DoWR and Pani Panchayats.

**Table 20: Maintenance Plan**

| Maintenance Measures | Agency Responsible |
|---|---|
| 1. Construction and repair of head structures | DoWR |
| 2. Canal Lining | DoWR |
| 3. Canal Roads | DoWR |
| 4. Embankments | DoWR |
| 5. Construction, maintenance and repair of all the water courses, field channels, field drains and other drain Structures | Pani Panchayats |

## 4.14 New Command Plan

Under this section, Department of Water Resources (DoWR) will have to visualise creation of additional irrigation potential to meet the increasing demand for irrigation in the district. Gradually, it should aim at access to irrigation by all farm families in the district.

For example, individual bore-wells, farm ponds can be constructed anywhere in the district for farmers to access some kind of irrigation, even if it is protective. The new command plan must consider activities by all water related departments including farmers themselves. OLIC, OAIC, watershed department, DRDA, blocks are important agencies who will also have some activity/work for adding new command in the district. New command plan should be presented as given in **Annexure 10.**

# 4.15 Capacity Building

## TRAINING NEEDS ASSESSMENT

A training needs assessment is a process that serves as a diagnostic tool for determining what training is required to help individuals and organizations to accomplish their goals and objectives. A survey is used to gather data to assess trainee's knowledge, skills, attitudes and abilities and to identify any gaps or areas of need. After the training needs are identified, learning objectives are determined and suitable training to reach these objectives designed and developed.

## TRAINING DESIGN

Training design consists of defining objectives of the entire training course, learning objectives for individual training sessions, contents of all the training sessions, names of resource persons, duration of different training sessions and the entire training course.

**Training Program Objectives:** It should be decided based on the gaps identified during the training needs assessments and jobs to be performed by the targeted trainees after undergoing the training. For example, objectives for imparting training to PP secretary would be

- Develop capability to prepare an operational plan of a canal.
- Develop ability to conduct participatory transact work and document the maintenance requirement of a canal.
- Familiarization with accounting and financial procedures like preparation of bills and utilization certificate.

**Training Plan:** The training plan is an elaborate statement mostly in a tabular format which will inform what is the sequence of activities and who will be doing what in the training course. All sessions/lesson topics, their duration, name of the trainer, type of target group, venue of the training, monitoring evaluation framework should form part of a training plan.

For institutionalisation of DIAP system in Odisha as a climate change adaptation action plan, there will be need for capacity building both for preparing the DIAP and its effective implementation in the district concerned. In DIAP, climate resilient cropping pattern, crop calendar, awareness for efficient use of water by educating on crop water budget and higher role to Water Users Associations (WUAs) are to be proposed. All these ingredients of DIAP are organically linked to climate change adaptation. Under capacity building activity, training for irrigation officials and field functionaries of DoWR and Pani Panchayat members is to be planned and incorporated in the DIAP. The training can be offered at Water and Land Management Institute (WALMI), an autonomous organization under DoWR, Govt. of Odisha. A template is given in Table 21 for furnishing the detailed requirement of capacity building.

**Table 21: Training**

| Sl. No | Target Group | No of participants | Duration | No. of training | Proposed Dates |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## 4.16 Training Evaluation

Training cycle starts with training needs assessment and should ideally complete with an evaluation. Training involves a lot of effort, costs and manpower, and it is imperative that an evaluation is carried out. Evaluation process can consist of comparing the level of trainees at the time of entry to that of exit in a training course. Questionnaire on knowledge and skills expected from the training for performing the job may be prepared. This questionnaire can be filled up by the evaluator in the beginning of the training course (Pre-training status) and at the end of training (post-training status). Besides the questions, provision should be kept for the participants to provide their suggestions and opinions about the course which they have attended. Analysis of the information collected through the questionnaire and summarization of the suggestions together can be compiled as an evaluation report.

## 4.17 Training Field Monitoring

The issue of training and all the related actions are meant for better functioning of the functionaries and stakeholders who are going to be directly or indirectly involved in planning, implementation and monitoring of the DIAP. Depending on the job assigned to a person and his ability to perform, a certain degree of performance is normally seen in the field. It is important to conduct field level monitoring of a sample consisting of those persons who have undergone training. For field monitoring, a schedule can be prepared covering what the individual is supposed to do, what he is doing and the working environment. Analysis of such feedback can lead to develop further strategies both in conduct of future trainings and changing the working environment leading to better performance of the functionaries.

05

# IMPLEMENTATION AND MONITORING

In this chapter, implementation of the DIAP for the concerned district should be discussed. Task should be specified at different levels in the hierarchical administration of the respective departments. Physical targets are to be fixed. A flow chart describing implementation process for operationalization of DIAP with definite milestones and timelines should be made and included in the DIAP. An illustrative flowchart for Cuttack and Subarnapur district is given in Figure 2 and Figure 3.

## MONITORING

Quarterly monitoring of the progress should be conducted within 15 days after the end of the quarter. The quarterly monitoring reports should be submitted to the concerned irrigation divisions PD (Watershed), PD (DRDA), Deputy Director (Agriculture), Deputy Director (Horticulture).

The nodal officer of DIAP should compile all reports after obtaining the same from the respective divisions and district level offices. A consolidated monitoring report with his observations should be submitted to District Collector within 1 month after end of the respective quarter. The nodal officer should also send the consolidated report to the Principal Secretary, DoWR and Agriculture with specific proposals for any intervention of the Govt. level.

**Figure 2: Flowchart for operationalization of irrigation planning in kharif season**

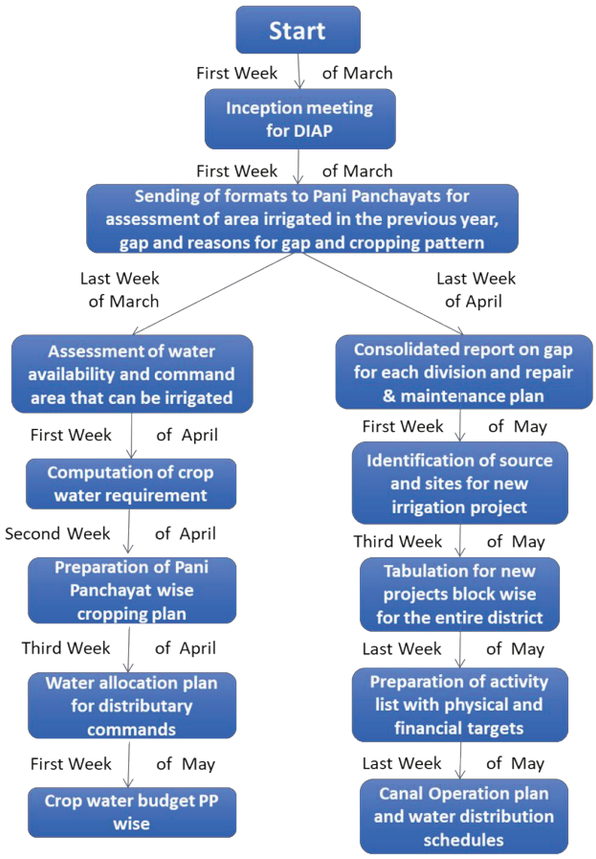
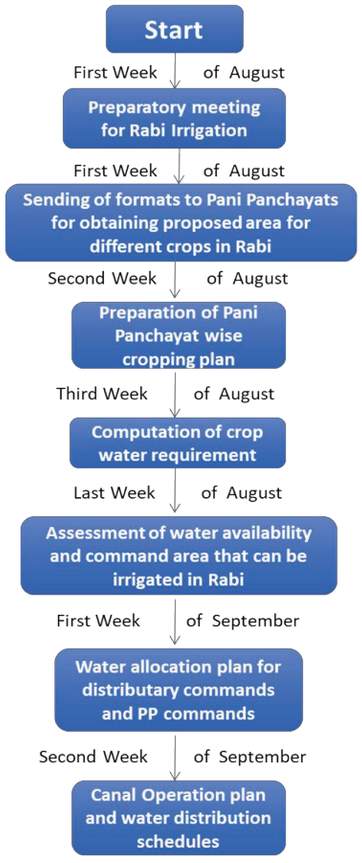



**Figure 3: Flowchart for Operationalization of Irrigation planning in Rabi Season**



# ANNEXURES

# Annexure 1:

Proposed Cropping Pattern (Data of Kusunpur MIP in Tangi-Choudwar Block of Cuttack District)[8]

| Season | Crop | Gross Requirement | Existing Area (ha) | Existing Volume (ha-m) | Proposed Area (ha) | Proposed Volume (ha-m) | Increase in Area (%) | Effect in Volume of water utilized (%) |
|---|---|---|---|---|---|---|---|---|
| Kharif | Paddy | 283.3 | 354 | 100 | 150 | 42.5 | 7.14 | - 26.17 (Proposed volume of irrigation water as less in percentage to the existing volume) |
| | Groundnut | 116.7 | 0 | 0 | 220 | 25.67 | | |
| | Bitter gourd | 466.7 | 10 | 5 | 20 | 9.33 | | |
| | Total | | 364 | 104.97 | 390 | 77.50 | | |
| Rabi | Chillies | 666.67 | 20 | 13 | 40 | 26.70 | 77.42 | Volume of irrigation water in rabi is 95.60% more than the existing volume |
| | Green gram | 350 | 42 | 15 | 50 | 17.50 | | |
| | Sunflower | 533.33 | 0 | 0 | 20 | 10.70 | | |
| | Total | | 62 | 28.03 | 110 | 54.83 | | |

8 While preparing the proposed cropping pattern paddy in Kharif is reduced and more area is allotted to Ground nut and Bitter gourd (crops which are presently grown in smaller area in the irrigation project. Similarly, in rabi season, more area is allotted to Chilly and 20 ha of area is allotted to Sunflower.

# Annexure 2:

Allocation of Water to Industries through WAC (Status as on 31.03.2016)

| | | | | | |
|---|---|---|---|---|---|
| 1 | NTPC | Dharlipali, Sambalpur | Power (3200 MW) | 95.000 | Hirakud Reservoir |
| 2 | ESSAR Steel Odisha Ltd., | Paradeep | Steel | 34.820 | Taladanda Canal |
| 3 | Odisha Integrated Power Project | Bhasma, Jharsuguda | Power | 150.000 | Hirakud Reservoir |
| 4 | POSCO India (P) Ltd. | Paradeep | Steel | 122.630 | Mahanadi Barrage |
| 5 | Vedanta Alumina Ltd. | Jharsugura | Aluminium | 40.900 | Hirakud Reservoir |
| 6 | INDAL | Hirakud | Aluminium | 20.000 | Hirakud Reservoir |
| 7 | Sterlite Energy Ltd. | Jharsuguda | Power | 72.000 | Hirakud Reservoir |
| 8 | Rathi Steel & Power Ltd. | Pottapally, Sambalpur | Steel | 9.810 | Power channel Pond-2 of Hirakud Reservoir |
| 9 | SPS Steel & Power Ltd. | Badmal, Jharsuguda | Steel | 3.730 | Hirakud Reservoir |
| 10 | Skol Brewaries Ltd | Paradeep | Beer | 0.300 | Taladanda Canal |
| 11 | NTPC | Gajamara, Dhenkanal | Power | 160.000 | Mahanadi River |
| 12 | Visa Power Ltd. | Brahmanabasta, Athagarh, Cuttack | Power | 20.000 | Mahanadi River |
| 13 | Eastern Steel & Power Ltd. | Jharsuguda | Steel | 2.200 | Ib River |
| 14 | Jain Steel & Power Ltd. | Durlaga, Jharsuguda | Steel | 4.090 | Ib River |
| 15 | Maheshwary Isapt Pvt. Ltd. | Rampei, Khuntuni, Cuttack | Steel | 4.080 | Mahandi River |
| 16 | Nayagarh Sugar Factory | Panipoila, Nayagarh | Sugar | 1.430 | Piteijhar MIP |
| 17 | Bhubaneswar Power Pvt. Ltd | Anantapur, Athagarh, Cuttack | Power | 5.400 | D/S of Mundali weir |
| 18 | Aditya Aluminium | Jharsuguda | Aluminium | 52.730 | Hirakud Reservoir |
| 19 | Bhushan Power & Steel Ltd. | Laphanga, Sambalpur | Steel | 70.000 | Hirakud Reservoir |
| 20 | Indian Oil Corporation Ltd. | Paradeep | Oil | 73.200 | Mahanadi Barrage |
| 21 | Shyam DRI Power Ltd. | Pandloi, Sambalpur | Steel | 5.640 | Hirakud Reservoir |
| 22 | SMC Power Generation Ltd. | Hirma, Jharsuguda | Steel | 2.450 | Hirakud Reservoir |
| 23 | Viraj Steel & Energy Ltd. | Gurupali Pandloi, Sambalpur | Steel | 1.500 | Hirakud Reservoir |
| 24 | KVK Nilachal Power Ltd. | Gurudighatia, Cuttack | Power | 48.000 | Mahanadi River |
| 25 | Tata Power Company Ltd. | Naraj, Cuttack | Power | 40.000 | Mahanadi River |
| 26 | Sesa Sterelite (Vedanta Alumina Ltd.) | Lanjigarh, Kalahandi | Aluminium | 19.620 | River Tel |
| 27 | Arati Steel Ltd. | Ghantikhal, Athagarh, Cuttack | Steel | 9.720 | Mahanadi River |
| 28 | Utkal Power Ltd. | Chasapada, Cuttack | Power | 4.610 | Mahanadi River |
| 29 | Navayuga Engg. Co. Ltd. | Astaranga, port | Steel | 2.040 | Devi River |
| 30 | Agrim Steel Industries Ltd. | Markuta, Jharsuguda | Steel | 4.210 | Hirakud Reservoir |
| 31 | T.S. Alloys (Rowmet Ferrow Alloys Ltd) | Athagarh, Cuttack | Steel | 1.000 | Mahanadi River |
| 32 | Anil Agarwal Foundation (Vedanta University) | Puri | University | 1.000 | Siaro cut (Constn. purpose) |
| 33 | Lanco Solar Pvt. Ltd. | Ramdaspur, Cuttack | Solar cell | 2.040 | Mahanadi river |
| 34 | Sahara India Power Corp. Ltd | Titlagarh | Power | 53.000 | Tel River (Assurance) |
| 35 | Action Ispat & Power (P) Ltd | Pandiripathar, Jharsuguda | Steel | 1.510 | Hirakud Reservoir |
| 36 | Kaz Story Service Infrastructure Pvt. Ltd.. | Bhubaneswar-Puri (NH-23 four laning) | Construction Company | 0.040 | Daya |
| 37 | Ind Barath Energy Ltd. | Shajbahal, Jharsuguda | Power | 42.000 | Hirakud Reservoir |

| | | | | | |
|---|---|---|---|---|---|
| 39 | MSP Metallics Ltd. | Marakuta, Jharsuguda | Steel | 4.080 | HR |
| 40 | Fisheries & ARD Deptt. | Chiplima Firm | Fodder | 1.500 | Power Channel (Hirakud) |
| 41 | Monnet Power Company Ltd. | Malibrahmini & NISA, Angul | Power | 37.000 | |
| 42 | Jindal Steel & Power Ltd. | Angul | Steel | 95.160 | Samal Barrage |
| 43 | NTPC | Kaniha, Angul | Power | 120.000 | |
| 44 | Jindal India Thermal Power Ltd. | Derjang, Angul | Power | 30.000 | Samal Barrage |
| 45 | LANCO Babandha Power Ltd. | Babandh, Dhenkanal | Power | 80.000 | Brahmani River |
| 46 | *Mahanadi Aban Power Co. Ltd. | Gantapada (Talcher) | Power | 35.810 | Brahmani River |
| 47 | Talcher Thermal Power Station | Angul | Power | 69.290 | Brahmani River |
| 48 | Jindal Stainless Ltd. | KIC* , Jajpur | Steel | 33.449 | Brahmani River |
| 49 | Nava- Bharat Power (P) Ltd. (Malaxmi) | Dhenkanal | Power | 42.000 | Brahmani River |
| 50 | G.M.R. Energy Ltd. | Komalanga, Angul | Power | 30.000 | Brahmani River |
| 51 | Maharastra Seamless Ltd. | KIC*, Duburi, Jajpur | Steel | 10.790 | Brahmani River |
| 52 | VISA Steel Ltd. | KIC*, Duburi, Jajpur | Steel | 6.340 | Kharsuan River |
| 53 | Surendra Mining | Barahmusa, Bonei, Sundergarh | Steel | 3.530 | Brahmani River |
| 54 | MGM Steel | Nimidhiha, Dhenkanal | Steel | 1.630 | Brahmani River |
| 55 | Essel Mining & Industries Ltd. | Kasia, Keonjhar | Mining | 1.160 | Karro River |
| 56 | Sree Metaliks Ltd. | Barbil, Keonjhar | Steel | 0.260 | |
| 57 | Bindal Sponge Ltd. | Sunakhani, Talcher | Steel | 0.810 | Brahmani River |
| 58 | CESC Ltd. | Neulapol, Dhenkanal | Power | 40.000 | Brahmani River |
| 59 | Tata Steel Ltd. | KIC*, Duburi, Jajpur | Steel | 74.320 | Kharasuan River |
| 60 | Bhushan Steel & Strips Ltd. | Meramundali, Dhenkanal | Steel | 46.000 | Brahmani River |
| 61 | BRG Iron & Steel Co. (P) Ltd. | Khurunti, Dhenkanal | Steel | 8.380 | Brahmani River |
| 62 | Deo Mines & Minerals | Thaiberna, Sundergarh | Steel | 5.890 | Brahmani River |
| 63 | Shri Mahavir Ferro Alloys | Kalugaon, Sundergarh | Steel | 4.900 | Brahmani River |
| 64 | Nava- Bharat Ventures Ltd. | Kharagaprasad, Dhenkanal | Steel | 5.000 | Sankha River |
| 65 | Adhunik Metaliks Ltd. | Kuanra munda Sundergarh | Steel | 3.730 | Koel River |
| 66 | Bhaskar Steel & Ferro Allosy. | Tumkela, Sundergarh | Ferro Alloys | 2.730 | Brahmani River |
| 67 | Arya Iron & Steel Co. Pvt. Ltd. | Matkambeda, Barbil, Keonjhar | Steel | 0.590 | Karro River |
| 68 | SCAW Industries (P) Ltd. | Dhenkanal | Steel | 2.450 | Brahmani River |
| 69 | Jindal Steel & Power Ltd. | Tensa, Bonai | Mining | 0.100 | Semiji Nallah |
| 70 | Hind Metals & Industries (P)Ltd. | Meramandali, Angul | Steel | 0.215 | Brahmani River |
| 71 | NALCO, Coal Mines | Durgapur, Angul | Aluminium | 0.400 | Singidajore |
| 72 | Shaslivahana Green Energy | Nimidha, Dhenkanal | Power | 1.000 | Brahmani River |
| 73 | OCL India Cement & Refractory Plant. | Rajgangapur, Sundargarh | Cement | 4.940 | Sankh River |
| 74 | Sree Ganesh Metaliks Ltd. | Kuanramunda, Rourkela | Steel | 1.180 | Sankh River |
| 75 | OCL India Iron & Steel Project | Lamioi Rajagangapur | Steel | 1.740 | Sankh River |
| 76 | IDCO | Kalingangar Industrial Complex | Water Supply Installation | 8.000 | Brahmani River |
| 77 | Odisha Thermal Power Corporation | Rengal, Angul | Power | 80.000 | Brahmani River (Relocation of plant under process) |

| | | | | | |
|---|---|---|---|---|---|
| 79 | Monnet Ispat Energy Ltd. | Malibrahmani & Nisa, Angul | Steel 0.25 MTPA & Coal Industry | 6.000 | Brahmani |
| 80 | IDCO, Rourkela | Sundergarh | Imphastructure Development | 0.170 | Sankh |
| 81 | M/s Vijaya Krishna Lall | Turumura, Sundargarh | Mines | 0.008 | Naktijore |
| 82 | M/s Vijaya Krishna Lall | Jarbeda, Sundargarh | Mines | 0.010 | Naktijore |
| 83 | M/s Shyam Steel Industries | Thaiberma, Sundargarh | Pallets Benefication Plant | 1.471 | Brahmani |
| 84 | ESSAR Steel Ltd. | Dabuna, Barbil, Keonjhar | Steel | 11.770 | Baitarani River |
| 85 | FACOR Power Ltd. | Randia, Bhadrak | Power | 1.800 | Salandi River |
| 86 | Sree Metaliks Ltd. | Khandband mines, Joda, Keonjhar | Mining | 0.061 | Sona River |
| 87 | Naibaga & Katupalli Iron Ore mines | Dabuna Joda, Keonjhar | Mining | 0.020 | Purunadihi Nallah |
| 88 | Brahmani River Pellet Ltd. | Tonto, Naidai in Keonjhar | Steel | 4.700 | Baitarani River |
| 89 | Jindal Steel & Power Ltd. | Deojhar, Keonjhar. | Iron Ore Beneficiation | 14.710 | Baitarani River (8.33 cusec in Ph-I) |
| 90 | Dhamra Port Company Ltd. | Dosinga/ Amarnagar Bhadrak | Port | 2.050 | Mantei River |
| 91 | M/s Sundarlal Sarda & Mohanlal Sarda (Sarda Mines Pvt. Ltd.) | Thakurani Iron Ore Mines, Block- B, Barbil Dist- Keonjhar | Mining | 0.330 | Betalatai Nallah |
| 92 | Emami Paper Mills Ltd. | Balagopalpur, Balasore | Paper | 5.518 | Sona River |
| 93 | Titanium Products Pvt. Ltd. | Ganjam | Titanium | 5.490 | Rushikulya River |
| 94 | Gopalpur Port Ltd. | Ganjam | Port | 0.140 | Kharia Nallah |
| 95 | Aditya Aluminum | Kansariguda, Rayagada | Aluminum | 8.170 | River Nagavali |
| 96 | Utkal Alumia International Ltd. | Rayagada | Aluminum | 9.000 | Indravati River |
| 97 | HINDALCO | Pottangi, Korapur | Bauxite Mining | 0.029 | Kolab Reservoir |
| 98 | NALCO | Damanjodi, Koraput | Mining | 0.929 | Jholaguda Stream |
| 99 | HAL | Sunabeda | Aeronautic | 6.130 | Kerandi River (Kolab Reservoir) |
| 100 | Indo Pallets Pvt. Ltd. | Motuda, Joda Keonjhar | Iron Ore beneficiation | 3.730 | Suna River |
| 101 | MCL, Talcher | Talcher | Mining | 18.578 | Brahmani River |
| 102 | NALCO | Angul | Aluminium | 46.321 | Brahmani River |
| 103 | BGR Energy System Ltd. | Bhapur, Nayagada | Power | 40.000 | Mahanadi River |
| 104 | J.R. Powerjen Pvt. Ltd. | Baija, Angul | Power | 58.000 | Mahanadi River |
| 105 | Kalinga Calciner Ltd. | Paradeep | Calcination | 0.185 | Taladanda Canal |
| 106 | Ib Thermals (OPGC) | Banharpali | Power | 52.980 | Hirakud Reservoir |
| 107 | RSB Metal Tech Pvt. Ltd. | Markata, Dhenkanal | 0.175 Al. Smelter 450MW CPP | 32.180 | Brahmani |
| 108 | NTPC-SAIL Power Company (P) Ltd. | Raurkela | Power-250 MW | 10.000 | Brahmani |
| 109 | Neelachal Ispat Nigam Ltd | Jaraka, Jajpur | 1.1MTPA Steel | 12.940 | Kharsuan |
| 110 | M/s Angul Alluminium Park Pvt. Ltd. (IDCO & NALCO) | Angul | Aluminium | 4.000 | Brahmani |
| 111 | J.K. Laxmi Cement Ltd. | Radhesyampur, Athagarh, Cuttack | Cement | 0.120 | Mahanadi |

# Annexure 3:

Report for assessment of gap through PPs

Name of PP:
Name of the Canal:
Name of distributary
Name of Project:
Name of GP and block:

| Sl. No | Name of the outlet | Total no of plots | Total area (CCA) in hectares | Plot Nos as per village map not getting assured water supply | Total Area of all plots as mentioned in Column 5. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Total | | Total | | | |

Total gap:

% of gap:

Causes for gap (Describe specific reasons with location details):
Suggestions for bridging the gap:

Signature:

(President PP) (Secretary PP) (JE/AE, Irrigation Section) (Asst. Agri Officer, Block)

# Annexure 4:

Compiled report on gap between irrigation potential and actual utilization in the assessment year

| Sl. No | Name of Distributary/ Canal/ RLIP | Design CCA | No of PPs | No of Chaks | No of outlets | Gap in Ha | Gap in % | Causes of Gap | Assessment year | Possible Remedies |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

# Annexure 5:

Step by Step CROPWAT Calculation

## PROCESS

Let us take the parameters of Cuttack district to better understand the process of using CROPWAT.

## STEP 1: INPUTTING AND COLLATING CLIMATE DATA

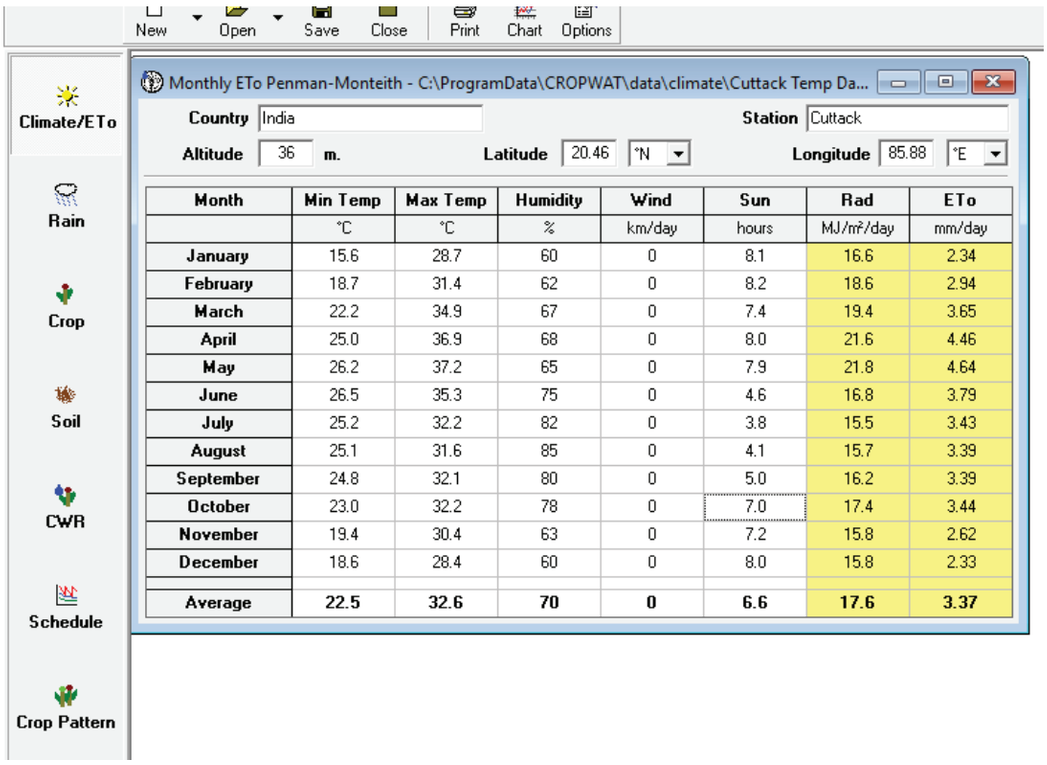
Click on the 'Climate/ETo' button on left side panel to input the collected climate data. CropWat uses daily, decade or monthly climate data to estimate reference evapotranspiration (ETo).

- If you want to calculate irrigation water requirements for any previous year, then you need to collect the climate data for that year from your nearest meteorological station.
- If you want to calculate irrigation water requirements for any future time then you need to collect future forecast data.
- If local climatic data are not available, you can obtain those data for over 5,000 stations worldwide from CLIMWAT (an associated climatic database).

CropWat requires the following climate data:

- maximum and minimum temperature (°C) or average temperature (°C),
- relative humidity (%) or vapour pressure (kPa),
- wind speed (km/day or m/s),
- Sunshine hour or percent of day length or fraction of day length.

**Figure 4: Climate Data**

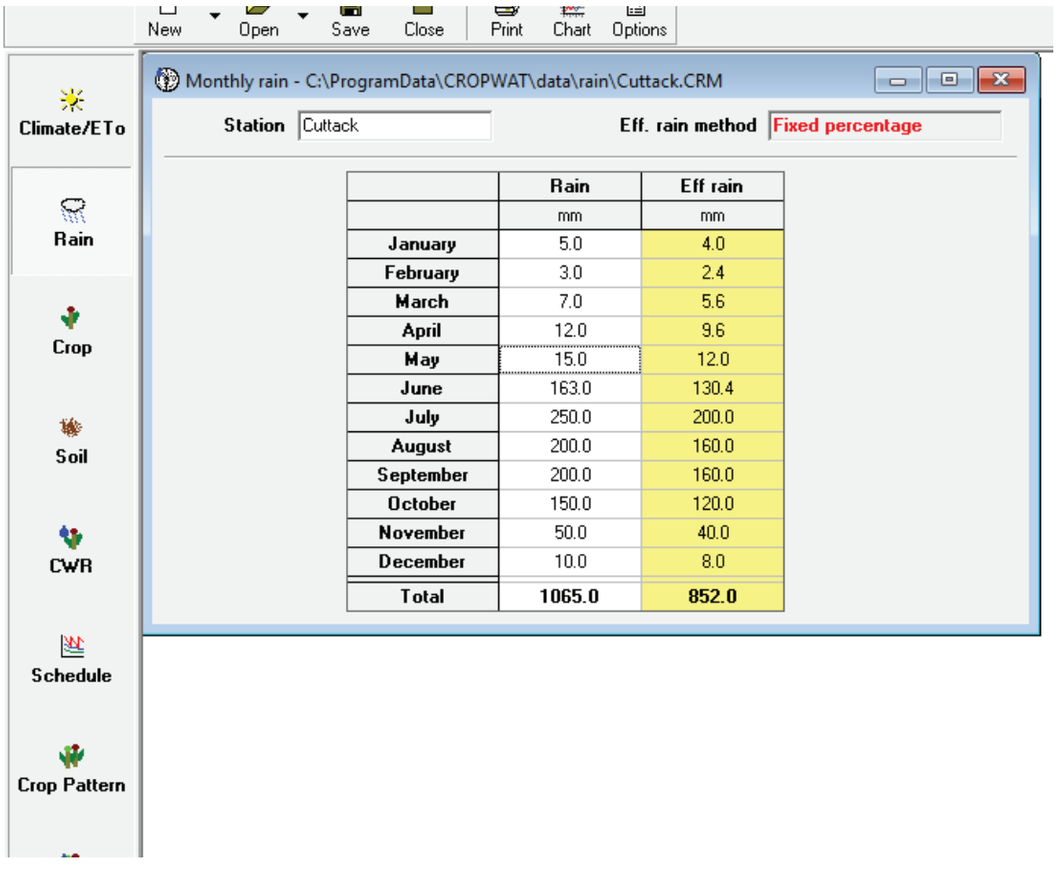



| Month | Min Temp | Max Temp | Humidity | Wind | Sun | Rad | ETo |
|---|---|---|---|---|---|---|---|
| | °C | °C | % | km/day | hours | MJ/m²/day | mm/day |
| January | 15.6 | 28.7 | 60 | 0 | 8.1 | 16.6 | 2.34 |
| February | 18.7 | 31.4 | 62 | 0 | 8.2 | 18.6 | 2.94 |
| March | 22.2 | 34.9 | 67 | 0 | 7.4 | 19.4 | 3.65 |
| April | 25.0 | 36.9 | 68 | 0 | 8.0 | 21.6 | 4.46 |
| May | 26.2 | 37.2 | 65 | 0 | 7.9 | 21.8 | 4.64 |
| June | 26.5 | 35.3 | 75 | 0 | 4.6 | 16.8 | 3.79 |
| July | 25.2 | 32.2 | 82 | 0 | 3.8 | 15.5 | 3.43 |
| August | 25.1 | 31.6 | 85 | 0 | 4.1 | 15.7 | 3.39 |
| September | 24.8 | 32.1 | 80 | 0 | 5.0 | 16.2 | 3.39 |
| October | 23.0 | 32.2 | 78 | 0 | 7.0 | 17.4 | 3.44 |
| November | 19.4 | 30.4 | 63 | 0 | 7.2 | 15.8 | 2.62 |
| December | 18.6 | 28.4 | 60 | 0 | 8.0 | 15.8 | 2.33 |
| Average | 22.5 | 32.6 | 70 | 0 | 6.6 | 17.6 | 3.37 |

## STEP 2: INPUTTING AND COLLATING RAINFALL DATA

Feed in the month-wise rainfall data to get effective rainfall data. It is illustrated in Figure 5

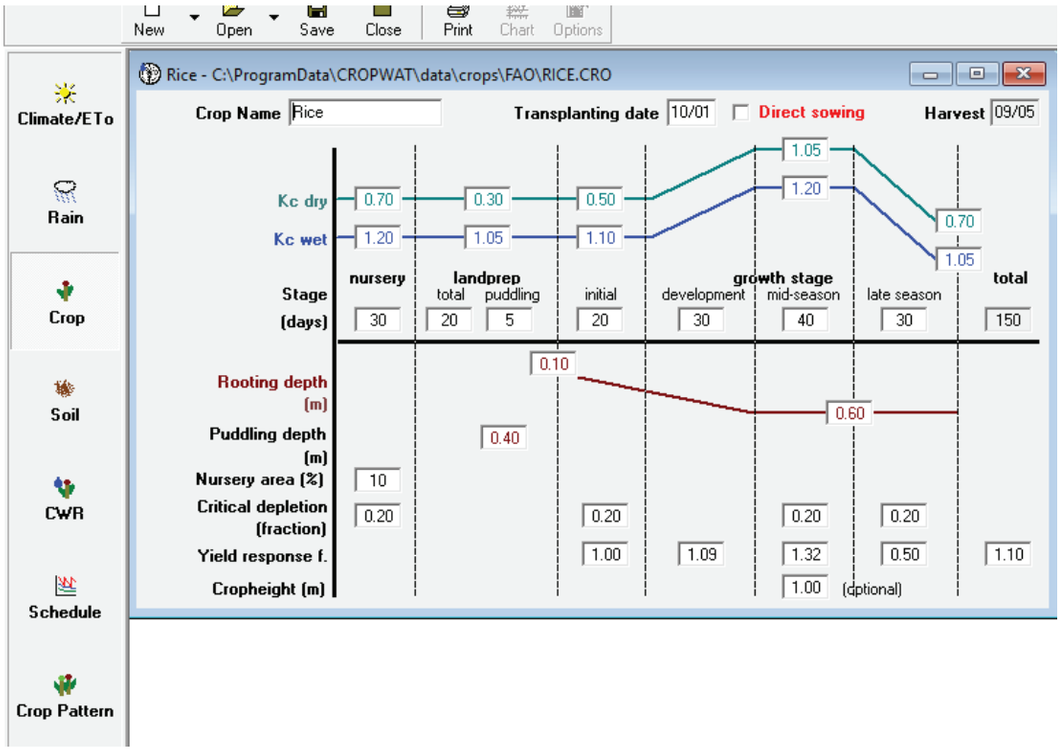
**Figure 5: Rainfall data**



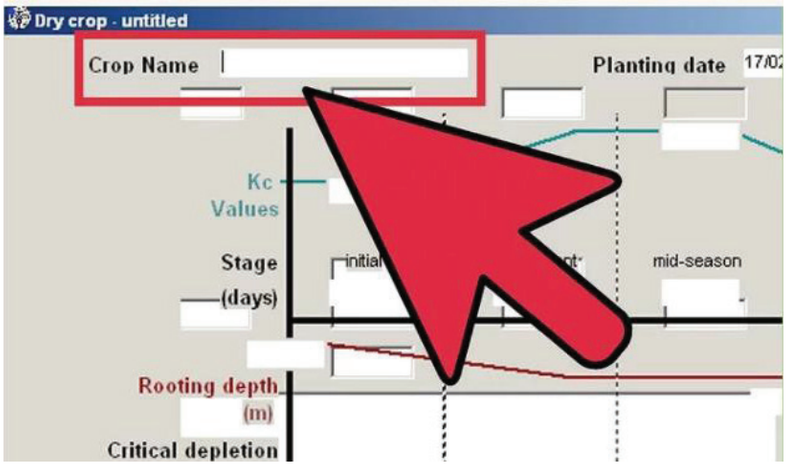

| | Rain | Eff rain |
|---|---|---|
| | mm | mm |
| January | 5.0 | 4.0 |
| February | 3.0 | 2.4 |
| March | 7.0 | 5.6 |
| April | 12.0 | 9.6 |
| May | 15.0 | 12.0 |
| June | 163.0 | 130.4 |
| July | 250.0 | 200.0 |
| August | 200.0 | 160.0 |
| September | 200.0 | 160.0 |
| October | 150.0 | 120.0 |
| November | 50.0 | 40.0 |
| December | 10.0 | 8.0 |
| Total | 1065.0 | 852.0 |

## STEP 3: INPUTTING AND COLLATING CROP DATA

**Figure 6: Crop data**




Collect and input crop data. Collect the required crop data. Click on the 'Crop' button on the left side panel to input the crop data. CropWat is suitable to estimate irrigation water requirements for both dry crops and rice.




Collect the following crop data for dry crops:

- planting date,
- Kc values at initial, mid-season and at harvest,
- number of days for initial, development, mid-season and late season,
- rooting depth (m),
- critical depletion (fraction) at initial, mid-season and late season,
- yield response factor at initial, development, mid-season and late season,
- Crop height (m).

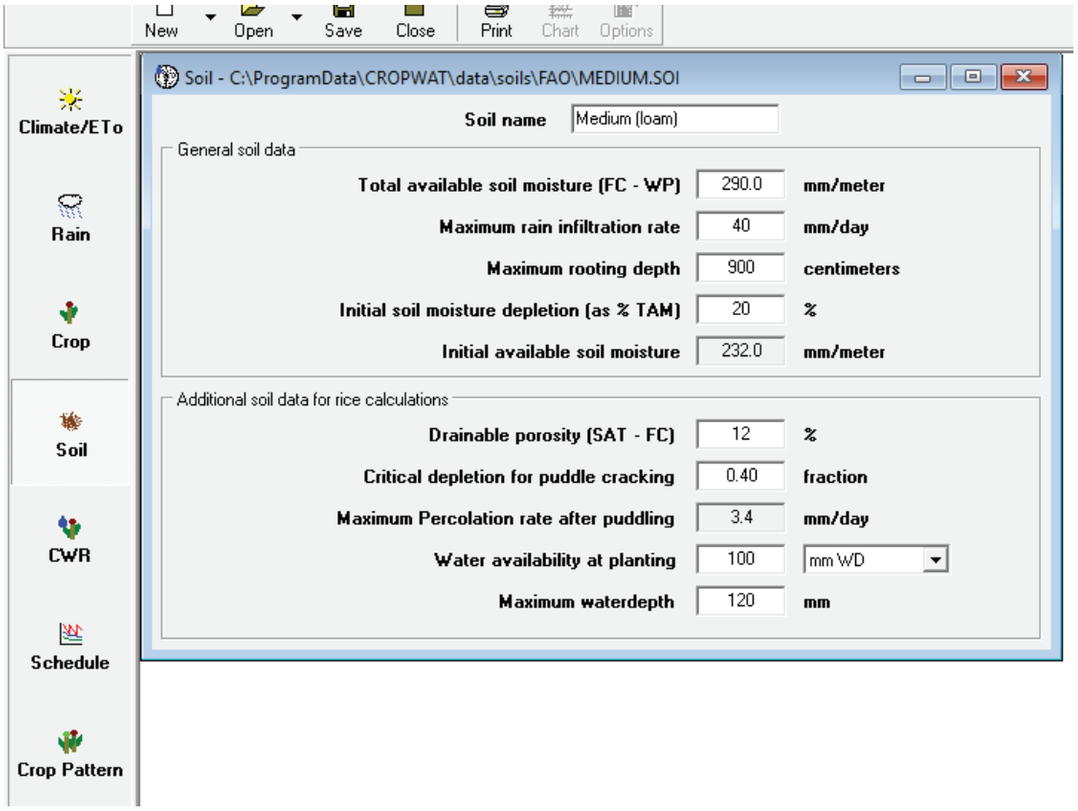
Collect the following data for rice (you need to collect some additional data):

- both Kc dry and Kc wet values at every stage,
- number of days for nursery and land preparation also,
- puddling depth (m),
- Nursery area (%).

## STEP 4- INPUTTING AND COLLATING SOIL DATA

Type of soil is also important criteria here. In Cuttack, rice is grown in medium loam soil. And hence characteristics of medium loam soil is put in Figure 7.

**Figure 7: Soil data**




Collect and input soil data. Collect the required soil data. Click on the 'Soil' button on the left side panel to input the soil data. CropWat requires the following soil data:

- total available soil moisture (mm/meter),
- maximum rain infiltration rate (mm/day),
- maximum rooting depth (cm),
- initial soil moisture depletion (as % TAM),
- Initial available soil moisture (mm/meter)

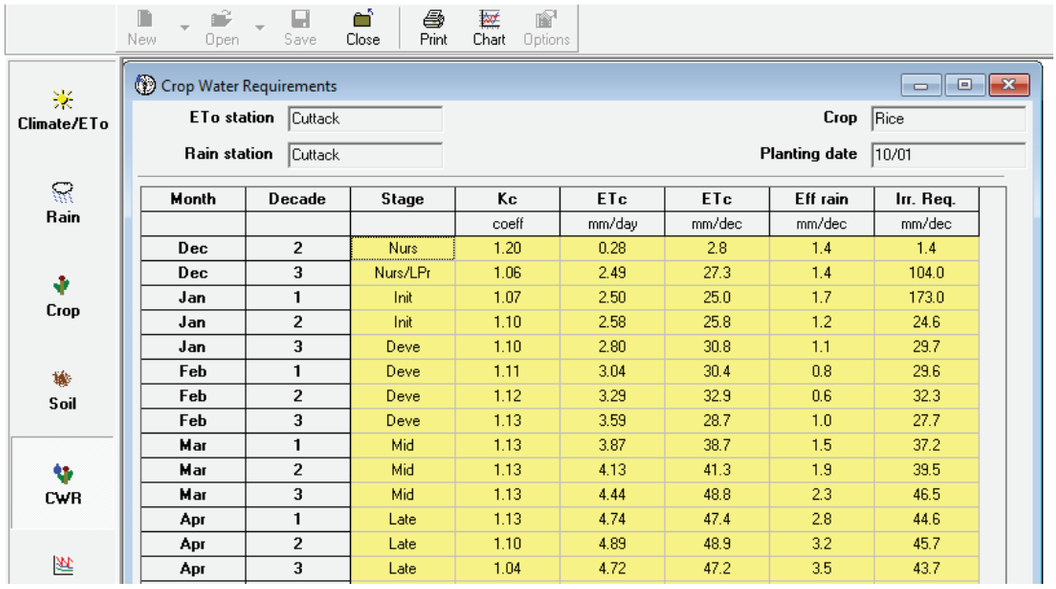
Provide additional soil data for rice:

- Drainable porosity (%),
- critical depletion for puddle cracking (fraction),
- maximum percolation rate after puddling (mm/day),
- Water availability at planting (mm WD or % desat. Or % depl.),
- Maximum water depth (mm).

## STEP 5- COMPUTATION OF CROP WATER REQUIREMENTS

After all the above data has been put in, the crop water requirements will automatically be calculated by the software. It is illustrated in Figure 8.

**Figure 8: Crop water requirements**

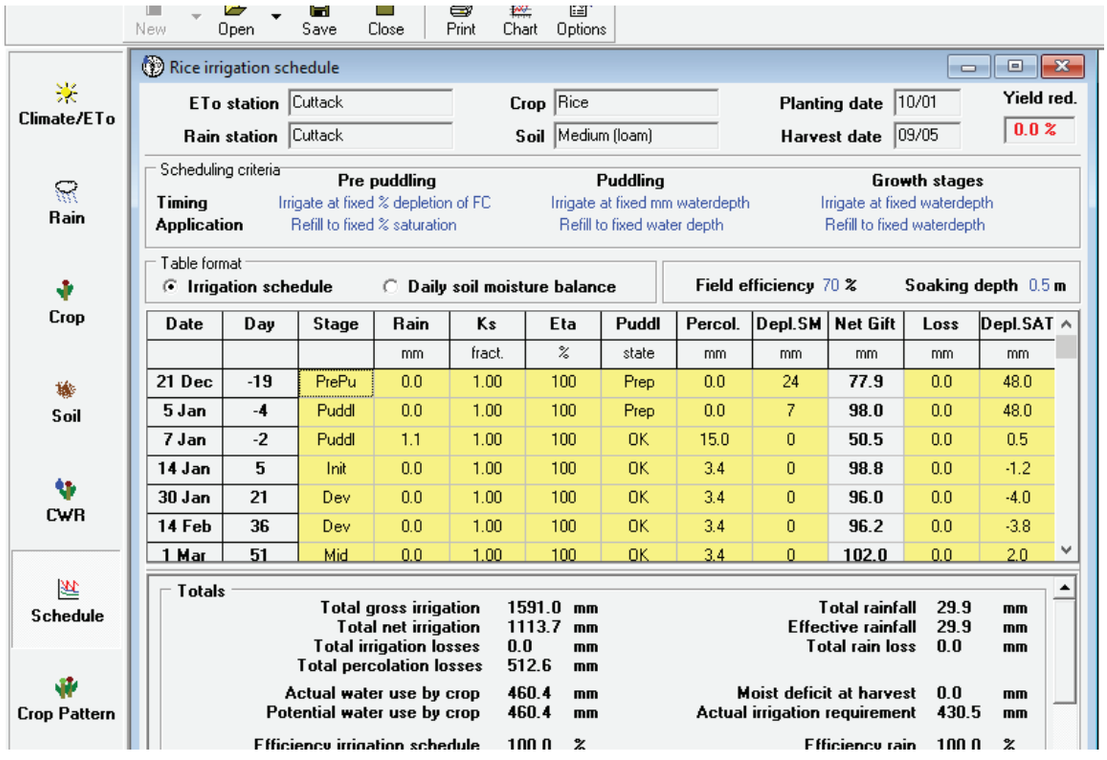



| Month | Decade | Stage | Kc | ETc | ETc | Eff rain | Irr. Req. |
|---|---|---|---|---|---|---|---|
| | | | coeff | mm/day | mm/dec | mm/dec | mm/dec |
| Dec | 2 | Nurs | 1.20 | 0.28 | 2.8 | 1.4 | 1.4 |
| Dec | 3 | Nurs/LPr | 1.06 | 2.49 | 27.3 | 1.4 | 104.0 |
| Jan | 1 | Init | 1.07 | 2.50 | 25.0 | 1.7 | 173.0 |
| Jan | 2 | Init | 1.10 | 2.58 | 25.8 | 1.2 | 24.6 |
| Jan | 3 | Deve | 1.10 | 2.80 | 30.8 | 1.1 | 29.7 |
| Feb | 1 | Deve | 1.11 | 3.04 | 30.4 | 0.8 | 29.6 |
| Feb | 2 | Deve | 1.12 | 3.29 | 32.9 | 0.6 | 32.3 |
| Feb | 3 | Deve | 1.13 | 3.59 | 28.7 | 1.0 | 27.7 |
| Mar | 1 | Mid | 1.13 | 3.87 | 38.7 | 1.5 | 37.2 |
| Mar | 2 | Mid | 1.13 | 4.13 | 41.3 | 1.9 | 39.5 |
| Mar | 3 | Mid | 1.13 | 4.44 | 48.8 | 2.3 | 46.5 |
| Apr | 1 | Late | 1.13 | 4.74 | 47.4 | 2.8 | 44.6 |
| Apr | 2 | Late | 1.10 | 4.89 | 48.9 | 3.2 | 45.7 |
| Apr | 3 | Late | 1.04 | 4.72 | 47.2 | 3.5 | 43.7 |

Get a crop water requirements graph. Click on the 'Charts' menu, then click on 'Crop Water Requirements' to get a graph of your crop water requirements. Within the same graph you can also get an ET crop by selecting the 'ET crop' option below the graph. You can also select whether those will show either as a bar or a curve.

## STEP 6- COMPUTATION RICE IRRIGATION SCHEDULE

**Figure 9: Irrigation schedule**




| Date | Day | Stage | Rain | Ks | Eta | Puddl | Percol. | Depl.SM | Net Gift | Loss | Depl.SAT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mm | fract. | % | state | mm | mm | mm | mm | mm |
| 21 Dec | -19 | PrePu | 0.0 | 1.00 | 100 | Prep | 0.0 | 24 | 77.9 | 0.0 | 48.0 |
| 5 Jan | -4 | Puddl | 0.0 | 1.00 | 100 | Prep | 0.0 | 7 | 98.0 | 0.0 | 48.0 |
| 7 Jan | -2 | Puddl | 1.1 | 1.00 | 100 | OK | 15.0 | 0 | 50.5 | 0.0 | 0.5 |
| 14 Jan | 5 | Init | 0.0 | 1.00 | 100 | OK | 3.4 | 0 | 98.8 | 0.0 | -1.2 |
| 30 Jan | 21 | Dev | 0.0 | 1.00 | 100 | OK | 3.4 | 0 | 96.0 | 0.0 | -4.0 |
| 14 Feb | 36 | Dev | 0.0 | 1.00 | 100 | OK | 3.4 | 0 | 96.2 | 0.0 | -3.8 |
| 1 Mar | 51 | Mid | 0.0 | 1.00 | 100 | OK | 3.4 | 0 | 102.0 | 0.0 | 2.0 |

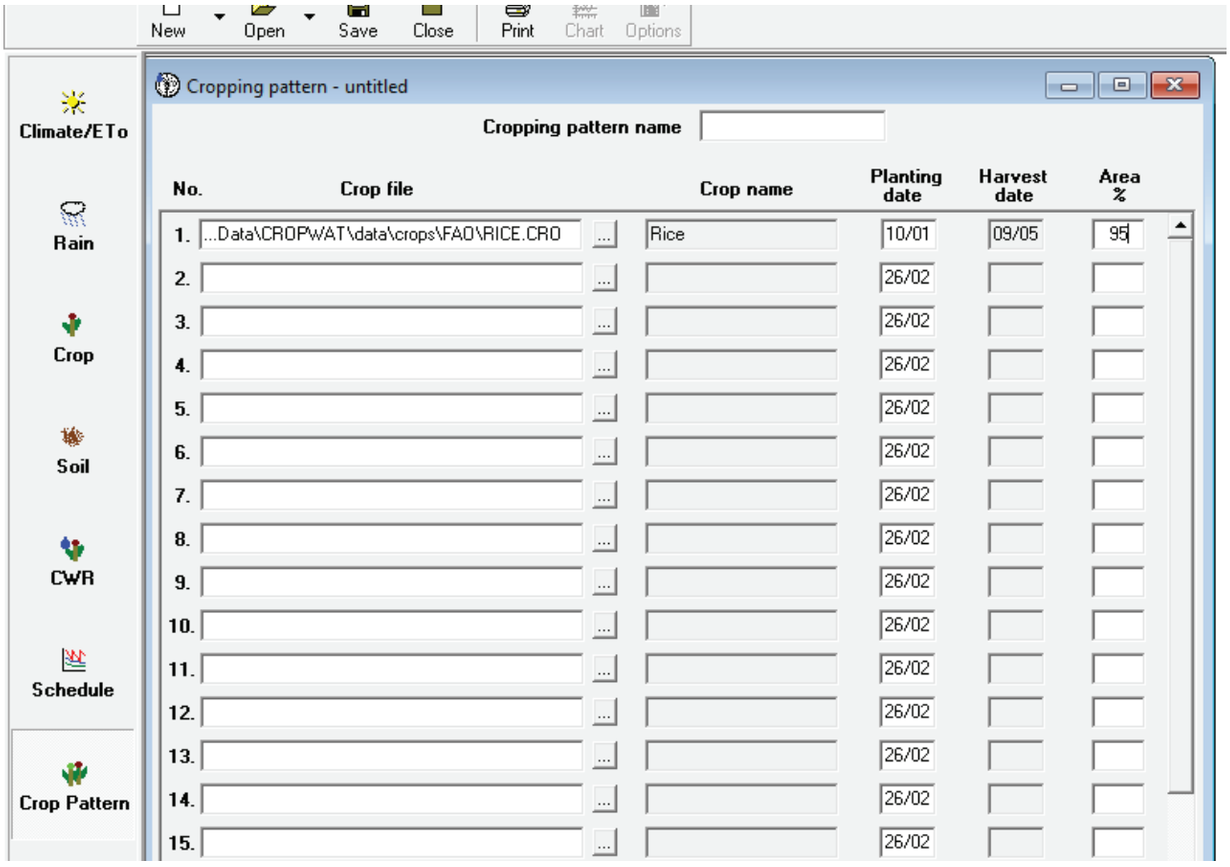
Click on the 'Schedule' button on the left side panel to get a tailored irrigation schedule.

By clicking on the 'Schedule' button, you will get a table of irrigation schedule and a table of

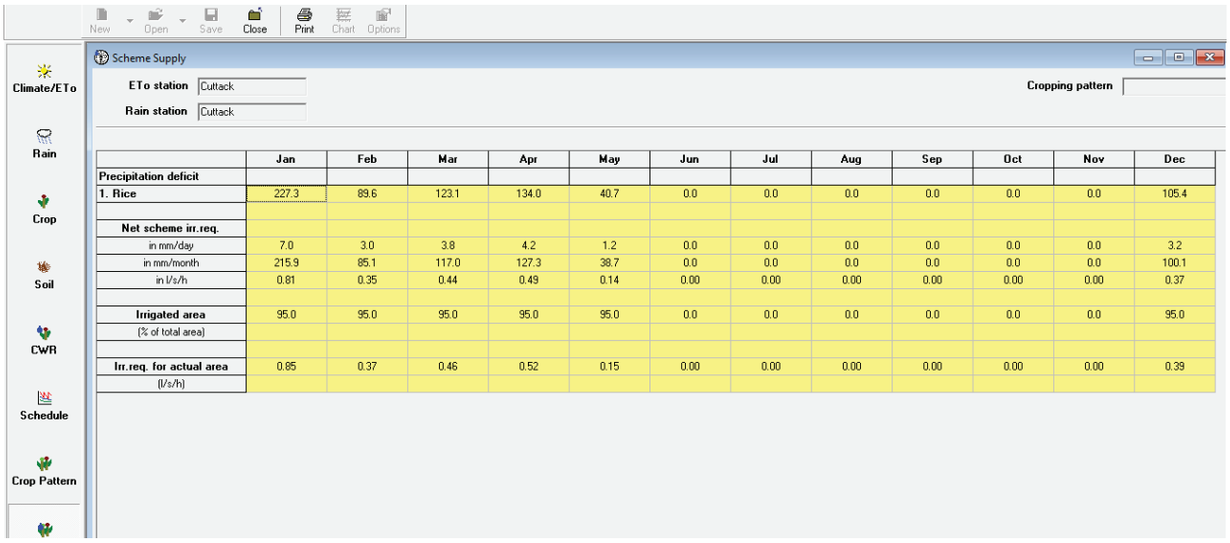
- total gross irrigation,
- total net irrigation,
- total irrigation losses,
- total percolation losses,
- actual water use by crop,
- potential water use by crop,
- effective rainfall,
- total rain loss,
- moist deficit at harvest,
- actual irrigation requirement, and
- Yield reduction.

Click on the 'Charts' menu, then click on 'Irrigation Schedule' to get a graph of your irrigation schedule. Below the graph you can select options (for example, depletion soil moisture, depletion saturated water, RAM root zone, TAM root zone, SAT root zone, TAM whole puddle and SAT whole puddle), which you can either show or hide in the graphs.

## STEP 7- CROPPING PATTERN PARAMETERS



## STEP 8- SCHEME SUPPLY COMPUTATIONS




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precipitation deficit | | | | | | | | | | | | |
| 1. Rice | 227.3 | 89.6 | 123.1 | 134.0 | 40.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 105.4 |
| | | | | | | | | | | | | |
| Net scheme irr.req. | | | | | | | | | | | | |
| in mm/day | 7.0 | 3.0 | 3.8 | 4.2 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.2 |
| in mm/month | 215.9 | 85.1 | 117.0 | 127.3 | 38.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 100.1 |
| in l/s/h | 0.81 | 0.35 | 0.44 | 0.49 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.37 |
| | | | | | | | | | | | | |
| Irrigated area | 95.0 | 95.0 | 95.0 | 95.0 | 95.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 95.0 |
| (% of total area) | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Irr.req. for actual area | 0.85 | 0.37 | 0.46 | 0.52 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 |
| (l/s/h) | | | | | | | | | | | | |

Click on the 'Options' button to modify the scheduling based on different irrigation timing, irrigation application system and irrigation efficiency. The available irrigation timing options are:

- irrigation at fixed water depth,
- irrigation at fixed % desaturation,
- irrigation at fixed % of critical depletion,
- irrigation at fixed WD/desaturation/critical depletion per stage,
- irrigation at fixed interval per stage,
- irrigation at given ET crop reduction,
- irrigation at given yield reduction,
- irrigate continuously,
- No irrigation (rain-fed)

# Annexure 6:

Template for Rotational Water distribution plan (among minors and distributaries) controlled by Govt.

| Sl. No | Distributary | Length (m) | CCA (ha) | Discharge (cumecs) | Filling Time | Draining time | Turn time |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# Annexure 7:

Template for Rotational Water distribution plan (among minors and distributaries) controlled by PP

| Distributary (Minor/ Subminor) | CCA (ha) | Length (m) | Filling Time | Draining Time | Turn Time (Hrs) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# Annexure 8:

Template for Rotational Water distribution plan (among outlets) of PP

| Outlet no | Area (Ha) | Length of outlet (M) | Filling time (Hr.) | Draining time (Hr.) | Net allotted time (Hr.) | Total Time (Hr.) | Flow rate m3/Hr | Total allocated time (Hr.) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# Annexure 9:

Template for data to be used for preparation of Warabandi Schedule for Water Distribution in the field channel

| Outlet No. | Sl. No. | Khata No. | Name of beneficiary | Village | Plot No. | Area (Ha) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# Annexure 10: New Command Plan

| Block | Cultivable Area | Irrigated Area | Non-Irrigated Area | Existing Irrigation Potential as % of Cultivable area | New Project | New Command (in Ha) | | Remark | Proposed Irrigation Potential by 2030 (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Proposed in 2018-19 | Proposed in 2030-31 | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

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