Drought Management Plan of Nabarangpur

Year 2025

ନବରଙ୍ଗପୁର

District- Nabarangpur

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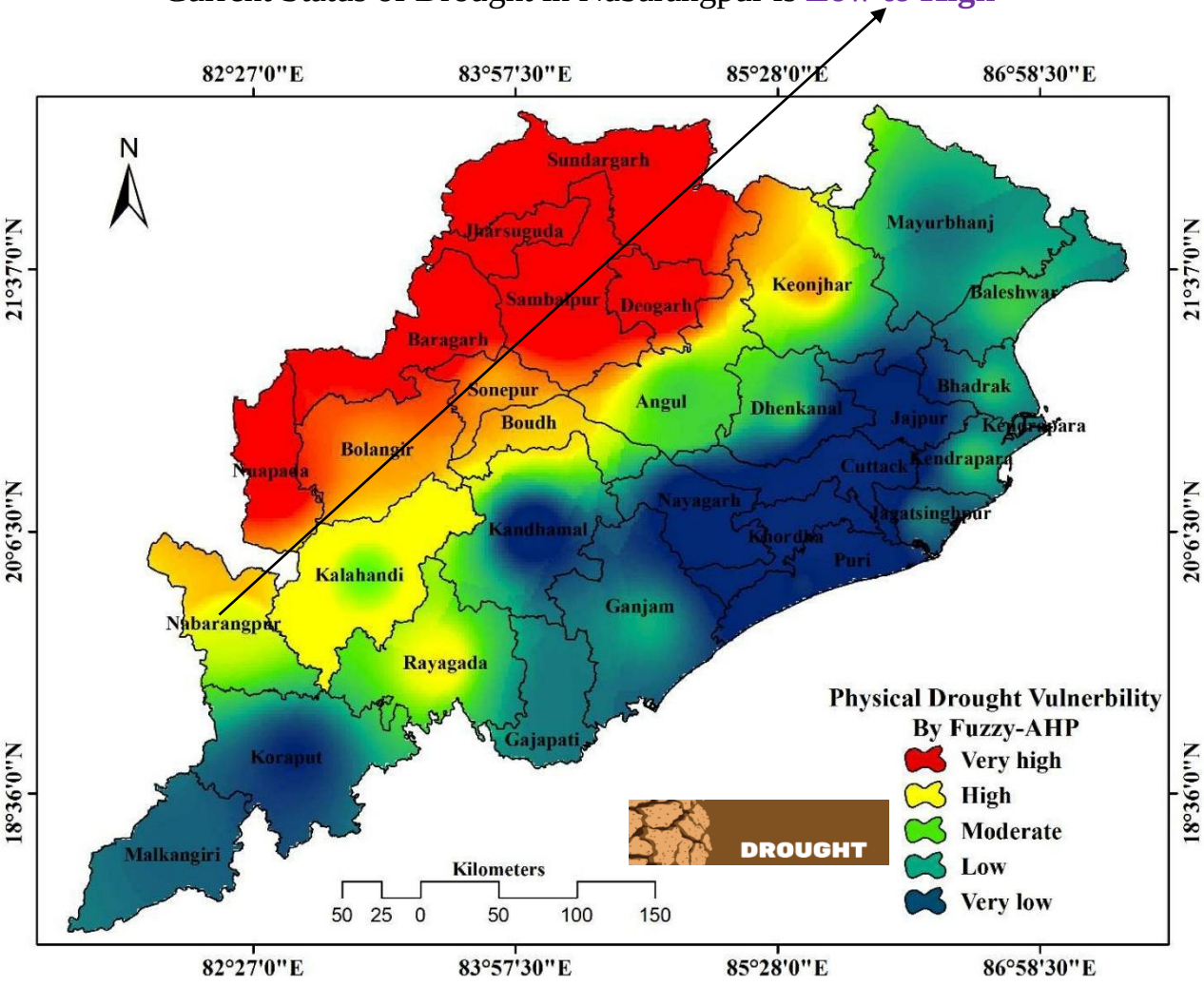
ACRONYMS

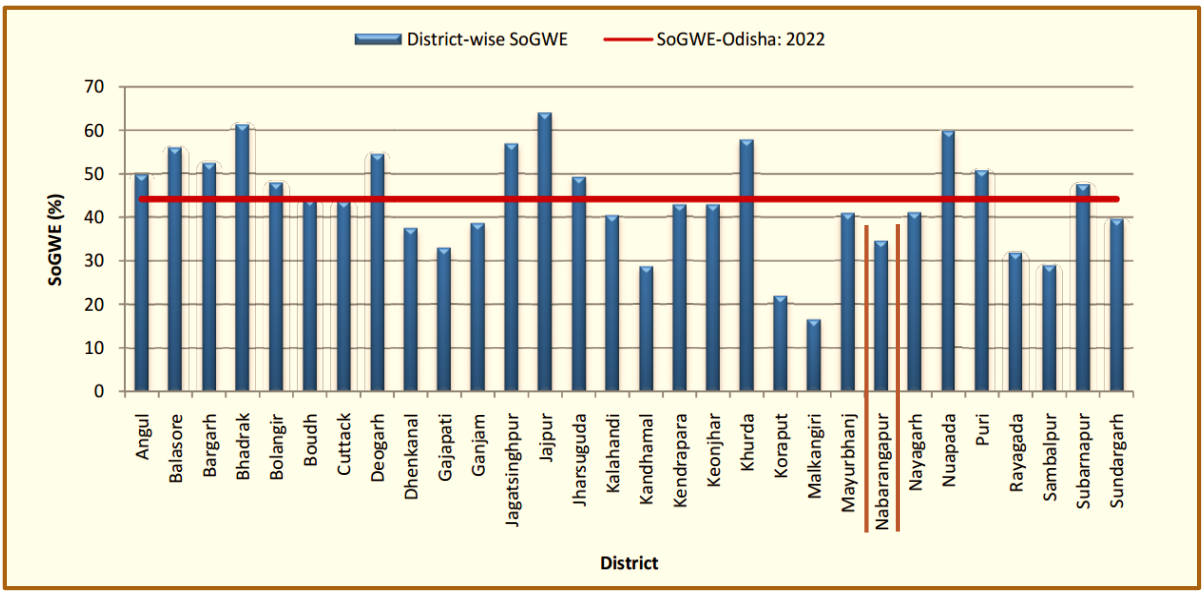
AAO	Assistant Agriculture Officer
ACSO	Assistance Civil Supply Officer
ADMO	Additional District Medical Officer
ADVO	Additional District Veterinary Officer
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
BEO	Block Education Officer
CDAO	Chief District Agriculture Officer
CDMO	Chief District Medical Officer
CDVO	Chief District Veterinary Officer
CPR	Cardio Pulmonary Resuscitation
CSO	Civil Supply Officer
DAO	District Agriculture Officer
DAO	District Accounts Officer
DDMA	District Disaster Management Authority
DDMP	District Disaster Management Plan
DEO	District Education Officer
DEOC	District Emergency Operation Centre
DLO	District Labour Officer
DM	Disaster Management
DMP	Drought Management Plan
DPM	District Programme Manager
DPO (RMSA)	District Programme Officer, Rashtriya Madhyamik Shiksha Abhiyan
DPO (SSA)	District Programme Officer, Sarva Shiksha Abhiyan
DRR	Disaster Risk Reduction
DSS	Distribution Substations
DSWO	District Social Welfare Officer
FP	Farm Pond
HR	Human Resource
HRVCA	Hazard Risk Vulnerability and Capacity Analysis
IWMP	Integrated Watershed Management Programme
KVK	Krishi Vigyan Kendra
LI	Labour Inspector

LI	Livestock Inspector
MI	Marketing Inspector
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MO	Medical Officer
MVI	Motor Vehicle Inspector
MSK	Medvedev, Sponheuer and Karnik Scale
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NFSM	National Food Security Mission
NEC	National Executive Committee
NGO	Non-Government Organization
NRDWP	National Rural Drinking Water Programme
NWDPRA	National Watershed Development Project for Rainfed Areas
ORS	Oral Rehydration Solution
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PV	Para Veterinary
PSS	Primary Substation
PwD	Persons with Disability
RI	Revenue Inspector
RTO	Regional Transport Officer
SAR	Search and Rescue
SDMA	State Disaster Management Authority
SDWO	Sub-Divisional Welfare Officer
SEC	State Executive Committee
SI	Supply Inspector
SLCNC	State Level Committee on Natural Calamity
SOP	Standard Operating Procedure
TO	Treasury Officer
VAW	Village Agriculture Worker
VDS	Veterinary Dispensaries
Vet	Veterinary
WHS	Water Harvesting Structure

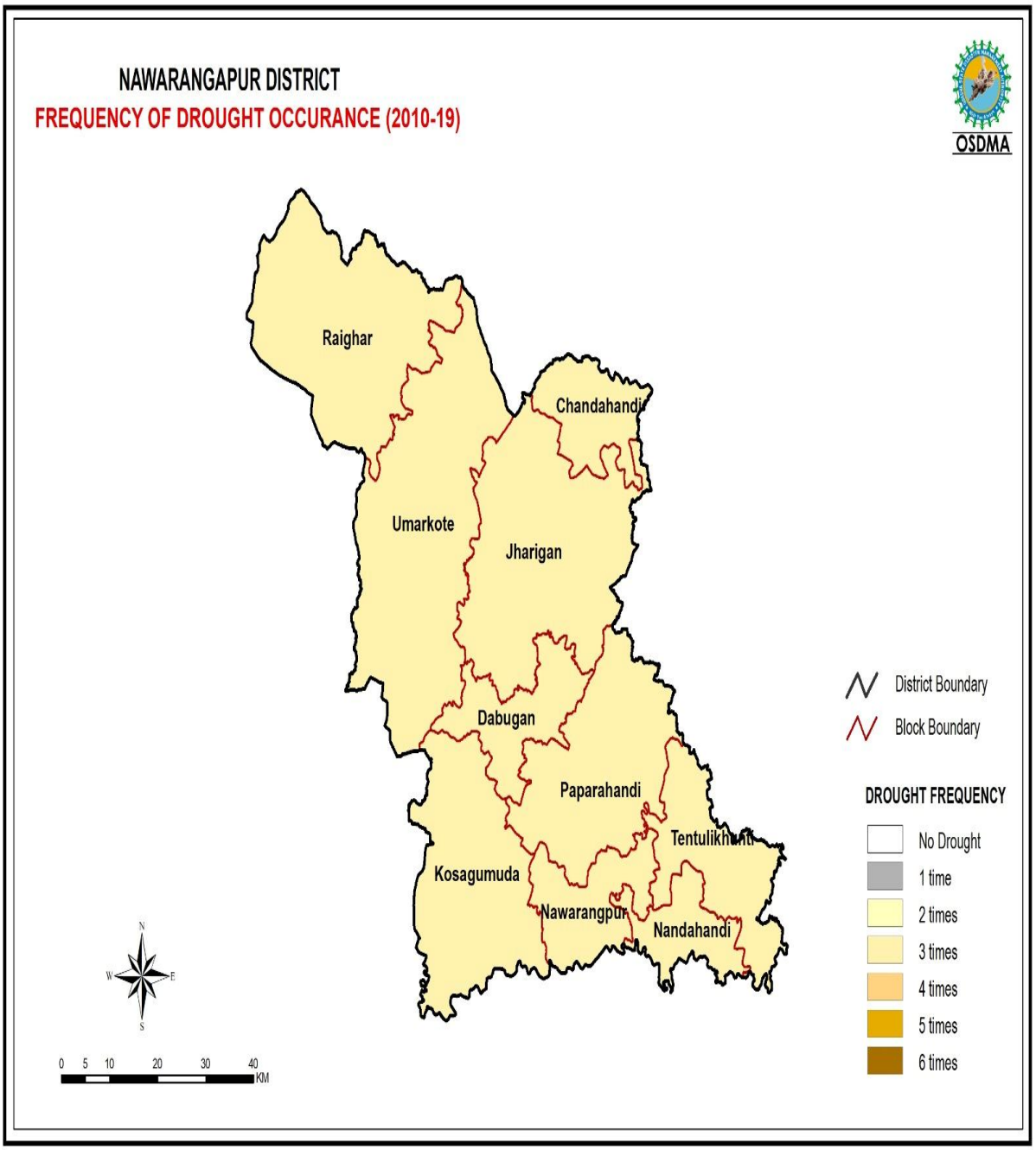
Drought Map of Odisha and Nabarangpur

Current Status of Drought in Nabarangpur is **Low to High**





District-wise stage of Ground Water Extraction


NAWARANGAPUR DISTRICT
FREQUENCY OF DROUGHT OCCURANCE (2010-19)
OSDMA
Raighar
Chandahandi
Umarkote
Jharigan
Dabugan
Paparahandi
Tentulikhunti
Kosagumuda
Nawarangpur
Nandahandi
District Boundary
Block Boundary
DROUGHT FREQUENCY
No Drought
1 time
2 times
3 times
4 times
5 times
6 times
N
W
E
S
0 5 10 20 30 40
KM

CHAPTER–1

INTRODUCTION

1.1 Background

Nabarangpur presents a panorama of many millennia in human history. It is uniquely endowed with lush green vegetation, different fauna and a rich cultural heritage. Historically, Nabarangpur is a place of nine colours and culturally rich evolved in the elite minds at the court of King Krishna Dev (1814-1843). He was the second direct ruler of Nabarangpur and was the son of Jagannath Dev of Suryavamsis of Jeypore Estate. The scenic beauty of *Hirli Dongar* and the lush green forest of this place influenced the king to set up his capital in this locality. Narang Paraja, an original settler of this place, had settled here with his family members and the habitat was called 'Narangpadar'. So, the king decided to have his capital in this habitat, and when the capital came into being, he named it the same as Nabarangpur.

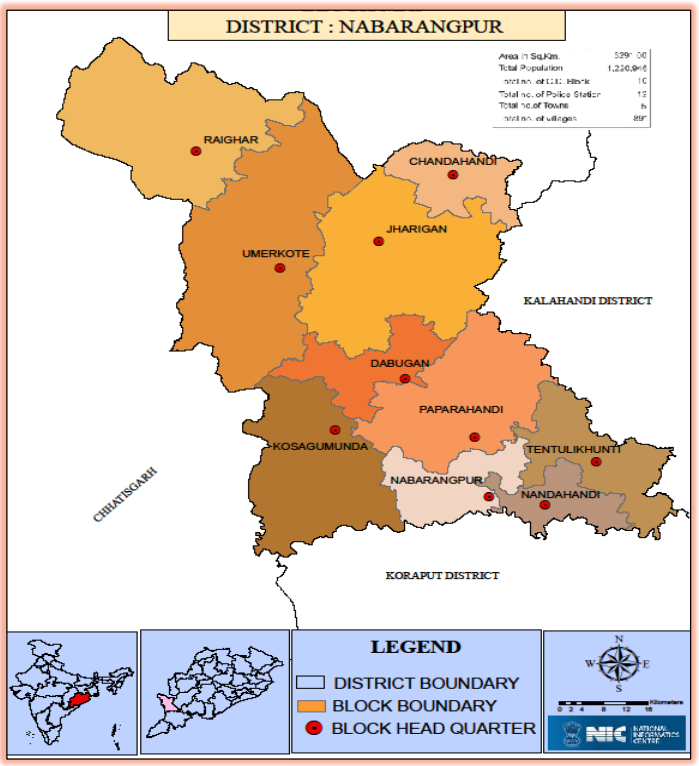


Fig 1, Map of Nabarangpur District

The history of Nabarangpur District is very much close and interlinked with Koraput, with which it shares its language, lifestyle, heritage, flora, fauna and climate. It was ruled by several dynasties, and the Solar Dynasty was one of them. In the first century B.C., it was the period of Mahamegha Bahan dynasty. During this period, Kalinga regained her former glory. The third king of this dynasty Kharabela made the Kalinga Empire and the Atavika land very strong. The successive dynasties- The Satavahans (2nd Century A.D), The Ikshvakus (3rd Century A.D), The Nalas (3rd and 4th Century A.D) ruled the Nabarangpur District. The Kesaribeda excavations bear testimony to the rule of King Bhabadatta Verma and King Arathapati. Nala kings were the kings who ruled from Gwalior in Madhya Pradesh. Their rapid growth landed them in Bastar in the Koraput region. During the 5th Century A.D., Koraput was a small principality of Tri Kalinga.

On 2nd October 1992, Nabarangpur became a separate district of Odisha State. The district is carved out of the Koraput district vide the Notification No.49137/R dated 0110-1992 of the R&E Department, Government of Odisha. Nabarangpur District is situated between 20.3^0 to 17.5^0 North latitude and 81.27^0 to 84.1^0 East longitude. The district is located in the Eastern Ghat High Land Zone. The geographical area of the district is 5.29 lakh hectares, out of which

gross cropped area is 284.84 ('000 ha), net sown area 181.00 ('000 ha) and forest area 2.47 ('000 ha). The total population of the district is 12,20,946 (Male-6,04,812, Female-6,16,134) in which Scheduled tribe population is 6,81,173 (55.79%) and Scheduled caste 1,77,384 (14.53%). The literacy percentage of the district is 38.53%. Major crops of the district are Rice, Maize, Sugarcane, Vegetables, Millets, Blackgram, Groundnut, etc. The majority of soils of the district are red and laterite and the mean annual rainfall is 1569 mm. The district boundary stretches north to Raipur and west to Bastar Districts of Chhattisgarh. The east side of Nabarangpur touches the Kalahandi and Rayagada Districts and south to the Koraput Districts of Odisha. The river Indravati forms the border between the Nabarangpur and Koraput Districts. Nabarangpur District covers an area of 5294 sq km. The district has a vast area of 1583.4 sq km covered by forests. The north of Nabarangpur District stretches up to the border of Kalahandi, having rock beds covering layers of coarse white quartz. This District is not industrially developed, and all these minerals sustain the various industries in other parts of the country. As per the current status of the drought situation in Nabarangpur district, mainly three blocks, namely Chandahandi, Raighar and Jarigaon, are pertinent to drought, but the other seven blocks are also vulnerable to drought.

To prepare a drought plan, you need to understand the background of drought in Nabarangpur district, including its historical occurrence, climate patterns that contribute to drought, potential impacts on water supplies, vulnerable populations, key sectors affected (like agriculture and industry), and existing water management systems, allowing you to identify areas for improvement and develop targeted mitigation strategies based on specific local conditions.

1.1.1 Key Aspects Considered for Building a Drought Plan

The drought plan should have three primary components, i.e., monitoring, risk assessment and mitigation & response. It is recommended that a committee be established to focus on the first two of these needs; the mitigation and response function can, in most instances, be carried out by the drought committee/ task force of the district. The committee/ task force has analysed the following aspects:

Climate Data Analysis:

- Average rainfall patterns and variability.
- Historical drought events, including severity and duration.
- Trends in temperature and precipitation based on climate models.

- **Water Source Assessment:**
  - Surface water bodies (rivers, reservoirs) and their capacity.
  - Groundwater levels and recharge potential.
  - Existing water infrastructure and distribution networks.
- **Vulnerability Mapping:**
  - Identify areas with high dependence on water resources.
  - Socioeconomic factors like population density and poverty levels.

- Sectors most susceptible to drought impacts (agriculture, livestock, industry, and domestic use).

- **Stakeholder Engagement:**
  - Identifying key stakeholders, including government agencies, water utilities, farmers, businesses, and community leaders.
  - Understanding their roles and potential contributions to drought mitigation and response.

- **Legal and Policy Framework:**
  - Existing water management laws and regulations.
  - Policies related to water conservation and allocation during drought.

Considering the increasing severity, frequency and impacts of droughts in the district, the District Administration decided to shift its approach from the erstwhile management of drought as a disaster to proactively managing the risks of drought. Important factors to consider when developing a drought plan:

- **Early Warning Systems:**

  Monitoring key indicators like rainfall, soil moisture, and reservoir levels to detect early signs of drought.

- **Water Conservation Measures:**

  Implementing strategies like water-efficient irrigation, leak detection, and public awareness campaigns.

- **Demand Management:**

  Prioritizing water usage for essential needs during drought conditions.

- **Emergency Response Plans:**

  Establishing procedures for managing water shortages, including potential rationing and distribution mechanisms.

- **Community Preparedness:**

  Educating the public on drought preparedness, water conservation practices, and potential impacts.

1.2 Purpose and Scope of the Plan

The purpose of a drought plan is to minimize the negative impacts of drought by proactively preparing for and responding to dry periods, aiming to reduce economic, social, and environmental damage through coordinated strategies that include monitoring drought conditions, implementing mitigation measures, and activating emergency response plans when necessary; its scope typically encompasses identifying vulnerable areas, assessing water resources, coordinating stakeholder actions, and outlining specific actions to be taken at different drought severity levels.

Drought is a complex phenomenon and has deep, widespread and underestimated impacts on societies, ecosystems and economies. They incur costs that are borne by the most vulnerable people. The pernicious effects of drought have extensive impacts on agricultural production, farm income, widespread rural unemployment, outmigration from rural areas, distress among livestock and biodiversity contributing to food insecurity, poverty and inequality.

To address such a complex phenomenon, a Drought Management Plan (DMP) is an actionable plan, which can be pressed into action in the event of a drought situation to help reduce the time taken in mobilizing resources for an effective response and enable a harmonious relationship among stakeholders. The drought management plan will facilitate overall management of the drought situation in a structured and planned manner with the most efficient and optimum utilization of time, effort and resources so that adverse impact on the community is minimized.

The Drought Management Plan will delineate the roles and responsibilities of different Departments of the State to work together to mitigate, prepare for, respond to and recover from the effects of drought regardless of cause, size, location, or complexity. The Drought Management Plan ensures better preparation and timely communication among stakeholders, which is critical in managing drought.

The main focus of drought risk management would include actions on (i) prevention of the creation of risks, (ii) mitigating and reducing existing risks, (iii) managing drought risks through preparedness, early actions and rapid response, (iv) risk-informed recovery and integration of drought mitigation approaches in convergence mode in various sectors through work plan and budgeting.

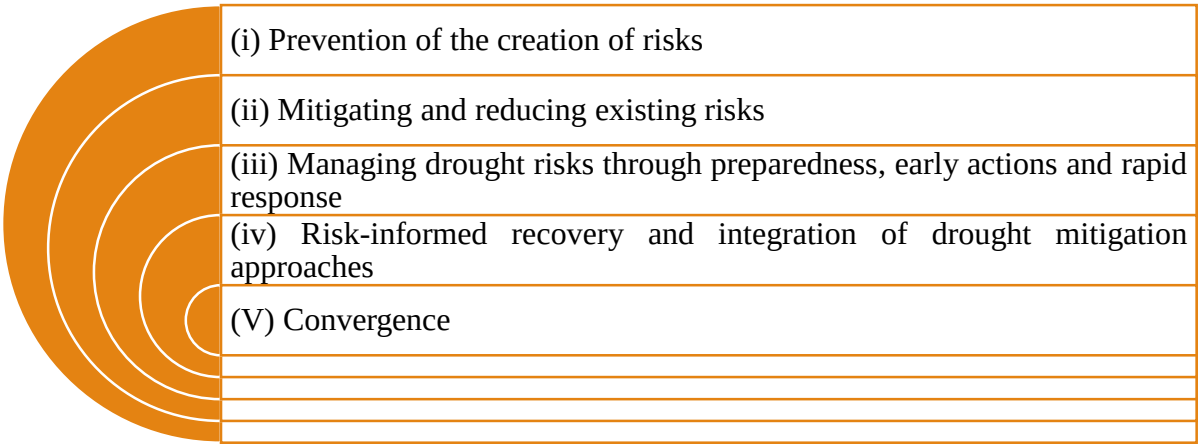


Fig 2, Risk Management of Drought

A generic statement of purpose for a plan is to reduce the impacts of drought by identifying principal activities, groups, or regions most at risk and developing mitigation actions and programs that alter these vulnerabilities.

1.2.1 Key Points about the Purpose and Scope of a Drought Plan

A drought plan typically encompasses a comprehensive set of strategies to monitor drought conditions, assess potential impacts, implement mitigation measures, and coordinate response

actions across various sectors, including agriculture, water management, and community preparedness, to minimize negative effects during a drought event and facilitate recovery afterwards. The details are as follows:

- **Proactive approach:**

  To move beyond reactive crisis management and instead plan for potential drought scenarios, allowing for early intervention and mitigation strategies.

- **Risk reduction:**

  To minimize the potential damage caused by drought to various sectors, including agriculture, water supply, ecosystems, and communities.

- **Stakeholder collaboration:**

  To involve diverse stakeholders like government agencies, water providers, farmers, businesses, and community leaders in the planning and implementation process.

- **Monitoring and assessment:**

  To establish systems for monitoring drought conditions using indicators like precipitation, soil moisture, streamflow, and reservoir levels to trigger appropriate response actions.

- **Multi-tiered response:**

  To define different drought severity levels and develop corresponding mitigation measures, ranging from water conservation practices to emergency water allocation plans.

A local drought management plan will strengthen your community's ability to provide enough water during a drought. A DMP should outline key actions to be taken in preparation for and during a drought. It has enormous scope and potential at district, block and GP levels to address the drought condition. The scope of a drought plan may include the following:

- **Drought monitoring and forecasting:**

  Identifying relevant drought indices, data collection methods, and forecasting tools.

- **Vulnerability assessment:**

  Identifying areas and populations most susceptible to drought impacts.

- **Water resource management:**

  Analysing available water sources, including surface water, groundwater, and reservoir storage.

- **Conservation measures:**

  Promoting water conservation practices in various sectors like agriculture, urban areas, and industries.

- **Emergency response actions:**

  Defining procedures for water rationing, potential relocation of livestock, and access to emergency water supplies during severe drought.

- **Communication and outreach:**

  Establishing communication strategies to inform the public about drought conditions and necessary actions.

- **Economic and social impact analysis:**

  Assessing potential economic losses and social impacts of drought to inform decision-making.

1.3 Authorities, Codes and Policies

1.3.1 National Disaster Management Act, 2005 (NDM Act 2005)

The National Disaster Management Act, 2005 (NDM Act 2005) is a law enacted by the Indian government to establish a comprehensive framework for managing disasters, including the creation of a National Disaster Management Authority (NDMA) headed by the Prime Minister, intending to prevent, mitigate, and effectively responding to natural and man-made disasters across the country; it also sets up state-level disaster management authorities under the respective Chief Ministers.

DM Act, 2005 lays down institutional and coordination mechanisms for effective Disaster Management (DM) at the national, state, district and local levels. Under the DM Act 2005, it is mandatory on the part of the District Disaster Management Authority (DDMA) to adopt a continuous and integrated process of planning, organizing, coordinating and implementing measures that are necessary and expedient for the prevention as well as mitigation of disasters. These processes are to be incorporated in the developmental plans of the different departments and preparedness to meet the disaster and relief, rescue and rehabilitation thereafter, to minimize the loss to be suffered by the communities. They are to be documented to be handy and accessible to the general public. The main focus areas are Prevention, mitigation, preparedness, response, and rehabilitation.

1.3.2 National Disaster Management Guidelines, Management of Drought, Sept. 2010

The Guidelines have been prepared by the National Disaster Management Authority (NDMA) to provide direction to the central ministries/departments and state governments for preparing detailed action plans to handle drought as a part of an overall hazard Disaster Management plan. As per **Section 7.3** of the Guidelines, all State Governments/SDMAs will prepare their drought management plans. The drought management plan will be prepared district-wise. These guidelines call for a participatory approach involving all the stakeholders to take forward the task of operationalizing the State Vision for securing proactive and pre-disaster preparedness and emphasizing a mitigation-centric approach.

1.3.3 Manual for Drought Management, December 2016 (updated December 2020)

A Manual for Drought Management was published by the DAC & FW in November 2009, which was revised and updated in December 2016 and subsequently in December 2020. The revised manual has come into effect from the Kharif season of 2017. The various indices and parameters appropriate for the declaration of drought have been revisited, and new indices like Standardized Precipitation Index, Vegetation Condition Index, Percentage Available Soil Moisture, and Hydrology Indices like Reservoir Storage Index, Stream-flow Drought Index

and Ground Water Drought Index have been added. Limitations of each of these indices/parameters have been specified wherever required. The magnitude of the drought event has been graded on a scale of values as "*Moderate*" and "*Severe*". Other factors, such as the extent of fodder supply, scarcity of drinking water supplies, demand for employment and migration of labour, wage trends, food grains supply position, etc. have been touched upon with the suggestion that State Governments may frame guidelines for objective evaluation based on monitoring mechanisms and baseline data.

Rainfall-related indices have been recommended as the first trigger in the assessment of drought. In the event of rainfall inadequacy of a certain magnitude, the first trigger is set off, which would then obligate State Governments to consider other impact indicators related to agriculture (crop sowing coverage), remote sensing, soil moisture and hydrology. The level of severity of drought will be based on the recorded values against the impact indicators and, accordingly, the second drought trigger is set off. In case the second drought trigger is set off, the Manual prescribes field-level verification of ground truthing of crop damage through a sample field survey in 10% of the villages selected randomly. The drought and the intensity of the calamity will be declared based on findings from the field survey.

Timelines have been indicated for the declaration of drought, namely, 30th October for Kharif and 31st March for Rabi. States will declare a drought and carry out relief operations. They can submit a Memorandum for Financial Assistance to the Government of India if the drought is found to be severe.

The Manual for Drought Management is a guide for the State Government and agencies engaged in the prevention, mitigation and management of drought. Chapter 3 of the revised Drought Manual relates to drought declaration, and provisions under this chapter have been made mandatory by the Ministry of Home Affairs for the declaration of drought by the State governments.

1.3.4 Sendai Framework for Disaster Risk Reduction (DRR)

The Sendai Framework for Disaster Risk Reduction 2015-2030 is a non-binding agreement, which the signatory nations, including India, will attempt to comply with voluntarily.
The four priorities for action under the Sendai Framework are:

(i) Understanding disaster risk
(ii) Strengthening disaster risk governance to manage disaster risk
(iii) Investing in disaster risk reduction for resilience
(iv) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

The Sendai Framework aims to achieve a substantial reduction of disaster risk and losses in lives, livelihoods, and health and the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries. The Drought Management Plan (DMP) has been broadly aligned with the goals and priorities set out in the Sendai Framework for DRR. Based on global practices and national experiences, the plan will incorporate changes during periodic reviews and updates.

1.4 Authority for approval, review and updating Drought Management Plan

As defined in Section 30 of DM Act 2005, DDMA shall act as the district planning, coordinating and implementing body for disaster management and take all measures for disaster management in the district under the guidelines laid down by the National Authority and the State Authority.

The District Collector will discuss the modalities and seek views for the preparation of a drought management plan in the meeting of the District Drought Monitoring Committee (DDMC) held in January and prepare the plan by the end of May every year based on the long season forecast issued by India Meteorological Department in April and also the previous season's rainfall.

After finalization, the District Authority shall send a copy of the District Drought Management Plan to the State Disaster Management Authority for approval. The District Plan for drought management should be reviewed and updated annually.

1.5 Vision

The Drought Management Plan will facilitate a progressive and systematic approach in alignment with the priorities of the State to promote innovative approaches and strategies that enhance system-level resilience to drought impacts and other climatic extremes, driving towards sustainability of agriculture and rural livelihoods. The Drought Management Plan will focus on four priorities:

(i) Strengthening drought risk governance

(ii) Improving drought vulnerability and risk assessment capacities.

(iii) Strengthening Drought Early Warning and monitoring systems for early action.

(iv) Increasing investments in drought risk mitigation and response.

1.6 Objectives

1. To assess the hazard, risk, vulnerabilities, and capacity associated with drought in the district.
2. To lay down various measures and guidelines for prevention and mitigation.
3. To provide clarity on roles and responsibilities for related Government departments and stakeholders concerned in various phases of drought management.
4. To build the capacity of all the stakeholders in the State to cope with the risk of drought and promote community-based disaster risk reduction.
5. To prescribe standard operating procedures and guidelines for drought risk mitigation, preparedness, capacity building, relief and response, recovery, and reconstruction.
6. To mainstream drought management concerns into the developmental planning for disaster risk reduction and climate change adaptation.
7. To invest in drought resilience through structural, non-structural, and financial measures, as well as comprehensive capacity development while ensuring community participation.
8. Strengthen drought risk modelling, assessment, mapping, monitoring and early warning systems with the effective use of science and technology.

1.7 Plan Activation

The Drought Management Plan will be activated based on monitoring of the key drought indices/parameters as mentioned in the Manual for Drought Management (updated December 2020), receipt of forecasts/early warning signals and advisories from scientific institutions /occurrence of the drought situation. At the State level, the State Drought Monitoring Centre (SDMC) functioning in Odisha State Disaster Management Authority (OSDMA) will collect, collate and analyze information on drought parameters as described in Chapter 3 of the Manual for Drought Management from National and State agencies and provide critical inputs to the State Executive Committee/ State Disaster Management Authority (SDMA). The occurrence of a drought situation may be reported by the concerned monitoring authority to the Special Relief Commissioner by the fastest means. Based on the identified trigger points for drought response, the Special Relief Commissioner will activate all concerned departments for emergency drought response, including the State EOC, District EOC and other stakeholders of the Response System. Also, they will issue instructions to include the following:

(i) The exact quantum of resources (in terms of manpower, equipment and essential items from concerned departments/stakeholders) that is required.
(ii) Type of assistance to be provided.
(iii) Time limit within which assistance is needed.
(iv) Details of the various responders involved in drought management through which communication and coordination should take place.

1.8 Plan Implementation

As enshrined in the Disaster Management Act of 2005, the District Authority shall act as the district planning, coordinating and implementing body for disaster management and take all measures for disaster management in the district under the guidelines laid down by the National Authority and State Authority.

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CHAPTER–2

DISTRICT PROFILE

2.1 Description of the District in General

The Tribal dominating District of Nabarangpur has a relatively low literate population. The district holds a total literate of 490156 (Male 298688 and Female 191468). Many educational Institutes are serving in the District of Nabarangpur. The district has one Technical Institute, i.e., Women's I.T.I of Umerkote. Govt. Secondary Training School, Nabarangpur and Govt. Secondary Training School, Umerkote are the professional Training Colleges running in the district. Jabahar Navadaya Vidyalaya, Khatiguda is the Central Government run special School also serving the educational requirement of the district.

As far as the administrative set-up is concerned there are 169 Gram Panchayats, 1 NAC (Umerkote) and 10 Police Stations in the District. The religion of the district is composite. There are Hindus, Christians and Muslims in good numbers with the tribal worshipping the Hindu gods. Like Mirganis, Snkharis, Malis and Sundhi, some other tribes such as Bhumias and Dombs are also residing here. Of these, the Mirganis appear to be a subcaste of the Dombs.

Mondei is the widely celebrated festival of Nabarangpur District. This festival is usually celebrated after the harvesting of crops. Most areas of Nabarangpur District experience the first arrival of monsoon much before the rest of the state. While the rest of Orissa gets rain due to monsoon from the Bay of Bengal, the whole of Nabarangpur gets it straight from the Arabian Sea, through the Southwest direction. The whole of this District enjoys 16912.57 mm of total rainfall and 1631.40 mm of normal rainfall annually. Notably, the Plateaus which are located between 2,000 and 3,000 feet remain cool round the year.

The climate of the district is typically tropical to subtropical with three distinct seasons namely summer, winter, and monsoon. December is the coldest month with a mean daily average temperature of 25^0C which reaches a maximum of 40^0C in May. The average annual rainfall varies from 1030.21 mm to 1569.50 mm. The average annual rainfall is higher in the central parts as compared to other parts of the district. Further droughts are frequent in Nabarangpur, Raighar and Umerkote blocks.

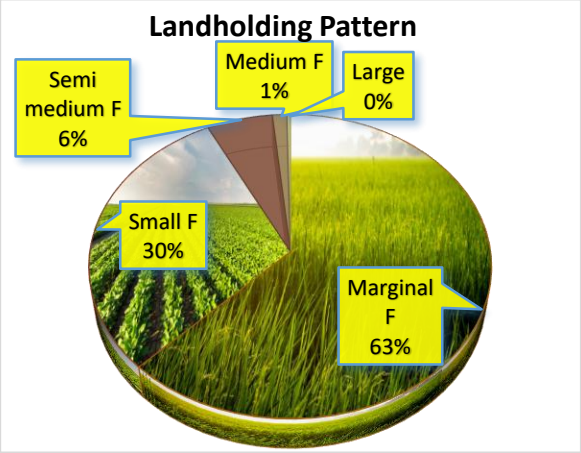
Predominantly an agricultural District, Nawarangpur has more than 90 per cent of its inhabitants depend on farming for their livelihood. The farming community largely depends on rains due to a lack of irrigation facilities. National Horticulture Mission is taking lots of steps to improve the cultivation of many fruits and vegetables in the district. Nabarangpur district is a treasure of many natural resources like iron, chlorite, mica, quartz etc. Heeraput village near Umerkote contains a fair deposit of hematite and limonite, each of which possesses about 60% iron. Similarly, Tentulikhunti area of Nabarangpur has fairly large deposits of granite. The north of Nabarangpur District, up to the border of Kalahandi, has rock beds covering layers of coarse

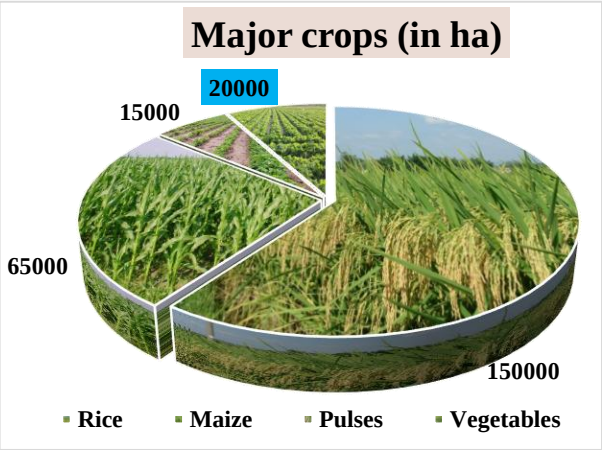
white quartz. Tough industrially this District is not that developed, all these minerals found in the district sustain the various industries in other parts of the country.

2.2 Area and Administrative Setup

The district comprises an area of 5294 sq. km with 887 villages having a population of 12,20,946 as per the 2011 census. As per the Administration is concerned, the administrative set-up of the district is decentralized into 10 blocks, 10 tahsils, 12 Police Stations and 2 Municipalities.

No of Sub-Divisions	02
No of Tehsils	10
No of Municipalities/ Corporations	02
No of NACs	01
No of Blocks	10
No of Gram Panchayats	189
No of Villages	887



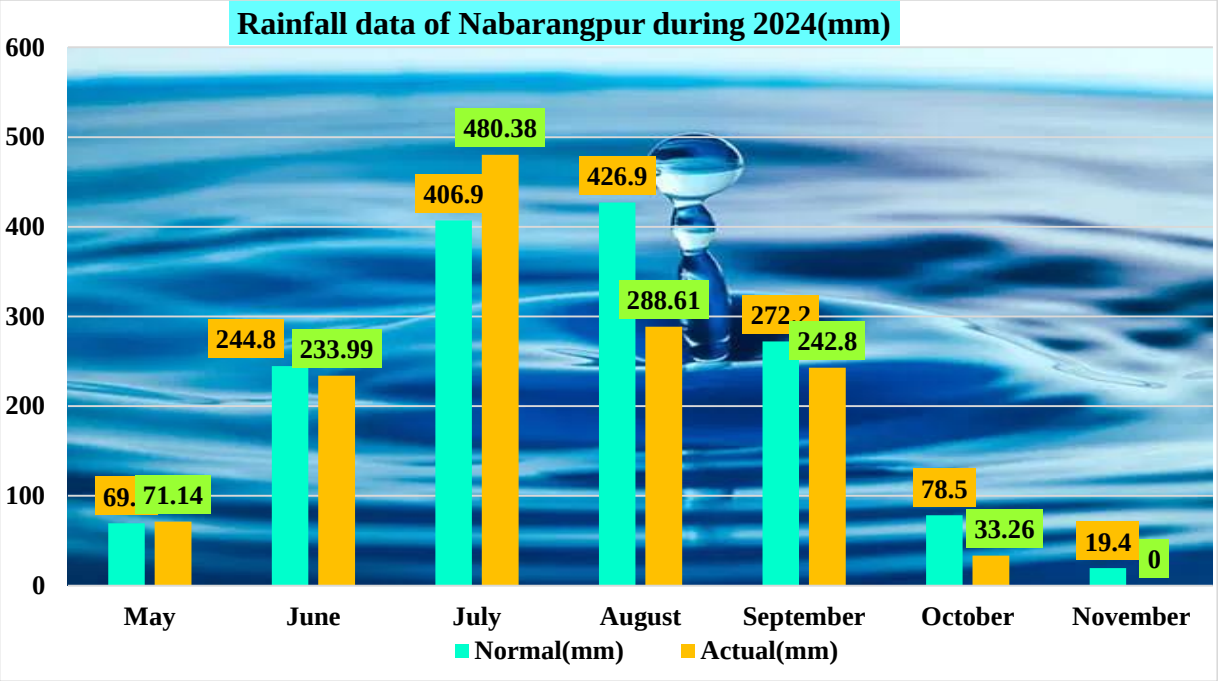


2.3 Geographical Profile

Geographical Coordinates of the district	It is situated at 20.3^0 to 17.5^0 North latitude and 81.27^0 to 84.1^0 East longitude.
Location and geographical boundaries	The district boundary stretches north to Raipur and west to Bastar Districts of Chhattisgarh. The east side of Nabarangpur touches the Kalahandi and Rayagada Districts and south to the Koraput Districts of Odisha.
Agro Climatic Zone/Region (Planning Commission)	Eastern Plateau & Hills Region (VII)
Agro Climatic Zone (NARP)	Eastern Ghat High Land Zone (OR-6)
Agro-Ecological Region	East Coast Plains and Hills Agro-climatic Zone
Agro-Ecological Sub-Region	Eastern plateau (Chhotanagpur) and Eastern Ghats, Hot Subhumid Eco-Region (12.1)
Total geographical area (in sq.km)	5294

2.4 Climate & Rain Fall

As per the Agro-Climatic Zone Nabarangpur district comes under East Coast Plains and Hills. The entire district except Dabugaon Block, falls under Eastern Ghat High Lands. Dabugaon Block falls under Western Undulating Lands. The climate is sub-tropical to temperate. It is characterised by a hot and dry summer, cool and humid monsoon and cold and dry winter. In 2022, Actual rainfall was 1307.19 mm against the Normal rainfall of 1569.5 mm of the district.



10	9	8	7	6	5	4	3	2	1	l. No	
Chandahandi	Jharigaon	Raighar	Umerkote	Dabugaon	Kosagumuda	Papadahandi	Tentulikhunti	Nandahandi	Nabarangpur	Name of Block	
										Normal Annual Rainfall (mm) 2024	
104.9	248.1	105	134.3	283.6	228.3	313	344	302.4	276.3	Rf (mm)	June
8	10	5	10	12	10	12	11	11	15	No. of Rainy days	
297.2	375.6	398.4	437.3	623	500	549	537.4	533.9	552	Rf (mm)	July
18	22	24	20	22	18	19	20	19	22	No. of Rainy days	
152.5	192.6	157.2	206.5	424.4	245.2	267.0	470.8	340.7	429.2	Rf (mm)	August
17	16	17	17	14	16	15	21	16	23	No. of Rainy days	
171.9	174.2	180	158.2	316.4	322	224	283.6	288.5	30.9.2	Rf (mm)	September
11	12	14	13	12	14	14	16	10	19	No. of Rainy days	
976.8	1106.7	923.8	1460.8	1119.4	1399.9	1295.1	1253.1	1357	1434	Avg. South West Monsoon Rf (mm)	
										No. of times deviation observed from Avg. South West Monsoon Rf during last 10 years	
										Min	Temperature (°C)
										Max.	
21	34	19	35	24	33	29	28	35	37	Min	Humidity (%)
44	49	42	59	49	58	53	51	56	62	Max.	

2.5 Agro-Ecological Situations

S. No	Agro-ecological situations	Blocks covered	Area in ha	% of Geographical area	Soil Type	Area under Saline Soil	Area under Acidic Soil
1	Eastern Ghat High Land	Nabarangpur	16101	3.04	Red laterite, sandy loam and alluvial	Nil	16101
2		Nandahandi	11838	60.06		Nil	11838
3		Tentulikhunti	13935	14.19		Nil	13935
4		Papdahandi	21239	44.68		Nil	21239
5		Kosagumda	30881	61.56		Nil	30881
6		Dabugaon	9217	40.90		Nil	9217
7		Umerkote	22776	41.71		Nil	22776
8		Raighar	28938	33.01		Nil	28938
9		Jharigaon	17774	17.31		Nil	17774
10	Western Undulating Zone	Chandahandi	13224	22.04	Red laterite, black soil and alluvial	Nil	13224

In the Nabarangpur district, Kosagumuda has the largest area under acidic soil, covering 30,881 hectares, which constitutes 61.56% of the geographical area. Ensuring that Papadahandi has 21,239 hectares (44.68%) of land with acidic soil. Umerkote comes next, with 22,776 hectares (41.71%) of acidic soil, followed by Raighar with 28,938 hectares (33.01%) under acidic soil. Other blocks, such as Jharigaon (17,774 hectares, 17.31%) and Tentulikhunti (13,935 hectares, 14.19%), also have significant areas under acidic soil. Dabugaon has 9,217 hectares (40.90%) under acidic soil, and Nabarangpur (16,101 hectares, 3.04%) and Nandahandi (11,838 hectares, 60.06%) have extensive areas of acidic soil as well. On the other hand, Chandahandi in the Western Undulating Zone spans 13,224 hectares (22.04%) with red laterite, black soil, and alluvial soils, all of which are also under acidic soil.

2.6 Agriculture Area Statistics

Sl. No	Category	Area in lakhs ha.	% of total geographical area
1.	Total Geographical Area	5.29000	100
2.	(i) Net Sown Area	1.99628	37.73
	(ii) Up land	1.32151	24.98
	(iii) Medium land	0.38342	7.24
	(iv) Low land	0.29135	5.50
3.	Gross Sown Area	2.66638	50.40
4.	Current fallow	0.67010	12.66
5.	Total Agricultural Area (2+3+4)	**1.99628**	37.73
6.	Net Irrigated Area	0.81212	15.35
7.	Percent Irrigated Area	40.68 %	-
8.	Cropping Intensity (3/2)	133.56%	-

The Nabarangpur district covers a total geographical area of 5.29 lakh hectares, which represents 100% of the area. Of this, the net sown area accounts for 1.99628 lakh hectares, or 37.73%, of the total area. This net sown area is made up of 1.32151 lakh hectares of upland

(24.98%), 0.38342 lakh hectares of medium land (7.24%), and 0.29135 lakh hectares of low land (5.50%). The gross sown area is 2.66638 lakh hectares, which represents 50.40% of the total geographical area. Additionally, current fallow land occupies 0.67010 lakh hectares or 12.66% of the total area. The total agricultural area, which includes the net sown area, gross sown area, and current fallow, is 1.99628 lakh hectares, representing 37.73% of the total area. The Nabarangpur district has 0.81212 lakh hectares of net irrigated area, which is 15.35% of the total area. The irrigated area constitutes 40.68% of the net sown area. The cropping intensity is calculated at 133.56%, indicating a relatively high level of cropping activity in the region.

2.7 Operational Holdings

Sl. No	Category	No. of holdings	Area operated in ha.	Percentage	
				No. of holdings	Area operated
1	**Marginal** (Less than 1.0 Ha)	123048	67306	62.40	33.41
2	**Small** (1.0 – 2.0 Ha)	59561	77425	30.20	38.43
3	**Semi-Medium (**2.0 – 4.0 Ha)	11443	31788	5.80	15.78
4	**Medium** (4.0 – 10.0 Ha)	2508	18131	1.27	9.0
5	**Large** (>10.0 Ha)	625	6771	0.31	3.36
	Total	**197185**	**201421**	**100**	**100**

It shows that marginal farmers, with land holdings of less than 1.0 hectares, constitute the largest group, comprising 62.40% of total holdings. However, they operate only 33.41% of the total agricultural land, highlighting their small-scale operations. Small farmers, owning between 1.0 to 2.0 hectares, make up 30.20% of the total holdings and cultivate 38.43% of the total agricultural area. This category manages a relatively larger share of land compared to the marginal group, despite fewer holdings. Semi-medium farmers, with land holdings between 2.0 to 4.0 hectares, represent 5.80% of total holdings but operate 15.78% of the total land area. This indicates a more balanced distribution of land per farmer in this category. Medium farmers, possessing 4.0 to 10.0 hectares, account for just 1.27% of the holdings yet operate 9.0% of the total land. Large farmers, with landholdings exceeding 10.0 hectares, form the smallest group, comprising only 0.31% of total holdings. Despite their minimal presence, they control 3.36% of the total agricultural area, indicating a high land concentration per farmer. In summary, marginal and small farmers dominate in numbers but operate relatively smaller portions of land, whereas medium and large farmers, though fewer in number, control a disproportionate share of the agricultural land.

2.8 Demography and socio-economic profile

Name of Block	Population			SC		ST		Others	
	Male	Female	Children*	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households
Nabarangpur	39351	40133	26494	11549	2656	44503	10235	23432	5465
Nandahandi	30689	31716	20801	9067	2157	34940	8315	18398	4380
Tentulikhunti	41214	43096	28103	12250	3013	47205	11612	24855	6154

Papadahandi	365981	68164	44715	19491	4525	74829	17136	39825	9019
Kosagumuda	79515	81270	53595	23662	5158	89702	19492	47421	10337
Dabugaon	33297	34357	22551	9830	2273	37745	8644	20079	4598
Umerkote	83253	83656	55636	24251	5148	93118	19461	49540	10353
Raighar	91362	90923	60761	27470	5603	101696	20705	53119	10789
Jharigaon	74107	75956	50021	21804	4835	83720	18837	44539	10021
Chandahandi	36460	37493	24651	10745	2766	41258	10520	21950	5597
Total	**875229**	**586764**	**387328**	**170119**	**38134**	**648716**	**144957**	**343158**	**76713**

*1-14 years age

Based on the demographic and socio-economic profile of Nabarangpur, the data indicates that the male population is highest in Papadahandi block followed by Raighar, Umerkote and Kosagumuda. Similarly, the female population is highest in Raighar block followed by Umerkote, Kosagumuda and Jharigaon. Among all blocks, Raigher block leads in child population succeeded by Umerkote and Kosagumunda. Papadahandi has the highest total population among all the blocks, with 365,981 people, followed by Raighar with 91,362, and Umerkote with 83,253. Kosagumuda ranks next with 79,515, while Jharigaon has 74,107 residents. In terms of the Scheduled Tribe (ST) population, Raighar leads with 101,696 members, followed by Umerkote (93,118) and Kosagumuda (89,702). Jharigaon comes next with 83,720, while Tentulikhunti has 47,205 ST members, slightly ahead of Nabarangpur with 44,503. For the Scheduled Caste (SC) population, Raighar again takes the lead with 27,470 SC members, followed by Umerkote (24,251) and Kosagumuda (23,662). Jharigaon has 21,804 SC members, while Tentulikhunti records 12,250. Among households, Raighar has the highest number of ST households (20,705), closely followed by Kosagumuda (19,492) and Umerkote (19,461). Jharigaon follows with 18,837 ST households, while Papadahandi has 17,136. When comparing the "Others" category, Raighar has the highest number of members (53,119) followed by Umerkote (49,540) and Kosagumuda (47,421). Jharigaon records 44,539, while Papadahandi follows with 39,825. Among the smaller blocks, Chandahandi has 36,460 people, followed by Dabugaon with 33,297, and Nandahandi with the lowest at 30,689. Similarly, Nandahandi has the least number of ST members (34,940) and SC members (9,067), making it the least populated block in multiple categories.

2.9 Agricultural workforce participation, livelihood and migration pattern

Name of Block	Marginal Farmers		Small Farmers		Semi-Medium Farmers		Medium Farmers		Large Farmers	
	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households
Nabarangpur	28460	7865	26980	7024	4183	1146	1062	320	236	68
Nandahandi	22135	4904	16308	3617	8412	1858	5312	1167	183	39
Tentulikhunti	28459	5508	17205	2920	4012	901	4517	1020	650	155
Papadahandi	65859	21953	30288	10096	1764	588	129	43	42	14
Kosagumuda	54641	12218	24032	5722	16641	3870	1344	328	153	34
Dabugaon	13780	3444	9120	2040	4135	839	585	117	120	25

Name of Block	Marginal Farmers		Small Farmers		Semi-Medium Farmers		Medium Farmers		Large Farmers	
	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households	No. of members	No. of households
Umerkote	33444	13099	28444	11183	1532	519	312	70	195	35
Raighar	25400	8150	60300	15200	14600	3550	4800	1050	2200	450
Jharigaon	51280	25640	2954	1477	1940	970	650	320	48	16
Chandahandi	13682	3326	9012	2012	4137	831	565	112	114	23
Total	**337140**	**106107**	**224643**	**61291**	**61356**	**15072**	**19276**	**4547**	**3941**	**859**

Marginal Farmer: less than 1.0 Ha (2.5 acres)
Small Farmer: 1.0 – 2.0 Ha (2.5 – 5.0 acres)
Semi-Medium Farmer: 2.0 – 4.0 Ha (5.0 – 5.0 acres)
Medium Farmer: 4.0 – 10.0 Ha (10.0 – 25.0 acres)
Large Farmer: >10.0 Ha (> 25.0 acres)

It shows in the above table that Raighar has the highest agricultural workforce participation, with 107,300 members. It is followed by Papadahandi, which has 98,082 members, and Kosagumuda, with 96,811 members. Next is Umerkote, where 63,927 members are engaged in agriculture, followed closely by Nabarangpur with 60,921 members. Tentulikhunti has 54,843 members, while Nandahandi records 52,350 members. Jharigaon follows with 56,872 members. Towards the lower end, Dabugaon has 27,740 members, and Chandahandi has the least agricultural workforce participation, with 27,510 members.

Sl. No	Name of Block	Total Cultivators	Landless agricultural labourers/Sharecroppers	Wage labourers	Fisherman	Animal Husbandry	Small Business	Others (Please Specify)
1	Nabarangpur	**16423**	**5598**	**4358**				
2	Nandahandi	**10450**	**6788**	**4311**				
3	Tentulikhunti	**10496**	**8530**	**4037**				
4	Papadahandi	**32694**	**10435**	**3200**				
5	Kosagumuda	**22172**	**4166**	**28629**				
6	Dabugaon	**6465**	**6407**	**4276**				
7	Umerkote	**24905**	**64720**	**3310**				
8	Raighar	**28322**	**6407**	**3200**				
9	Jharigaon	**28423**	**4027**	**2500**				
10	Chandahandi	**16835**	**7266**	**2865**				
	Total	**197185**	**124344**	**60686**				

It is revealed from the above table that Papadahandi has the highest cultivators of 16.58 percent as compared to other blocks. Similarly, Umerkote block has the highest of 52.04 percent landless agricultural labourers/Sharecroppers and Jharigaon shows the lowest only3.23 percent. Where the workforce is highest at 47.17 percent, is in Kosagumda block.

2.10 Livestock information

Sl. No	Name of Block	Small Animals				Large Animals						Draft Animals		Area under Fodder Crops(in
		No. of broilers	No. of layers	No. of Ducks	No. of Pigs	No. of Goats (Improved &	No. of Sheep	No. of Indigenous Cow	No. of Cross bred Cow	No. of indigenous buffalo	Hybrid Buffalo	No. of cattle	No of buffalo	
1	Nabarangpur	23500	13000	3800	18	2584	11853	6500	720	3100	40	4800	480	
2	Nandahandi	3500	1130	520	150	1848	5860	4005	660	880	27	9488	654	
3	Tentulikhunti	4500	1450	1000	73	6900	8089	20835	468	3704	51	11502	2201	
4	Kosagumuda	33793	7530	4200	440	5508	15657	15730	2300	1005	45	25510	2330	
5	Papadahandi	4000	1300	2005	152	5793	20507	864	195	266	6	18050	3050	
6	Dabugaon	3200	600	1578	57	4576	7553	1038	125	161	2	15638	2865	
7	Umerkote	12000	4000	3000	213	9976	15982	9114	2065	2152	80	27340	1076	
8	Raighar	33400	2200	1980	1060	9450	4300	12100 (ND)	3500	1050 (ND)	10	50200	1025	
9	Jharigaon	43000	23000	4000	212	9450	11830	9095 (ND)	1472	1015 (ND)	30	31330	2025	
10	Chandahandi	8000	35000	3000	0	8000	10000	6000	600	2000	10	4000	500	

In the Nabarangpur district, Jharigaon has the highest number of small animals, with 43,000 broilers, 23,000 layers, and 4,000 ducks. It also leads in the number of goats, with 11,830 sheep and 9,095 goats, followed by Raighar, which has 33,400 broilers, 2,200 layers, and 1,980 ducks, along with 1,060 pigs, 4,300 sheep, and 9,450 goats. Next, Kosagumuda follows closely with 33,793 broilers, 7,530 layers, and 4,200 ducks. It also has 5,508 goats and 15,657 sheep, making it a major hub for livestock. Nabarangpur is another key block with 23,500 broilers, 13,000 layers, and 3,800 ducks, along with 2,584 goats and 11,853 sheep. When it comes to large animals in the district, Tentulikhunti has the highest number of Indigenous cows, with 20,835, followed by 3,704 indigenous buffalo and 468 crossbred cows. It also has the highest number of indigenous buffalo among the blocks. Kosagumuda follows closely with 15,730 indigenous cows, 2,300 crossbred cows, and 1,005 indigenous buffalo, along with 45 hybrid buffalo. Raighar comes next with 12,100 indigenous cows, 3,500 crossbred cows, and 1,050 indigenous buffalo, but only 10 hybrid buffalo. Nabarangpur has 6,500 indigenous cows, 720 crossbred cows, and 3,100 indigenous buffalo, with 40 hybrid buffalo, ranking it next in terms of indigenous buffalo. Jharigaon also has a significant number of indigenous buffalo (1,015) and 1,472 crossbred cows, along with 9,095 indigenous cows. Raighar has the highest number of draft animals, with 50,200 cattle and 1,025 buffalo. Following closely, Jharigaon comes in second with 31,330 cattle and 2,025 buffalo, making it the block with the second-highest number of draft animals. Kosagumuda ranks third with 25,510 cattle and 2,330 buffalo, while Papadahandi is next, having 18,050 cattle and 3,050 buffalo, contributing a significant number of draft animals.

Umerkote also has a considerable number of draft animals, with 27,340 cattle and 1,076 buffalo. Dabugaon follows with 15,638 cattle and 2,865 buffalo. Tentulikhunti has 11,502 cattle and 2,201 buffalo, while Nandahandi has 9,488 cattle and 654 buffalo.

2.11 Crop Sowing Window Period

Name of Block	Name of the Crop	Season	Sowing/Planting method (BC/TP/DS)	Sowing Period	Harvesting Period
All Block	Rice	Kharif	BC -, TP - DS	July - August	October - November
		Rabi	TP	December - January	Mar - April
		Summer	-	-	-
	Maize	Kharif	DS	June - July	October - November
		Rabi	-DS	December - January	Mar - April
		Summer	-	-	-

BC: Broadcasting
TP: Transplanting
DS: Direct Sowing

Rice is cultivated in all blocks across three seasons: Kharif, Rabi, and summer. During the Kharif season, rice is sown using Broadcast (BC), Transplanting (TP), and Direct Seeding (DS) methods between July and August, and it is harvested from October to November. In the Rabi season, rice is planted using the Transplanting (TP) method between December and January, with harvesting occurring from March to April. Rice is not cultivated during the summer season. Maize is also grown in Kharif and Rabi seasons but is not cultivated in the summer. In the Kharif season, maize is sown using the Direct Seeding (DS) method from June to July and harvested between October and November. During the Rabi season, it is sown using the Direct Seeding (DS) method from December to January, with harvesting taking place between March and April.

2.12 Area, Production and Yield of Major Crops in Irrigated/Rainfed Conditions during Kharif Season

Name of the Block: Chandahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	2535	3011	5546	129792	142721	273418	51.2	47.4	49.3
Maize	2340	467	467	2807	260676	49595.4	305401.6	111.4	108.8
Total	4875	3478	8353	390468	192316.4	578819.6	162.6	153.6	158.1

In the Chandahandi block, paddy is cultivated on 5,546 hectares (2,535 hectares irrigated and 3,011 hectares rainfed), yielding a total production of 2,73,418 quintals. The productivity is 51.2 quintals per hectare for irrigated land, 47.4 quintals per hectare for rainfed land, and an overall average of 49.3 quintals per hectare. Maize is grown on 2,807 hectares (2,340 hectares irrigated and 467 hectares rainfed), producing a total of 3,05,401.6 quintals. The productivity is 111.4 quintals per hectare for irrigated land, 108.8 quintals per hectare for rainfed land, and an overall average of 110.1 quintals per hectare. Overall, the block has 8,353 hectares of cultivated land, yielding a combined production of 5,78,819.6 quintals, with an average productivity of 158.1 quintals per hectare.

Name of the Block: Jharigaon									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	3505	4856	8361	187518	215121	4172149	53.5	44.3	49.9
Maize	2980	4456	7436	382930	544969	932474	128.5	122.3	125.4
Total	6485	9312	15797	570447	760089	1349688	182	166.6	175.3

In the Jharigaon block, paddy is cultivated on 8,361 hectares (3,505 hectares irrigated and 4,856 hectares rainfed), yielding a total production of 4,17,214 quintals. The productivity is 53.5 quintals per hectare for irrigated land, 44.3 quintals per hectare for rainfed land, and an overall average of 49.9 quintals per hectare. Maize is grown on 7,436 hectares (2,980 hectares irrigated and 4,456 hectares rainfed), producing a total of 9,32,474 quintals. The productivity is 128.5 quintals per hectare for irrigated land, 122.3 quintals per hectare for rainfed land, and an overall average of 125.4 quintals per hectare. Overall, the block has 15,797 hectares of cultivated land, yielding a combined production of 13,49,688 quintals, with an average productivity of 175.3 quintals per hectare.

Name of the Block: DABUGAM									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Rice	695	3839	4534	32318	163158	201763	46.5	42.5	44.5
Maize	1850	1683	3533	200725	168805	368845	108.5	100.3	104.4
Total	2545	5522	8067	233043	331962	570608	155	142.8	148.9

In the Dabugam block, rice is cultivated on 4,534 hectares (695 hectares irrigated and 3,839 hectares rainfed), yielding a total production of 2,01,763 quintals. The productivity is 46.5 quintals per hectare for irrigated land, 42.5 quintals per hectare for rainfed land, and an overall average of 44.5 quintals per hectare. Maize is grown on 3,533 hectares (1,850 hectares irrigated and 1,683 hectares rainfed), producing a total of 3,68,845 quintals. The productivity is 108.5 quintals per hectare for irrigated land, 100.3 quintals per hectare for rainfed land, and an overall average of 104.4 quintals per hectare. Overall, the block has 8,067 hectares of cultivated land, yielding a combined production of 5,70,608 quintals, with an average productivity of 148.9 quintals per hectare.

Name of the Block: Papadahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Rice	1394	9293	10687	77785	423761	541831	55.8	45.6	50.7
Maize	3250	3886	6736	44325	488470	883090	136.5	125.7	131.1
Total	4644	13179	17423	521410	912231	1424921	192.3	171.3	181.8

In the Papadahandi block, rice is cultivated on 10,687 hectares (1,394 hectares irrigated and 9,293 hectares rainfed), yielding a total production of 5,41,831 quintals. The productivity is 55.8 quintals per hectare for irrigated land, 45.6 quintals per hectare for rainfed land, and an overall average of 50.7 quintals per hectare. Maize is grown on 6,736 hectares (3,250 hectares irrigated and 3,886 hectares rainfed), producing a total of 8,83,090 quintals. The productivity is 136.5 quintals per hectare for irrigated land, 125.7 quintals per hectare for rainfed land, and

an overall average of 131.1 quintals per hectare. Overall, the block has 17,423 hectares of cultivated land, yielding a combined production of 14,24,921 quintals, with an average productivity of 181.8 quintals per hectare.

Name of the Block: Raighar									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Rice	5138	6626	11764	259469	286905.8	551731.6	50.5	43.3	46.9
Maize	8674	6331	15005	1192675	788209.5	1968656	137.5	124.5	131.2
Total	13812	12957	26769	1452144	1075115	2520388	188	167.8	178.1

In the Raighar block, rice is cultivated on 11,764 hectares (5,138 hectares irrigated and 6,626 hectares rainfed), yielding a total production of 5,51,731.6 quintals. The productivity is 50.5 quintals per hectare for irrigated land, 43.3 quintals per hectare for rainfed land, and an overall average of 46.9 quintals per hectare. Maize is grown on 15,005 hectares (8,674 hectares irrigated and 6,331 hectares rainfed), producing a total of 19,68,656 quintals. The productivity is 137.5 quintals per hectare for irrigated land, 124.5 quintals per hectare for rainfed land, and an overall average of 131.2 quintals per hectare. Overall, the block has 26,769 hectares of cultivated land, yielding a combined production of 25,20,388 quintals, with an average productivity of 178.1 quintals per hectare.

Name of the Block: Umerkote									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	**Irrigated**	**Rainfed**	**Total**	**Irrigated**	**Rainfed**	**Total**	**Irrigated**	**Rainfed**	**Average**
Rice	9599	2540	12139	523146	113538	602094	54.5	44.7	49.6
Maize	4550	3662	8212	598325	449327	1043745	131.5	122.7	127.1
Total	14149	6202	20351	1121471	562865	1645840	186	167.4	176.7

In the Umerkote block, rice is cultivated on 12,139 hectares (9,599 hectares irrigated and 2,540 hectares rainfed), yielding a total production of 6,02,094 quintals. The productivity is 54.5 quintals per hectare for irrigated land, 44.7 quintals per hectare for rainfed land, and an overall average of 49.6 quintals per hectare. Maize is grown on 8,212 hectares (4,550 hectares irrigated and 3,662 hectares rainfed), producing a total of 10,43,745 quintals. The productivity is 131.5 quintals per hectare for irrigated land, 122.7 quintals per hectare for rainfed land, and an overall average of 127.1 quintals per hectare. Overall, the block has 20,351 hectares of cultivated land, yielding a combined production of 16,45,840 quintals, with an average productivity of 176.7 quintals per hectare.

Name of the Block: Nabarangpur									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	**Irrigated**	**Rainfed**	**Total**	**Irrigated**	**Rainfed**	**Total**	**Irrigated**	**Rainfed**	**Average**
Paddy	5474	4743	10217	270963	190194	457722	49.5	40.1	44.8
Maize	1250	586	1836	136875	60182	194800	109.5	102.7	106.1
Total	6724	5329	12053	407838	20377	652521	159	142.8	150.9

In the Nabarangpur block, paddy is cultivated on 10,217 hectares (5,474 hectares irrigated and 4,743 hectares rainfed), yielding a total production of 4,57,722 quintals. The productivity is 49.5 quintals per hectare for irrigated land, 40.1 quintals per hectare for rainfed land, and an overall average of 44.8 quintals per hectare. Maize is grown on 1,836 hectares (1,250 hectares

irrigated and 586 hectares rainfed), producing a total of 1,94,800 quintals. The productivity is 109.5 quintals per hectare for irrigated land, 102.7 quintals per hectare for rainfed land, and an overall average of 106.1 quintals per hectare. In total, the block has 12,053 hectares of cultivated land, with a combined production of 6,52,521 quintals of crops and an average productivity of 150.9 quintals per hectare.

Name of the Block: Nandahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	6171	1020	7191	338788	43350	350202	54.9	42.5	48.7
Maize	1250	215	1465	135625	21092	151335	108.5	98.1	103.3
Total	7421	1235	8656	474413	64442	501536	163.4	140.6	152

In the Nandahandi block, paddy is cultivated on 7,191 hectares (6,171 hectares irrigated and 1,020 hectares rainfed), producing a total of 3,50,202 quintals. The productivity is 54.9 quintals per hectare for irrigated fields, 42.5 quintals per hectare for rainfed fields, and an overall average of 48.7 quintals per hectare. Maize is grown on 1,465 hectares (1,250 hectares irrigated and 215 hectares rainfed), yielding a total production of 1,51,335 quintals. The productivity stands at 108.5 quintals per hectare for irrigated land, 98.1 quintals per hectare for rainfed land, and an overall average of 103.3 quintals per hectare. Overall, the block has 8,656 hectares of cultivated land, producing 5,01,536 quintals of crops, with an average productivity of 152 quintals per hectare.

Name of the Block: Tentulikhunti									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	1336	4871	6207	70674	225527	307867	52.9	46.3	49.6
Maize	2250	3454	5704	262800	364742	634285	116.8	105.6	111.2
Total	3586	8325	11911	333474	590270	942152	169.7	151.9	160.8

In the Tentulikhunti block, paddy is cultivated on 6,207 hectares, with 1,336 hectares under irrigation and 4,871 hectares rainfed, yielding a total production of 3,07,867 quintals. The productivity is 52.9 quintals per hectare for irrigated fields, 46.3 quintals per hectare for rainfed fields, and an overall average of 49.6 quintals per hectare. Maize is grown on 5,704 hectares (2,250 hectares irrigated and 3,454 hectares rainfed), with a total production of 6,34,285 quintals. The productivity is 116.8 quintals per hectare for irrigated land, 105.6 quintals per hectare for rainfed land, and an overall average of 111.2 quintals per hectare. In total, the block has 11,911 hectares of cultivated land, producing 9,42,152 quintals of crops, with an overall average productivity of 160.8 quintals per hectare.

2.13 Area, Production and Yield of Major Crops in Irrigated/Rainfed Conditions during Rabi Season

Name of the Block: Chandahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	32	-	32	1680	-	1680	52.5	-	52.5
Maize	307	-	307	35151	-	35151	114.7	-	114.7
Total	339	-	339	36831	-	36831	167	-	167

During the Rabi season in Chandahandi, Paddy is cultivated on 32 hectares under irrigation, yielding 1721.6 quintals, with a productivity of 53.8 quintals per hectare**.** Maize is grown on 1552 hectares of irrigated land, producing 206105.6 quintals, with a productivity of 132.8 quintals per hectare. The total cultivated area for both crops is 1,584 hectares, with an overall production of 207827.2 quintals and an average productivity of 186.6 quintals per hectare. No rainfed cultivation is recorded for these crops in the block.

Name of the Block: Jharigaon									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	32	-	32	1721.6	-	1721.6	53.8	-	53.8
Maize	1552	-	1552	206105.6	-	206105.6	132.8	-	132.8
Total	1584	-	1584	207827.2	-	207827.2	186.6	-	186.6

In Jharigaon**,** Paddy is cultivated on 32 hectares under irrigation, yielding 1721.6 quintals, with a productivity of 53.8 quintals per hectare**.** Maize is grown on 1552 hectares of irrigated land, producing 206105.6 quintals, with a productivity of 132.8 quintals per hectare. The total cultivated area for both crops is 1,584 hectares, with an overall production of 207827.2 quintals and an average productivity of 186.6 quintals per hectare. No rainfed cultivation is recorded for these crops in the block.

Name of the Block: Dabugam									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	42	-	42	1990.8	-	1990.8	47.4	-	47.4
Maize	580	-	580	62988	-	62988	108.6	-	108.6
Total	622	-	622	64978	-	64978	156	-	156

In Dabugam block, paddy cultivation is carried out on 42 hectares of irrigated land, yielding a total production of 1990.8 quintals, with a productivity rate of 47.4 quintals per hectare. Maize is cultivated on 580 hectares of irrigated land, producing 62,988 quintals, with a productivity rate of 108.6 quintals per hectare. The combined total area under cultivation in the block is 622 hectares, yielding 64,978 quintals of production, with an overall productivity of 156 quintals per hectare.

Name of the Block: Papadahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	84	-	84	4645.2	-	4645.2	55.3	-	55.3
Maize	737	-	737	99789.8	-	99789.8	135.4	-	135.4
Total	821	-	821	104435	-	104435	190.7	-	190.7

In Papadahandi block, paddy is cultivated on 84 hectares of irrigated land, yielding a total production of 4645.2 quintals, with a productivity of 55.3 quintals per hectare. Maize is grown on 737 hectares of irrigated land, producing 99789.8 quintals, with a productivity of 135.4 quintals per hectare. Overall, the block has 821 hectares under cultivation, with a total production of 104435 quintals and an average productivity of 190.7 quintals per hectare.

Name of the Block: Kosagumuda									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	131	-	131	6354	-	6354	48.5	-	48.5
Maize	835	-	835	98948	-	98948	118.5	-	118.5
Total	966	-	966	105301	-	105301	167	-	167

In the Kosagumuda block, paddy is cultivated over an irrigated area of 131 hectares, yielding a total production of 6,354 quintals, with a productivity of 48.5 quintals per hectare. Maize is grown on 835 hectares of irrigated land, producing 98,948 quintals, with a productivity of 118.5 quintals per hectare. The total cultivated area for both crops is 966 hectares, resulting in an overall production of 1,05,301 quintals, with an average productivity of 167 quintals per hectare.

Name of the Block: Umerkote									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	502	-	502	27359	-	27359	54.5	-	54.5
Maize	1967	-	1967	266529	-	266529	135.5	-	135.5
Total	2469	-	2469	293887.5	-	293887.5	190	-	190

In Umerkote block, rice is cultivated on 502 hectares of irrigated land, yielding a total production of 27,359 quintals, with a productivity of 54.5 quintals per hectare. Maize is grown on 1,967 hectares of irrigated land, producing 2,66,529 quintals, with a productivity of 135.5 quintals per hectare. Overall, the block has 2,469 hectares under cultivation, with a total production of 2,93,887.5 quintals, maintaining a consistent productivity of 190 quintals per hectare across all crops.

Name of the Block: Nabarangpur									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	151	-	151	7369	-	7369	48.8	-	48.8
Maize	1260	-	1260	149436	-	149436	118.6	-	118.6
Total	1411	-	1411	156804.8	-	156804.8	167.4	-	167.4

In Nabarangpur block, paddy is cultivated on 151 hectares of irrigated land, producing 7,369 quintals, with a productivity of 48.8 quintals per hectare. Maize is grown on 1,260 hectares of irrigated land, yielding 1,49,436 quintals, with a productivity of 62 quintals per hectare. The total cultivated area in the block is 1,290 hectares, yielding a total production of 1,56,804.8 quintals, with an overall productivity of 167.4 quintals per hectare.

Name of the Block: Nandahandi									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	90	-	90	4752	-	4752	52.8	-	52.8
Maize	826	-	826	92099	-	92099	111.5	-	111.5
Total	916	-	916	96851	-	96851	164.3	-	164.3

In Nandahandi block, paddy is cultivated on 90 hectares of irrigated land, producing 4,752 quintals, with a productivity of 52.8 quintals per hectare. Maize is grown on 826 hectares of

irrigated land, yielding 92,099 quintals, with a productivity of 111.5 quintals per hectare. The total cultivated area in the block is 916 hectares, yielding a total production of 96,851 quintals, with an overall productivity of 164.3 quintals per hectare.

Name of the Block: Tentulikhunti									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Paddy	84	-	84	4502	-	4502	53.6	-	53.6
Maize	448	-	448	51699	-	51699	115.4	-	115.4
Total	532	-	532	56201.6	-	56201.6	169	-	169

In Tentulikhunti block,paddy is cultivated on 84 hectares of irrigated land, producing 4,502 quintals, with a productivity of 53.6 quintals per hectare. Maize is grown on 448 hectares of irrigated land, yielding 51,699 quintals, with a productivity of 115.4 quintals per hectare. The total cultivated area in the block is 532 hectares, yielding a total production of 56,201.6 quintals, with an overall productivity of 169 quintals per hectare.

2.14 Area, Production and Yield of Major Horticultural Crops in Irrigated/Rainfed Conditions

Name of the Block:									
	Area (in ha)			Production (in q)			Productivity (q/ha)		
Crops	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Average
Total									

2.15 Production and Productivity of Livestock

Name of the Block	Milk		Eggs		Broiler		Meat	
	Nos.	Production	Nos.	Production	Nos.	Production	Nos.	Production
Nabarangpur	2500 Ind cow in milk 350 CB cow in milk	Ind cow- 1 lt/day CB cow- 6 lt / day	13000 in laying stage	39000/ annum	23500	282 MT/ annum	6300	55 MT/ annum
Nandahandi	4665	3400 ltrs	1130	980	3500	260 kg	7708	85 kgs
Tentulikhunti	1475	2500 lit/day	1450	1200/day	4100	1500 kg/day	4500	450/day
Kosagumuda	1980	5940 liter	7530	6400	33793	3800kg	21165	264kg/day
Papadahandi	1325 Cows and buffaloes	1890 Litr	1300 layer birds	1000	4000	356 kg	26300	140 kg
Dabugaon	1199 Ind Cows and buffaloes and 127 CB cows and buffaloes	Ind cows- 2 lit/day CB cows- 8 lit/day	500layer birds	1250/ annum	3200	38.4 MT/annum	6576	58 MT/annum
Umerkote	12254 (Cows and Buffalo)	15527 ltrs	4000	3600	12000	224 kg	25958	160 kg
Raighar	6232	24000liter	2000	1800/DAY	33000	500kg/day	14750 no of SA	180kg/day

Name of the Block	Milk		Eggs		Broiler		Meat	
Jharigaon	5872	20360 liter	23000	14000/DAY	43000	800kg/day	21280 no of SA	238kg/day
Chandahandi	12400(Cows and buffalo)	4000 ltr.	34000	32000	8000	160qt.	15000	1500qt.

In Nabarangpur Block, there are 2,500 indigenous cows and 350 crossbred cows in milk production. Indigenous cows produce 1 litre per day, while crossbred cows yield 6 liters per day. The block has 13,000-layer birds, producing 39,000 eggs annually. Additionally, 23,500 broilers contribute 282 metric tons of meat per annum, and 6,300 animals provide 55 metric tons of meat per year. In Nandahandi Block, 4,665 cows produce 3,400 litres of milk daily, while 1,130-layer birds yield 980 eggs. The broiler production consists of 3,500 birds, contributing 260 kg of meat, and 7,708 animals produce 85 kg of meat. In Tentulikhunti Block, 1,475 cows provide 2,500 litres of milk per day, and 1,450-layer birds produce 1,200 eggs daily. The block has 4,100 broilers, yielding 1,500 kg of meat daily, and 4,500 animals, producing 450 kg of meat daily. In Kosagumuda Block, 1,980 cows generate 5,940 liters of milk, and 7,530-layer birds produce 6,400 eggs. The broiler count is 33,793, yielding 3,800 kg of meat, while 21,165 animals provide 264 kg of meat daily. In Papadahandi Block, 1,325 cows and buffaloes produce 1,890 liters of milk, and 1,300-layer birds lay 1,000 eggs daily. There are 4,000 broilers, contributing 356 kg of meat, and 26,300 animals, producing 140 kg of meat.

In Dabugaon Block, 1,199 Indigenous cows and buffaloes produce 2 litres per day each, while 127 crossbred cows and buffaloes yield 8 litres per day each. The block has 500-layer birds, producing 1,250 eggs annually; 3,200 broilers, yielding 38.4 metric tons of meat per annum; and 6,576 animals, contributing 58 metric tons of meat annually. In Umerkote Block, 12,254 cows and buffaloes produce 15,527 litres of milk, while 4,000-layer birds lay 3,600 eggs. The block has 12,000 broilers, yielding 224 kg of meat, and 25,958 animals, contributing 160 kg of meat. In Raighar Block, 6,232 cows produce 24,000 liters of milk, and 2,000-layer birds lay 1,800 eggs daily. The broiler population is 33,000, producing 500 kg of meat daily, while 14,750 animals provide 180 kg of meat per day. In Jharigaon Block, 5,872 cows produce 20,360 liters of milk, while 23,000-layer birds lay 14,000 eggs daily. The block has 43,000 broilers, yielding 800 kg of meat daily, and 21,280 animals, contributing 238 kg of meat per day. In Chandahandi Block, 12,400 cows and buffaloes produce 4,000 liters of milk, while 34,000-layer birds lay 32,000 eggs. The block has 8,000 broilers, producing 160 quintals of meat, and 15,000 animals, yielding 1,500 quintals of meat.

2.16 Fisheries Information

	Inland Ponds			Rivers			Reservoirs			Marine		
Name of Block	**No. of Units**	**Area**	**Average Yield (t/ha)**	**Water Spread Area**	**Area**	**Average Yield (t/ha)**	**No. of Units**	**Area**	**Average Yield (Kg/ha)**	**No. of fisherme n**	**No. of boats**	**Average catch per boat (t)**
Nabarangpur	304	74.92	2t/Ha	NA		2.13 t/Ha	1	72 Ha	11Kg/Ha	Nil	Nil	Nil
Nandahandi	290	127.2					Nil	Nil	Nil	Nil	Nil	Nil
Tentulikhunti	277	101.87					4	1252Ha	11Kg/Ha	Nil	Nil	Nil

Papadahandi	611	153.3				Nil	Nil	Nil	Nil	Nil	Nil
Dabugaon	294	79.6				Nil	Nil	Nil	Nil	Nil	Nil
Umerkote	549	168.16				1	670 Ha	11Kg/Ha	Nil	Nil	Nil
Jharigaon	751	330.38				Nil	Nil	Nil	Nil	Nil	Nil
Raighar	958	364.8				Nil	Nil	Nil	Nil	Nil	Nil
Chandahandi	282	163				Nil	Nil	Nil	Nil	Nil	Nil
Kosagumuda	818	217.9				Nil	Nil	Nil	Nil	Nil	Nil

In Raighar Block, inland pond fisheries are the most extensive, with 958 units covering 364.8 hectares, making it the highest among all blocks. Jharigaon and Kosagumuda follow with 751 units (330.38 ha) and 818 units (217.9 ha), respectively. When considering reservoir fisheries, Tentulikhunti Block leads with 1,252 hectares across 4 reservoirs, producing an average yield of 11 kg/ha. Umerkote comes next, with 670 hectares under reservoir fisheries, while Nabarangpur has 72 hectares with a similar yield of 11 kg/ha. For river fisheries, Nabarangpur district is with an average yield of 2.13 tons per hectare. Notably, none of the blocks report any marine fisheries activity. Overall, Raighar and Jharigaon lead in inland pond fisheries, while Tentulikhunti dominates reservoir fisheries.

2.17 Basin Details

Name of the Basin	Total Catchment Area (in sq.km)	Catchment Area within the district (in sq.km)	Avg. Annual Flow (in BCM) inside the district	Name of the blocks under the catchment area	% of the Geographical Area of the district	Major Tributaries
Mahanadi River Basin (as Nabarangpur is part of this basin)		4,660 sq.km.	2.1 BCM	Nabarangpur Jharigam Raighar Kosagumuda Papadahandi Chandahandi Umerkote Tentulikhunti		• Indravati River (a major tributary of the Godavari River) • Tungabhadra River • Tel River

2.18 Sources of Irrigation

Sources of Irrigation	Nos.			Command/Ayacut Area (in ha)	% of Total Area Irrigated	Remarks
	Functional	Defunct	Total			
Major Canals				8.5	32.16	
Medium Canals						
Minor Canals (Flow)						
Lift Irrigation Points				14.3	54.10	
Bore Wells (Community & Private)				2.3	8.70	
Open Wells (Community & Private)				0.8	3.02	

Farm Ponds (Community & Private)						
Micro-Irrigation (Drip/Sprinkler)						
Water Harvesting Structures				146		
Other Sources						
Water lifting devices **(a) Electric Pump sets** **(b) Diesel Pump sets** **(c) Others**						

2.19 Irrigation Based Classification

Name of the Block	Irrigated Area (ha)		Rainfed Area (ha)	
	Gross Irrigated Area (ha)	Net Irrigated Area (ha)	Partially irrigated/ Protective Irrigation	Unirrigated/Totally rainfed

2.20 Soil Nutrient and Fertility Status

Name of the Block	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Copper	Iron	Manganese	Zinc
Nabarangpur	160	120	50	NA	NA	NA	
Nandahandi	160	120	50	NA	NA	NA	
Tentulikhunti	160	120	50	NA	NA	NA	
Papadahandi	160	125	45	NA	NA	NA	
Kosagumuda	160	125	45	NA	NA	NA	
Dabugaon	160	120	50	NA	NA	NA	
Umerkote	160	120	50	NA	NA	NA	
Raighar	185	140	53	NA	NA	NA	
Jharigaon	124	105	45	NA	NA	NA	
Chandahandi	35	16	280	NA	NA	NA	

Raighar block has the highest available nitrogen at 185 kg/ha, followed by Nabarangpur, Nandahandi, Tentulikhunti, Dabugaon, Umerkote, Papadahandi, and Kosagumuda, all with 160 kg/ha. Jharigaon has a lower nitrogen level at 124 kg/ha, while Chandahandi records the lowest at 35 kg/ha. In terms of available phosphorus, Raighar again leads with 140 kg/ha, followed by Kosagumuda and Papadahandi, both with 125 kg/ha. Nabarangpur, Nandahandi, Tentulikhunti, Dabugaon, and Umerkote have 120 kg/ha, while Jharigaon has a slightly lower phosphorus level at 105 kg/ha. Chandahandi, however, has the least available phosphorus at 16 kg/ha. Chandahandi stands out with the highest available potassium at 280 kg/ha, far exceeding all other blocks. Raighar follows with 53 kg/ha, while Nabarangpur, Nandahandi, Tentulikhunti, Dabugaon, and Umerkote have 50 kg/ha each. Kosagumuda, Papadahandi, and Jharigaon have the lowest potassium levels at 45 kg/ha. Overall, Raighar has the highest nitrogen and phosphorus levels, making it the most nutrient-rich block in these categories. Chandahandi, despite having the lowest nitrogen and phosphorus, stands out for its

exceptionally high potassium content. Meanwhile, Jharigaon has consistently lower values in all three categories compared to most other blocks.

2.21 Groundwater status

Name of Block	Annual Extractable Ground water Resource (Ham)	Current Annual Ground Water Draft (Ham)				Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorisation (Over Exploited/Critical/Semi critical/Safe/ Saline)
		Irrigation	Domestic	Industrial	Total				
Chandahandi	4675.07	953.44	11.05	232.77	1197.26	254.21	3456.37	25.61	safe
Dabugaon	2430.36	464.89	11.05	213.92	689.86	234.19	1720.23	28.39	safe
Jharigaon	6528.74	1037.58	6.63	472.63	1516.84	516.33	4968.19	23.23	safe
Kasagumuda	11343.19	3089.14	13.26	498.44	3600.84	540.00	7700.79	31.74	safe
Nabarangapur	2860.29	1174.64	28.73	364.67	1568.04	403.38	1253.54	54.82	safe
Nandahandi	3822.99	1123.48	8.84	158.32	1290.64	163.71	2526.96	33.76	safe
Papadhandi	4760.89	938.73	22.1	407.83	1368.66	425.99	3374.07	28.75	safe
Raighar	8398.54	4310.07	4.42	539.68	4854.17	564.85	3519.2	57.80	safe
Tentulikhunti	3526.66	893.45	17.68	262.75	1173.88	276.91	2338.62	33.29	safe
Umerkote	9555.08	2003.97	35.36	698.95	2738.28	762.29	6753.46	28.66	safe
Total	57901.81	15989.39	159.12	3849.96	19998.5	4141.86	37611.4	34.54	safe
Source: Dynamic Ground Water Resources of Odisha, 2022									

Categorization: Overexploited: GW utilization>100%; Critical:90-100%; Semi-critical:70-90%; Safe<70%

2.22 Infrastructure Availability

(a) **Agriculture:** (Input dealer points, Fertilizers, Pesticides, PACS, Banks, FIAC, Custom Hiring Centre, Agro-Service Centre)

Name of the Block	Input dealer points-Seeds	Fertilisers	Pesticides	PACS	Banks	FIAC	Custom Hiring Centre	Agro-Service Centre
Nabarangpur	32	36	19	1	9	1	0	0
Nandahandi	27	26	12	1	1	1	4	2
Tentulikhunti	41	33	10	2	4	1	0	0
Papadahandi	27	40	9	2	7	1	4	0
Kosagumuda	32	51	11	2	5	1	2	0
Dabugaon	33	13	7	1	2	1	0	1
Umerkote	329	114	65	1	11	1	30	5
Raighar	148	83	93	1	3	1	2	2
Jharigaon	64	51	16	1	2	1	1	1
Chandahandi	43	29	13	1	2	1	1	0
Total	**776**	**476**	**255**	**13**	**46**	**10**	**44**	**11**

In terms of agricultural support infrastructure, Umerkote Block stands out as well-equipped. It has the highest number of input dealer points, with 329 for seeds, 114 for fertilizers, and 65 for pesticides, ensuring a strong supply chain for farmers. Raighar follows 148 seed dealers, 83

fertilizer dealers, and 93 pesticide dealers, making it the second most resourceful block in this sector. When it comes to Primary Agricultural Cooperative Societies (PACS), Tentulikhunti, Papadahandi, and Kosagumuda each have two PACS, while all other blocks have just one. Banking services are also most concentrated in Umerkote, which has 11 banks, followed by Nabarangpur (9 banks) and Papadahandi (7 banks). Every block has a Farm Information & Advisory Centre (FIAC) to support farmers with technical guidance. However, Custom Hiring Centres (CHC) are unevenly distributed, with Umerkote leading at 30 CHCs, followed by Nandahandi and Papadahandi with 4 each. Similarly, Agro-Service Centres are most available in Umerkote (5 centres), while Nandahandi and Raighar have 2 each. Overall, Umerkote Block emerges as the most well-supported in terms of agricultural inputs, financial services, and mechanization support, followed by Raighar and Kosagumuda. Other blocks have varying levels of access to these facilities, indicating potential areas for improvement in agricultural service distribution.

(b) **Horticulture:** (same as above)

Sl No	Name of Block	Name of Farm/ Nursery	Input material (Grafts) available	Total Graft available
1	Nabarangpur	T.N.Nuaguda	Mango Graft - 10000	15000
			K.Lime - 5000	
2	Nandahandi	BLN, Daibhatta	Mango Graft - 50000	130000
			K.Lime - 25000	
			Jackfruit -10000	
			Hyb Papaya - 45000	
3	Papadahandi	Semla Farm	Mango Graft - 50000	65000
			K.Lime - 5000	
			Jackfruit -10000	
		BLN, Papadahandi	Mango Graft - 15000	22500
			Guava Goote-2500	
			K.Lime - 5000	
4	Tentulikhunti	Nil	Nil	
5	Dabugaon	T.N.Dabughaon	Mango Graft - 10000	12500
			Guava Goote-2500	
6	Kosagumuda			
7	Umerkote	HDPO,Umerkote	Mango Graft - 10000	22000
			Litchi -2000	
			K.Lime - 10000	
		Cashew Nursery,Umerkote	Cashew Graft -50000	50000
8	Raighar	BLN, Raighar	Mango Graft - 5000	5000
9	Jharigaon	BLN, Jharigaon	Mango Graft - 10000	13000
			Litchi Gootee -3000	
10	Chandahandi	Nil	Nil	
			Total	335000

In the district, Nandahandi has the highest total graft availability with 130,000 grafts, which includes mango, K. Lime, jackfruit, and hybrid papaya. Following that, Papadahandi ranks second with a total of 87,500 grafts, consisting of mango, K. Lime, jackfruit, and guava, across two farms. Next is Umerkote, which has a total of 72,000 grafts, made up of mango, litchi, K. Lime, and cashew grafts. Nabarangpur comes in fourth with 15,000 grafts, primarily mango and K. Lime. Dabugaon follows with 12,500 grafts, including mango and guava. Jharigaon has 13,000 grafts, consisting of mango and litchi goote. Raighar has 5,000 grafts of mango, while Tentulikhunti and Kosagumuda have no grafts available. Chandahandi also does not have any grafts available.

(c) Soil Conservation and Watershed Development

Name of the Block	Check Dam		Farm Pond		WHS		Grafted Cashew plantation in Ha
	Nos.	Ayacut in Ha	Nos.	Ayacut in Ha	Nos.	Ayacut in Ha	
Nabarangpur	17	169.44	238	95.20	5	47.30	180
Nandahandi	6	61.80	53	21.20			10
Tentulikhunti	17	181.90	426	170.40			150
Kosagumuda	42	469.32	928	371.20	6	60.57	1260
Papadahandi	44	451.06	628	251.20	7	66.26	870
Dabugaon	18	162.48	327	130.80			330
Umerkote	43	421.26	889	355.60	15	82.04	400
RAighar	46	449.87	472	188.80	4	19.36	360
Jharigaon	39	384.20	1153	461.20	9	49.29	592
Chandahandi	9	88.20	411	164.40			20
Total	**281**	**2839.53**	**5525**	**2210.00**	**46**	**324.82**	**4172**

In terms of Check Dams, Raighar has the highest number, with 46 units, followed by Papadahandi with 44 units and Umerkote with 43 units. Kosagumuda leads in the area with 469.32 hectares of check dams, followed by Raighar with 449.87 hectares and Umerkote with 421.26 hectares. When it comes to Farm Ponds, Jharigaon stands out with the highest number of 1,153 units and the largest area of 461.20 hectares. Kosagumuda follows with 928 units and 371.20 hectares, while Umerkote has 889 units and 355.60 hectares. For Water Harvesting Structures (WHS), Umerkote leads with 15 units and the largest area of 82.04 hectares, followed by Papadahandi with 7 units and 66.26 hectares. Nabarangpur comes next with 5 units and 47.30 hectares. In terms of Grafted Cashew Plantation, Kosagumuda again takes the lead with 1,260 hectares, followed by Papadahandi with 870 hectares, and Raighar with 360 hectares. Overall, Kosagumuda excels in grafted cashew plantations, while Jharigaon leads in farm ponds, and Umerkote stands out in water-harvesting structures. Raighar is the leader in check dams.

(d) **Animal Resources** (Veterinary Hospitals, Vaccine Centres, Fodder Availability/Hubs/Depots or Sale Points)

Name of the Block	Veterinary Hospitals	Livestock Aid Centre	Vaccine Centres	Fodder Availability	Hubs	Depots	Sale Points
Nabarangpur	1	11	Nil	Nil	Nil		
Nandahandi	01	07		NA	NA	NA	
Tentulikhunti	02	07	00	02	00	00	
Kosagumuda	2	11	Nil	Nil	Nil	Nil	
Papadahandi	1	7	Nil	Nil	Nil	Nil	

Dabugaon	1	6	Nil	Nil	Nil		
Umerkote	3	13	-	-			
Raighar	2	9	In 5 locations	Nil	Nil	Nil	
Jharigaon	2	11	In 3 locations	Nil	Nil	Nil	
Chandahandi	1	7					

Umerkote has the highest number of Veterinary Hospitals (3) and Livestock Aid Centres (13), followed by Kosagumuda, Raighar, and Jharigaon, each with 2 Veterinary Hospitals and 9-11 Livestock Aid Centres. Nabarangpur, Papadahandi, Dabugaon, Chandahandi, and Nandahandi each have one Veterinary Hospital, with Livestock Aid Centres ranging from 6 to 11. In terms of Vaccine Centres, Raighar leads with centres in 5 locations, followed by Jharigaon with centres in 3 locations. All other blocks have no Vaccine Centres. Tentulikhunti stands out with 2 Fodder Availability Hubs, while all other blocks have none. None of the blocks have Depots or Sale Points.

(e) **Fisheries:** (Fish feeds, Fingerlings production units, other input points)

Name of the Block	Name of the Unit	Production capacity
Kosagumuda	Sri Ganesh Feed Mill	1000-1200 Kg/Day
Nabarangpur	Nabarangpur Fish Farmer Association	300 lakh Spawn
Umerkote	Sujit Das	250 lakh Spawn
Umerkote	Govt Fish Farm, Pujariguda	40 Lakh Fry

Kosagumuda's Sri Ganesh Feed Mill has a production capacity of 1000-1200 Kg per day, making it a significant feed producer in the district. In terms of fish production, Nabarangpur Fish Farmer Association leads with an impressive 300 lakh spawn, followed by Sujit Das in Umerkote, which produces 250 lakh spawn. Additionally, the Government Fish Farm in Pujariguda, Umerkote, specializes in fry production, with a capacity of 40 lakh fry. This data highlights that Nabarangpur and Umerkote are major contributors to fish seed production, while Kosagumuda is focused on feed manufacturing.

(f) **Water Supply:** (PR & DW for Drinking Water Supply; DoWR for Agriculture/ Life Saving Irrigation Purpose)

DISTRICT PROFILE OF RWS &S DIVISION, NABARANGPUR

Sl No.	Block.	No of G.Ps	Total no. of Village & Habitations			Rural population As Per 2011	Rural Households	Position of Sources	No. of Commissioned PWS Scheme			Total Nos. of Existing Solar Schemes	Status of SEMs
			Village	Habitation	Total			TW	Total Running No. of PWS	No of (40 LPCD)	No of (70 LPCD)		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Chandahandi	14	86	160	246	73,993	18664	1408	22	17	5	80	31
2	Dabugam	12	66	168	234	77,369	17560	1235	16	13	3	37	31
3	Jharigam	23	111	390	501	163,015	37463	2495	47	31	16	54	69
4	Kosagumuda	26	118	389	507	191,785	46220	2249	45	25	20	92	65

5	Nabarangpur	13	55	116	171	100,726	23436	1336	29	28	1	31	27
6	Nandahandi	11	47	87	134	84,892	20094	988	31	21	10	24	24
7	Papadahandi	23	86	233	319	154,647	37262	2381	38	37	1	73	52
8	Raighar	26	117	456	573	187,827	40580	2779	44	0	44	57	76
9	Tentulikhunti	15	64	147	211	104,004	24767	1497	26	24	2	27	40
10	Umerkote	26	104	269	373	183,969	43280	2454	107	0	107	39	73
	TOTAL:	189	854	2415	3269	1322227	309326	18822	405	196	209	514	488

(g) Energy:

Name of the Block	Name of the Section	Name of the Subdivision	Load Details
Chandahandi	Umerkote	Umerkote & Chandahandi	554
Dabugaon	Papadahandi	Papadahandi	54
Jharigam	Umerkote	Umerkote & Jharigaon	92
Kosagumuda	Papadahandi	Kosagumuda	280
Nabarangpur	Nabarangpur & Papadahandi	Nabarangpur & Papadahandi	50
Nandahandi	Nabarangpur & Papadahandi	Nabarangpur & Papadahandi	132
Papadahandi	Papadahandi	Papadahandi & Kosagumuda	96
Raighar	Umerkote	Umerkote & Raighar	88
Tentulikhunti	Nabarangpur	Nabarangpur	10
Umerkote	Umerkote	Umerkote & Raighar	106

Chandahandi has the highest load at 554, making it the most significant in terms of load distribution. It falls under the Umerkote section and covers subdivisions in both Umerkote and Chandahandi. Following Chandahandi, Kosagumuda holds the second position with a load of 280, managed under the Papadahandi section and Kosagumuda subdivision. Nandahandi ranks third, carrying a load of 132, which is handled under the Nabarangpur and Papadahandi sections and subdivisions.

(h) Food Supply

Functioning of Fair Price Shop Dealers:

Sl. No.	Name of the Block/ULB	Category-wise FPS dealers functioning				
		GP	WSHG	Co-operative	Private	Total
1	Chandahandi	14	--	--	--	14
2	Dabugaon	12	01	--	--	13
3	Jharigam	23	--	--	--	23
4	Kosagumuda	26	--	--	--	26
5	Nabarangpur	02	22	--	--	24

Sl. No.	Name of the Block/ULB	Category-wise FPS dealers functioning				
		GP	WSHG	Co-operative	Private	Total
6	Nandahandi	11	--	--	--	11
7	Papadahandi	22	01	--	--	23
8	Raighar	26	--	--	--	23
9	Tentulikhunti	15	03	--	--	18
10	Umerkote	26	--	--	--	26
11	Nabarangpur Mplt.	--	07	01	--	08
12	Umerkote Mplt.	--	--	01	--	01
	Total	**177**	**33**	**02**	--	212

Kosagumuda and Umerkote have the highest number of Fair Price Shop (FPS) dealers, with 26 FPS dealers each, all under the Gram Panchayat (GP) category. They are followed by Raighar, which has 23 FPS dealers, also under GP. Next, Papadahandi and Jharigam each have 23 FPS dealers, with Papadahandi including one WSHG dealer, while Jharigam has only GP-run FPS. Tentulikhunti comes next with 18 FPS dealers, including 3 under WSHG. Chandahandi has 14 FPS dealers, all under GP, while Dabugaon has 13, including 1 WSHG dealer. Nandahandi has the lowest number of FPS dealers among the blocks, with just 11, all under GP. Overall, the distribution of FPS dealers in Nabarangpur district shows that most of them operate under the GP category, with WSHG playing a role in a few blocks, while the involvement of cooperative and private FPS dealers is nearly absent**.**

STORAGE OF FOOD GRAINS DURING THE YEAR 2024-25

(Flood-affected area)

Name of the Block	Name of the G.P	Name of the Inaccessible Pocket	People may be affected (Approx.)	Quantity of Rice/K oil stored	
				Rice in Quintal	K oil in Litters
Nabarangpur	Bhatrasiuni	Sirsi	1400	100.00	200
	Bodomosigam	Debraguda	800	50.00	200
Kosagumuda	Ukiyapalli	Ghatabashuli	1400	100.00	400
Tentulikhunti	Manchagam	Gurumaiguda	280	100.00	200
		Bagra	133		
		Talanga	70		
		Tangnikot	130		
		Jhulaguda	25		
Total			**4238**	**350.00**	**1000**

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CHAPTER–3

CHARACTERISING DROUGHT IN THE DISTRICT

3.1 Drought Definitions

Drought is generally defined as an extended period - a season, a year, or several years of deficient precipitation compared to the statistical multi-year average for a region that results in water shortage for some activity, group, or environmental sector (NDMC, 2008).

A drought is characterized as a danger by the Food and Agriculture Organization (FAO, 1983) of the United Nations as "the percentage of years when crops fail from the lack of moisture."

A drought is described as "an extended period - a season, a year, or several years - of deficient rainfall relative to the statistical multi-year mean for a region" in Schneider's 1996 Encyclopaedia of Climate and Weather.

"Drought as a sustained period without significant rainfall" was the definition given by Linsley et al. in 1959.

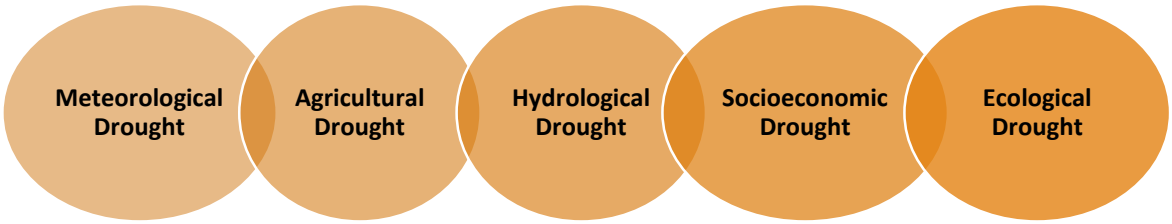
"Drought is the smallest annual value of daily stream flow," according to Gumbel (1963).

A drought is a situation or period when there is a lack of rainfall, which leads to a water shortage. Droughts can occur for a few days, for a week, for a month, or for years and can have serious impacts on agriculture.

A drought is a period of abnormally dry weather that lasts for a prolonged period, usually a season or more. It's characterized by a lack of precipitation, which leads to water shortages. In other words, drought is a prolonged dry period in the natural climate cycle that can occur anywhere in Odisha. It is a slow-onset disaster characterized by a lack of precipitation, resulting in a water shortage.

3.1.1 Types of Droughts

Droughts are generally categorized based on their causes and impacts, as outlined below:



3.1.1.1 Meteorological Drought

A meteorological drought must be considered region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. A meteorological drought is usually defined based on the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought identifies periods of drought based on the number of days with precipitation less than

some specified threshold. This measure is only appropriate for regions characterized by a year-round precipitation regime, such as a tropical rainforest, humid subtropical climate, or humid mid-latitude climate. Other climatic regimes are characterized by a seasonal rainfall pattern, weather patterns or a prolonged period of below-average precipitation. The key characteristics are region-specific, as precipitation norms differ worldwide, often the first indication of a developing drought and doesn't directly measure water availability or impacts.

Causes

Meteorological droughts are caused by a lack of rainfall over some time. Some of the causes of meteorological droughts include:

- **Climate change**: Rising temperatures can increase evaporation rates, which can lead to more water loss from soil and water bodies.
- **Altered precipitation patterns**: Climate change can cause changes in precipitation patterns, which can lead to droughts.
- **Early or late monsoon**: Early monsoon withdrawal or late monsoon onset can lead to droughts.
- **Prolonged breaks in monsoon**: Prolonged breaks in the monsoon can lead to droughts.
- **Depression over India**: A lack of depressions over India can lead to weak monsoons and below-average rainfall.
- **Soil moisture levels**: When soil moisture levels are low, there is less evaporation of water to create clouds, which can lead to droughts.

3.1.1.2 Agricultural Drought

Agricultural drought occurs when there is not enough rainfall and soil moisture to support crop growth. This can cause crops to wilt and become stressed. Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.

Causes

- **Rainfall deficits**: When there is less rainfall than normal over a while.
- **Soil water deficits**: When the soil doesn't have enough water to support crops.
- **Reduced groundwater**: When the amount of groundwater available for irrigation is low.
- **Low reservoir levels**: When there is not enough water in reservoirs for irrigation.

A deficient soil moisture regime at the time of planting may hinder germination, and moisture stress at the time of critical stages of crop growth may lead to low plant populations per hectare and a drastic reduction of crop yield.

3.1.1.3 Hydrological Drought

Hydrological drought is associated with the effects of periods of precipitation shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, and groundwater). The frequency and severity of hydrological drought are often defined on a watershed or river basin scale. Simply, we can say that hydrological drought arises when water resources go down below normal levels in rivers, lakes, WHS and groundwater.

Causes

- **Insufficient precipitation**: When there is less than normal rainfall over a prolonged period, it can lead to hydrological drought.
- **Freezing**: Freezing weather can also cause hydrological drought.
- **Intensive agriculture**: Practices like compacting soil and using a lot of water can reduce the amount of precipitation that reaches the water table.
- **Climate change**: Global warming can increase drought events in some areas.

Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system, such as soil moisture, streamflow, and groundwater and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors. It adversely affects the water-dependent sectors like hydroelectric power, irrigation, and urban water supply.

3.1.1.4 Socio-Economic Drought

Socioeconomic drought is associated with the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought. It occurs when water shortages affect the economy and society, disrupting daily life. It differs from the aforementioned types of droughts because their occurrence depends on the time and space processes of supply and demand to identify or classify droughts.

Causes

- **Climate change:** Rising temperatures and altered precipitation patterns caused by climate change can exacerbate existing droughts by increasing evaporation rates and reducing rainfall.
- **Poor water management:** Inefficient irrigation practices, excessive water extraction from groundwater sources, and lack of water conservation measures can contribute to water scarcity.
- **Rapid population growth:** Increasing population leads to higher water demand, putting strain on existing water resources.
- **Inadequate infrastructure:** Lack of proper water storage facilities, distribution networks, and treatment plants can hinder efficient water management.
- **Agricultural practices:** Intensive agriculture with high water-demand crops can deplete water sources rapidly.

- **Industrial water usage:** Heavy industrial water consumption can further deplete water supplies.
- **Socioeconomic disparities:** Unequal access to water resources can exacerbate the impacts of drought in vulnerable communities.
- **Political factors:** Poor water governance, lack of policies promoting water conservation, and inadequate investment in water infrastructure can contribute to socioeconomic drought.

A socio-economic drought occurs when the water demand exceeds the available supply due to a combination of factors, including meteorological drought (low rainfall), poor water management practices, rapid population growth, inadequate infrastructure, and climate change, ultimately impacting the economy and society at large. It also increases food prices, unemployment, and social instability.

3.1.1.5 Ecological Drought

Ecological drought is a prolonged and widespread deficit in naturally available water supplies, including changes in natural and managed hydrology that create multiple stresses across ecosystems. Natural phenomena and human activities can cause ecological droughts.

Causes

- **Natural Phenomena**
  - **Low precipitation**: A period of unusually low rainfall over a long period.
  - **Warming temperatures**: Global warming increases the temperature of the Earth's surface.
  - **Atmospheric conditions**: High-pressure systems, winds carrying continental air masses, and ocean temperatures can contribute to droughts.
- **Human Activities**
  - **Land use**: Decisions about how land is used, such as storing water for future use, can impact the amount of water available to ecosystems
  - **Irrigation**: Increased irrigation can cause a shortfall in water available to crops
  - **Soil conditions**: Poorly planned agricultural practices can cause soil erosion, which can reduce the amount of water available to crops

3.2 Drought Occurrence and Spread in the District

The occurrence and spread of drought in a district depend on several factors, including climate, geography, land use, and water management. Here's a general outline of how drought develops and spreads at the district level:

Nabarangpur's history of drought indicates that the district is very susceptible to drought because of its monsoonal climate and natural rainfall variability in both space and time. In varied degrees, about 55% of the areas are vulnerable to drought. About 45% of the three blocks, namely Chandahandi, Raighar and Jarigaon, are classified as drought-prone because they get precipitation that is very erratic and uneven.

Drought can have a serious impact on agriculture and allied sectors, social life, economic conditions, and the environment across the District/G.P. Drought encompasses a long dry period of deficient rainfall that affects the agriculture and livelihood of vulnerable people. Various time-bound activities of agriculture and allied sectors are affected due to scanty rainfall and lack of water availability. Every alternative year's drought frequently happens due to rainfall patterns and climate change. Drought shattered the economic condition of people in all the 10 blocks in the district, but the severity is very high in Chandahandi, Raighar and Jarigaon blocks. Only 43.6 percent of areas are irrigated during the Kharif season, and the remaining 56.4% of land is non-irrigated.

Agriculture and allied sectors are the prime movers for livelihood support to the drought-prone blocks of Nabarangpur district. However, frequent and recurring droughts threaten the livelihood system year after year. Land holdings are highly skewed; small and marginal farmers comprise 92% of the operational holding. The soils are mainly red and yellow laterite where the organic carbon content is 0.2 to 1 per cent. The water-holding capacity of soils is significantly low in all blocks. The main crops grown are Rice, followed by maize and vegetables.

Nabarangpur district is prone to drought. Even during normal rainfall, people can grow only one crop that meets the partial food requirement for the family. Poor water holding capacity of the soil, high intensity of rainfall in a short period and heavy runoff of the rainwater due to the topography consent little moisture after the Kharif crop, thus leaving no scope for the second crop. Soil erosion is also very high in the district. During droughts, people are forced to migrate to other states. Mainly, the difficult terrain, poor hydro-physical properties of the soil leading to poor soil water retention, high soil loss and other socio-political situations in these areas lead to food insecurity problems for the underprivileged section of the society. Implementation of social development programmes in a food insecure area, compounded with a huge economically poorer population, is a very difficult task that the district administration is trying to address in the best possible manner. The solution to this problem can be tackled through a holistic and dedicated rainwater harvesting and management programme following a watershed approach. This approach would emphasize both the quality and quantity of intervention in this programme to overcome the barriers to the participation of these people in the economic growth of the district. The major indicators of drought are precipitation, temperature, streamflow, ground and reservoir water levels and soil moisture. The need is clearly to ensure food security through the creation of sustainable livelihood security, keeping the interests of the vulnerable sections of the population. The various causes are detailed below:

➔ **Natural causes**

- **Weather patterns**: The jet stream can change its pattern, which can cause different weather patterns to occur in a region.
- **Ocean temperatures**: Changes in ocean temperatures can contribute to droughts.
- **Local landscape**: Changes in the local landscape, such as the amount of snow and ice cover, vegetation, and soil moisture, can contribute to droughts.

➔ **Human activities**

- **Climate change**: Rising temperatures caused by climate change can increase the risk of drought.
- **Deforestation**: Deforestation can contribute to droughts.
- **Intensive farming**: Intensive farming can contribute to droughts.
- **Population spikes**: Population spikes can contribute to droughts.

3.2.1 Indicators of Drought

Drought monitoring involves observing indicators and indices that evaluate changes in a region's hydrological cycle. Indicators describing drought conditions are variables such as precipitation, temperature, streamflow, ground and reservoir water levels, soil moisture, and snowpack. Drought indicators are measurements that describe the severity, location, and duration of a drought. They can also indicate the impact of drought on a region over time. The major Indicators of drought are precipitation, temperature, streamflow, ground and reservoir water levels, soil moisture, and snowpack. Examples of drought indices are:

- **Standardized Precipitation Index (SPI)**: Compares the amount of precipitation that has fallen to the probability of precipitation
- **Palmer Drought Severity Index (PDSI)**: A complex formula that uses precipitation and temperature data to calculate a drought index
- **Palmer Crop Moisture Stress Index (CMSI)**: Measures the impact of drought on agriculture during the growing season

Drought indicators can be used to create early warning systems that can help people prepare for and respond to droughts. Mainly, the drought indicators indicate the severity of drought in a particular area. These are:

Droughts can have serious impacts, including:

Fig 3, Indicators of Drought

Rising temperatures caused by climate change are making already-dry regions drier and wet regions wetter. In dry regions, this means that when temperatures rise, water evaporates more quickly, thus increasing the risk of drought or

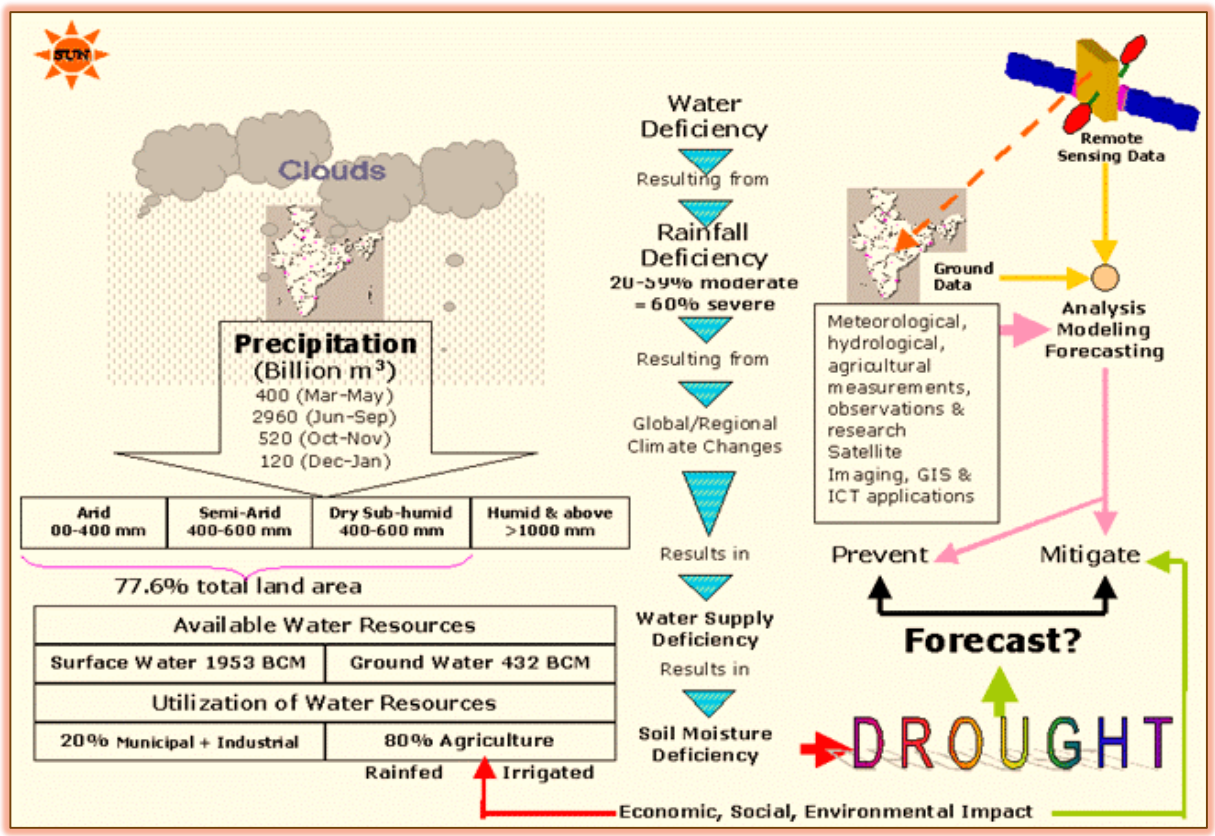


Fig 4, Process of Drought Management

prolonging periods of drought. The details of drought and indicators are given below:

3.2.2 Factors Specific to a District

Factors specific to a district include its geographic characteristics, demographics, economic activity, infrastructure development, cultural nuances, administrative structure, local governance practices, natural resource availability, historical context, educational attainment levels, health indicators, and prevailing social issues; all of which contribute to a unique profile that differentiates one district from another within a larger administrative unit. The spread and severity of drought in a district depend on:

1. **Geography:** Topography, climate, soil type, river systems, proximity to Eastern Ghats.
2. **Rainfall patterns:** It is dependent on seasonal rainfall or monsoons.
3. **Water storage infrastructure:** Adequate storage structures, check dams, reservoirs, or rainwater harvesting systems.
4. **Land use patterns:** Agricultural practices, water-intensive, over-irrigated or deforested.
5. **Population density and water demand:** Higher demand intensifies water stress, population density, ethnicity, literacy rate, age distribution, and gender balance.
6. **Policy and governance:** Effective drought monitoring, response systems, and community awareness can mitigate its spread.
7. **Economy:** Dominant industries, agricultural practices, employment sectors, and income levels.
8. **Infrastructure:** Road network, transportation facilities, electricity access, water supply.
9. **Culture:** Language, traditions, festivals, community norms.
10. **Governance:** Administrative structure, local government bodies, political landscape.
11. **Natural Resources:** Mineral deposits, forest cover, water availability.
12. **Education:** School access, quality of education, dropout rates.
13. **Health:** Healthcare facilities, disease prevalence, maternal mortality rates.
14. **Social Issues:** Poverty, crime rates, caste/class disparities, gender inequality.

3.3 Impact of drought in the district

A drought in a district can have severe impacts, primarily affecting agriculture through crop failure, reduced livestock productivity, and decreased water availability for irrigation, leading to significant economic losses for farmers, potential food shortages, and increased rural unemployment; additionally, it can lead to water scarcity for domestic use, impacting health and sanitation, and potentially causing migration from the area due to the lack of livelihood opportunities. The impact of drought in a district varies depending on the severity, duration, and the district's socioeconomic and environmental characteristics. Below is a comprehensive outline of the potential impacts of drought at the district level:

3.3.1 Economic Impacts

A drought's economic impact primarily stems from reduced agricultural productivity due to crop failure and pasture losses, loss of employment, leading to increased food prices for

consumers, decreased income for farmers, and potential disruptions to related industries like livestock production and food processing; additionally, water scarcity during drought can affect energy production, tourism, and other sectors reliant on water availability, causing further economic strain across different industries and regions.

- **Loss of Employment:** Agricultural labourers lose income opportunities, especially during the planting and harvesting seasons.
- **Price Inflation:** The scarcity of agricultural produce drives up the cost of food and other essentials.
- **Industry Slowdown:** Industries relying on water (e.g., food processing, textiles) face production declines or shutdowns.
- **Migration:** Economic hardships force people, especially rural populations, to migrate to urban areas in search of work.
- **Agriculture is most directly affected:** Crop yields decline significantly during drought, leading to reduced food production and higher food prices for consumers.
- **Reduced livestock productivity:** Lack of water for grazing animals can impact their health and productivity, further impacting the agricultural sector.
- **Increased water costs:** As water sources become depleted during drought, the cost of accessing water for irrigation and other uses rises.
- **Impact on related industries:** Businesses that rely on agriculture, like food processing and transportation, can face disruptions due to reduced agricultural output.
- **Energy sector impacts:** Hydroelectric power generation can be significantly reduced during a drought, leading to increased reliance on alternative energy sources.
- **Tourism decline:** Drought can negatively affect tourism industries in regions dependent on water-based activities.

3.3.2 Environmental Impacts

A drought's environmental impacts include: significant losses in plant growth, increased risk of wildfires due to dry vegetation, altered carbon and nutrient cycling, potential local species extinction, soil erosion from lack of vegetation cover, disruption of aquatic ecosystems, and a higher likelihood of insect outbreaks, all contributing to a decline in ecosystem services provided to human communities.

- **Deforestation:** Dry conditions and human activities, such as tree cutting for fuel, degrade forests and ecosystems.
- **Biodiversity Loss:** Wildlife habitats dry up, leading to the migration or death of species dependent on water and vegetation.
- **Soil Degradation:** Loss of soil moisture and fertility causes desertification, making land unsuitable for future cultivation.
- **Reduced plant growth:** Lack of water directly impacts plant growth, leading to reduced vegetation cover and affecting the entire food chain.

- **Wildfire risk:** Dry conditions during a drought significantly increase the risk of wildfires, which can further damage ecosystems and air quality.
- **Altered nutrient cycling: Reduced plant growth:** Lack of water directly impacts plant growth, leading to reduced vegetation cover and affecting the entire food chain.
- **Species decline:** When vegetation is reduced due to drought, certain species may struggle to survive, leading to potential local extinctions.
- **Soil erosion:** Lack of vegetation cover during a drought can exacerbate soil erosion, impacting land fertility.
- **Aquatic ecosystem disruption:** Reduced water availability in streams and rivers during a drought can negatively impact aquatic life and their habitats.
- **Insect outbreaks:** Drought conditions can sometimes favour the proliferation of certain insect species, leading to outbreaks that can further damage vegetation.

3.3.3 Social Impacts

Social impacts include public safety and health, conflicts between people when there isn't enough water to go around, and lifestyle changes. Examples of social impacts include Anxiety or depression about economic losses caused by drought. Health problems related to low water flows and poor water quality.

- **Rural-Urban Migration:** Mass migration creates pressure on urban infrastructure and disrupts family and community structures.
- **Educational Disruptions:** Children from affected families may drop out of school due to financial constraints or migration.
- **Social Conflicts:** Competition for scarce resources (e.g., water, grazing land) may result in disputes within or between communities.
- **Gender Inequality:** Women and girls, often responsible for fetching water, face increased workloads and health risks.
- **Loss of life**: People may die from drought, especially if they don't have access to clean water or food
- **Displacement**: People may be forced to leave their homes or move to cities to find work or water
- **Conflicts**: People may fight over water resources, especially if political or economic factors are involved
- **Health problems**: People may experience health problems from poor water quality, dust, or forest fires
- **Mental health issues**: People may experience anxiety or depression about economic losses or the threat of displacement
- **Reduced incomes**: People may have reduced incomes or lose their livelihoods
- **Fewer recreational activities**: People may have fewer opportunities for recreation
- **Social breakdown**: Drought can cause social breakdown in communities

Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

Droughts are far-reaching, impacting water quality, public health, the economy, the natural environment, public infrastructure, and much more. Understanding drought's potential impacts enables drought planners and decision makers to better address those impacts and, ultimately, improve their communities' preparedness to cope with drought and minimise the losses.

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CHAPTER-4

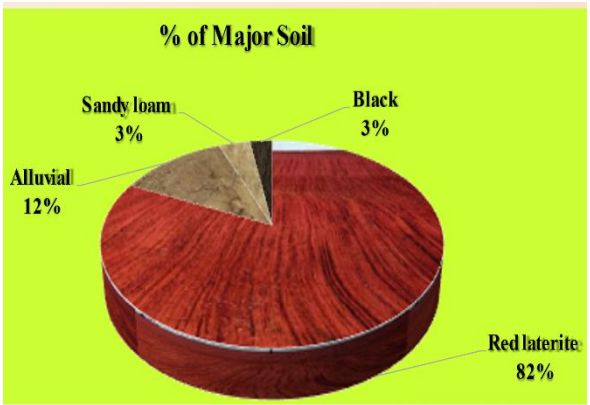
HAZARD, RISK AND VULNERABILITY ASSESSMENT

4.1 Climate Change and Drought Proneness in the District

Climate change is the prime threat to food security and the ecosystem in the 21st century. Climate change has posed major threats to the future productivity of the agricultural, forestry, and allied sectors. In this changing scenario, "**we have to produce more from less".** The climate normally pacts with the average weather conditions of a certain region or place, including temperature, rainfall, and wind. We can merely say that it is a meteorological change over the years. Climate is mostly affected by latitude, the tilt of the Earth's axis, the movements of the Earth's wind belt, the difference in temperatures of land and sea, and topography. Human activity, especially actions relating to the depletion of the ozone layer, is also an important factor for the climate. Climate change includes both global warming driven by human-induced emissions of greenhouse gases and the resulting large-scale shifts in weather patterns.

Climate change and its variability are emerging as the major challenges influencing the agrarian economy and the performance of agriculture. Climate change will affect agriculture through higher temperatures, elevated carbon dioxide (CO2) concentration, precipitation changes, increased weed infestation, pests & disease outbreaks and high emissions of various greenhouse gases (GHG). Such changes will have more or less severe impacts on all components of food security, food production and availability, the stability of food supplies, access to food and food utilization.

Nabarangpur is a paradox in many ways. It has abundant natural resources, paramount ecology, a large pool of manpower, and the fastest-growing agrarian economy, but it is vulnerable to drought and climate change. Agriculture is the primary source of livelihood for more than 80 percent of the population of Nabarangpur. The district is well known for Maize and hybrid Rice cultivation in Odisha. Because 66 percent of land is upland, followed by 19 percent medium land and only 15 percent is low land. Soils are alfisol, utisol, and vertisol. Most of the soil is red laterite (82%) and alluvial (12%), which are deficient in organic carbon. Mainly, 92 per cent of soils are acidic. Alfisol includes red sandy soils and red loamy soils. The red loamy and sandy soils are occurring throughout the district. Vertisols are medium black soils found in the northeastern corner of the district in the Chandahandi block. The soils are highly argillaceous and contain high amounts of iron, calcium and magnesium. Thus, land reclamation is essential with lime, paper mill sludge or dolomite. But farmers are to be used for reclamation. We have to increase the organic carbon in the soil to increase the moisture retention in the soil and also follow better land husbandry practices to accelerate crop production and productivity.



Cropping systems are planned proficiently based on the available resources and executed efficiently to fully utilize resources like land, water and nutrients. Besides these, crops are to be selected very carefully and follow-up the best management practices such as tillage, applying well rotten FYM, weeds control measures, residue management, effective utilization of plant protection chemicals, fertilizer and efficient utilization of water resources. Cropping systems play a pivotal role in enhancing land-use efficiency as per capita availability of agricultural land is declining at a fast rate from 0.48 ha in 1951 to 0.14 ha in 2001. The district has a vast area of 1583.4 sq km covered by forests. Climate change threatens to increase the number of droughts, the potential for soil erosion, reduce soil quality, lower agricultural productivity and negatively impact food security. The district has experienced drought in the past and is prone to uneven, erratic rainfall. In this perspective, sharing of information as well as available resources with the stakeholders will surely strengthen the capacity of the Administration to stand against the disaster with managerial skill. The district is prone to drought, and most of the blocks are susceptible to drought. The district has experienced droughts in the past and has seen erratic, uneven rainfall with long dry spells.

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration; it differs from aridity, which is restricted to low-rainfall regions and is a permanent feature of climate.

Drought is an insidious hazard of nature. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a particular area, a condition often perceived as “normal”. It is also related to the timing (i.e., the principal season of occurrence, delays in the start of the rainy season, the occurrence of rains with principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this “natural” hazard.

An operational definition for agriculture might compare daily precipitation values to evapotranspiration rates to determine the rate of soil moisture depletion, then express these relationships in terms of drought effects on plant behaviour (i.e., growth and yield) at various stages of crop development. Operational definitions can also be used to analyze drought frequency, severity, and duration for a given historical period. However, requires weather data on hourly, daily, monthly, or other time scales and, possibly, impact data (e.g., crop yield), depending on the nature of the definition being applied. Developing the climatology of drought for a region provides a greater understanding of its characteristics and the probability of

recurrence at various levels of severity. Information of this type is extremely beneficial in the development of response and mitigation strategies and preparedness plans.

Access to the vulnerability Atlas of Nabarangpur district reveals that almost all the parts of the district are coming under Wind & Cyclone Moderate Damage Risk Zone 'B' (39 m/s), Earthquake Low Damage Risk Zone II with No Flood Zone category. Also, the majority of the Chandahandi Block comes under Wind & Cyclone Moderate Damage Risk Zone 'A' (44 m/s). However, on assessment of the last ten years of disaster occurrence history, the majority of Nabarangpur district's life and property were affected due to heavy rain, flood, lightning, drowning, snake bite, fire, drought and road accidents.

4.2 History and Geographical Spread of Drought (last 10 years)

Droughts have occurred throughout history in many parts of the Nabarangpur district. Droughts are a natural part of climate cycles and can vary in length, severity, and size. The district is also vulnerable to drought due to deficient rainfall, low levels of groundwater and less water content in the soil. The frequency, intensity and extent of droughts are gradually on the rise. This is leading to crop failure, the decline in surface and groundwater levels, and increasing unemployment and indebtedness. In the last 10 years, many parts of the district, especially the highlands, faced serious problems of drought. The intensity has increased substantially.

Table 4.1, History and geographical spread of drought (Last 10 years)

Year of drought	Blocks Affected	Villages affected	Mostly affected blocks	Mostly affected villages	Remarks
2015	10	859	10	859	Rice area of 31484 ha affected
2018	10	816	10	816	Rice area of 32968 ha affected
2021	1	88	1	88	Rice area of 2277 ha affected

It reveals from the above table that the drought during Kharif 2018 affected 32968 ha of the rice area in 816 Villages, whereas in 2015, it affected 859 villages with a rice area of 31484 ha. The number of villages most affected in 2015 as compared to 2018. Similarly, in 2018, the highest rice areas of 32968 ha were affected. It shows that in 2021, only 2277 ha areas were affected by drought in one block only. The drought intensity was highest in 2025, followed by 2018 and 2021 in terms of villages. However, the highest rice area was affected in 2018 as compared to 2015 and 2021. Due to Global warming, the weather pattern and temperature increased significantly in all 10 blocks.

4.3 Causes of Recurring Drought Events

Recurring drought events are often the result of a combination of natural and human-induced factors. These causes vary across regions, but common underlying factors include climate variability, poor water management, and environmental degradation. Recurring droughts can be caused by several factors, including climate change, changes in precipitation patterns, and human activities. Rising temperatures triggered by climate change are making already-dry regions drier and wet regions wetter. In dry regions, this means that when temperatures rise,

water evaporates more quickly, thus increasing the risk of drought or prolonging periods of drought. The detailed overview of the causes is as follows:

4.3.1 Natural Causes

a) Climate Variability

- **EI Nino and La Nina Events:** During normal conditions in the Pacific Ocean, trade winds blow west along the equator, taking warm water from South America towards Asia. To replace that warm water, cold water rises from the depths in a process called upwelling. El Nino and La Nina are two opposing climate patterns that break these normal conditions. These global weather phenomena disrupt normal rainfall patterns, leading to prolonged dry conditions with erratic and uneven rainfall in some regions.
- **Monsoon Irregularities:** Delayed, weak, or erratic monsoon rains (in regions dependent on monsoons) often trigger recurring droughts and crop failure in various regions.
- **Global Weather Patterns:** These cold waters in the Pacific push the jet stream northward. This tends to lead to drought prevailing in many parts. Persistent high-pressure systems can prevent cloud formation and block precipitation.

b) Geographical Factors

- **Arid and Semi-Arid Regions:** Arid and semi-arid regions are areas of land that receive little or erratic rainfall and have high temperatures, intense solar radiation, and high winds. They are important for food production and ecosystem diversity. The districts in naturally dry climates with low annual rainfall are more prone to recurrent droughts.
- **Rain Shadow Effect:** The rain shadow effect is a phenomenon that occurs when a mountain range blocks precipitation from reaching a region on the other side of the mountain. The areas located on the protected side of the mountains receive limited rainfall, making them drought-prone.
- **Soil Characteristics:** Soil has many characteristics, including its texture, structure, colour, depth, erosion and organic matter content. These characteristics help scientists or researchers to understand how ecosystems work and how to use soil without damaging the ecosystem. Mainly, the sandy or shallow soils with low water retention exacerbate drought conditions.

c) Climate Change

- **Rising Temperatures:** The Earth's average temperature has been rising since the many revolutions, including the Industrial Revolution. The temperature has increased due to climate change. It happens due to various reasons. This is due to human activities, agriculture and allied sectors also responsible for the emission of greenhouse gases. That helps to increase the evaporation rates and reduce soil moisture and water availability.
- **Changing Rainfall Patterns:** Rainfall patterns change due to climate change and other environmental factors. These changes can affect the timing, intensity, and distribution

of rainfall. Global warming alters precipitation distribution, causing prolonged dry spells in various regions.

- **Frequent Extremes:** Frequency of extreme events are weather or climate events that occur more often and with greater intensity due to climate change. These events can have devastating impacts on people, communities, and the environment. Intensification of heat waves and dry periods increases drought frequency in various parts.

4.3.2. Human-Induced Causes

a) Overexploitation of Water Resources

- **Excessive Groundwater Extraction:** Excessive groundwater extraction can have many negative consequences, including water depletion, land subsidence, salinity intrusion, ecosystem degradation and increased energy costs. Over-reliance on groundwater for agriculture, industry, and domestic use leads to the depletion of aquifers. So, we have to use the resources very carefully.
- **Unsustainable Irrigation Practices:** Unsustainable irrigation practices can have several negative consequences, including Water scarcity, Environmental damage, Soil degradation, Social and economic tensions and Food export reduction. Flood irrigation and inefficient water use waste water resources.

b) Deforestation and Land Degradation

- **Loss of Forest Cover:** Between 2015 and 2020, India lost 668,400 hectares of forest cover, which was the second-highest rate of deforestation in the world. In the last 10 years, India has diverted forest land for infrastructure and industrial projects. Trees play a pivotal role in maintaining the water cycle through transpiration and soil moisture retention. Deforestation disrupts this balance.
- **Desertification:** Desertification is the process by which drylands, such as grasslands and shrublands, become increasingly arid and eventually turn into deserts. It's caused by climate change and human activities that degrade the land. Overgrazing, deforestation, and poor land management degrade soil quality, making it prone to drought.
- **Urbanization:** Urbanization is the process of people moving from rural to urban areas and the resulting changes to the land and the population. It can also refer to the growth of urban populations. The expansion of urban areas reduces natural water infiltration, leading to rapid runoff and limited groundwater recharge.

c) Poor Water Management

- **Inadequate Storage Infrastructure:** Inadequate storage infrastructure is a problem in Nabarangpur that affects the quality of agricultural produce and leads to food wastage. This is especially true in rural areas. The lack of reservoirs, dams, and rainwater harvesting systems limits water availability during dry periods.
- **Water Wastage:** Water wastage is the loss of water due to human activities and natural processes. It can occur in homes, businesses, and industries. The inefficient use of water in agriculture, industry, and households exacerbates scarcity.

- **Neglected Watershed Management:** Watershed management is the practice of managing land and water resources to protect and improve the quality of the water and other natural resources in a watershed. Neglected watershed management can lead to water shortages, environmental damage, and loss of biodiversity. Poor maintenance of catchment areas and drainage systems leads to reduced water retention.

4.3.3. Socioeconomic and Policy Factors

a) Population Growth

- **Increased Demand:** A growing population puts immense pressure on limited water resources for drinking, agriculture, and industry. That "increased demand of population" refers to the growing need for resources like food, water, land, forest, housing, energy, healthcare, and transportation as the number of people in a region or globally increases, putting pressure on infrastructure and the environment due to higher consumption rates.
- **Urban Sprawl:** Urban sprawl" refers to the uncontrolled expansion of a city's geographic area, often characterized by low-density residential development, sprawling outwards into surrounding rural areas, leading to increased reliance on cars for transportation and a decrease in the density and connectedness of urban communities; essentially, the outward spread of a city population into less populated regions, usually with poor planning and a lack of mixed-use development. The expanding cities consume more water, often diverting it from rural and agricultural areas.

b) Agricultural Practices

- **High Water-Intensive Crops:** Water-intensive crops are crops that require a lot of water to grow. The growing water-demanding crops (e.g., rice, sugarcane) in drought-prone areas worsens water scarcity.
- **Dependence on Rain-Fed Agriculture:** Dependence on rain-fed agriculture" refers to a situation where a region or community heavily relies on rainfall as the primary source of water for their crops, meaning their agricultural production is largely dictated by the amount and timing of monsoon rains, making them highly vulnerable to fluctuations in weather patterns and potential droughts; essentially, their farming practices are directly dependent on the rain received, with little to no irrigation systems in place to supplement water needs. Lack of irrigation infrastructure forces reliance on rainfall, increasing vulnerability to drought.

c) Policy and Governance Issues

- **Lack of Drought Preparedness:** Lack of drought preparedness" refers to a situation where a community, region, or government does not have adequate plans, strategies, or infrastructure in place to effectively manage and mitigate the impacts of drought, potentially leading to severe water shortages, crop failures, economic disruption, and environmental damage when dry conditions occur. The inadequate monitoring systems and delayed government responses worsened the impacts of the drought.

- **Ineffective Water Policies:** Ineffective water policies can lead to water scarcity and pollution, which can negatively impact the environment and human health. Poor regulation of water usage, coupled with subsidies for water-intensive practices, exacerbates resource depletion.
- **Fragmented Resource Management:** Fragmented resource management is the management of resources in a fragmented environment, such as a network, supply chain, or society. Fragmentation can occur when resources are not used efficiently or when resources are spread out across multiple sites or systems. Lack of coordination among stakeholders (government, communities, and industries) hampers sustainable water management.

4.3.4 Feedback Loops

- **Recurrent Dry Soil Conditions:** Recurrent dry soil conditions can be caused by droughts and other factors. These conditions can reduce the availability of nutrients for plants, making them more vulnerable to pests and diseases. Frequent droughts reduce soil fertility and moisture-holding capacity, increasing the likelihood of future droughts.
- **Reduced Vegetation Cover:** Loss of vegetation cover can have many negative impacts on the environment, including global warming, Desertification, soil erosion, Habitat alteration and urban expansion. Recurring drought events lead to vegetation loss, further disrupting local water cycles and exacerbating drought conditions.

4.3.5. Regional and Local Factors

Certain local issues contribute to recurring droughts:

- **Inadequate Rainwater Harvesting:** Inadequate rainwater harvesting can occur when the system doesn't collect enough water or is not installed correctly. The main reason is the failure to collect and store rainwater during wet seasons in the existing water harvesting structure.
- **Neglected Traditional Practices:** Neglected traditional practices are cultural practices that are not being promoted or preserved. These practices can include traditional crops, handicraft techniques, and art forms. Abandonment of indigenous water conservation methods (e.g., step wells, check dams) that could mitigate drought.

4.4 Drought Risk, Vulnerabilities and Challenges

Drought risk is the chance that a region will experience negative consequences from drought, such as loss of life or property damage, disruption to the socioeconomic system, water and food shortages, and increased risk of disease and death. Drought risks, vulnerabilities, and challenges are interconnected and depend on environmental, social, economic, and governance factors. Here's an in-depth analysis of each aspect stated below:

1. Drought Risk

Drought risk refers to the potential for negative impacts from a drought event, which is determined by a combination of "hazard" (the likelihood of a drought occurring), "exposure" (the level of dependence on water in a particular area), and "vulnerability" (the susceptibility of a community to the impacts of a drought), with vulnerabilities arising from factors like socio-

economic conditions, infrastructure limitations, and environmental characteristics; key challenges related to drought risk include managing water resources effectively, adapting agricultural practices, mitigating the effects on vulnerable populations, and implementing proactive monitoring and early warning systems. Drought risk refers to the probability of drought occurrence and its potential impacts on society, economy, and environment. It depends on three components: **hazard**, **exposure**, and **vulnerability**.

a) Hazard

A hazard is a situation or process that has the potential to cause harm to people, property, the environment, or a combination of these. Hazards can be natural, human-made, or a combination of both. These hazards are associated with natural processes and phenomena, such as:

- Prolonged periods of low rainfall or precipitation deficits.
- High temperatures lead to increased evaporation rates.
- Climate change intensifies the frequency, duration, and severity of droughts.

b) Exposure

- **Agricultural Areas:** Regions with significant dependence on rain-fed agriculture are highly exposed to drought risk.
- **Water-Scarce Regions:** Areas with limited surface and groundwater resources face greater risks.
- **Population Density:** High-density areas increase pressure on water resources.

c) Vulnerability

- Weak adaptive capacities in sectors like agriculture, industry, and urban water supply.
- Dependence on unsustainable practices, such as over-extraction of groundwater and deforestation.

2. Vulnerabilities

Drought vulnerability is a starting point for developing strategies to manage drought and reduce its effects. It's also important to regularly evaluate drought vulnerability because it's a dynamic concept that changes along with its factors. For example, poverty can be reduced over time, which can reduce drought vulnerability. Drought vulnerabilities arise from a district's inability to cope with or adapt to drought conditions during the season. These vulnerabilities can be categorized as environmental, social, economic, and institutional.

a) Environmental Vulnerabilities

Environmental vulnerability to drought is the degree to which an area is susceptible to the impacts of drought. It depends on the natural characteristics of the area, such as its soil, vegetation, and location. The major causes are:

- **Degraded Ecosystems:** Loss of forest cover, wetlands, and grasslands reduces natural resilience.
- **Soil Degradation:** Over-cultivation, desertification, and poor land management make soils less capable of retaining moisture.

- **Groundwater Depletion:** Over-reliance on groundwater reduces reserves, especially in recurring drought events.
- **Arid and Semi-Arid Regions:** Naturally low rainfall areas are more prone to drought impacts.

b) Social Vulnerabilities

The social vulnerabilities of drought refer to the characteristics of a community or population that make them particularly susceptible to the negative impacts of drought, often stemming from factors like poverty, lack of access to water infrastructure, reliance on rain-fed agriculture, limited economic diversity, and social inequalities, which can exacerbate the effects of water scarcity during drought periods, leaving certain groups disproportionately affected. The major causes are:

- **Poverty and Inequality:** Marginalized communities lack the resources to adapt to drought conditions.
- **Population Growth:** Rising demand for water and food increases stress on limited resources.
- **Gender Disparities:** Women, particularly in rural areas, bear the burden of fetching water, leading to increased physical and social challenges during droughts.
- **Health Impacts:** Malnutrition, waterborne diseases, and heat stress are common during prolonged droughts.

c) Economic Vulnerabilities

Economic vulnerabilities related to drought primarily stem from reduced agricultural productivity due to crop failures, leading to food insecurity, increased food prices, and income losses for farmers, alongside potential impacts on sectors like hydropower generation, tourism, and overall economic growth, particularly in regions heavily reliant on water-intensive industries; essentially, drought can disrupt entire supply chains and significantly strain local economies, especially in Nabarangpur with limited adaptive capacity. The major causes are:

- **Dependence on Agriculture:** Rural economies reliant on rain-fed agriculture are highly susceptible to drought.
- **Industrial Water Use:** Industries requiring large quantities of water, such as textiles or power generation, face significant losses.
- **Unemployment:** Reduced agricultural and industrial output leads to job losses.

d) Institutional Vulnerabilities

The institutional vulnerabilities to drought refer to weaknesses within a society's governance structures, policies, and systems that exacerbate the negative impacts of drought, making communities more susceptible to its effects due to inadequate preparedness, response mechanisms, and lack of effective water management practices. The major causes are:

- **Poor Water Governance:** Inefficient policies and lack of coordination among stakeholders exacerbate drought impacts.

- **Limited Infrastructure:** Insufficient reservoirs, canals, and rainwater harvesting systems hinder water storage and distribution.
- **Weak Disaster Management Systems:** Lack of early warning systems, drought monitoring, and contingency plans increases vulnerability.

3. Challenges in Addressing Drought

Drought threatens people's livelihoods, increases the risk of various health disorders, diseases and death, and fuels mass migration. Water scarcity impacts about 50% of the agricultural growth and as many as people are at risk of being displaced as a result of drought by 2030. Addressing drought can be challenging due to the costs of drought relief, the need for long-term solutions, and the impact on people's lives. Addressing drought is complex due to its multi-dimensional nature. Key challenges include:

a) Environmental Challenges

The environmental consequences of drought include losses in plant growth; increases in disease and insect outbreaks; fires; altered rates of carbon, nutrient, and water cycling; and local species extinctions.

- **Climate Change:** Increasing temperatures and unpredictable weather patterns make droughts more frequent and severe.
- **Resource Overexploitation:** Overuse of water resources, particularly groundwater, accelerates drought impacts.
- **Deforestation and Land Degradation:** Reduced vegetation cover diminishes the region’s ability to retain moisture and recharge aquifers.

b) Social Challenges

Drought can create many social challenges, including health issues, economic losses, and migration.

- **Rural-Urban Divide:** Rural areas often lack access to drought mitigation resources like irrigation systems or alternative livelihoods.
- **Water Conflicts:** Competing demands between agricultural, industrial, and domestic sectors can lead to disputes.
- **Health Impacts:** Prolonged droughts strain healthcare systems due to malnutrition, dehydration, and disease outbreaks. Low water flow and poor water quality can cause health problems.

c) Economic Challenges

Drought can cause economic losses in agriculture, which can account for nearly half of all economic losses linked to drought. Droughts can cause economic challenges in many ways, including:

- **Financial Constraints:** Limited budgets for drought mitigation and adaptation programs restrict the implementation of effective strategies.
- **Crop Failures and Food Insecurity:** Reduced agricultural output leads to higher food prices and lower household incomes.

- **Loss of Livelihoods:** Dependence on climate-sensitive sectors like farming makes communities vulnerable to economic shocks.

d) Institutional Challenges

Institutional challenges related to drought include a lack of coordinated response across different government agencies, inadequate monitoring and early warning systems, insufficient funding for drought mitigation strategies, poor communication with communities, limited capacity to implement water conservation measures, and a lack of clear policy frameworks for managing water during drought periods; often leading to ineffective responses when drought strikes, causing significant socio-economic impacts.

- **Lack of Data and Monitoring:** Limited access to real-time weather and hydrological data hampers early warning systems.
- **Fragmented Policies:** Overlapping responsibilities among government agencies result in inefficient drought management.
- **Inadequate Community Participation:** Limited involvement of local communities in water conservation and drought planning reduces effectiveness.

4. Strategies to Reduce Risk and Vulnerability

To reduce the risk and vulnerability of drought, key strategies include implementing the water conservation practices in agriculture, utilizing drought-resistant crops, improving water harvesting systems, monitoring weather patterns for early warning, developing robust water management plans, raising community awareness about water conservation, and investing in research on drought-tolerant varieties considering local conditions and basic needs. Mitigation and adaptation strategies to address drought risks and vulnerabilities include the following:

- **Improved Water Management:** Promote rainwater harvesting, efficient irrigation techniques (e.g., drip irrigation), and water recycling.
- **Reforestation and Ecosystem Restoration:** Enhance vegetation cover to support water retention and biodiversity.
- **Drought-resilient crops:** Encourage the cultivation of drought-tolerant crop varieties.
- **Early Warning Systems:** Develop robust monitoring and forecasting systems for timely drought alerts.
- **Community Engagement:** Empower local communities through education, capacity building, and participatory planning.
- **Policy Reforms:** Enforce regulations on groundwater usage and incentivize sustainable agricultural practices.

4.5 Emerging Concerns

Emerging concerns of drought include the increasing frequency and intensity of drought events due to climate change, rapid depletion of groundwater reserves, the potential for large-scale migration due to water scarcity, impacts on public health from reduced water quality and access, heightened wildfire risk, economic disruption to agriculture and related industries, and the potential for social unrest in drought-stricken regions. All factors are becoming more

pronounced as global temperatures rise. As droughts become more frequent, severe, and prolonged due to climate change and human activities, several emerging concerns are gaining global and local attention. These concerns highlight the complex and interconnected nature of drought impacts. The key points about emerging drought as stated below:

- **Novel drought patterns:** Climate change is leading to new types of droughts, including longer durations, more extreme intensity, and altered geographical patterns, making them harder to predict and manage.
- **Ecosystem collapse:** Severe droughts can push ecosystems beyond their tipping points, resulting in large-scale shifts in vegetation, species composition, and ecosystem functions, with potential long-term impacts.
- **Water quality degradation:** As water sources deplete during droughts, pollutants can become more concentrated, affecting drinking water quality and aquatic life.
- **Increased wildfire risk:** Drier vegetation due to drought significantly increases the risk and intensity of wildfires, impacting air quality and causing large-scale habitat destruction.
- **Impacts on vulnerable species:** Endangered species are particularly susceptible to drought conditions due to their limited distribution and specialized habitat needs.
- **Feedback loops:** Drought can trigger further environmental degradation, like soil erosion and desertification, which can exacerbate future drought conditions.
- **Transboundary impacts:** Droughts in one region can have cascading effects on neighbouring areas due to shared water sources, creating complex management challenges.
- **Shifting migration patterns:** Wildlife may be forced to migrate further distances in search of water, disrupting ecological balance.
- **Changes in plant phenology:** Drought can alter plant flowering and fruiting times, affecting pollination and food availability for animals.
- **Increased disease outbreaks:** Reduced water availability can lead to higher concentrations of pathogens, impacting both wildlife and human populations.
- **Impacts on carbon sequestration:** Droughts can reduce the ability of forests to absorb carbon dioxide, contributing to climate change.

4.5.1 Economical

Emerging concerns regarding drought from an economic perspective are increased food prices due to reduced crop yields, disruptions to supply chains, higher energy costs from reduced hydropower generation, livestock losses, soil degradation, the potential for increased social unrest due to food scarcity, and the growing cost of implementing mitigation strategies in regions facing more frequent and severe droughts due to climate change. Drought has a profound impact on economies, both at local and global scales. As droughts become more frequent and severe, their economic implications are emerging as a significant challenge. The key points about the economic impacts of drought are as follows:

- **Climate change amplification:** With increasing global temperatures, the frequency and severity of droughts are expected to rise, potentially magnifying their economic impacts.
- **Impact on vulnerable communities:** Droughts disproportionately affect marginalized communities with limited access to water and financial resources.
- **Long-term economic consequences:** Repeated drought events can lead to long-term economic damage, including land degradation and decreased investment in affected areas.
- **Agriculture is most affected:** Droughts directly impact crop yields, causing significant losses for farmers and leading to potential food shortages, particularly in regions with limited irrigation systems.
- **Increased food prices:** Reduced agricultural output due to drought often translates to higher food prices, impacting consumers and exacerbating food insecurity, especially in vulnerable populations.
- **Livestock losses:** Drought can also lead to significant losses in livestock due to reduced pasture availability and water scarcity.
- **Impact on energy production:** Regions reliant on hydropower can experience significant energy production disruptions during droughts due to reduced water levels in reservoirs.
- **Water scarcity issues:** Beyond agriculture, drought can lead to water scarcity in urban areas, impacting industrial operations and household water use, potentially leading to additional economic costs.
- **Supply chain disruptions:** Drought-induced agricultural losses can disrupt supply chains, affecting the availability of food products and impacting related industries.
- **Social and political impacts:** Severe droughts can lead to social unrest, migration, and political instability due to food shortages and economic hardship.

4.5.2 Environmental

Emerging concerns regarding drought from an environmental perspective include: increased wildfire risk, altered ecosystem dynamics due to species loss and shifts, disruption of carbon cycling, soil degradation, potential for mass die-offs of aquatic life, and the amplification of existing environmental stressors like invasive species outbreaks all of which can have cascading effects on biodiversity and the services ecosystems provide to humans. Drought events are increasingly severe, prolonged, and widespread due to climate change and human activities, leading to significant environmental challenges. The key points about the economic impacts of drought are as follows:

- **Agriculture is heavily impacted:** Droughts directly affect crop production, leading to lower yields and higher food prices, particularly in regions heavily reliant on agriculture.

- **Water-dependent industries affected:** Sectors like hydropower generation, manufacturing, and tourism can face significant disruptions due to reduced water availability.
- **Increased cost of water management:** As droughts become more prevalent, the cost of water treatment, desalination, and irrigation systems may rise considerably.
- **Rural communities are disproportionately affected:** Drought often hits rural areas hardest, leading to income loss for farmers, potential migration, and increased poverty.
- **Impact on global trade:** Food shortages caused by drought can disrupt international trade, affecting food security worldwide.
- **Climate change exacerbates the issue:** Changing weather patterns are expected to increase the frequency and severity of droughts, magnifying their economic impacts. Specific emerging concerns:
- **Impact on water-intensive industries:** Growing concerns about the impact of drought on industries with high water needs, like semiconductor manufacturing.
- **Financial risk for insurance companies:** Increasing claims related to drought-induced crop losses and other damages could pose significant financial risks for insurance providers.
- **Geopolitical tensions:** Competition for limited water resources in drought-prone regions could lead to increased geopolitical tensions between nations.

4.5.3 Social

Emerging concerns regarding the social impact of drought include: increased mental health issues like anxiety and depression due to economic losses, potential for mass migration as people leave drought-stricken areas, heightened social tensions over dwindling water resources, disruptions to community structures, increased risk of infectious diseases due to poor water quality, and a widening gap between vulnerable populations and those with greater resilience to drought conditions. Drought impacts communities in profound and far-reaching ways, exacerbating social vulnerabilities and inequalities. The key points about the social impacts of drought are as follows:

- **Economic hardship:** Reduced agricultural yields and income losses from drought can lead to poverty, food insecurity, and economic instability, particularly in rural communities heavily reliant on agriculture.
- **Health concerns:** Poor water quality due to drought can lead to waterborne diseases, while dust storms associated with dry conditions can exacerbate respiratory issues.
- **Social displacement:** Severe droughts can force people to migrate from their homes and communities in search of water and livelihood opportunities, leading to social disruption and displacement.
- **Mental health impacts:** Stress and anxiety related to drought-induced economic hardship and loss of livelihoods can significantly affect mental well-being.

- **Conflict potential:** Competition for scarce water resources during drought can exacerbate existing social tensions and lead to conflicts between communities.
- **Vulnerable populations:** Marginalized groups like the elderly, children and low-income communities are often disproportionately affected by drought due to limited access to resources and coping mechanisms.
- **Community resilience:** Building community resilience through preparedness plans, water conservation practices, and social support systems can help mitigate the social impacts of drought.

4.6 Crop Loss due to Drought

Droughts are a major cause of crop loss and can have a wide range of impacts on agriculture from 2015 to 2021.

Table 4.2, Crop loss due to drought

Year of drought	No. of Blocks affected	No. of GPs affected	No. of villages affected	Area in ha (Rice & Non-Rice) affected with crop loss of >33%	No. of farmers affected
2015	10	169	859	Rice 31484	38450
2018	10	181	816	Rice 32968	42632
2021	1	14	88	Rice 2277	2456

It shows from the above table that the highest rice area of 32968 ha was affected during 2018 and the lowest area was affected during 2018. But, if we compare the number of affected villages, the highest was 859 in 2015, followed by 2018. The lowest number of villages were affected during 2021, and it was only 14 villages.

4.7 Livestock/Poultry loss due to drought

There is no loss of livestock/poultry birds during drought.

Table 4.3, Livestock/Poultry loss due to drought

Year of drought	No. of Blocks affected	No. of GPs affected	No. of villages affected	No. of livestock affected			No. of livestock died		
				large	small	Poultry	large	small	Poultry
Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

4.8 Vulnerable Population

About 319465 households are vulnerable to drought in all blocks. Kosagumuda block shows that the highest households are vulnerable and Umerkote MPL shows the lowest vulnerable to drought. Out of the total households, 99 percent of NFSA HHs and only 1 percent of SFSA HHs are vulnerable to drought in all 10 blocks of the district.

Table 4.4, Block-wise Vulnerable Households

Name of Blocks	No. of GPs	No. of villages	No. of households			No. of farmers/agricultural labourers	
			NFSA	SFSA	Total	Small & Marginal Farmers	Agricultural labourers
Nabarangpur			21978	109	22087		
Nandahandi			16558	362	17220		
Tentulikhunti			24176	461	24637		
Papadahandi			37708	291	37999		
Kosagumuda			42016	860	42876		
Dabugaon			17808	118	17926		

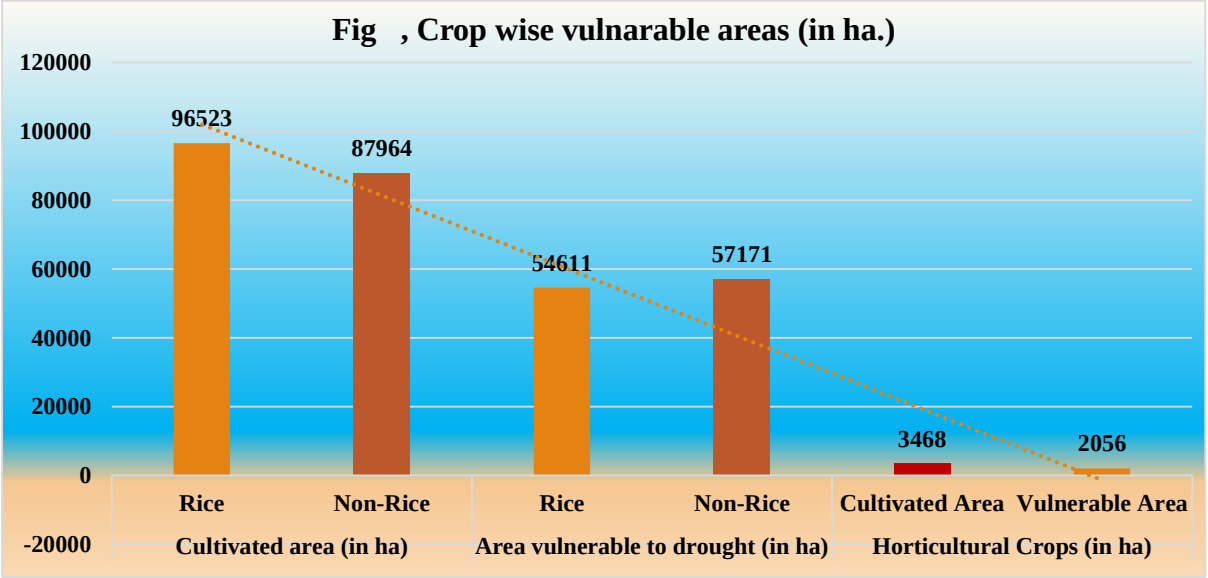
Name of Blocks	No. of GPs	No. of villages	No. of households			No. of farmers/agricultural labourers	
			NFSA	SFSA	Total	Small & Marginal Farmers	Agricultural labourers
Umerkote			41468	630	42098		
Raighar			40861	115	40976		
Jharigaon			38748	366	39114		
Chandahandi			22727	296	23023		
Nabarangpur MPL			5697	232	5929		
Umerkote MPL			5662	218	5880		
Total			**315407**	**4058**	**319765**		

4.9 Agriculture and Drought Vulnerability

Rice is the subsistence crop of Nabarangpur district, followed by maize and vegetable crops. The total cultivated area of rice is 96523 ha, and the non-rice area is 87964 ha in the district. Out of the total area, 54611 ha of rice and 57171 ha of non-rice crops areas are vulnerable to drought in all 10 blocks. Similarly, out of the 3468 ha of horticultural crops area, 2056 ha of area is vulnerable to drought in the district. Hence, there is an urgent need to increase the irrigation potential in the district to cope with the drought situation in the district.

Table 4.5, Agriculture and Drought Vulnerability

Name of the block	Cultivated area (in ha)		Area vulnerable to drought (in ha)		Horticultural Crops (in ha)	
	Rice	Non-Rice	Rice	Non-Rice	Cultivated Area	Vulnerable Area
Nabarangpur	10217	5884	6522	2664	375	230
Nandahandi	7191	4697	5330	1412	394	140
Tentulikhunti	6207	7728	4947	5159	485	292
Papadahandi	10687	9278	6184	8596	277	163
Kosagumuda	18554	12327	8899	9920	518	424
Dabugaon	4534	4683	3533	3380	116	0
Umerkote	12139	10667	4070	4283	227	45
Raighar	11764	15005	7537	10764	490	284
Jharigaon	9000	8094	4762	5210	111	03
Chandahandi	6230	9601	2827	5783	475	475
Total	**96523**	**87964**	**54611**	**57171**	**3468**	**2056**



4.10 Livestock/Poultry and Drought Vulnerability

Table 4.6 , Livestock/Poultry and Drought Vulnerability

Name of the block	Total livestock population			Fodder demand and availability (in qtl.)		
	large	small	poultry	Dry Fodder	Green Fodder	Source
	Nil	Nil	Nil	Nil	Nil	Nil

4.11 Observed trends in temperature, rainfall and dry spell (last 02 years)

Table 4.7, Year-wise trend of Temperature, Rainfall and Dry spells

Year	Temperature (Max.)			Rainfall (mm)			No. of Dry spell weeks
	April	May	June	Observed	Normal	% Departure from Normal	From June to September
2022		34	27	175	352	14	
2023	37	33	29	200	352	10	
2024	38	38	37	210	352	12	

The above table shows that the temperature reached 38^0C in June 2024, which was higher than in the subsequent years 2023 and 2022. The trend of temperature increasing every year is shown. The temperature of May was the highest, at 38^0C, in 2024 compared to other years. Similarly, there was a deviation in the percentage of rainfall in three years from 2022 to 2024.

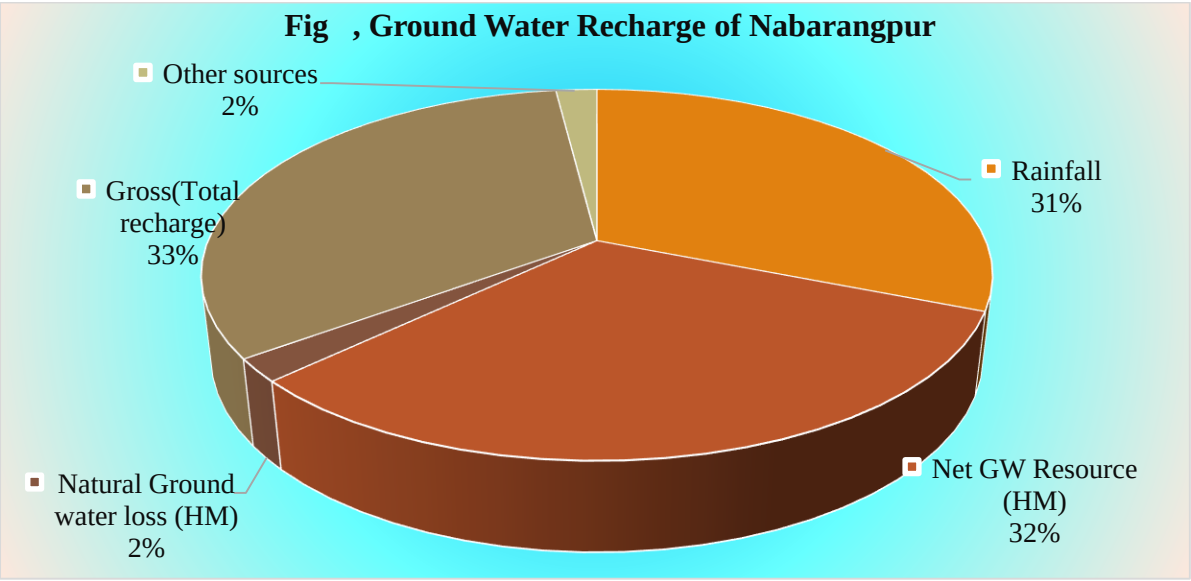
4.12 Observed Trends in Groundwater Availability and Utilization

Groundwater availability is decreasing during droughts due to reduced recharge and over-extraction. Utilization surges as surface water sources dry up, intensifying aquifer depletion. This trend is especially evident in agriculture-driven regions, where irrigation demand rises sharply. Unsustainable groundwater use exacerbates long-term water scarcity, highlighting the need for conservation and sustainable management practices.

The groundwater resources of the district have been assessed by adopting the methodology recommended by the Groundwater Estimation Committee (1997), constituted by the Government of India. The task was jointly carried out by the Central Ground Water Board and Ground Water Survey & Investigation, Department of Water Resources, Govt. of Odisha. The block-wise computation of groundwater resources in the district has been presented in the table. The groundwater resources in the district are computed as 50306 Ham, out of which the existing Ground Water Draft for irrigation is 4050 Ham. The groundwater draft for irrigation is through dug wells and shallow tube wells. A large number of hand pumps fitted in PHED bore wells and tube wells also cater to the rural and urban water supply needs. Based on the estimated groundwater potentials, a detailed scheme for groundwater development may be launched in the district. So far, groundwater development in the district has been meager. The stage of groundwater development varies from 8.38% to 26.63% in different blocks. The overall Stage of Groundwater development in the district is 13.88 %. The major source of recharge is from rainfall (31%), and other sources contribute only 2% towards the total recharge of 33%, with net groundwater accounting for 32%. There is ample scope for stepping up groundwater development in the district. The major source of recharge from rainfall (31%) and other sources

contributes only 2% towards total recharge of 33%, with net groundwater accounting for 32 % (Fig.).

Fig , Ground Water Recharge of Nabarangpur



Excepting a small area in the western part where purple shales occur, hard rocks occupy the entire district. The eastern part of the district is hilly and rugged. Dug wells are feasible in the intermontane valleys and undulating plains. The net annual extractable fresh groundwater resource of the district is assessed to be 579.01 MCM and the gross annual extraction for domestic, industrial, and irrigation uses is 199.98 MCM. Raighar is the block with the highest groundwater utilization of 57.79% and Jharigaon is the block with the lowest groundwater utilization of 23.23%. The SOGWE for the district as a whole is estimated as 34.54% and all the **10 blocks of the district have been categorized as safe from a groundwater extraction point of view.**

Table 4.8, Dynamic groundwater resources of Nabarangpur in 2022 (Block-wise)

Name of Block	Annual Extractable Ground water Resource (Ham)	Current Annual Ground Water Draft (Ham)				Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorisation (overexploited/Critical/semi-critical/Safe/ Saline)
		Irrigation	Domestic	Industrial	Total				
Chandahandi	4675.07	953.44	11.05	232.77	1197.26	254.21	3456.37	25.61	safe
Dabugaon	2430.36	464.89	11.05	213.92	689.86	234.19	1720.23	28.39	safe
Jharigaon	6528.74	1037.58	6.63	472.63	1516.84	516.33	4968.19	23.23	safe
Kasagumuda	11343.19	3089.14	13.26	498.44	3600.84	540.00	7700.79	31.74	safe
Nabarangapur	2860.29	1174.64	28.73	364.67	1568.04	403.38	1253.54	54.82	safe
Nandahandi	3822.99	1123.48	8.84	158.32	1290.64	163.71	2526.96	33.76	safe
Papadhandi	4760.89	938.73	22.1	407.83	1368.66	425.99	3374.07	28.75	safe
Raighar	8398.54	4310.07	4.42	539.68	4854.17	564.85	3519.2	57.80	safe
Tentulikhunti	3526.66	893.45	17.68	262.75	1173.88	276.91	2338.62	33.29	safe
Umerkote	9555.08	2003.97	35.36	698.95	2738.28	762.29	6753.46	28.66	safe
Total	57901.81	15989.39	159.12	3849.96	19998.5	4141.86	37611.4	34.54	safe

Source: Dynamic Ground Water Resources of Odisha, 2022

The annual groundwater recharge of the state in 2022 estimates shows an increase of 0.71 BCM as compared to that of 2020 estimates. The groundwater extraction for irrigation, domestic and industrial purposes has increased by 0.37 BCM in 2022 estimates as compared to 2020 estimates. The main reasons for these variations may be attributed to refinement in the recharge-worthy area of kilometers assessment units through the generation of DEM, change in methodology, refinement of parameters for resources estimation, refinement in well census data and changing groundwater regime. Similarly, in Nabarngpur, ground was used significantly across the district. The district-wise annual groundwater recharge and extraction figures are presented.

Table 4.8, Annual Extractable Ground Water Resource of Nabarangpur in 2022

Name of District	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as of 2025 (Ham)	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Irrigation	Domestic	Industrial	Total			
Nabarangpur	57901.81	15989.39	159.12	3849.97	19998.48	4141.86	37611.43	34.54

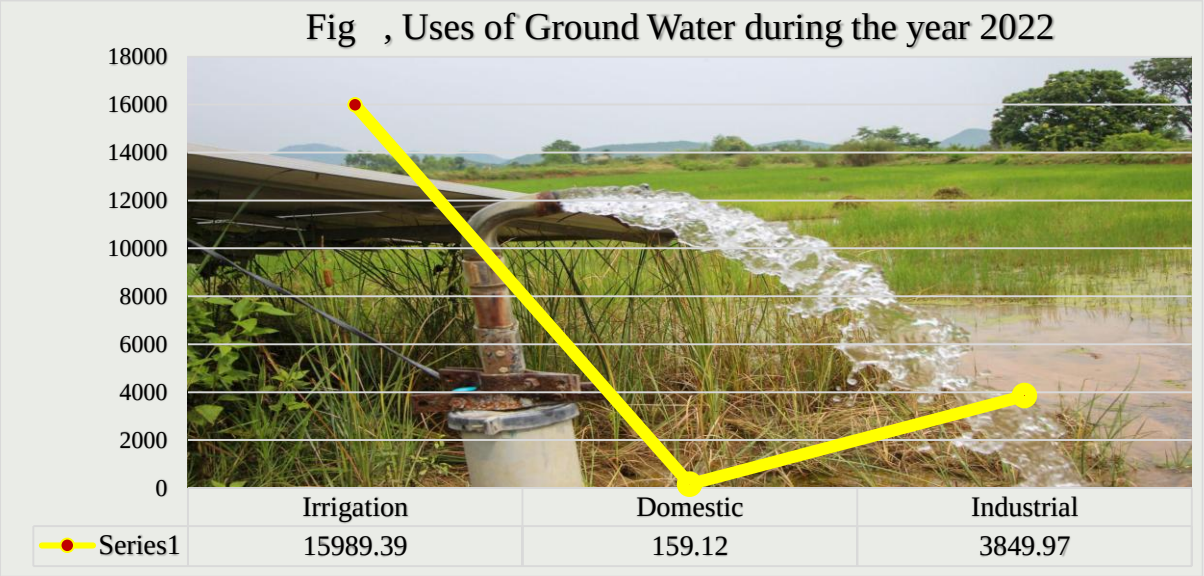
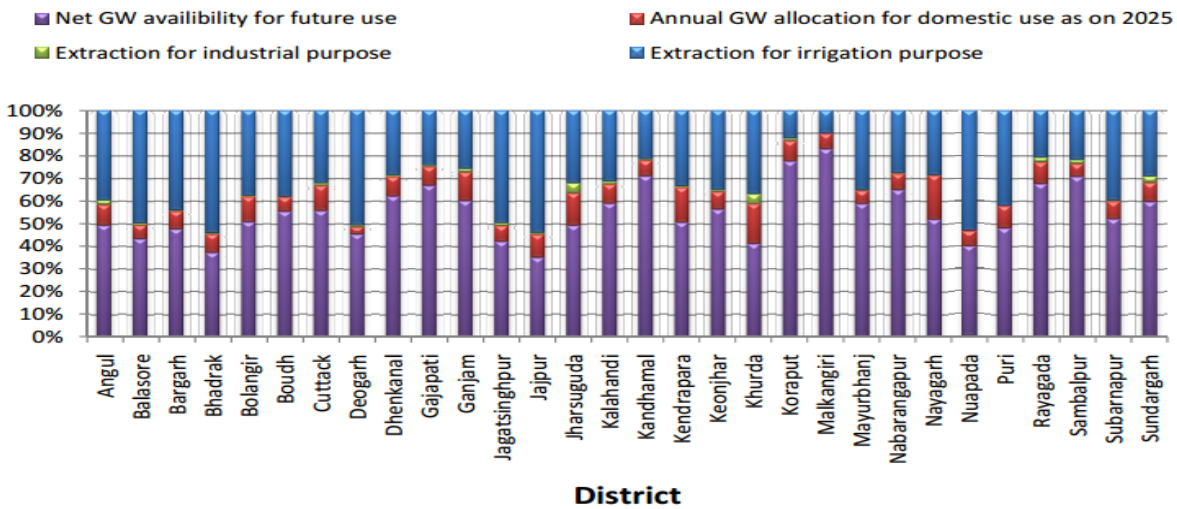


Fig , Total Annual Groundwater Extraction and Availability for Future Use



The total groundwater recharge in different blocks of Nabarangpur district is 0.50306 BCM, out of which the draft is only 0.07592 BCM (15.1 %), thereby generating a gap of 0.42714 BCM (84.9 %). · The current crop water demand is estimated to be 0.546 BCM and the major crops groups are cereals and vegetables. The existing water potential is 0.492 BCM and the existing water potential available for crops after meeting the demand of domestic, livestock and industries is coming down to 0.420 BCM. Ultimate crop water potential (UCWP) to be created under different scenarios varied from 0.61 to 5.50 BCM from 10 to 90% of the crop sown area to be irrigated. Similarly, water potential created in different scenarios varied from 0.19 to 5.08 BCM. · Available surface water resource (0.40302 BCM) is more than four times higher than the total groundwater resource (0.08927 BCM). More than 46% of the total water resources are available in three blocks (Umerkote, Chandahandi, and Kosagumuda). At present, there is a gap of 0.10 BCM of available water in the district. But to meet the demand of 2025 under 90 % of net cropped area to be brought under irrigation, the district has to create an additional water potential of 5.08 BCM. The percentage of irrigated area to rainfed area is highest for Nandahandi (78.4%), followed by Kosagumuda (44.3%) and Nowarangapur (43.1%). Whereas the same is the least for Chandahandi (17.1%) followed by Papadahandi block (21.9%). The total water available from surface irrigation and groundwater is about 0.67353 BCM in Nabarangpur district, out of which 0.35958 (53.4 %) and 0.31395 (46.6 %) BCM are available during Kharif and Rabi, respectively.

4.13 Climate change risks and emerging concerns

Climate change intensifies drought risks through altered precipitation patterns, rising temperatures, and increased evaporation. Prolonged droughts threaten agriculture, water security, and ecosystems, exacerbating food and livelihood vulnerabilities. Emerging concerns include groundwater depletion, loss of biodiversity, and socio-economic inequalities. Mitigating these risks requires adaptive water management and climate-resilient practices.

Climate and its inevitable symptoms of change are now becoming a part of people's lives. They have realized the related potential threats and magnitude of the skewed pace of development for generations to come as an outcome of climate-induced natural disasters. Prior knowledge and conditioning about climate change are a much pressing need in Nabarangpur, where it is circumscribed only to the elite rural and urban mass. Climate change poses a growing list of risks including more frequent and intense extreme weather events like heatwaves, floods, droughts, wildfires, and storms, rising sea levels, disruptions to food security, increased spread of infectious diseases, mass migration due to climate-related displacement, biodiversity loss, and potential cascading effects on global economies and human health, with emerging concerns focusing on the potential for tipping points in the Earth's climate system, the disproportionate impact on vulnerable populations, and the need for rapid adaptation and mitigation strategies to address these risks.

4.14 Drought Risk Assessment: Identification of factors leading to drought risk

Drought risk assessment involves identifying factors contributing to drought, including climatic, environmental, and socio-economic elements. Key factors include prolonged rainfall deficits, high temperatures, and increased evaporation due to climate change. Unsustainable water management, over-extraction of groundwater, deforestation, and soil degradation

exacerbate vulnerability. Socioeconomic factors like population growth, agricultural dependency, and inadequate infrastructure further heighten risk. Assessing these factors helps prioritize regions for intervention, enabling proactive planning and implementation of adaptive measures to reduce drought impacts and enhance community resilience. A combination of natural climatic variations and human activities can exacerbate drought risk in a region. The key factors are categorized:

- **Climate factors:**
  - Low rainfall amounts
  - Irregular precipitation patterns
  - Increased temperatures leading to higher evaporation rates
  - Changes in atmospheric circulation patterns
  - Oceanographic events like El Nino and La Nina
- **Land use practices:**
  - Deforestation - reduced water retention capacity
  - Intensive agriculture - excessive water extraction from soil
  - Poor irrigation practices
  - Overgrazing - soil degradation and reduced water infiltration
- **Human factors:**
  - Growing population and increased water demand
  - Inadequate water management infrastructure
  - River diversion projects impacting downstream water availability
  - Urbanization leading to increased impervious surfaces

4.15 Drought Vulnerability Assessment:

Area (Villages, GPs), Land Use Extent, Populations, Households, Animal Resources, Infrastructures

Data required

4.16 Existing Capacity and Gap Analysis

The existing capacity for managing drought risks includes government policies, early warning systems, water conservation programs, and community-level initiatives. Infrastructure like reservoirs and irrigation systems provide resilience, while schemes like MGNREGA support livelihoods. However, gaps remain in areas such as accurate forecasting, equitable resource distribution, and awareness at the grassroots level. Limited financial resources, insufficient adoption of sustainable practices, and weak coordination between stakeholders hinder effective response. Addressing these gaps requires improved data systems, enhanced infrastructure, capacity building, and stronger institutional frameworks.

A "gap analysis of drought risk" refers to identifying the discrepancies between the current capacity to manage drought risks and the necessary level of preparedness, essentially highlighting areas where significant improvements are needed in terms of early warning

systems, water management practices, community resilience, and policy frameworks to effectively mitigate drought impacts; this analysis considers existing capacities like water storage infrastructure, irrigation systems, disaster response plans, community awareness programs, and compares them to the projected needs based on drought risk assessments, identifying critical gaps in preparedness and response capabilities. The main components of a drought risk gap analysis:

- **Assessing Existing Capacity:**
  - **Water resource management:** Analysing current water storage capacity (dams, reservoirs), groundwater extraction levels, irrigation efficiency, and water conservation measures.
  - **Monitoring systems:** Evaluating the effectiveness of existing drought monitoring tools like precipitation gauges, streamflow data, soil moisture monitoring, and early warning systems.
  - **Community preparedness:** Assess existing community awareness programs, preparedness plans, and access to emergency water supplies.
  - **Institutional capacity:** Evaluating the capabilities of government agencies, local authorities, and relevant organizations in managing drought response activities.
- **Identifying Gaps in Capacity:**
  - **Data limitations:** Identifying missing data or inadequate data quality for accurate drought risk assessment.
  - **Infrastructure deficiencies:** Lack of sufficient water storage capacity, outdated irrigation systems, or inadequate water distribution networks.
  - **Communication gaps:** Deficiencies in disseminating drought warnings and information to affected communities.
  - **Financial constraints:** Insufficient funding for drought mitigation projects and response activities.
  - **Policy gaps:** Lack of comprehensive drought management policies, regulations, and incentives for water conservation.
- **Analyzing Drought Risk Factors:**
  - **Climate change impacts:** Projecting future drought severity and frequency under changing climate conditions.
  - **Socioeconomic vulnerability:** Assessing the susceptibility of communities based on factors like poverty levels, access to water, and reliance on agriculture.
  - **Environmental factors:** Examining land use patterns, soil conditions, and water availability in different regions.

- **Gap analysis for drought risk:**
  - **Prioritizing mitigation strategies:** Identifying critical areas requiring immediate attention for drought preparedness and response.
  - **Policy development:** Informing the design of new policies and regulations to address drought risks.
  - **Resource allocation:** Guiding investments in infrastructure development, water conservation initiatives, and community-based adaptation programs.
  - **Project planning:** Supporting the design of drought-resilience projects, including water harvesting, groundwater recharge, and improved irrigation systems.

4.17 Risk Associated with Different Stages of Crop Cultivation (indicative one)

Stages of crop	Required Resources	Remarks
Land Preparation	• Human Workforce • Primary and secondary tillage implements, livestock	1. High temperatures and prolonged heat wave situations may delay land preparation timing and deep summer ploughing in the croplands.
Crop Establishment	• Seeds • Human Workforce • Implements • Livestock	1. Delayed onset of monsoon affects seed sowing timing and changes in the calendar of crop cultivation operation. 2. Dry spell affects the seeds and seedlings in crop fields and nurseries.
Irrigation	• Human Workforce • Water supply for irrigation • Functional Irrigation system availability • Implementations like pump sets availability • Electricity supply	1. Delayed irrigation at critical stages can affect crop establishment.
Active Crop Growth	• Human workforce for intercultural operations • Nutrient and fertilizer availability • Plant protection chemicals like Herbicides, Pesticides, etc. • Implement availability	1. Prolonged dry spells and moisture stress situations can affect the efficacy of fertilizers, herbicides and pesticides on the crop stand. 2. The nonavailability of water and irrigation can affect the application of such agricultural inputs.
Harvesting	• Farm implements and machinery • Human Workforce	1. Moisture stress/Drought situation will delay the crop phenology and result in poor harvest.
Post-Harvest Processes	• Storage Structures • Packaging, transportation and marketing	1. Less procurement of the harvest and a fall in crop productivity 2. Rise in food grain prices 3. Black marketing

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CHAPTER–5

INSTITUTIONAL ARRANGEMENT FOR DROUGHT MANAGEMENT

5.1 Drought Monitoring Cell at District Level

An institutional arrangement for drought management typically involves a multi-tiered structure with central, state, district, and local level agencies working together to monitor drought conditions, implement mitigation strategies, provide early warnings, and coordinate relief efforts during drought events, often including dedicated departments within government ministries, farmer cooperatives, and community-based organizations.

An institutional arrangement for drought management is crucial because it establishes a coordinated framework between different government agencies, communities, and stakeholders to effectively monitor, predict, mitigate, and respond to drought events, ensuring a unified approach to address the complex and multifaceted nature of droughts across various sectors like agriculture, water supply, and disaster relief. This collaborative system allows for better information sharing, resource allocation, and timely decision-making to minimize the impacts of drought on vulnerable populations and ecosystems.

➔ **State Government Level**

- **State Disaster Management Authority (SDMA):** Manages drought response at the state level, including monitoring, early warning systems, and coordinating relief efforts.
- **Department of Agriculture:** Implements drought-resistant crop varieties, water conservation techniques, and farmer training programs.
- **Irrigation Department:** Responsible for water resource management, reservoir monitoring, and canal irrigation systems.

➔ **District Level**

- **District Disaster Management Authority (DDMA):** Coordinates drought mitigation activities at the district level, including vulnerability assessment, community engagement, and resource mobilization.
- **District Agriculture Officer:** Provides technical support to farmers on drought-resilient agricultural practices.
- **Gram Panchayat (Village Council):** Plays a critical role in community-based water harvesting and conservation initiatives.

➔ **Community Level**

- **Farmer Producer Organizations (FPOs):** Facilitate collective action, information sharing, and access to drought mitigation technologies among farmers.
- **Water User Associations (WUAs):** Manage local water resources, including irrigation scheduling and equitable distribution.

- **Community-Based Organizations (CBOs):** Promote awareness, capacity building, and participation in drought preparedness activities.

Important aspects of an effective drought management institutional arrangement:

- **Early Warning Systems:** Robust monitoring systems to identify potential drought conditions early through rainfall data, reservoir levels, and soil moisture monitoring.
- **Risk Assessment and Vulnerability Mapping:** Identifying drought-prone areas and vulnerable communities to prioritize interventions.
- **Integrated Approach:** Combining water conservation measures like rainwater harvesting, efficient irrigation practices, and watershed management.
- **Capacity Building:** Training farmers, community leaders, and government officials on drought-resistant technologies and disaster preparedness.
- **Community Participation:** Engaging local communities in decision-making and implementation of drought mitigation activities.

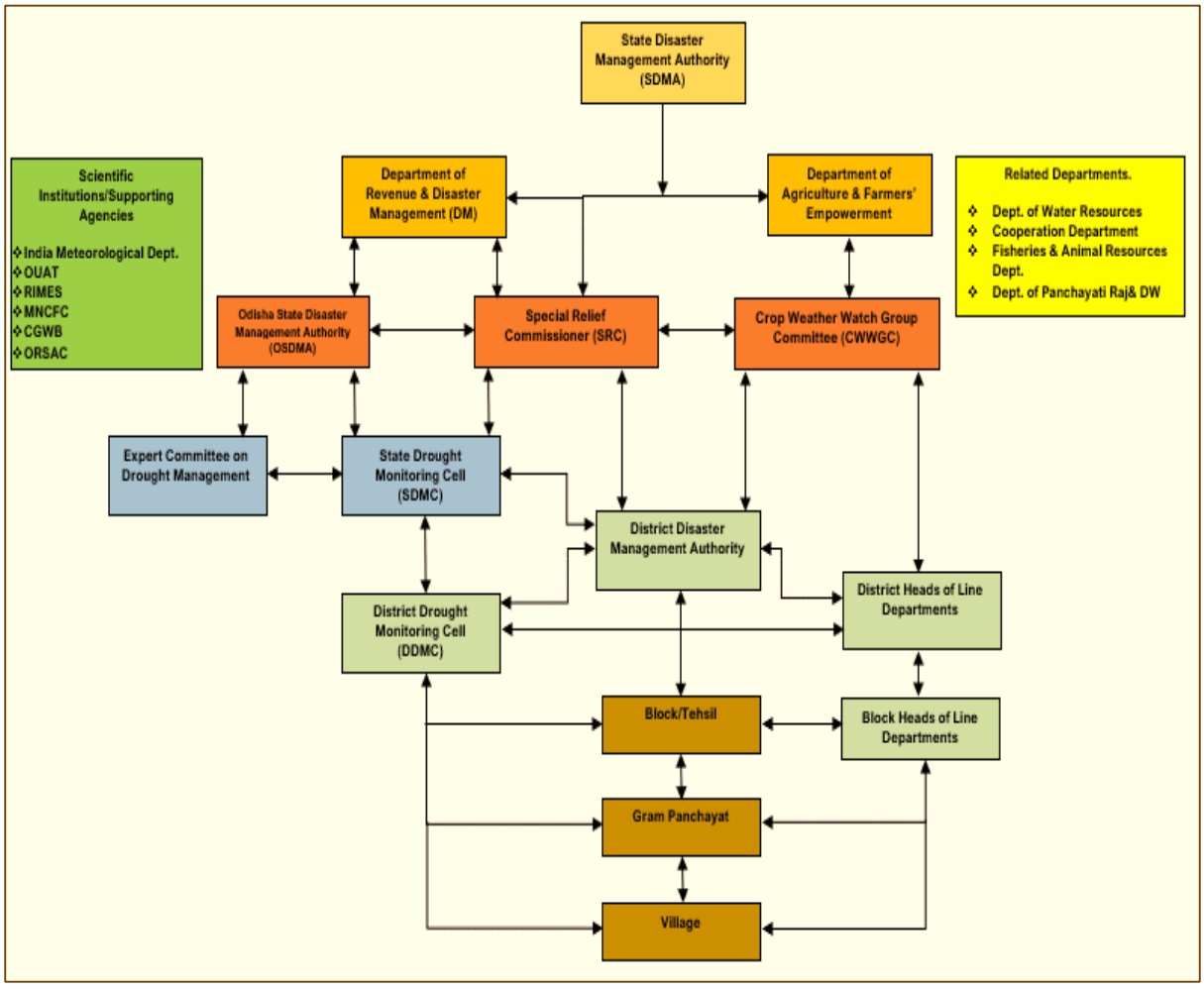

Fig , Institutional arrangement for Drought Management

5.2 Roles and Responsibilities of Different Stakeholders

5.2.1 Role of District Administration

District administration plays a pivotal role in managing drought through planning, mitigation, and relief efforts. It monitors water availability, assesses drought impact, and coordinates with various agencies to implement contingency plans. The District Administration plays a crucial role in drought management by overseeing the implementation of drought mitigation strategies at the local level, including monitoring weather conditions, assessing drought severity, coordinating relief efforts, mobilizing resources, and ensuring effective delivery of support to affected communities, all under the leadership of the District Collector. Key responsibilities include ensuring drinking water supply, promoting water conservation, and supporting farmers with crop insurance and subsidies. The administration also oversees public awareness campaigns, drought-resistant crop promotion, and employment programs under schemes like MGNREGA. Effective disaster management and equitable resource distribution are crucial to minimize the socio-economic impacts of drought. Besides that, some other key responsibilities of District Administration in drought management are:

- **Monitoring and Early Warning:**
  - Regularly tracking rainfall patterns, water levels in reservoirs, and other drought indicators to issue timely warnings about potential drought situations.
  - Utilized weather forecasting tools and collaborated with meteorological departments for accurate data analysis.
- **Assessment and Impact Analysis:**
  - Conduct field surveys to assess the severity of drought impacts on agriculture, livestock, and human populations in different areas of the district.
  - Identifying vulnerable communities and prioritizing areas for targeted interventions.
- **Planning and Response Strategies:**
  - Developing a comprehensive drought management plan outlining preventive measure, mitigation strategies, and emergency response actions.
  - Coordinating with various departments like agriculture, water resources, animal husbandry, and health to ensure a coordinated response.
- **Resource Mobilization and Allocation:**
  - Funds from the state government's disaster relief fund to implement drought mitigation initiatives.
  - Facilitating the procurement and distribution of essential supplies like drinking water, fodder, and seeds to affected areas.
- **Community Engagement and Awareness:**
  - Conducting awareness campaigns to educate farmers about drought-resistant crop varieties, water conservation techniques, and rainwater harvesting methods.

- Engaging local communities in decision-making processes and mobilizing them to participate in drought mitigation efforts.

➔ **Implementation of Relief Measures:**

- Providing temporary employment through drought relief works programs to support vulnerable households.
- Facilitating access to drinking water through water tankers and other distribution systems.
- Implementing livestock support programs like fodder distribution and veterinary services.

➔ **Post-Drought Recovery:**

- Assessing the long-term impacts of drought and initiating recovery programs focused on infrastructure development, watershed management, and sustainable agricultural practices.
- Monitoring the effectiveness of implemented drought mitigation measures and making necessary adjustments based on feedback from affected communities.

5.2.2 Role of Panchayati Raj Institutions

Panchayati Raj Institutions (PRIs) play a crucial role in drought management by addressing local needs and implementing grassroots-level solutions. Evacuation to temporary shelters and running relief camps. Supplementing rescue and relief efforts in coordinating different agencies. Monitoring of Relief distribution. Safe disposal of carcass and arranging safe drinking water and sanitation. They promote water conservation practices, such as rainwater harvesting and watershed management, and ensure equitable distribution of water resources. PRIs mobilize communities to adopt drought-resilient crops and sustainable farming practices. They also help implement government schemes like MGNREGA for drought relief and provide employment. Through awareness campaigns, PRIs foster community participation, enhancing preparedness and resilience against the impacts of drought.

5.2.3 Role of NGOs and Civil Society Organizations

NGOs and Civil Society Organizations (CSOs) play a vital role in mitigating drought impacts by supporting vulnerable communities. They promote sustainable water management practices, such as rainwater harvesting and watershed development, and provide technical assistance for drought-resilient agriculture. NGOs actively participate in relief efforts, offering food, water, and financial aid during crises. They raise awareness about climate adaptation, advocate for policy changes, and empower communities through capacity-building programs. Their grassroots presence fosters resilience, ensuring effective and inclusive drought mitigation and recovery strategies. Non-governmental organisations (NGOs) play a crucial role in drought management through various activities that aim to mitigate the impacts of drought on communities and ecosystems. Here are some key roles they undertake:

1. **Advocacy and Awareness**: NGOs often work to raise awareness about the causes and effects of drought, advocating for policies that support sustainable water management and climate resilience.

2. **Capacity Building**: Many NGOs provide training and resources to local communities, helping them develop skills in water conservation, sustainable agriculture, and other practices that enhance resilience to drought.
3. **Research and Data Collection**: NGOs frequently engage in research to collect data on drought conditions, impacts, and effective response strategies. This information can be vital for informing policy decisions and community actions.
4. **Emergency Response**: In times of drought, NGOs may coordinate relief efforts, including the distribution of food, water, and other essential supplies to affected populations. They often work in collaboration with government agencies and other organizations.
5. **Sustainable Development Projects**: NGOs implement projects aimed at improving water management, such as rainwater harvesting, irrigation systems, and reforestation, which can help communities better cope with drought conditions.
6. **Community Engagement**: By involving local communities in decision-making processes, NGOs ensure that drought management strategies are culturally appropriate and tailored to the specific needs of the population.
7. **Advocacy for Climate Change Mitigation**: NGOs often advocate for broader climate action policies that address the root causes of climate change, which can exacerbate drought conditions.
8. **Monitoring and Evaluation**: NGOs help monitor the effectiveness of drought response strategies and evaluate their impact, providing feedback to improve future interventions.

Overall, NGOs serve as vital intermediaries that connect communities, governments, and international organizations, facilitating a coordinated response to drought challenges. Their work helps build resilience and supports long-term sustainable development in drought-prone areas.

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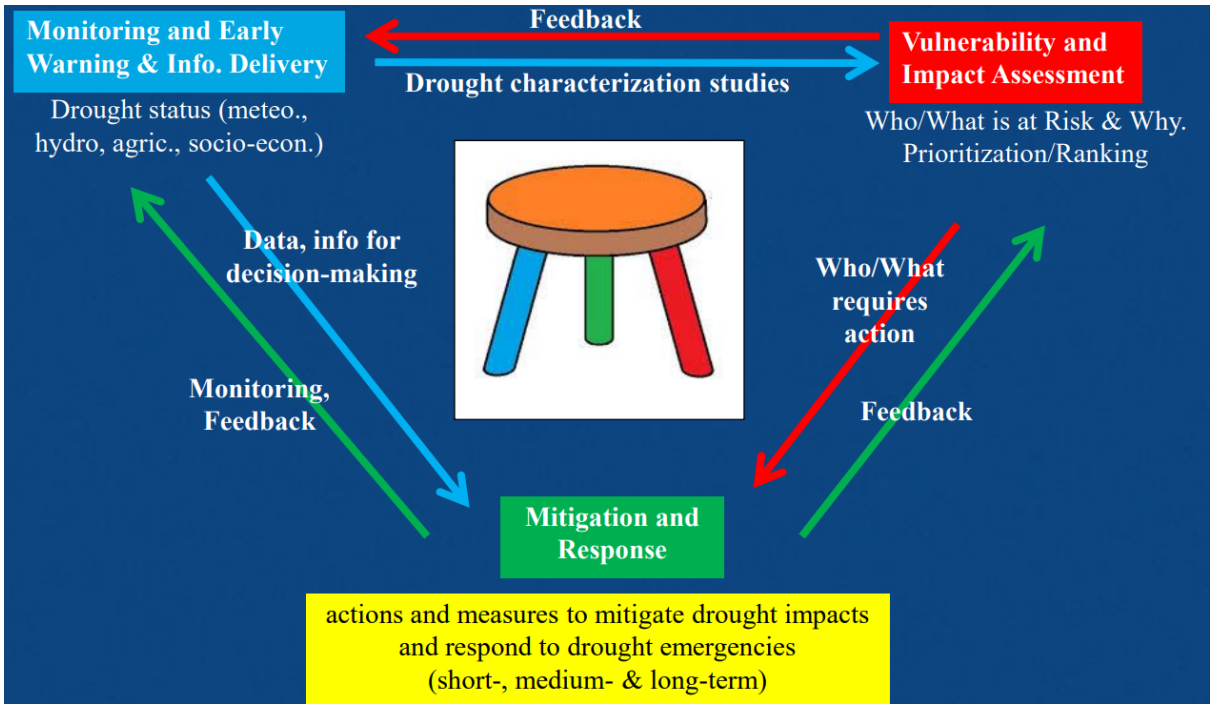
CHAPTER–6

PREPAREDNESS AND EARLY WARNING

6.1 Preparedness

Drought preparedness includes water conservation, cultivation of trace-tolerant crop varieties, planting drought-tolerant plants, renovation of old silted waterbodies and construction of water harvesting structures like major or minor irrigation projects (MIP), water harvesting structures (WHS), farm ponds (FP), percolation tanks (PT) and check dams (CD). Installation of water-efficient irrigation devices, such as micro and drip irrigation and soaker hoses. Use mulch to retain moisture in the soil. Also, choose low-water-use or drought-tolerant plant species to limit the need for supplemental watering.

Drought risks are complex and systemic, and the impacts are increasing slowly, disproportionately among communities, ecosystems and sectors. Due to its slow onset nature, careful monitoring of drought indicators and early detection with meticulous preparedness measures are key to effective management of this slow-creeping disaster. Drought Preparedness is a peacetime and normal phase proactive step that provides an opportunity with sufficient time to take stock of the existing capabilities and resources, building capacities, interventions, and infrastructures of the system and communities. All the concerned departments and stakeholders develop and enhance their skills, capabilities and resources well in advance to be able to perform their assigned roles and responsibilities at the onset of a drought-like situation and respond to the situation. The three pillars of drought management policy and preparedness linkage are as follows:



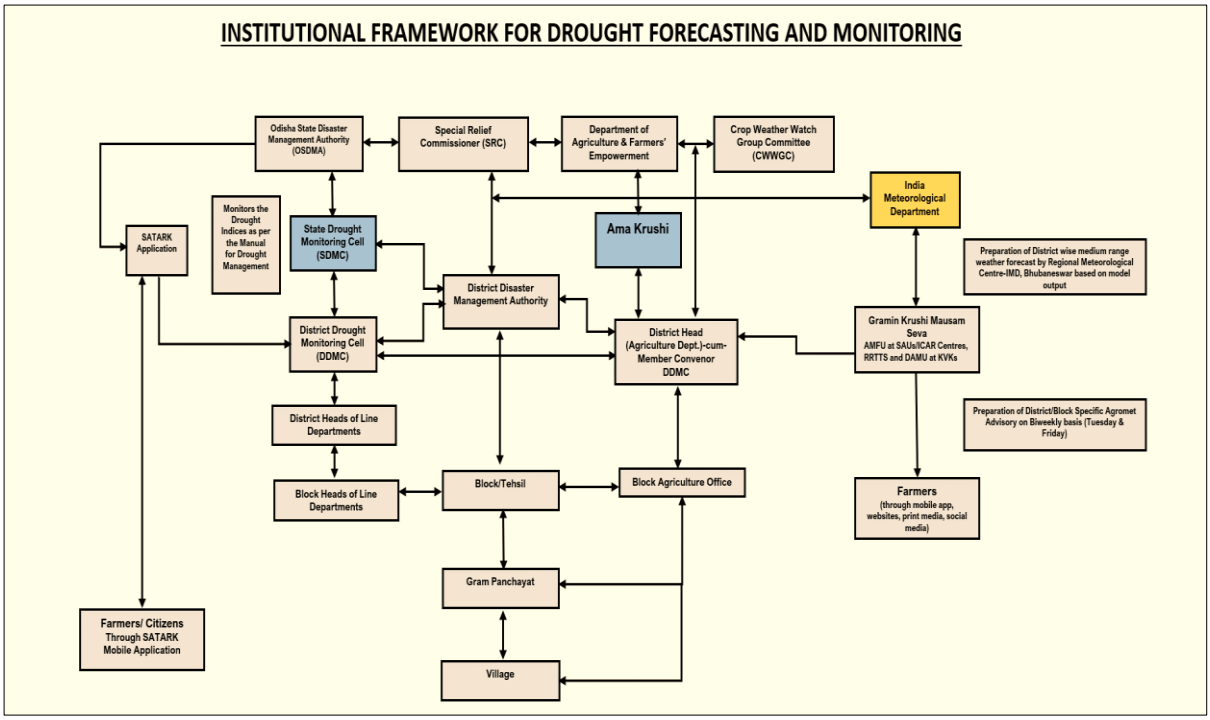
6.2 Stakeholders' preparation for drought along with roles and responsibilities during preparedness

Sl. No	Step/Activity/Task	Stakeholder/Line Dept.
1	Operationalization of District Drought Monitoring Cell and strengthening of DOEC and Emergency Response Centres.	District Disaster Management Authority
2	Updating the Drought Management Plan by reviewing the policies, rules and regulations, standards, interventions, organizational arrangements, etc.	District Disaster Management Authority
3	Updated District Crop contingency plans kept in readiness and available with extension functionaries at Block /Tehsil levels.	Department of Agriculture & FE, OUAT, KVKs
4	Rainfall and monsoon forecast	India Meteorological Department
5	Sufficient provisioning for drought-resilient varieties of seeds at appropriate hubs and prepositioning in PACS	Department of Agriculture & FE, Cooperation Department
6	Cultivation of drought-resistant fodder crops & crop varieties.	Animal Resources Department
7	Prepositioning of agricultural inputs (seeds, Fertilizers, Pesticides) at strategic hubs.	Department of Agriculture & FE, Cooperation Department
8	Sufficient shelf of projects and funds under MGNREGA.	PR&DW
9	Contingency Plans for veterinary care for all livestock, water, health, energy and food are kept in readiness at the operational/functional levels.	Animal Resources Department
10	Availability of fodder, feed and water for each Livestock.	Animal Resources Department
11	Availability of medicines and vaccines for livestock at the time of emergency.	Animal Resources Department
12	Repair of hand pumps, tube wells and drinking water schemes through flexi funds & the state's resources.	PR&DW
13	Readiness of water tankers for supply of drinking water.	PR&DW (RWSS)
14	Availability of food grains and other items	Department of Food Supply & Consumer Welfare
15	Repair of Transformers in rural areas.	Department of Energy
16	Desiltation /repair of canals.	Department of Water Resources
17	Readiness of life-saving irrigation facilities	Department of Water Resources and Department of Agriculture & FE
18	Repairing and maintenance of vital infrastructures (godowns, irrigation points, etc.)	Department of Agriculture & FE, Cooperation Department
19	Enrolment of farmers under Crop Insurance (PMFBY) and livestock insurance	Department of Agriculture & FE, Cooperation Department
20	Status on extension of credit facilities to the farmers	Department of Agriculture & FE, Cooperation Department, Lead District Manager (SLBC)

21	Capacity building and awareness among the farming communities on advisories and drought preparedness	Concerned Departments

6.3 Drought Early Warning (Pre-Disaster)

An effective monitoring of important drought parameters will act as an early warning to detect the portents of any drought conditions as early as possible. This will facilitate the execution of District Contingency Plans with the coordinated efforts of all stakeholders, thereby minimizing the impacts of drought on the communities, ecosystems and sectors. The institutional framework for drought management and early warning dissemination is represented below:



The various institutions responsible for drought early warning and forecasting are as follows:

(i) Crop Weather Watch Group for Drought Management, DAC&FW

CWWGDM evaluates the information and data from multiple sources- scientific and technical bodies to determine the likely impact of meteorological and other environmental parameters on agriculture. The same is updated in the Krishi DSS portal. This system provides an approach to drought early warning and forecast based on the Manual for Drought Management.

(ii) India Meteorological Department (IMD)

(a) IMD is the principal government agency under the Ministry of Earth Sciences (MoES) and provides national weather-based services and forecasts. Operational forecasts for the South-West Monsoon Season (June-September) are issued in two stages. The first stage forecast is issued in April, and the second stage forecast is issued in June.

(b) Agrometeorological Advisory Service (AAS) is rendered under the Gramin Krishi Mausam Sewa (GKMS) scheme as a step towards contribution to weather information and 5 days of weather forecasting to assist farmers in taking agricultural management decisions at district level through Agro-Met Field Unit (AMFU) located in 10 Agro-climatic Zones of the States and DAMU (District Agro-Met Unit) located in 10 Krishi Vigyan Kendra in the State. It also provides crop advisories as Agro-Met Bulletins twice (Tuesday and Friday) at districts prepared in collaboration with AMFU, DAMU, State Agriculture Universities and ICAR institutes.

These bulletins are also transmitted to the State Government Department as an early warning for drought monitoring and management.

(iii) Crop Weather Watch Group Committee at State Level

(a) The Crop Weather Watch Group Committee (CWWGC) under the Chairmanship of the Agriculture Production Commissioner acts as an inter-agency/departmental mechanism to meet at least once a week (Every Monday) from June to September for the Kharif season and November to March for Rabi Season.

(b) The CWWGC comprises key members from various line departments like the Department of Revenue & Disaster Management, Department of Water Resources, Department of Agriculture & FE, Department of Animal Resources and Development, Department of Panchayati Raj & DW, Supporting/Scientific Organizations like- State Drought Monitoring Cell (SDMC), OSDMA, IMD, OUAT, ICAR-IIWM etc.

(iv) State Drought Monitoring Cell (SDMC)

The State Drought Monitoring Cell (SDMC) functioning in the Odisha State Disaster Management Authority (OSDMA) monitors all the indices and indicators as enshrined in the Manual for Drought Management (2020) on a scientific basis and provides technical advice to the Government. It interacts with multiple National and state-level scientific institutions and departments, obtains relevant information related to different aspects of drought, facilitates in providing early warning information, and assists the Government in the management of drought relief and mitigation.

6.4 Institutional Mechanism for Drought Preparedness and Monitoring

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
1.	District Disaster Management Authority	District Collector	1. Ensure the establishment of a District Drought Monitoring Cell. 2. Updating the Drought Management Plan by reviewing the policies, rules and regulations, standards, interventions, organizational arrangements, etc. 3. Dissemination of monsoon forecasts among all the line departments for preparatory measures well in advance. 4. Conduct a coordination meeting of all line departments to review the drought preparedness in the district. 5. Conduct overall surveillance of assessments and activities of drought preparedness of various departments. 6. Involve elected representatives, local NGOs, and CSOs and conduct orientation on their roles and responsibilities in various phases of drought management.
2.A.	Department of Agriculture & F.E.	Chief District Agriculture Officer	1. Updated District Crop contingency plans prepared in consultation with Krishi Vigyan Kendras kept in readiness and available with

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
	(Directorate of Agriculture & Food Production)		extension functionaries at Block /Tehsil levels. 2. Sufficient provisioning of drought-resilient variety seeds at appropriate hubs and prepositioning in PACS with the support of the Cooperation Department. 3. Identification of additional retail points for the sale of agricultural inputs and issue of letter of authority for prepositioning and selling of inputs. 4. Repairing of storage godowns and stock-taking of Custom Hiring Centers for the supply of farm implements and machinery. 5. Promote excavation of deep bore wells well in advance through the ongoing schemes. 6. Excavate dug wells and promote the installation of solar-powered pump sets in coordination with the Department of Panchayati Raj & DW. 7. Capacity building and awareness among the farming communities on advisories and drought preparedness. 8. Awareness and proactive measures through mass campaigning for the enrollment of farmers under PMFBY. 9. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
2.B.	Department of Agriculture & F.E. (Directorate of Horticulture)	Deputy Director of Horticulture	1. Facilitate updating the District Crop Contingency Plan in consultation with Krishi Vigyan Kendra. 2. Prepositioning of seeds and raising of sufficient seedlings of different horticultural crops in Govt. nurseries. 3. Campaigns for the inclusion of farmers on drip and sprinkler irrigation systems under PMKSY. 4. Capacity building and awareness among the farming communities on advisories and drought preparedness. 5. Identification of additional retail points for the sale of agricultural inputs and the issue of a letter of authority for the prepositioning and selling of inputs.

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
			6. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
2.C.	Department of Agriculture & F.E. (Directorate of Soil Conservation & Water Shed Development)	Deputy Director of Soil Conservation-cum- Project Director, Watershed	1. Identify the vulnerable areas in the district. 2. Promote land development like contour bunds, field bunds, and bench terracing in cultivable lands with mild slopes to check soil erosion and retain moisture. 3. Promote gully control works like drop spillways, check dams, and boulder check dam's hexagonal wares to stop the advancement of gully heads and improve the soil moisture regime in the command areas. 4. Facilitate repairing, renovation and de-siltation of water harvesting structures such as farm ponds, check dams, percolation tanks, etc. for efficient use of rainfall. 5. Promote in-situ soil moisture conservation practices. 6. Promote plantation programmes of agroforestry systems for checking surface runoff and soil-erosion. 7. Monitors implementation of watershed development schemes. 8. Capacity building of farmers on the importance of soil, water, ecology and environment. 9. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
3.	Department of Water Resources	Superintending Engineer of Division/Executive Engineer	1. Conduct an assessment of water availability for irrigation, plan irrigation for the season and distribute water optimally during the drought situation. 2. Ensure institutionalization and operationalization of Pani Panchayats in various locations. 3. Ensure immediate repair and renovation of water channels and temporary arrangements to respond. 4. Repairing of RLIP and pump-houses. 5. Facilitate the development of various Command Areas focusing on soil and moisture conservation measures and crop diversification in convergence with the Agriculture Department.

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
			6. Promote repairing, renovation and de-siltation works of field channels, dug wells, etc. 7. Capacity building of communities on Climate Change, Disaster Risk Reduction, Water Budgeting, Conservation measures, etc. 8. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
4.	Department of Panchayati Raj & Drinking Water	Chief Development Officer, Zilla Parishad	1. Facilitate repairing of non-functional dug wells, shallow tube wells, borewells, etc. 2. Repair of hand pumps, tube wells and drinking water schemes through flexi funds & state's resources. 3. Readiness of water tankers for supply of drinking water. 4. Identification of sufficient projects on a priority basis and funds under MGNREGA and Livelihood Mission. 5. Promote capacity building and IEC awareness campaigns among rural communities on water conservation measures and drought preparedness. 6. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district.
5.A	Department of Cooperation	Deputy Registrar of Cooperative Societies	1. Preparation of farmer's database in the district for better credit facilities extension under component A of Crop Loan 2. Enrolment of left-over eligible farmers for crop loans through campaigns. 3. Promote the formation of Joint Liability Groups and SHGs to reduce the burden of loans on a single individual farmer. 4. Promote and ensure the enrollment of farmers under PMFBY through mass campaigns. 5. Repairing and renovation of PACS godowns before the beginning of the cropping season. 6. Prepositioning of agricultural inputs (seeds, Fertilizers, Pesticides) at PACS godowns. 7. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
5.B.	Banking and Financial Institutions	Lead District Manager	1. Enrolment of eligible farmers for crop loans under the Kisan Credit Card through mass credit campaigns and Loan Mela. 2. Promote the formation of Joint Liability Groups and SHGs to reduce the burden of loans on a single individual farmer. 3. Promote the enrollment of farmers for crop insurance under PMFBY and cattle owners to insure their livestock. 4. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district
6.A	Department of Fisheries & Animal Resources (Directorate of Animal Husbandry & Veterinary Services)	Chief District Veterinary Officer	1. Update the Contingency Plan for Animal Resources in the district in consultation with Krishi Vigyan Kendras and other scientific institutes. 2. Cultivation of drought-resistant fodder crops & crop varieties in coordination with Agriculture and Panchayati Raj Department. 3. Ensure availability of fodder, feed and water for each Livestock. 4. Ensure the availability of medicines and vaccines for livestock at the time of emergency. 5. Establish fodder depots in the drought-affected areas for selling fodder, cattle feed and concentrates at a proper price fixed by the State Government. 6. Conduct awareness campaigns in drought-vulnerable areas to make farmers aware of cattle health, feeds, vitamins, minerals and other sanitation issues. 7. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district
6.B.	Department of Fisheries & Animal Resources (Directorate of Fisheries)	District Fisheries Officer	1. Update the Fisheries Contingency/Disaster Management Plan in the district. 2. Ensure prepositioning and supply of lime, CIFAX, and feeds at strategic hub points in the district. 3. To liaise with the Department of Water Resource/Panchayati Raj for linking of check dams to water sheds which will harvest the rainwater and utilize it in the ponds and tanks.

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
			4. Conduct awareness programmes for fisheries management due to the drought situation. 5. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
7.	Department of Food Supply & Consumer Welfare	Civil Supply Officer	1. Ensure the availability of food grains and other items in the identified drought-vulnerable areas of the district. 2. Facilitate immediate repair of storage godowns and temporary hub points for storage and distribution of food grains in the affected areas. 3. Conduct campaigns for the enrollment of eligible beneficiaries under NFSA/SFSA. 4. Ensure necessary updates and rectification in the ration cards of the eligible households for the inclusion of eligible members. 5. Take the initiative for starting new Fair Price Shops and new ones to be started through SHGs/Cooperatives. 6. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district.
8.	Department of Energy	TPCODL/TPWODL/TPSODL/TPNODL Division Head	1. Repair of Transformers in rural areas. 2. Ensure electricity supply to the River Lift Irrigation Points (RLIP) and pump houses.
9.	Department of Women & Child Development	District Social Welfare Officer	1. Updating the database relating to children below 5 years, pregnant women and nursing mothers in the drought-vulnerable areas in the district. 2. Regular monitoring of various ongoing activities ensuring nutritional security for the beneficiaries. 3. Conduct of IEC activities and capacity building of staff on nutritional security and drought preparedness. 4. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
10.	Department of Health & Family Welfare	Chief District Medical Officer	1. Inspection of laboratories for diagnosis of waterborne and vector-borne diseases. 2. Periodic health camps in vulnerable areas to identify the vulnerable groups, make disease projections and measure the adaptive capacity of the communities.

Sl. No.	Lead Department/Agency	Authority	Specific Preparatory Actions
			3. Placement of indent for supply of emergency medicines well in advance. 4. Ensure sufficient medical staff and specialists in the laboratories, hospitals, etc. 5. Conduct an IEC awareness and capacity building programme on the impacts of drought on health and precautionary measures during drought. 6. Since drought is often characterized by high temperatures, communities should be made aware of safe drinking water and vector-borne diseases. 7. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.

6.5 Drought Monitoring Mechanism and Early Warning Systems

Parameters	District Level	Field Agencies
Delay in the onset of monsoon	D	D
Daily rainfall reporting	D	D
Dry spell during the sowing period	W	D
Dry spell during critical crop growth period.	W	D
Water availability in reservoirs	W	D
Water availability in tanks	F	F
Groundwater level	S	S
Delay in crop sowing	W	W
Crop sown area	W	W
Soil moisture deficit	F	F
Change in crop condition (Stress condition)	F	F
Status of agricultural operation	W	W
Availability and supply of agricultural inputs.	W	W

(D=Daily, W=Weekly, F=Fortnightly, M=Monthly, S=Seasonal)

6.6 Strategic Action Planner for Drought Preparedness and Early Warning

Activity	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Review of DMP												
Monitoring												

Operationalization of DDMC												
Rainfall												
Temperature												
Surface Water Level												
Soil Moisture												
Normal Area vs Sown Area												
Assessment												
Drinking Water Availability												
Irrigation Water Availability												
Fodder Availability												
Food Grains Availability												
Emergency medicines and vaccines available for livestock												
Agricultural inputs availability												
Energy requirement and availability												
Water Conservation/Supply Measures												
Check dams/Watersheds												
Rain Water Harvesting												
Groundwater recharge												
Protection of aquatic resources for aquaculture												

6.7 Information, education and communication strategies

Effective drought management in the Nabarangpur district requires a comprehensive approach that includes information dissemination, education, and communication strategies. Effective Information, Education, and Communication (IEC) strategies for drought management should focus on raising awareness about drought causes, impacts, and mitigation practices, tailored to specific audiences, utilizing diverse communication channels, and emphasizing actionable steps individuals and communities can take to manage water resources efficiently during

drought periods; key strategies include: early warning systems, community engagement, targeted messaging, utilizing local media, capacity building, and promoting behaviour change through practical demonstrations and success stories; ensuring information is accessible, understandable, and culturally relevant is crucial for impactful communication. Here are several strategies to consider:

Public Awareness Campaigns: Conduct regular awareness campaigns to educate the community about drought risks, water conservation practices, and sustainable agricultural techniques. Utilize local media, social media, and community meetings to reach a wide audience. Clearly explain different types of droughts (meteorological, hydrological, agricultural) and how they impact the community. Educate people on key indicators like rainfall patterns, water levels, and vegetation changes that signal potential drought conditions. Highlight the potential impacts of drought on livelihoods, agriculture, health, and the environment.

Capacity Building Workshops: Organize workshops and training sessions for farmers, local officials, and community leaders on drought preparedness, efficient water use, and crop management practices. Provide practical demonstrations and hands-on training to ensure effective learning.

Community Engagement: Involve local communities in planning and decision-making processes related to drought preparedness and response. Organize regular meetings to share information, discuss concerns, and gather feedback. Identify and train community leaders to act as information relays and advocates for water conservation practices.

Early Warning Systems: Develop and implement early warning systems to provide timely information on drought conditions. Use weather forecasts, satellite data, and ground observations to monitor drought indicators and communicate potential risks to the community.

Community-Based Water Management: Promote community-based water management practices, such as rainwater harvesting, construction of check dams, and maintenance of traditional water bodies. Encourage community participation in planning and implementing water conservation projects.

School Education Programs: Integrate drought education into school curricula to raise awareness among students about the importance of water conservation and sustainable practices. Organize school competitions, exhibitions, and field trips to engage students in drought management activities.

Targeted messaging: Provide tailored guidance on drought-resistant crops, water-efficient irrigation techniques, and livestock management practices. Educate urban residents on water conservation measures like fixing leaks, rainwater harvesting, and responsible water usage. Prioritize communication efforts to reach marginalized communities disproportionately affected by drought.

Information Dissemination Platforms or Communication Channels: Utilize radio, television, and newspapers to reach a wider audience with important updates and messages. Leverage platforms like Facebook, Twitter, and WhatsApp for real-time information sharing and community interaction. Organize awareness campaigns, workshops,

and demonstration events in villages and neighbourhoods. Establish information dissemination platforms, such as mobile apps, websites, and helplines, to provide real-time information on drought conditions, water availability, and best practices for drought management. Ensure that these platforms are accessible to all community members.

Collaboration with NGOs and CSOs: Foster partnerships with government agencies, NGOs, community organizations, and research institutions to enhance the reach and impact of IEC efforts. Partner with non-governmental organizations (NGOs) and civil society organizations (CSOs) to leverage their expertise and resources in drought management. Collaborate on projects, share information, and coordinate efforts to enhance community resilience.

Policy Advocacy: Advocate for policies and regulations that support sustainable water management, drought preparedness, and climate resilience. Engage with policymakers, stakeholders, and community members to promote the adoption of effective drought management strategies. By implementing these strategies, Nabarangpur district can enhance its capacity to manage drought risks, protect water resources, and ensure the well-being of its communities. Ensure messages are tailored to local cultural norms and languages for maximum understanding. Regularly assess the effectiveness of IEC activities to identify areas for improvement and track progress.

6.7.1 Receipt of forecasts, early warning signals and advisories

After getting forecasts and advisories from the State Authorities/ District Administration, the State/District Authorities will disseminate information to the field. Mass media like TV, Radio, Print Media, and Social Media Platforms should also be considered for early warning dissemination and preparedness.

6.7.2 Monitoring of Key Drought Indices

The State Drought Monitoring Cell (SDMC) monitors drought by obtaining information from various sources on key drought variables, including rainfall, reservoir water levels, surface water/groundwater, soil moisture, sowing/crop conditions, etc.

i. Meteorological Data: Rainfall and other parameters like Temperature, Wind speed and Relative Humidity.
ii. Weather forecast - Short, medium, extended range
iii. Soil Moisture
iv. Sown Area / Crop Health / Stress
v. Satellite-based Vegetation Index
vi. Stream Flow – Discharge
vii. Groundwater Levels
viii. Reservoir and Lake Storage / Level
ix. Impacts: distress sale and migration of cattle, human migration, fodder availability, drinking water, animal health, employment opportunities in the agriculture sector

Sl. No	Indices	Data Source	Frequency and level at which data is available
1.	**Rainfall Indices** (i) Rainfall data/ deviation	DEOC	Daily
	(ii) Dry Spell	Agriculture	Fortnight
	(iii) Standardized Precipitation Index	Agriculture	Weekly
2.	**Crop Situation-Related Indices** (i) Crop Sown Area	Agriculture	Weekly
3.	**Soil Moisture based indices** (i) Percent Available Soil Moisture (PASM)	Agriculture	Weekly
	(ii) Moisture Adequacy Index (MAI)	Agriculture	Weekly
3.	**Remote Sensing/Satellite based indices** (i) NDVI, NDWI deviation from normal		
	(ii) VCI form of NDVI/NDWI		
4	**Hydrological Indices** (i) Reservoir Storage Index (RSI)	Irrigation	
	(ii) Ground Water Drought Index (GWDI)	Irrigation	
	(iii) Stream Flow Drought Index (SFDI)	Irrigation	

6.7.3 Efficient dissemination of advisories and early warning

Efficient dissemination of advisories and early warnings" refers to the process of quickly and effectively delivering important alerts and information to the relevant individuals or communities at risk, ensuring they receive timely warnings about potential dangers so they can take appropriate action to minimize damage or loss of life, often utilizing multiple communication channels to reach the widest possible audience. The efficient dissemination of advisories and early warnings is crucial for minimizing the impact of potential hazards and ensuring public safety. Below are key strategies and methods to achieve this:

1. Use of Technology

- **Mass Notification Systems**: Leverage SMS, email, and push notifications to deliver real-time alerts to affected populations.
- **Mobile Apps**: Develop or utilize apps that provide localized early warnings and safety guidance.
- **Social Media**: Use platforms like Twitter, Facebook, and Instagram for rapid information sharing.
- **Radio & Television**: Traditional media remains effective for reaching large audiences quickly.

2. Multiple Communication Channels

- Use a **multi-channel approach** (radio, TV, sirens, websites, and social media) to ensure the message reaches diverse audiences.
- Ensure **redundancy** so that if one channel fails, others can still deliver the message.

3. Localized Alerts

- Customize warnings for specific regions or communities to avoid unnecessary panic in unaffected areas.
- Implement **geo-targeted alerts** that send notifications based on location.

4. Clear and Concise Messaging

- Use simple language and avoid technical jargon to ensure the public understands the advisory.
- Include actionable steps (e.g., "Evacuate immediately," "Seek shelter," or "Avoid flood-prone areas").
- Incorporate visuals like maps or infographics to enhance understanding.

5. Community Engagement

- Educate the public through regular campaigns on how to respond to advisories.
- Build partnerships with local leaders, community organizations, and schools to disseminate warnings effectively.

6. Early Warning Systems Integration

- Use automated systems that monitor hazards (e.g., weather forecasts, seismic activity) and trigger alerts immediately.
- Collaborate with meteorological, geological, and disaster management agencies for accurate and timely data.

7. Accessibility

- Ensure advisories are accessible to all, including people with disabilities, by using audio messages, captions, and sign language interpreters.
- Translate advisories into local languages for wider reach.

8. Feedback Mechanisms

- Set up hotlines or feedback systems so the public can report back on evolving situations or seek clarification.
- Regularly evaluate and improve dissemination methods based on public feedback.

9. Regular Drills and Testing

- Conduct simulations and drills to test the effectiveness of warning systems.
- Identify gaps and train responders to act swiftly in real scenarios.

10. Trust and Credibility

- Ensure that information comes from reliable sources to build public trust.
- Avoid false alarms, as they can lead to complacency.

11. Targeted reach

- Identifying and prioritizing the specific populations most vulnerable to the potential hazard and directing warnings directly to them.

6.7.4 Capacity building and activation of drought contingency measures

Capacity building and activation of drought contingency measures" refers to the process of developing the skills and knowledge needed to effectively implement drought response strategies, alongside actively putting those plans into action when a drought occurs, including monitoring conditions, triggering necessary water conservation measures, and mobilizing resources to mitigate the impacts of drought. Capacity building and activation of drought contingency measures are critical for mitigating the impacts of droughts and ensuring communities and systems are prepared and resilient. Here's how to approach it:

1. Capacity Building for Drought Preparedness

A. Training and Skill Development

- **Training Local Authorities and Communities**: Conduct workshops and training sessions for government officials, community leaders, and local organizations on drought risk management, early warning systems, and response mechanisms.
- **Training on Water Conservation**: Teach communities about water-saving techniques, efficient irrigation practices, and sustainable land use.
- **Climate Change Awareness**: Increase understanding of how climate change exacerbates droughts and integrate climate adaptation into local planning.

B. Strengthening Institutions and Systems

- **Enhance Meteorological and Early Warning Systems**: Equip national and regional meteorological departments with advanced technologies and trained personnel to monitor drought conditions (e.g., satellite data, hydrological models).
- **Multi-stakeholder Coordination**: Establish clear roles and responsibilities between government agencies, NGOs, local authorities, and the private sector to ensure coordinated response during droughts.
- **Research and Data Collection**: Build capacity to collect and analyze drought-related data, including rainfall patterns, soil moisture levels, and water availability.

C. Community Involvement

- **Community-based Monitoring Systems**: Empower communities to observe local conditions (e.g., monitoring of water sources, crops, and livestock) and report back to local authorities.
- **Drought Preparedness Plans**: Involve communities in developing drought preparedness plans that reflect local needs and realities.

2. Activation of Drought Contingency Measures

A. Pre-emptive Actions

- **Water Conservation Initiatives**: Implement water-saving measures such as water rationing, rainwater harvesting, and reuse systems. Promote practices like drip irrigation in agriculture.
- **Water Supply Diversification**: Develop alternative water sources such as boreholes, desalination plants, or water recycling to mitigate water shortages.

- **Drought-Tolerant Crop Varieties:** Encourage farmers to use drought-resistant crops and promote conservation agriculture techniques.
- **Resource Stockpiling:** Ensure that essential resources like food, water, and fodder are stored and accessible when drought conditions worsen.

B. Early Warning Activation

- **Monitor and Disseminate Alerts**: Once a drought is anticipated, activate early warning systems to inform communities and stakeholders about the expected duration, intensity, and impact of the drought.
- **Agricultural Insurance Programs**: Activate drought insurance schemes that can provide financial relief to affected farmers and communities.
- **Mobilize Emergency Funds**: Governments and humanitarian organizations should mobilize emergency funds to assist in the immediate relief efforts.

C. Response Measures

- **Livestock Care Programs**: In regions dependent on livestock, ensure the availability of water and feed, and implement measures to reduce livestock mortality rates.
- **Food and Water Distribution**: Deploy relief teams to provide emergency food and water supplies to affected areas.
- **Health and Nutrition Support**: Monitor malnutrition levels, particularly among vulnerable groups such as children and the elderly, and provide supplementary feeding and medical care.

D. Post-Drought Recovery

- **Rehabilitation and Restoration**: After the drought, focus on restoring ecosystems, replenishing groundwater supplies, and supporting the recovery of agriculture and livelihoods.
- **Monitoring and Evaluation**: Assess the effectiveness of drought response measures, identify gaps, and improve preparedness for future events.

3. Community and Stakeholder Engagement

- **Public Awareness Campaigns**: Regularly inform the public about drought risks, preparedness strategies, and how to conserve water during dry periods.
- **Partnership with NGOs and International Organizations**: Work with local and international NGOs that specialize in disaster relief, drought mitigation, and community resilience building.
- **Engage the Private Sector**: Encourage businesses to implement drought-resilient practices and help in resource mobilization for drought relief.

4. Sustainable Land and Water Management

- **Soil Conservation Techniques**: Promote agroforestry, terracing, and other techniques to improve soil water retention and reduce desertification.
- **Water Efficient Technologies**: Introduce technologies like soil moisture sensors, efficient irrigation systems, and water-efficient technologies for industries.

5. Policy Development

- **National Drought Policy**: Develop and implement a comprehensive national drought policy that outlines preparedness, response, and recovery strategies.
- **Integrated Water Resource Management**: Promote policies that manage water resources effectively across sectors (agriculture, domestic use, industry, etc.) to ensure equitable and sustainable access.

6. Funding and Resource Mobilization

- **Climate Financing**: Secure funding through climate adaptation funds and international donors to finance long-term drought preparedness projects.
- **Drought Relief Funds**: Set up dedicated funds that can be quickly accessed in the event of a drought.

6.7.5 Community Preparedness

(i) Community warning system

A **Community Warning System (CWS)** is a crucial tool for ensuring that communities are informed and prepared for potential disasters, including droughts, floods, earthquakes, and other natural hazards. The system aims to provide early warnings, offer guidance on actions to take, and enhance community resilience through effective communication and collaboration.

A community warning system on drought in Nabarangpur district would involve utilizing local networks and communication channels to alert communities in drought-prone areas about potential water scarcity, allowing them to take proactive measures like water conservation, adjusting farming practices, and seeking support from authorities when drought conditions arise; this system would likely leverage existing infrastructure like community radio, village leaders, and mobile messaging to disseminate timely information based on data from the Odisha State Disaster Management Authority (OSDMA) drought monitoring cell.

(ii) **Community awareness and education**

Community awareness and education are fundamental to building resilience, improving safety, and ensuring that individuals are equipped to respond effectively to hazards, disasters, and emergencies. The goal is to empower communities with the knowledge and skills to prevent, mitigate, and cope with disasters.

Community awareness and education are efforts to inform and educate people about important topics, such as health, safety, and environmental issues. These efforts can help people make positive choices and take action to improve their communities.

6.7.6 Knowledge management, networking and sharing

Knowledge management, networking, and sharing" refers to the practice of actively capturing, organizing, and distributing information within an organization through interconnected networks of individuals, allowing for the seamless exchange of knowledge and expertise across different teams and levels, ultimately enhancing collaboration, innovation, and decision-making within the company; essentially, it's about making sure the right people have access to the necessary information at the right time by facilitating connections and sharing mechanisms

across the network. These are essential components of building resilient communities and effective disaster management systems. By systematically managing and sharing knowledge, communities and organizations can improve decision-making, enhance preparedness, and ensure that valuable experiences and insights are accessible to those who need them.

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CHAPTER-7

TRAINING, CAPACITY BUILDING AND PUBLIC AWARENESS

In Nabarangpur, training programs in agriculture, water resources, and administration are pivotal for enhancing resilience against drought. A training program on drought would typically cover the concepts of drought formation, its impacts on various sectors like agriculture, water resources, and ecosystems, methods for drought monitoring and early warning systems, mitigation strategies including water conservation practices, drought-resistant crop cultivation, and disaster preparedness plans for drought-affected areas, alongside awareness building on community resilience and response mechanisms. The Odisha State Disaster Management Authority (OSDMA) has initiated various programs focused on improving the skills of officials and farmers in managing drought conditions. These initiatives include workshops on water conservation techniques, sustainable agricultural practices, and effective disaster management strategies tailored to the state's unique climatic challenges.

7.1 Existing

Capacity building training to farmers given on Soil Health Aspects, Moisture Conservation practices through Micro and Drip Irrigation and Mulching, Soil Leveling, Line Sowing, Zero / Minimum Tillage, Relay Cropping and Cover Cropping, Crop Diversification from Rice to Non-Rice, Comprehensive Rice Fallow Management, Climate Resilient Agriculture, Organic Farming, In-situ biomass incorporation, Backyard Horticulture Nutri Gardens, Fish Farming, Duckery, Poultry, Goatary, Diary Farming, Integrated Farming System etc.

- Collaboration with existing training institutions.
- Overview of current training programs in agriculture, water resources, and administration.
- Gaps in the present system: Despite these efforts, gaps exist in the current training system. Limited outreach to remote areas, inadequate integration of local knowledge into training modules, and insufficient emphasis on practical applications hinder effective capacity building. Additionally, the need for continuous updates to training content based on evolving climatic conditions remains a challenge.

7.2 New Initiatives

New initiatives in drought management are essential for improving resilience in areas prone to droughts, especially as climate change increases the frequency and intensity of drought events. These initiatives often focus on proactive, long-term strategies that address water scarcity, improve agricultural practices, enhance early warning systems, and foster collaboration across sectors.

New initiatives in drought management include advanced water harvesting techniques like fog harvesting, improved irrigation systems like drip irrigation and smart irrigation technology, utilizing drought-tolerant crops and genetically modified crops, community-based water management, real-time drought monitoring systems, and integrating climate data for

proactive drought planning, alongside efforts to restore natural water sources and promote sustainable land use practices. Below are some emerging and innovative approaches to drought management:

1. Early Warning Systems and Technology

A. Drought Monitoring and Forecasting Tools

- **Satellite-based Monitoring**: The use of satellite imagery and remote sensing technologies to monitor changes in vegetation, soil moisture, and water levels. Platforms like NASA's Earth Observatory provide real-time data that can be used to predict droughts and assess their severity.
- **Predictive Modeling**: Advanced climate models and machine learning algorithms are being used to predict drought conditions, giving governments and communities the chance to prepare ahead of time. These models use data such as rainfall patterns, temperature trends, and soil moisture content to forecast drought risk.
- **Integrated Early Warning Systems (EWS)**: Modern EWS integrate weather data, environmental monitoring, and community feedback to offer early warnings about droughts, which can trigger early action plans. Platforms like the **FAO's Integrated Drought Management Program (IDMP)** use such systems for better coordination between local authorities, farmers, and relief organizations.

B. Mobile Apps for Drought Monitoring

- Mobile applications, such as **Farmer's Friend**, allow farmers to track drought conditions, receive early warnings, and access weather forecasts. These apps provide real-time information, agricultural advice, and water-saving techniques that can be applied based on local conditions.
- **Drought Information Systems (DIS)**: Some countries are implementing national or regional systems that provide tailored drought information to farmers, communities, and policymakers through mobile platforms.

2. Water Conservation and Efficiency

A. Smart Irrigation Systems

- **Automated Irrigation Technologies**: The introduction of **smart irrigation systems** that use sensors to monitor soil moisture levels and weather conditions is becoming more widespread. These systems allow farmers to optimize water use, reducing waste and ensuring crops receive adequate hydration without over-watering.
- **Drip Irrigation**: New developments in **drip irrigation** systems are making them more affordable and accessible to smallholder farmers. These systems are highly water-efficient and allow water to be delivered directly to the roots of plants, minimizing evaporation and runoff.

B. Water Harvesting Techniques

- **Rainwater Harvesting**: New technologies for rainwater harvesting are being promoted, including improved **rainwater collection tanks** and systems that store and

filter rainwater for agricultural, domestic, and industrial use. These systems can be used to supplement water supplies during drought conditions.

- **Floodwater Farming and Recharge Pits**: Some innovative methods like using **floodwater farming** and **subsurface water recharge pits** are being employed to capture and store water during brief rain events and recharge underground aquifers.

3. Drought-Tolerant Crop Development

A. Climate-Resilient Crop Varieties

- **Genetic Engineering and Biotechnology**: There have been advances in developing drought-resistant crops through genetic modification or selective breeding. For example, crops like **drought-tolerant maize**, **sorghum**, and **wheat** have been developed to thrive in arid conditions with reduced water requirements.
- **Indigenous Crop Promotion**: In many regions, there is a renewed focus on promoting indigenous drought-tolerant crops that have evolved to survive harsh conditions, such as **millet**, **teff**, **cassava**, and **sweet potatoes**. These crops require less water and are more resilient to drought stress.
- **Climate-Smart Agriculture**: Initiatives like **Climate-Smart Agriculture (CSA)** focus on practices that increase crop yields while reducing water consumption. These include conservation tillage, mulching, agroforestry, and other soil-water management practices.

4. Community-based Drought Management

A. Local Drought Adaptation Plans

- **Community Action Plans**: New programs are encouraging local communities to create their **drought adaptation plans** based on local knowledge and vulnerabilities. These plans integrate water management strategies, alternative livelihoods, and preparedness actions to mitigate drought impacts.
- **Drought Risk Reduction Committees**: Community-based committees are being set up to monitor drought conditions and coordinate responses. These committees engage local farmers, women, indigenous groups, and other stakeholders to tailor drought management strategies to community needs.

B. Community-Led Resource Management

- **Water User Associations (WUAs)**: WUAs are being strengthened to manage local water resources, ensure equitable water distribution, and develop strategies for sustainable water use during droughts. These associations are particularly important in agricultural areas where water is often scarce.
- **Peer-to-Peer Support Networks**: Peer networks, where farmers share information, tools, and resources related to drought resilience, are becoming more common. These networks are often supported by local NGOs and government programs and help farmers learn best practices for drought management from one another.

5. Integrated Water Resources Management (IWRM)

A. Coordinated Water Management Across Sectors

- New initiatives are focusing on **integrated water resources management (IWRM)**, which coordinates the development and management of water, land, and related

resources. IWRM promotes a more holistic approach that includes collaboration between agricultural, industrial, and domestic water users.

- **Transboundary Water Cooperation**: For regions with shared water sources, new programs are encouraging cooperation between countries to manage droughts and water shortages. This may involve joint investments in water infrastructure, cross-border water-sharing agreements, and collaborative research on drought mitigation strategies.

B. Recycled and Reused Water

- **Wastewater Recycling**: In urban and agricultural contexts, the recycling of treated wastewater is gaining traction as a way to augment water supplies during droughts. Techniques like **greywater reuse** and large-scale **wastewater treatment plants** are becoming more common in water-scarce areas.
- **Desalination**: While energy-intensive, **desalination** technology is advancing, and some regions are beginning to rely on desalinated seawater for irrigation and domestic use during prolonged droughts.

6. Financial and Policy Initiatives

A. Drought Insurance and Risk Financing

- **Index-based Insurance**: New financial products like **index-based insurance** are being introduced in drought-prone areas. These insurance policies payout based on measurable indicators (like rainfall levels) rather than crop yield losses, providing faster payouts to farmers and communities.
- **Catastrophe Bonds**: Some countries are exploring **catastrophe bonds** (or "cat bonds"), which allow governments to access financial resources quickly in the event of a natural disaster, including droughts.

B. Policy and Institutional Innovations

- **Drought Resilience Building Programs**: Governments are creating policies aimed at building drought resilience, such as providing subsidies for drought-resistant crops, setting up irrigation infrastructure, or providing tax incentives for water-efficient technologies.
- **Data Sharing Platforms**: New platforms are emerging to share data on drought conditions, such as rainfall measurements, groundwater levels, and crop status, to better inform decision-making at all levels of government and among local communities.

7. Public Awareness and Education Campaigns

A. Community Education Programs

- **Drought Awareness Campaigns**: Educational initiatives are raising awareness about the importance of water conservation and preparing communities for potential droughts. These campaigns often include training on drought-resistant agricultural techniques, water-saving technologies, and emergency response plans.
- **School-based Programs**: Programs in schools teach children about the importance of water conservation and climate change. These programs often include hands-on projects like rainwater harvesting systems or soil moisture measurement activities.

8. Regional and Global Collaboration

A. Regional Drought Management Initiatives

- **Africa Drought Risk and Development Initiative (DRDI)**: This program is working to strengthen drought resilience in Africa by improving monitoring, early warning systems, and policy frameworks across multiple countries.
- **Global Framework for Climate Services (GFCS)**: The GFCS aims to strengthen climate services that help countries manage drought risks through improved weather forecasts, early warnings, and climate information.

B. International Aid and Cooperation

- International organizations, such as the World Bank, United Nations, and International Fund for Agricultural Development (IFAD), are increasingly focusing on long-term drought resilience by supporting capacity-building initiatives, funding water infrastructure projects, and promoting sustainable agricultural practices in vulnerable regions.

7.3 Capacity Building Plan

A capacity-building plan for drought management aims to enhance the ability of individuals, communities, governments, and institutions to effectively prepare for, respond to, and recover from droughts. The plan focuses on enhancing knowledge, skills, and institutional capabilities across various stakeholders, including farmers, government officials, researchers, and community leaders, to effectively identify, monitor, prepare for, and respond to drought events through a combination of awareness campaigns, training programs, technology adoption, and community engagement initiatives, ultimately building resilience to drought impacts. This plan focuses on increasing knowledge, improving technical skills, building institutional frameworks, and promoting community engagement to ensure resilience against drought impacts. Below is a detailed outline for a comprehensive capacity-building plan for drought management.

7.3.1 Objectives of the Capacity-Building Plan

1. **Knowledge Enhancement:** Raise awareness about drought causes, impacts, and mitigation strategies. Provide scientific understanding of climate patterns and drought forecasting tools. Educate on traditional and innovative water conservation practices.
2. **Skill Development:** Train farmers in drought-resistant crop variety selection and water-efficient irrigation techniques. Well equip extension workers with skills to disseminate information and facilitate community engagement. Empower local authorities to develop and implement drought contingency plans.
3. **Enhance preparedness and resilience**: Strengthen the ability of communities and organizations to anticipate, manage, and recover from drought.
4. **Develop local leadership**: Empower local communities and stakeholders to lead and manage drought responses effectively.
5. **Build institutional and technical capacity**: Equip governments, NGOs, and agencies with the skills, knowledge, and tools needed to address drought risks.

6. **Promote collaborative actions**: Foster partnerships between governments, communities, the private sector, and international organizations to strengthen drought management.
7. **Increase awareness:** Ensure that individuals and communities understand the importance of water conservation, drought mitigation, and early warning systems.

7.3.2 Target Audiences for Capacity Building

- **Local Communities**: Farmers, community leaders, water users, and vulnerable populations.
- **Government Agencies**: Local, regional, and national government officials involved in disaster management, water resources management, agriculture, and emergency response.
- **Private Sector**: Businesses involved in water-intensive industries, agricultural supply chains, and infrastructure development.
- **Non-governmental Organizations (NGOs)**: Local and international NGOs working on water resources, agriculture, disaster management, and climate resilience.
- **Academia and Researchers**: Universities, research institutions, and think tanks focused on drought, climate change, and sustainable development.
- **Media and Awareness Campaigns**: Journalists, public information officers, and communication specialists.

7.3.3 Key Areas of Capacity Building

A. Knowledge and Awareness Building

- **Drought Risk Awareness**: Educate local communities about the risks of drought, signs of drought, and its impacts on agriculture, water availability, and livelihoods.
- **Climate Change and Drought**: Provide an understanding of how climate change is affecting drought frequency and severity and how these impact planning and mitigation efforts.
- **Water Conservation Techniques**: Teach communities and farmers about sustainable water use practices, such as rainwater harvesting, water-efficient irrigation methods (e.g., drip irrigation), and soil moisture conservation techniques.
- **Disaster Risk Reduction (DRR)**: Build awareness around the principles of DRR and how drought fits within broader disaster risk management strategies.

B. Technical Skills Development

- **Early Warning Systems (EWS)**: Train government officials, agricultural advisors, and community leaders on using drought monitoring tools (satellite data, remote sensing, soil moisture monitoring) and early warning systems. These tools help in predicting drought events and triggering timely actions.
- **Data Collection and Analysis**: Strengthen the skills of local authorities and field workers in collecting and analyzing drought-related data, including precipitation, soil moisture, crop yields, and groundwater levels.

- **Climate-Resilient Agricultural Practices**: Train farmers on drought-resistant crop varieties, soil and water conservation techniques, and climate-smart farming practices.
- **Water Resource Management**: Equip water resource managers with knowledge of integrated water resources management (IWRM) and sustainable practices for managing both surface and groundwater during drought conditions.
- **Technology Use**: Provide training in mobile apps, GIS mapping, and other technologies that can assist in monitoring drought, tracking water resources, and providing timely information to communities.

C. Institutional Capacity Building

- **Strengthening Government Frameworks**: Support governments in integrating drought management into national and local policy frameworks. This includes developing drought action plans, early warning protocols, and disaster response strategies.
- **Inter-agency Coordination**: Facilitate training programs for improving coordination among various agencies (e.g., water management, agriculture, environment, health, and emergency management) to ensure that drought responses are well coordinated.
- **Drought Contingency Planning**: Guide institutions in developing and testing drought contingency plans, including response and recovery protocols. This ensures that resources and actions are pre-allocated and roles are clearly defined when drought strikes.
- **Financial Planning and Risk Financing**: Build the capacity of governments and financial institutions to develop drought risk financing mechanisms, including insurance, contingency funds, and climate adaptation budgets.

D. Community Engagement and Empowerment

- **Community-Based Drought Management**: Empower local communities to develop their drought response plans, utilizing local knowledge and ensuring the participation of all stakeholders. Engage women, youth, and marginalized groups to ensure inclusive planning.
- **Participatory Monitoring**: Train community members in the participatory monitoring of drought conditions and water use. Encourage community-driven data collection, such as monitoring rainfall, water quality, and soil moisture, to ensure timely reporting of drought risks.
- **Crisis Communication**: Equip community leaders with crisis communication skills to disseminate early warning information and critical drought updates effectively. This includes using radio, mobile phones, social media, and community meetings.
- **Livelihood Diversification**: Train communities in alternative livelihoods that reduce dependence on rain-fed agriculture, such as agroforestry, livestock management, eco-tourism, and small-scale water-based industries.

E. Policy Advocacy and Collaboration

- **Multistakeholder Platforms**: Encourage the formation of platforms that bring together government, civil society, private sector, and local communities to discuss drought issues, share knowledge, and plan joint actions.
- **Regional and International Collaboration**: Foster partnerships with regional bodies, international agencies, and neighbouring countries for knowledge exchange, joint early warning systems, and shared water resources management.
- **Advocacy for Drought Risk Management**: Train advocacy groups on how to influence policy changes related to drought management, climate change, and water governance. This includes advocating for the inclusion of drought preparedness and resilience measures in national development plans.

7.3.4 Implementation Strategies for the Capacity-Building Plan

- **Workshops and Training Programs**: Organize training sessions, workshops, and courses for various target groups. These can be in-person, virtual, or hybrid formats and should include practical, hands-on learning opportunities.
- **Pilot Projects**: Implement pilot projects in select regions to test new drought management techniques and build local capacity through direct involvement. These pilots can serve as models for wider-scale implementation.
- **Train-the-Trainer Programs**: Identify and train key individuals (e.g., local agricultural extension workers, community leaders, and government officials) who can then train others in their communities or networks. This helps scale the impact of the capacity-building efforts.
- **Simulation Exercises**: Conduct drought simulation exercises and drills for government agencies and local communities. These exercises allow stakeholders to practice drought response actions, identify gaps in their plans, and improve coordination.
- **Online Platforms and E-Learning**: Develop online courses, webinars, and digital resources that provide ongoing access to training materials, case studies, and tools for drought management.

7.3.5 Monitoring and Evaluation (M&E)

- **Performance Indicators**: Establish clear indicators for measuring the effectiveness of capacity-building activities. These could include improvements in drought preparedness, increased adoption of drought-resistant agricultural practices, or the creation of local drought management plans.
- **Feedback Mechanisms**: Implement regular feedback loops with training participants, community members, and stakeholders to assess the relevance and impact of the capacity-building activities. Use surveys, interviews, and focus groups to collect input.
- **Evaluation and Adjustment**: Periodically review and adjust the capacity-building plan based on feedback, new scientific knowledge, and emerging drought risks. This ensures that the plan remains relevant and effective in building long-term drought resilience.

7.3.6 Resources and Partnerships

- **Funding**: Secure funding from governments, international donors, NGOs, and private sector partners to support capacity-building activities, especially for vulnerable communities.
- **Knowledge Partners**: Collaborate with academic institutions, research organizations, and technical experts to access the latest research and best practices in drought management.
- **Tools and Materials**: Develop or adapt training materials, toolkits, and guidelines specific to the local context. These should be culturally appropriate, accessible, and easy to use for different audiences.

7.4 Institutional Capacity Building

Institutional Capacity Building on Drought Management is about strengthening the ability of governmental, non-governmental, and private sector organizations to effectively prevent, manage, and respond to droughts. Institutional capacity refers to the skills, resources, coordination, and governance structures that organizations need to perform their roles in drought management. This includes improving leadership, institutional frameworks, inter-agency collaboration, resource allocation, and technical expertise. Below is a comprehensive plan for **institutional capacity building on drought management**.

7.4.1 Objectives of Institutional Capacity Building

- **Strengthen institutional frameworks**: Develop strong institutions with clear mandates, responsibilities, and coordination mechanisms for managing droughts.
- **Enhance technical and managerial capabilities**: Build technical skills in drought risk assessment, early warning systems, water management, and disaster response among institutional staff.
- **Foster cross-sectoral coordination**: Promote collaboration between various sectors (agriculture, water resources, environment, health, and emergency management) to ensure coordinated and effective drought management.
- **Develop sustainable funding and resource management**: Ensure institutions have the financial and human resources to implement long-term drought management strategies.
- **Improve governance and policy frameworks**: Strengthen the governance structures for drought management, including policy development, institutional roles, and decision-making processes.

7.4.2 Key Areas of Institutional Capacity Building

A. Institutional Frameworks and Governance

- **Drought Management Agencies and Coordination Bodies**: Establish or strengthen national and local drought management agencies or units that are responsible for coordinating all drought-related activities. This may involve creating cross-sectoral committees that bring together experts from various fields (water, agriculture, health, disaster risk management).

- Example: **National Drought Mitigation Center (NDMC)** in the United States, or similar national bodies in other countries, which coordinate efforts across sectors.

- **Policy Development and Implementation**: Build institutional capacity for formulating, adopting, and implementing drought policies, including national drought plans, contingency frameworks, and long-term adaptation strategies.
    - Example: Development of a **National Drought Plan** that sets out proactive and reactive measures for water scarcity management, including detailed institutional roles.
- **Legal and Regulatory Frameworks**: Strengthen the capacity of institutions to design legal and regulatory frameworks that support drought risk management, such as water rights, resource allocation during droughts, and conservation policies.

B. Technical and Analytical Capacity

- **Drought Risk Assessment and Early Warning Systems (EWS)**: Improve institutional capacity to conduct drought risk assessments using climate data, hydrological models, and socio-economic analyses. Train institutions in designing, implementing, and interpreting **early warning systems (EWS)**, which can predict drought onset and severity.
    - Example: The **Integrated Drought Management Program (IDMP)** offers tools and training to institutions on how to develop EWS using satellite data, weather forecasting, and ground-level monitoring.
- **Drought Monitoring and Data Collection**: Train institutions in monitoring and interpreting drought-related data (e.g., soil moisture, precipitation, temperature) and using this information to predict drought conditions. This includes improving the use of **remote sensing technologies**, GIS mapping, and data analysis tools.
    - Example: The **Global Drought Information System (GDIS)** provides institutions with access to global drought monitoring and forecasting data.
- **Climate Impact Modelling**: Build institutional expertise in climate modelling to predict future drought trends based on different climate scenarios, allowing for long-term planning.
- **Water Resource Management**: Strengthen the technical knowledge of institutions responsible for managing water resources, including water storage, distribution, and efficient usage during droughts. This includes training in **Integrated Water Resource Management (IWRM)** to balance human, agricultural, and ecological needs during droughts.
    - Example: Use of **smart irrigation systems** and **drought-resistant crops** within water-scarce regions can be integrated into IWRM strategies.

C. Disaster Risk Management (DRM) and Emergency Response

- **Crisis Management Capacity**: Build institutional readiness for managing drought-related crises, ensuring that there are clear roles and procedures for action when a drought is declared. Institutions should develop rapid response mechanisms for drought relief, including the provision of water, food aid, and public health interventions.
- **Contingency and Response Planning**: Train institutions in drafting and updating **drought contingency plans** that outline how resources will be allocated, actions taken, and coordination with other sectors (e.g., health, agriculture, water).
    - Example: A **Drought Contingency Fund** can be established, and institutions can be trained on activating the fund quickly when drought impacts are predicted.
- **Crisis Communication**: Improve institutional communication strategies for delivering timely and accurate drought information to the public, decision-makers, and affected populations through media, social networks, and public alerts.

D. Cross-Sectoral Coordination and Collaboration

- **Inter-Agency Collaboration**: Foster collaboration between government departments (agriculture, water, health, disaster response) and agencies, local governments, and the private sector. Cross-sectoral drought management requires aligning policy objectives and ensuring all stakeholders are involved in decision-making.
- **Stakeholder Engagement**: Engage institutions in dialogue with key stakeholders, including local communities, farmers, civil society organizations, and the private sector. This includes setting up advisory committees and holding consultations to ensure all relevant parties are involved in drought policy and planning.
    - Example: **Multi-stakeholder platforms** can be set up to discuss drought risks and mitigation strategies, bringing together government officials, the private sector, local leaders, and NGOs.
- **Regional and International Cooperation**: Strengthen institutional linkages between countries and regions with shared water resources. Regional cooperation is essential in transboundary water management and drought response.
    - Example: Countries sharing river basins (e.g., the **Nile Basin Initiative**) can work together to jointly manage drought impacts.

E. Financial Resources and Risk Management

- **Drought Financing**: Build the financial capacity of institutions to access funds for drought response and long-term drought resilience. This includes preparing for emergency drought funding, integrating drought risk management into national budgets, and accessing international climate finance.

- **Drought Insurance and Risk Financing**: Train institutions on mechanisms such as **index-based drought insurance** that can help manage financial risk during droughts. Institutions should also be familiar with **catastrophe bonds**, which allow quick access to funds when droughts or other climate events occur.
    - Example: The **African Risk Capacity (ARC)** provides drought insurance to African countries, ensuring that governments can access funds rapidly when droughts are predicted.

F. Institutional Capacity for Policy Advocacy

- **Building Policy Advocacy Skills**: Strengthen the ability of drought management institutions to advocate for policies that prioritize drought resilience and adaptation. This involves training officials in communicating the long-term benefits of drought mitigation, the urgency of preparedness, and integrating drought resilience into national development plans.
- **Public Engagement and Awareness**: Train institutions to engage the public, decision-makers, and the private sector in supporting drought management efforts. This includes public awareness campaigns, advocacy, and lobbying for better policies and practices to address drought risks.

7.4.3 Implementation Strategy

A. Training and Education Programs

- **Workshops and Seminars**: Organize regular workshops for government officials, technical experts, and other stakeholders on drought management and relevant technical tools (e.g., early warning systems, GIS, water conservation).
- **On-the-job training**: Provide practical training through field visits, participatory monitoring exercises, and simulations to reinforce technical and institutional knowledge.
- **Online Learning**: Develop online platforms for continuous learning on drought-related topics for institutions and personnel who need access to information but may not be able to attend in-person sessions.

B. Capacity Assessments and Needs Analysis

- **Institutional Capacity Audit**: Conduct an assessment to identify institutional gaps, strengths, and weaknesses in drought management. This helps prioritize capacity-building activities based on the institution's current capabilities.
- **Regular Needs Assessments**: Continuously assess the changing needs of institutions about drought management as new risks emerge due to climate change or shifting socio-economic conditions.

C. Knowledge Sharing and Networking

- **Regional Knowledge Hubs**: Establish knowledge hubs and networks at regional levels where institutions can exchange experiences, best practices, and lessons learned. This can be facilitated through regional drought management forums or virtual platforms.

- **Peer-to-Peer Learning**: Encourage collaboration between drought management agencies across regions or countries to foster cross-learning. Institutions in areas with strong drought management capacity can mentor those in regions with less experience.

7.4.4 Monitoring and Evaluation (M&E)

- **Track Progress**: Set up performance indicators to track the effectiveness of institutional capacity-building activities. These indicators might include the number of institutions with updated drought management plans, the use of early warning systems, or the speed of emergency response.
- **Evaluate Outcomes**: Conduct periodic evaluations to assess the outcomes of capacity-building activities, adjusting strategies based on feedback and new insights.
- **Impact Assessment**: Assess how improved institutional capacity has influenced drought resilience at the national, regional, and local levels.

7.4.5 Partnerships and Resources

- **Financial Resources**: Seek financial support from international donors, development agencies, and climate change funds to support capacity-building initiatives.
- **Technical Partners**: Collaborate with universities, research institutions, and international organizations to provide technical expertise, research data, and technical tools for drought management.

7.5 Community Capacity Buildings

A **Community Capacity Building Plan on Drought Management** focuses on empowering local communities to respond effectively to and manage droughts. This plan strengthens community-level resilience by equipping individuals with the knowledge, skills, and resources necessary to cope with drought, mitigate its impacts, and recover from it. It emphasizes the active involvement of communities in the decision-making process and integrates traditional knowledge with modern drought management practices.

Below is a detailed outline for a **Community Capacity Building Plan on Drought Management**:

7.5.1 Objectives of the Community Capacity Building Plan

- **Enhance local resilience**: Equip communities with the tools and knowledge to anticipate, cope with, and recover from droughts.
- **Empower community leaders**: Build the leadership capacity of local leaders to guide their communities through drought-related challenges.
- **Promote sustainable practices**: Encourage the adoption of water-saving, drought-resistant agricultural, and resource management practices at the community level.
- **Foster community-based disaster risk management (CBDRM)**: Engage local populations in drought risk reduction and preparedness activities.
- **Improve local communication and response**: Ensure timely, accurate information reaches the community to facilitate effective drought responses.

7.5.2 Key Areas of Community Capacity Building

A. Awareness and Knowledge Building

- **Drought Risk Awareness**: Educate communities on the causes and impacts of drought, including how it affects agriculture, water resources, health, and livelihoods. Help them understand the importance of drought resilience.
    - **Workshops and Information Campaigns**: Conduct community workshops, radio programs, and local events to disseminate information about drought risks and how to prepare for them.
    - **Integration with School Curricula**: Include drought and climate resilience in educational materials to teach children the importance of sustainable water use, conservation, and the impacts of drought.
- **Understanding Early Warning Systems (EWS)**: Train communities on early warning systems and how to interpret early signals of drought. This includes understanding weather forecasts, drought indices, and flood-drought prediction models.
    - **Community Early Warning Networks**: Establish and train community-based monitoring and alert systems, such as weather stations or community radios, to disseminate drought warnings and updates.

B. Skill Development and Training

- **Water Conservation Practices**: Teach communities water-saving techniques such as rainwater harvesting, efficient irrigation practices (e.g., drip irrigation, mulching), and water recycling methods.
    - **Training in Water-Saving Technologies**: Introduce modern, low-cost irrigation systems and efficient water management tools.
- **Drought-Resilient Agricultural Practices**: Provide training in drought-tolerant crop varieties, agroforestry, soil moisture conservation, and organic farming techniques that require less water.
    - **Diversified Livelihoods**: Teach alternative livelihoods that reduce dependence on water-intensive agriculture, such as small-scale livestock farming, aquaculture, or non-farm income sources (e.g., crafts, eco-tourism).
- **Disaster Risk Reduction (DRR) Skills**: Provide training on disaster preparedness, response, and recovery in the context of drought. This includes emergency food and water distribution, first aid, and organizing community-based relief efforts.
    - **Training in Basic First Aid and Nutrition**: Droughts often affect food and water security, so training community members in first aid, emergency nutrition, and food preservation is crucial.

C. Community-Based Risk Management and Planning

- **Community Drought Management Plans**: Facilitate communities in developing their drought contingency plans, including clear action steps for water rationing, agricultural support, and emergency relief.
    - **Inclusive Planning**: Involve all community members in the planning process, particularly vulnerable groups such as women, youth, and marginalized populations, ensuring their needs and knowledge are incorporated.
    - **Risk Mapping**: Involve communities in participatory risk mapping to identify the most vulnerable areas, critical water resources, and potential points of intervention in case of drought.
- **Crisis Response Teams**: Train and organize community-based teams that can respond quickly when drought conditions worsen. These teams should be equipped with knowledge about disaster response, first aid, and relief efforts.
- **Community Stockpiling**: Encourage communities to prepare for drought by setting aside emergency stocks of food, water, and essential supplies.

D. Empowerment of Local Leaders and Institutions

- **Leadership Training**: Equip local leaders (e.g., village chiefs, council members, farmers' group leaders) with leadership and decision-making skills to guide their communities during droughts.
    - **Capacity Building for Local Institutions**: Strengthen local institutions, such as cooperatives, women's groups, and agricultural extension services, to play a central role in drought management.
    - **Promoting Gender Equality**: Ensure women's leadership roles in drought preparedness and response. Women are often the primary water managers and food providers in many communities and play a crucial role in drought resilience.
- **Community-based Organizations (CBOs)**: Support the development of local organizations that can help mobilize resources, provide training, and act as intermediaries for government or NGO drought relief programs.
- **Peer-to-Peer Learning**: Establish networks where communities can share knowledge and experiences with others facing similar drought challenges. These networks can provide mutual support and exchange best practices.

E. Community-Level Infrastructure and Resource Management

- **Water Resource Management**: Promote the establishment of local water management committees or water-user associations that manage communal water resources, such as wells, ponds, and rivers.

- **Water Storage and Conservation**: Train communities to build and maintain rainwater harvesting systems, such as tanks, cisterns, and reservoirs. These systems can store water during the rainy season to be used during dry periods.
- **Soil and Water Conservation Projects**: Implement community-led soil erosion control projects, such as building terraces, planting drought-resistant vegetation, and using organic mulches to conserve soil moisture.
- **Vegetation Management**: Train communities on sustainable land and vegetation management practices that prevent desertification and maintain soil fertility, such as reforestation, agroforestry, and sustainable grazing practices.

F. Communication and Information Sharing

- **Community Communication Channels**: Develop communication systems that ensure drought-related information reaches all members of the community, including marginalized groups. These can include village loudspeakers, SMS alerts, community radio, or mobile apps.
    - **Participatory Radio and social media**: Use community radio stations and social media platforms to raise awareness about drought risks, promote water conservation practices, and provide drought updates.
- **Information Sharing with External Stakeholders**: Create linkages between the community and external agencies (government bodies, NGOs, research organizations) to receive updates on drought conditions, technical advice, and early warning data.
- **Feedback Mechanisms**: Set up feedback mechanisms to enable community members to provide input on drought management strategies and to ensure that their concerns are addressed in ongoing efforts.

7.5.4 Implementation Strategies for the Community Capacity Building Plan

A. Workshops and Training Sessions

- Organize regular training sessions on drought preparedness, water management, and sustainable agricultural practices.
- Offer hands-on training to demonstrate water-saving technologies and drought-resilient agricultural methods.
- Host participatory workshops that allow the community to develop their drought action plans and disaster response strategies.

B. Use of Local Knowledge

- Combine modern scientific knowledge with traditional drought management practices. Local communities often have a deep understanding of drought patterns, water availability, and coping strategies that can be integrated into more formal approaches.
- Document and share traditional knowledge about water sources, drought-resistant crops, and sustainable agricultural techniques.

C. Simulation Exercises

- Conduct drought simulation drills that help communities practice responding to drought conditions. These drills can involve mock relief distribution, water rationing, and emergency health measures.
- Used role-playing and scenario planning to simulate the impact of different drought severity levels, allowing communities to prepare for different levels of response.

D. Monitoring and Evaluation

- Establish clear performance indicators to track the effectiveness of community capacity-building activities, such as the number of water conservation initiatives implemented or the success of drought-related early warning systems.
- Regularly evaluate the knowledge and skills gained by community members and adjust the capacity-building approach as necessary.
- Collect feedback from community members to understand how well the capacity-building initiatives are meeting their needs and where improvements are needed.

7.5.5 Partnerships and Resources

- **Local Government and NGOs**: Collaborate with local governments, NGOs, and international organizations that are working on drought-related issues, ensuring that resources and expertise are shared.
- **Donor Funding**: Secure funding from international donors, climate funds, or local government to support capacity-building efforts, including the construction of water infrastructure, training programs, and community outreach campaigns.
- **Technical Support**: Partner with universities, research institutions, and agricultural extension services to provide technical training, drought risk assessments, and expert advice to the community.

7.5.6 Sustainability and Long-Term Impact

- **Institutionalizing Capacity Building**: Ensure that capacity building is not a one-time event but an ongoing process. Encourage communities to form committees or local disaster risk reduction teams that continue to strengthen resilience even after the formal capacity-building program ends.
- **Encourage Local Ownership**: Foster a sense of ownership over drought management efforts. When communities take charge of the implementation and maintenance of drought-resilience measures, the chances of long-term success increase.
- **Linkage to National and Regional Plans**: Ensure that community-level efforts are linked to broader national and regional drought management and climate change adaptation plans so that local actions are supported by larger policy frameworks.

7.6 Training of Trainers

Training of Trainers (ToT) on Drought Management is an essential approach for building long-term community and institutional resilience to droughts. By equipping key

individuals with the knowledge and skills to train others, this approach ensures that drought management practices are disseminated widely and sustainably. The trainers will, in turn, be able to provide training to various stakeholders, including community members, government personnel, and local organizations, thereby fostering a multiplier effect. Here's a comprehensive **Training of Trainers (ToT) Plan on Drought Management**:

7.6.1 Objectives of ToT on Drought Management

- **Build a pool of skilled trainers**: Equip a core group of trainers with the knowledge and skills necessary to teach others about drought management.
- **Create awareness**: Ensure that trainers understand the key aspects of drought management, including drought preparedness, mitigation, response, and recovery.
- **Promote sustainable practices**: Focus on transferring knowledge of sustainable water management, drought-resistant agriculture, and adaptive practices to the trainees.
- **Enhance leadership and facilitation skills**: Strengthen trainers' abilities to deliver impactful, community-specific drought management training and to engage with different stakeholders.

7.6.2 Key Areas of the ToT Curriculum

A. Introduction to Drought Management

- **Definition and Types of Droughts**: Clarify what drought is, its types (e.g., meteorological, agricultural, hydrological), and its impacts on various sectors such as agriculture, water, health, and economy.
- **Understanding Drought Risk**: Teach how to assess drought risk and vulnerabilities, including climate variability, socio-economic conditions, and local geography.
- **The Drought Cycle**: Educate on the stages of a drought (monitoring, early warning, preparedness, response, and recovery) and explain how to act at each stage.

B. Key Concepts in Drought Management

- **Preparedness and Mitigation Strategies**: Cover actions that can be taken before and during a drought to reduce its impacts. This may include water conservation practices, crop management, drought-resistant crops, and sustainable agriculture practices.
- **Early Warning Systems (EWS)**: Explain how early warning systems function and how to interpret and communicate drought warnings effectively.
    - **Technology in EWS**: Training in the use of remote sensing, weather forecasts, and hydrological data to predict drought conditions.
- **Community-Based Drought Management**: Emphasize the role of local communities in drought management, promoting bottom-up approaches to risk reduction and response planning.

C. Facilitation and Training Methodology

- **Adult Learning Techniques**: Train on how to use participatory and interactive teaching methods, such as group discussions, role-playing, and scenario simulations. This helps ensure that trainees retain the information.
- **Training Material Development**: Show how to design and adapt training materials, including manuals, handouts, presentations, and visual aids, to meet the needs of different audiences.
- **Effective Communication**: Focus on communication skills, including how to tailor messages for different community groups, stakeholders, and levels of literacy and how to use media channels effectively (e.g., radio, social media, community meetings).
- **Monitoring and Evaluation (M&E)**: Train trainers to track and evaluate the impact of their training, assessing participants' understanding and practical application of drought management practices.

D. Key Skills for Trainers

- **Leadership and Group Management**: Develop leadership qualities in trainers, such as decision-making, problem-solving, and team coordination, which are crucial during training and in times of drought crisis management.
- **Cultural Sensitivity**: Emphasize the importance of being culturally sensitive and adapting training techniques to local customs and beliefs. This ensures that the training is well-received and understood by all community members.
- **Facilitation of Group Discussions**: Encourage an environment where active participation is promoted. Trainers should know how to facilitate open, inclusive discussions that allow for the exchange of ideas and solutions.

E. Practical Components of Drought Management

- **Water Conservation Techniques**: Demonstrate practical water-saving measures, such as rainwater harvesting, drip irrigation, and water-efficient farming practices.
- **Drought-Resilient Crop Techniques**: Provide hands-on training in sustainable farming techniques, such as crop rotation, use of drought-tolerant crops, and soil moisture retention practices.
- **Drought Recovery Practices**: Teach methods to help communities recover after a drought, such as water and food distribution plans, emergency relief strategies, and restoring livelihoods.

F. Case Studies and Best Practices

- **Global and Local Case Studies**: Provide real-world examples of successful drought management initiatives from around the world and locally. These case studies can show how other communities or countries have successfully managed drought risks and developed resilience strategies.

- **Lessons Learned**: Focus on what worked and what didn't in past drought situations, with a focus on practical takeaways for future preparedness.

7.6.3 Training Delivery Methods

A. In-Person Workshops

- **Duration**: A typical ToT workshop may last from 3 to 5 days, depending on the complexity of the material and the needs of the participants.
- **Venue**: The workshops should be held in locations that are accessible to participants, preferably in the communities that will benefit from the training.
- **Hands-On Activities**: Incorporate practical demonstrations of water conservation techniques, drought-resistant agriculture, and early warning systems to ensure that trainers can apply the knowledge in real-world contexts.

B. Online Training (Blended Learning)

- **E-Learning Modules**: Develop online courses or webinars that trainers can access remotely. This is particularly useful for reaching remote communities or trainers who cannot attend in-person sessions.
- **Interactive Webinars**: Hold virtual sessions where trainers can interact with experts, ask questions, and discuss drought management issues.
- **Resource Centers**: Create online libraries with resources, toolkits, and best practices that trainers can refer to when conducting their training sessions.

C. Peer Learning and Networking

- **Study Visits**: Arrange for trainers to visit regions that have effectively managed droughts, allowing them to learn from the experience of other communities or countries.
- **Networking Platforms**: Set up virtual or physical networks where trainers can share knowledge, challenges, and solutions related to drought management.
- **Peer Support Groups**: Facilitate mentorship programs where experienced trainers guide those who are less experienced in drought management.

7.6.4 Monitoring and Evaluation of ToT Program

A. Pre-Training Assessment

- Conduct a needs assessment before training begins to understand the baseline knowledge of the trainees and identify specific knowledge gaps.
- Use surveys or interviews to gather information on the participants' current understanding of drought management, training needs, and preferred learning methods.

B. Post-Training Evaluation

- Evaluate participants' performance through tests, quizzes, and practical exercises to ensure they have understood the key concepts and can apply them in real-life situations.
- Collect feedback from trainees on the content, delivery methods, and effectiveness of the training. This feedback will inform improvements in future training sessions.

C. Ongoing Support

- Provide continuous learning opportunities, such as refresher courses, workshops, and updates on new drought management technologies and practices.
- Offer a support system where trainers can contact facilitators for further guidance and resources after completing the ToT program.

7.6.5 Building Sustainability and Long-Term Impact

- **Train the Trainer Model**: Encourage trained trainers to pass on their knowledge to others, multiplying the impact of the training. Over time, this will create a network of trained individuals capable of educating communities and institutions about drought management.
- **Community Involvement**: Engage local community members in the ToT program, ensuring that the training is grounded in local contexts and priorities. Empower local trainers to lead the way in creating community-driven drought management initiatives.
- **Integration with Local Development Plans**: Ensure that the knowledge gained in the ToT program is embedded into local development plans, policies, and drought preparedness strategies. Encourage trained trainers to integrate drought management into schools, local organizations, and government agencies.

7.6.6 Resources Needed

- **Trainers and Experts**: Engage experts in drought management, climate change adaptation, and agricultural practices to deliver the training.
- **Training Materials**: Develop and provide trainers with manuals, guides, and digital resources to support their work. This could include templates for creating drought management plans, community engagement tools, and technical handbooks.
- **Funding and Partnerships**: Secure funding through national governments, international organizations, or NGOs to support the ToT program. Partnerships with educational institutions and research centers can also provide technical and logistical support.

7.7 Inventory of Trained Professionals

Action	Sub-Thematic Area of DRR	Responsibility-District	Department /Agency	Remarks
1. Training and Capacity Building	1. Govt. officials /Departments. 2. Farming Community 3. Students/Volunteers/CBOs 4. Farm women/ differently abled person	All Departments are doing training on their respective subjects for Capacity building	All Department	
1. Awareness Generation	1. Mass media campaigns 2. Promoting a culture of drought risk, prevention and mitigation.	All departments are to do the IEC campaign from	All Department	

	3. Promote attitude and behaviour change of the community through IEC	their respective allotted funds.		

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CHAPTER-8

RESPONSE AND RELIEF MEASURES

8.1 Mechanism for Early dissemination

Drought response and relief measures primarily focused on water conservation, emergency water distribution, support for affected farmers, livestock management, and implementing long-term drought mitigation strategies like rainwater harvesting, improved irrigation systems, and promoting drought-resistant crops.

After getting warnings on portents of drought-like situations from the State Authorities/ District Administration, information will be disseminated to the field by the State/District Authorities, also through specific applications like the Meghdoot App developed by IMD and the SATARK App developed by OSDMA. Mass media like TV, Radio, Print Media, and Social Media Platforms should also be considered for early warning dissemination.

Immediate Relief Measures:

- **Water Distribution:** Providing access to clean drinking water through tanker trucks and setting up temporary water distribution points in severely affected areas.
- **Livestock Support:** Providing fodder and supplementary feed for livestock, facilitating access to water sources for animals.
- **Crop Insurance and Compensation:** Providing financial assistance to farmers experiencing crop losses due to drought, including crop insurance pay-outs.
- **Emergency Water Supply Projects:** Repairing existing water infrastructure and drilling new borewells to access groundwater.

Mitigation and Long-Term Measures:

- **Water Conservation Campaigns:** Public awareness campaigns promoting water conservation practices like rainwater harvesting and efficient water usage in households and agriculture.
- **Improved Irrigation Systems:** Promoting drip irrigation and sprinkler systems to minimize water wastage in agriculture.
- **Drought-Resistant Crops:** Encouraging the cultivation of crops that require less water and are better suited to drought conditions.
- **Community-Based Water Management:** Empowering local communities to manage water resources effectively through water harvesting structures like check dams and ponds.
- **Watershed Management:** Implementing measures to improve water retention capacity in watersheds through reforestation and vegetation restoration.
- **Early Warning Systems:** Enhancing drought monitoring and early warning systems to enable proactive response measures.

Important Considerations:

- **Vulnerable Groups:** Prioritizing support for marginalized communities and vulnerable populations disproportionately affected by drought.
- **Inter-sectoral Coordination:** Collaboration between government agencies, NGOs, and local communities to design and implement effective drought response strategies.
- **Climate Change Adaptation:** Incorporating climate change adaptation measures into drought mitigation strategies.

8.2 Institutional response and roles **(each stakeholder needs to submit their roles and responsibilities)**

Although drought declaration signifies the beginning of Government response to conditions representing a drought situation, the effectiveness of any drought response system is reflected in the early warnings received and the robustness of the government institutional structures with delineated roles and responsibilities. While the primary responsibility to monitor, declare, plan and manage the response to drought is of the State Government, the district administration headed by the Collector spearheads the government's institutional response to drought on the ground. As per the decision taken in the 4th State Executive Committee meeting under the Chairmanship of Chief Secretary, Odisha held on 15.02.2019 and sub-chapter "Institutional Response" under Chapter-4: Drought Response and Relief of the Manual for Drought Management of Government of India, District Drought Monitoring Committee & Cells (DDMC) have been formulated at the district levels with District Collector as the Chairman, Deputy Director of Agriculture (now Chief District Agriculture Officer) as Member Convenor, District Emergency Officer as Coordinator and other district heads of line departments, public representatives as the members of the DDMC. The DDMC shall liaise with the State Drought Monitoring Cell (SDMC) and provide all relevant information to the committee on drought monitoring and drought-like situations. The DDMC shall meet frequently and review the progress of drought response and relief measures in the district.

Institutional Mechanism for Drought Response and Relief at District level

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
1.	District Disaster Management Authority	District Collector	1. The authority responsible for the implementation of all decisions related to drought management on the ground in the district. 2. Ensure the functioning of District Drought Monitoring Cells and Control Rooms and coordinate for dissemination of the advisories on drought management. 3. District Level Coordination of line departments for drought relief and response along with appointment of Nodal Officers.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			4. Ensure regular monitoring of drought parameters in the district, especially in the vulnerable areas and submit reports on the situation to the State 5. Facilitates drought assessment and submits report to the State level for drought declaration and assistance of funds under SDRF/NDRF. 6. Coordination in sharing of information with print, electronic media, and social media on drought advisories and monitoring of the situation. 7. Facilitate gratuitous assistance in cash or food to old, differently abled and destitute persons in drought-affected areas as per eligibility under SDRF/NDRF norms. 8. Any other tasks as the situation demands or directions from the State level relating to drought management.
2.A.	Department of Agriculture & F.E. (Directorate of Agriculture & Food Production)	Chief District Agriculture Officer	1. Monitors the crop sowing, crop conditions and status of various agricultural operations carried out in the district. 2. Plans for implementation of the District Agriculture Contingency Plan 3. Ensures seeds for second sowing have been secured and supplied. 4. Facilitating supply of drought tolerant/resistant crop seeds with short duration. 5. Ensures farmers have been registered under Crop Insurance (PMFBY) and premiums have been paid before the cut-off date for the season. 6. Facilitates for irrigation of sown areas from available water resources in coordination with the Department of Water Resources & Department of Energy. 7. Promote diversification of crops preferably low-duty crops like- millets, and oilseeds over paddy. 8. Agronomic Advisories regarding crop and nutrient management practices along with water conservation measures. 9. Encouraging Agroforestry practices. 10. Monitor operationalization of Custom Hiring Centres for hiring of agricultural

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			implements and farm machinery to the farmers 11. Ban on the digging of deep borewells 12. Monitors pest attack situations and ensures supply of plant protection chemicals and fertilizers at the identified points. 13. Ensure proper enforcement to prevent black marketing of agricultural inputs. 14. Capacity building of farmers for alternate livelihood options like mushroom cultivation, goatery, poultry, etc. 15. Ensure the availability of funds at the district and block level to meet contingency expenses during drought management. 16. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district.
2.B.	Department of Agriculture & F.E. (Directorate of Horticulture)	Deputy Director of Horticulture	1. Monitors the sowing of various horticultural crops in the district. 2. Ensure implementation of the District Agriculture Contingency Plan 3. Ensure supply of horticultural crops for drought tolerance in the district. 4. Facilitates for irrigation of sown areas from available water resources in coordination with the Department of Water Resources & Department of Energy under PMKSY 5. Facilitate MGNREGS work as relief employment for the farmers as an immediate response through plantation programme and the development of horticultural orchards. 6. Capacity building of alternate sources of livelihood options. 7. Ensure the availability of funds at the district and block level to meet contingency expenses during drought management. 8. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
2.C.	Department of Agriculture & F.E. (Directorate of Soil Conservation & Water Shed Development)	Deputy Director of Soil Conservation-cum-Project Director, Watershed	1. Facilitate immediate repairing, renovation and de-siltation of water harvesting structures such as farm ponds, check dams, percolation tanks etc. for efficient use of rainfall. 2. Promote in-situ soil moisture conservation practices.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			3. Promote plantation programmes of agroforestry systems for checking surface runoff and soil erosion. 4. Monitors implementation of watershed development schemes. 5. Capacity building of farmers on the importance of soil, water, ecology and environment. 6. Facilitate MGNREGS work as relief employment for the farmers as an immediate response through plantation programme, development of watersheds, soil conservation and water conservation measures. 7. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
3.	Department of Water Resources	Superintending Engineer of Division /Executive Engineer	1. Monitoring of reservoir water levels in various irrigation projects, i.e., Reservoir Storage Index and stream flow data 2. Ensuring appropriate distribution of water for various purposes like drinking, commercial, industrial and agricultural 3. Conduct an assessment of water availability for irrigation and irrigation planned for the season and distribute water optimally during the drought situation. 4. Ensure institutionalization and operationalization of Pani Panchayats in various locations. 5. Ensure immediate repair and renovation of water channels and temporary arrangements to respond. 6. Repairing of RLIP and pump-houses. 7. Facilitate the development of various Command Areas focusing on soil and moisture conservation measures and crop diversification in convergence with the Agriculture Department. 8. Promote repairing and renovation works of field channels, dug wells, etc. 9. Capacity building of communities on Climate Change, Disaster Risk Reduction, Water Budgeting, Conservation measures, etc.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			10. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
4.	Department of Panchayati Raj & Drinking Water	Chief Development Officer, Zilla Parishad	1. Ensure alternate employment opportunities as a relief measure in the drought-affected areas. 2. Ensure the supply of drinking water to the communities and livestock. 3. Ensure there is no contamination of drinking water, and if required, chlorination should be done at proper intervals. 4. Ensure immediate repairing of non-functional dug wells, shallow tube wells, borewells, etc. and facilitate temporary piped water supply as an immediate response to the situation through rural water supply and sanitation and public-health engineering divisions. 5. Facilitate awareness of the judicious use of water for different purposes. 6. Identifies priority areas for relief employment in water conservation, water harvesting measures, minor irrigation works, agroforestry, horticulture, sanitation, rural houses, land development, afforestation, etc. 7. Ensure alternate livelihood activities under the Odisha Livelihood Mission. 8. Monitoring of migration activities in the district due to drought. 9. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
5.A	Department of Cooperation	Deputy Registrar of Cooperative Societies	1. Preparation of a database of farmers availing loans for the season. 2. Listing of Loanee and Non-Loanee farmers under PMFBY. 3. Conversion and rescheduling of medium-term loans for the farmers of drought-affected areas based on the crop-loss assessment as per the instructions from the State Level. 4. Conduct campaigns for financial risk management among farmers during the distress situation.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			5. Promote the formation of Joint Liability Groups and SHGs to reduce the burden of loans on a single individual farmer. 6. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
5.B.	Banking and Financial Institutions	Lead District Manager	1. Conversion of short-term loans and rescheduling of medium-term loans for the affected farmers as per eligibility. 2. Facilitate early payouts of crop insurance as per the provision of PMFBY through DBT. 3. Promote financial assistance through Credit Camps such as consumption loans or small business loans for immediate resumption of alternate sources of livelihood. 4. Conduct a massive campaign on financial risk management to protect against money lenders. 5. Promote the formation of Joint Liability Groups and SHGs to reduce the burden of loans on a single individual farmer. 6. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district
6.A	Department of Fisheries & Animal Resources (Directorate of Animal Husbandry & Veterinary Services)	Chief District Veterinary Officer	1. Assess the extent of loss in the area, report to the higher quarters, closely monitor the situation and activate the implementation of the Contingency/Disaster Management Plan for the sector in the district. 2. Facilitate the supply of fodder from surplus districts/States in coordination with DDMA and State Authorities. 3. Ensure cattle and livestock feed and water requirements in the district based on the database of the cattle population, fodder demand and shortfall. 4. Procure fodder through the Forest Department, traders, private cultivators, and Tribal Development Agencies, if possible, as per the price fixed by the State Government. 5. Establish fodder depots in the drought-affected areas for selling fodder, cattle feed and concentrates at a proper price fixed by the State Government.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			6. Provide vitamins, minerals, medicines and vaccines at subsidized/affordable costs to the farmers of the drought-affected areas. 7. Conduct periodic health check-ups through cattle health camps at frequent intervals, at least once a week, to prevent the outbreak of any disease. Ensure availability of fodder and drinking water supply in the cattle camps. 8. Liaise with the Agriculture Department and Water Resource Department for fodder cultivation under ATMA, seed farms, instructional farms of State Agriculture University, Krishi Vigyan Kendra and Water Resources Department to cultivate fodder in Command Areas in convergence mode. 9. Conduct awareness campaigns in the drought-affected areas to make farmers aware of cattle health, feeds, vitamins, minerals and other sanitation issues. 10. Ensure periodic quality checking of feeds and fodder supplied through fodder depots and cattle camps and check if the feeds provided are fit for consumption. 11. Promote awareness among farmers for growing drought-resilient local grasses, shrubs, and leguminous tree species on the canal bunds. 12. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district
6.B.	Department of Fisheries & Animal Resources (Directorate of Fisheries)	District Fisheries Officer	1. Assessment of village-wise fisheries tanks and ponds in the vulnerable areas along with the number of beneficiaries affected. 2. Ensure implementation of the Fisheries Contingency/Disaster Management Plan in the district. 3. Facilitate the supply of lime, CIFAX, and feeds at strategic hub points. 4. Ensure movement of mobile teams for field inspection and supply of fisheries medicines, fish seeds etc. 5. Conduct awareness programmes for fisheries management due to the drought situation. 6. Temporary arrangement of pump sets for pumping water into the fisheries tanks and ponds.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			7. Liaise with the Energy Department for electricity supply to the bio-floc units, tanks and ponds. 8. To liaise with the Department of Water Resource/Panchayati Raj for the linking of check dams to water sheds, which will harvest the rainwater and utilize it in the ponds and tanks. 9. Regular monitoring and reporting of the situation to the higher quarters. 10. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
7.	Department of Food Supply & Consumer Welfare	Civil Supply Officer	1. Pre-assessment of food grains available, extent of loss, deficit/surplus, area affected, and requirement should be done with Market Intelligence 2. In case of a deficit in food grains, immediate measures are to be taken for the supply of food grains from nearby surplus districts. 3. Facilitate immediate repair of storage godowns and temporary hub points for storage and distribution of food grains in the affected areas. 4. Supply of subsidized food grains to affected areas to the eligible households. 5. Conduct special drives for coverage of left-out eligible beneficiaries under NFSA/SFSA. 6. Immediate measures for necessary update and rectification in the ration cards of the eligible households for inclusion of eligible members. 7. Ensure proper distribution of food grains in the affected areas through Fair Price Shops. 8. Where Fair Price Shops are not available, new ones are to be started through SHGs/Cooperatives. 9. Monitor the supply and distribution of food grains, be vigilant about black marketing, diversion or misutilization of food grains, and surveillance of prices of essential commodities with proper mobile enforcement teams. 10. Inspection of warehouses and fair price shops, along with quality checks to ensure

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			availability of food grains and distribution during and after the drought period. 11. Regular monitoring and reporting of the situation to the higher quarters. 12. Any other tasks as per the situation and as assigned by DDMA or the State for the management of drought in the district.
8.	Department of Energy	TPCODL/TPWODL/ TPSODL/TPNODL Division Head	1. Ensure power supply to the drought-affected area in the district for the operation of water pumps for drinking, agricultural, and livestock purposes.
9.	Department of Women & Child Development	District Social Welfare Officer	1. Ensure food and nutritional security for children, women and adolescents in the affected areas. 2. Continuously monitor the nutrition status of children under 5 years of age, pregnant women and nursing mothers. 3. Ensure the continuation of Mid-Day Meal programmes even during the vacation in the drought-affected areas. 4. Functioning of a community kitchen for old age, differently abled, and destitute in the drought-affected areas till the situation improves in coordination with DDMA with the support of local NGOs, charitable trusts, etc. 5. Regularly monitor the various activities and report to higher quarters on demand. 6. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.
10.	Department of Health & Family Welfare	Chief District Medical Officer	1. Ensure vigilance about waterborne and vector-borne diseases in the drought-affected areas. 2. Ensure laboratory support for the diagnosis of waterborne and vector-borne diseases through public health laboratories, district hospitals and medical colleges. 3. IEC measures for the affected population on prevention of water-borne and vector-borne diseases, ways to compensate for nutritional deficiencies 4. Conduct regular health camps in the drought-affected areas to screen local populations for common ailments.

Sl. No	Lead Department/Agency	Authority	Specific Response Actions
			5. Deployment of Rapid Response Teams for managing any outbreak of water-borne or vector-borne diseases, conduct surveillance among vulnerable populations (i.e., children, pregnant women, old age persons, differently abled persons, etc.) 6. Regularly monitor the various activities and report to higher quarters on demand. 7. Submit an update report to DDMA and State level on the prevailing situation. 8. Any other tasks as per the situation and as assigned by DDMA or State for management of drought in the district.

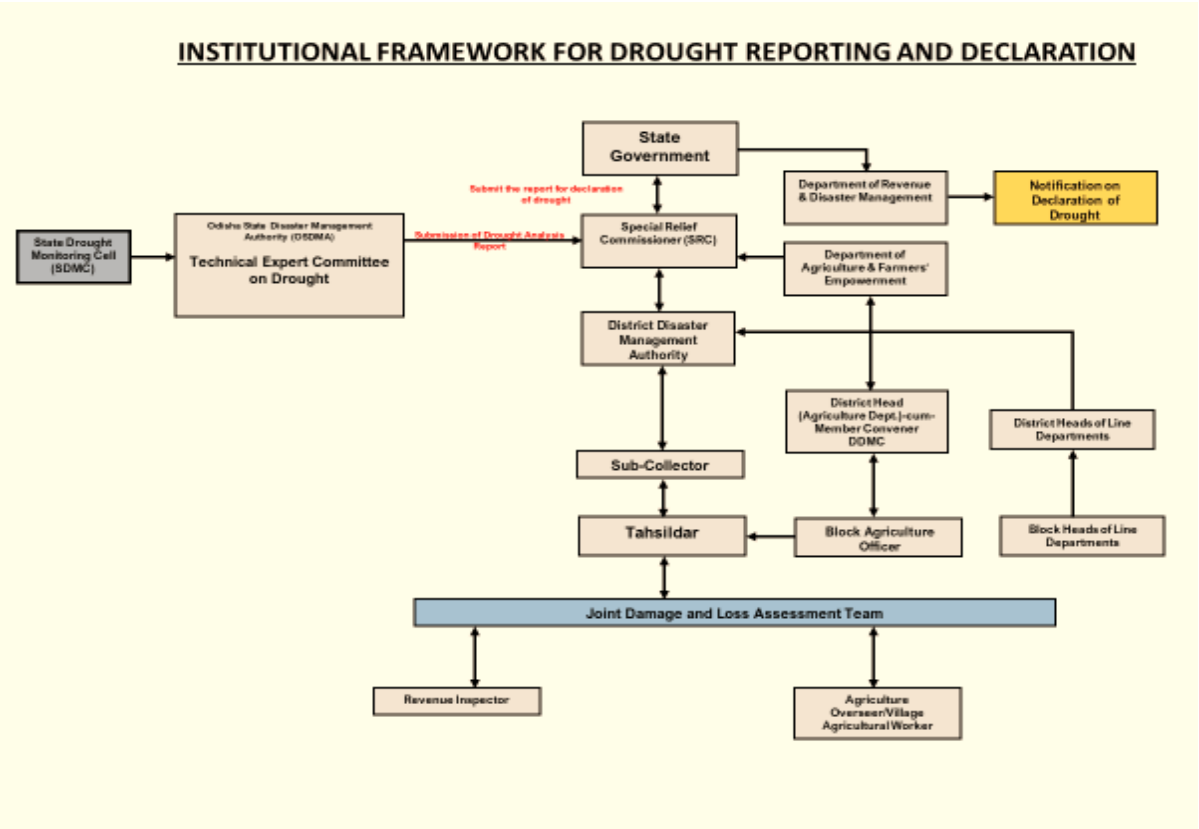
8.3 Reporting procedure and formats

8.4 Drought Assessment, Reporting and declaration

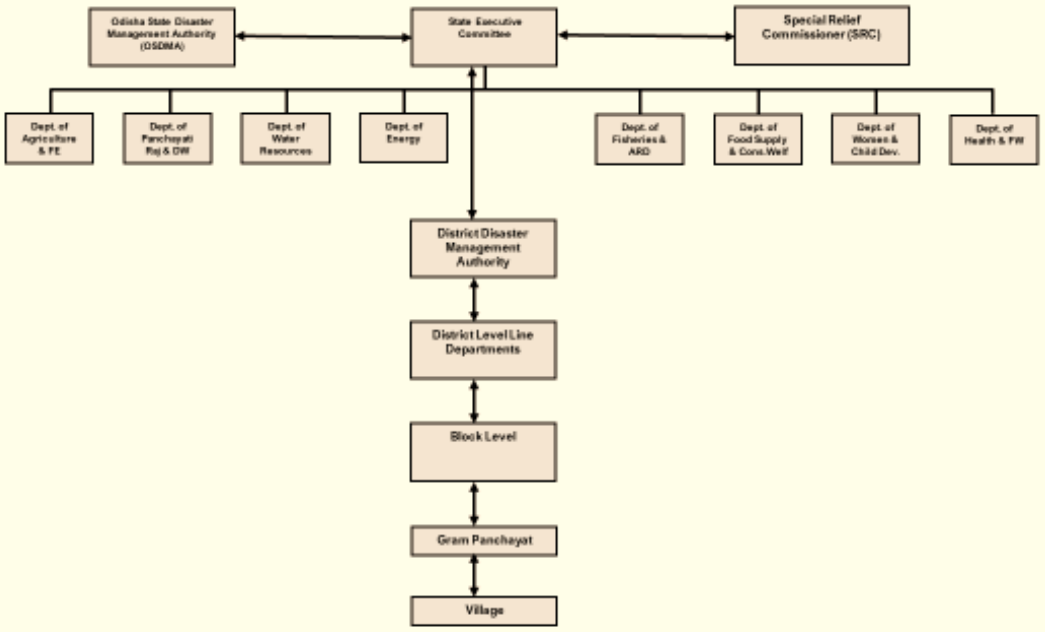
8.5 Communication and Coordination Mechanism

8.6 Important Nodal Agencies and their contact details

8.7 Response and relief measures, financial allocations-State/CSS for response and relief



INSTITUTIONAL COORDINATION MECHANISM FOR DROUGHT RESPONSE ,RELIEF & RECOVERY



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CHAPTER-9

RECOVERY AND RESTORATION

9.1 Restoration of Livelihoods

Restoring livelihoods after a drought involves a multi-pronged approach focusing on rebuilding agricultural practices through water conservation techniques like rainwater harvesting, introducing drought-resistant crops, livestock management improvements, diversifying income sources, community-based initiatives for infrastructure repair, and providing access to financial support to help communities recover from economic losses caused by the drought. Restoring livelihoods in drought management focuses on rebuilding affected communities by addressing immediate needs and fostering long-term resilience. Key strategies include providing emergency relief, such as cash transfers and livestock feed, while rehabilitating agricultural land, irrigation systems, and water resources. Promoting drought-resilient crops, climate-smart agriculture, and sustainable livestock practices ensures recovery. Diversifying income sources through non-agricultural activities, microenterprise development, and renewable energy solutions reduces dependence on climate-sensitive sectors. Capacity-building programs, social safety nets, and access to microfinance empower communities to recover sustainably. Integrating these measures with water management and climate adaptation enhances resilience, ensuring livelihoods withstand future droughts.

Key strategies for Livelihood Restoration after Drought:

➔ **Water management:**

- **Rainwater harvesting:** Implementing systems to collect and store rainwater for irrigation.
- **Drip irrigation:** Using efficient irrigation methods that minimise water waste.
- **Water conservation practices:** Educating farmers on mulching and contour farming techniques to retain soil moisture.
- **Small-scale water storage:** Building small ponds or tanks to store water for dry periods.

➔ **Agricultural practices:**

- **Drought-resistant crops:** Introducing crop varieties that can tolerate dry conditions.
- **Crop diversification:** Planting a mix of crops with different water needs to spread risk
- **Improved grazing management:** Rotational grazing to prevent overgrazing and promote pasture recovery
- **Agroforestry:** Integrating trees with crops to provide shade and improve soil quality

➔ **Livelihood diversification:**

- **Micro-enterprises:** Supporting the development of small businesses like livestock rearing, beekeeping, or handicrafts
- **Off-farm income generation:** Promoting income sources not reliant on agriculture, like tourism or skilled labour
- **Community-based initiatives:** Establishing community gardens, seed banks, or cooperative marketing systems

➔ **Social support and capacity building:**

- **Financial assistance:** Grants or loans to farmers to purchase inputs and rebuild infrastructure
- **Training and education:** Providing workshops on drought-resistant farming practices, water management, and disaster preparedness
- **Community engagement:** Fostering community participation in decision-making and project implementation

➔ **Infrastructure development:**

- **Repairing damaged irrigation systems:** Maintaining and repairing existing irrigation canals and pumps
- **Developing water harvesting infrastructure:** Building check dams and small dams to capture water runoff
- **Improving rural access to water:** Providing clean drinking water sources for communities

Besides the above some other measures to restore land, halt desertification and combat drought. These seven ways are:

Important Considerations:

- **Climate change adaptation:** Incorporating climate change projections into livelihood restoration plans to build resilience against future droughts
- **Gender equity:** Ensuring that women are actively involved in decision-making and benefit equally from restoration efforts
- **Monitoring and evaluation:** Regularly assessing the effectiveness of livelihood restoration projects to make necessary adjustments

9.2 Short-term recovery programmes, loans/assistance/aid/grants

Short-term recovery programs in drought management focus on providing immediate support to affected communities. These include direct cash transfers, food aid, and emergency water supply to ensure basic needs are met. Financial assistance, such as low-interest loans, grants, and subsidies, helps farmers and pastoralists rebuild livelihoods by purchasing seeds, feed, and tools. Aid programs may also offer livestock restocking, veterinary care, and irrigation repairs to restore agricultural productivity. Community-based cash-for-work initiatives support infrastructure rehabilitation, such as water storage and soil conservation projects, while generating income. These measures provide rapid relief, stabilize livelihoods, and create a foundation for long-term drought resilience. The immediate measures are:

- Provision for the distribution of safe drinking water.
- Medicines for the victims
- Availability of fodder and water for the cattle.
- Shifting of the people and their livestock to safer places.

The National Disaster Management Framework recognizes **12 types of calamities**, which include **Cyclone, Drought, Earthquake, Fire, Flood, Tsunami, Hailstorm, Landslide, Avalanche, Cloud Burst, Pest Attack and Cold Wave/Frost.**

Standing instructions for branches to initiate action after district/state government declaration.

SLBC/DCC meetings for coordinated action plans for implementation of the relief programme in collaboration with the state Government authorities.

Declaration of Natural Calamity:

District/state government declares natural calamities based on crop loss. with a crop loss of 33% or more and relief measures shall be extended to farmers/entrepreneurs.

Restructuring/Rescheduling of Existing Loans:

All the short-term loans, except those that are overdue at the time of occurrence of natural calamities, can be restructured.

The principal and interest due in the year of the calamity will be converted into a term loan within 3 months from the date of calamity.

Long-term (Investment) loans shall be restructured based on asset damage. Other Loans can be restructured as decided by SLBC/DCC based on severity.

Sanctioning of Fresh Loans:

Fresh crop loans shall be sanctioned based on the scale of finance and cultivation area for raising the crops. Further, Long-term loans for agriculture, allied activities, rural artisans, etc, can be undertaken. Consumption loans up to Rs.10,000/- without collateral.

Applicability of natural calamities relief measures guidelines in Riots and Disturbances:

The bank extends assistance to riot/disturbance-affected persons based on SLBC/DCC approvals.

Utilization of insurance proceeds:

The bank shall adjust the insurance proceeds received to restructured loans.

9.3 Long-term Recovery Programme

Long-term recovery programs in drought management focus on building resilience and sustainable livelihoods. These include promoting climate-smart agriculture, such as drought-resistant crops, efficient irrigation systems, and soil conservation techniques. Restoring degraded land, improving water management through rainwater harvesting and reservoir construction, and diversifying income sources, like agroforestry and eco-tourism, reduce vulnerability to future droughts. Financial inclusion initiatives, such as microfinance, insurance schemes, and savings groups, empower communities economically. Capacity-building programs enhance local skills in disaster risk reduction and resource management. Collaborative efforts with governments, NGOs, and private sectors ensure integrated, sustainable solutions to mitigate the long-term impacts of drought. The long-term measures are:

- Identification of groundwater potential in the form of aquifers.
- Transfer of river water from the surplus to the deficit areas.
- Planning for inter-linking of rivers.
- Construction of reservoirs and dams.
- Remote sensing and satellite imagery can be useful in identifying the possible river basins that can be interlinked and in identifying the groundwater potential.
- Dissemination of knowledge about a long period without rain-resistant crops and proper training to farmers.
- Rainwater harvesting can be an effective method in minimizing the effects of a long period without rain.

9.4 Any other information, if necessary, may be included here

Drought is a protracted period of dry weather that may occur everywhere on the planet as part of the natural climate cycle. It's a slow-moving calamity marked by a lack of precipitation, which causes a water deficit. Drought has the potential to affect health, agriculture, economy, and energy negatively. All should follow the drought management guidelines. The major highlights are:

- Drought monitoring cells DMCs to be created at the state level

- Use of information and communication technology for real-time drought-related information
- For comprehensive information, the ground-based information is to be collated and synchronised with the satellite-based information to have a broader picture of the onset, occurrence, and severity
- Vulnerability maps must be prepared for each state by the respective state DMCs
- Agricultural research institutes to research and develop drought-resistant varieties of crops
- Promotion of crop diversification and use of drip and sprinkler irrigation systems
- All productive animals must be provided with fodder to prevent the distressed sale of animals
- If possible, corporate social responsibility (CSR) initiatives to be coupled with drought management strategies

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CHAPTER 10

PREVENTION AND MITIGATION

10.1 Current Drought Mitigation Programmes

The drought mitigation programs currently running in India include the **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** for enhanced irrigation, **National Rural Drinking Water Programme (NRDWP)** for safe drinking water access, **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)** for rural employment generation, **National Watershed Development Project for Rainfed Areas (NWDPRA)** for watershed development, and the **National Food Security Mission (NFSM)** to promote sustainable agriculture in drought-prone areas; all aimed at improving water management and resilience in drought-affected regions.

Current drought mitigation programs focus on sustainable water management, agricultural resilience, and livelihood support. Key initiatives include watershed development programs like the Integrated Watershed Management Programme (IWMP)**,** the promotion of rainwater harvesting, and efficient irrigation techniques such as micro-irrigation under PMKSY (Per Drop More Crop)**.** Schemes like MGNREGA provide rural employment and water conservation works. Crop insurance schemes like PMFBY mitigate agricultural risks, while drought-prone area programs focus on afforestation and soil conservation. These programs aim to enhance drought preparedness, reduce vulnerability, and ensure long-term sustainability.

Drought mitigation measures are initiatives undertaken to reduce the incidence or minimize the impacts of drought. Besides drought-proofing, these measures help in adapting to climate change, restoring ecological balance and bringing development benefits to the people. However, drought mitigation programmes are not to be construed as stand-alone interventions that are to be implemented only in the wake of a drought; they must form part of developmental planning in the domain of soil conservation, watershed development and forestry. As such, drought mitigation measures are to be mainstreamed in regular development programmes of Central and State Governments. The government's policy towards drought management has changed considerably over the years and now rests upon early warning & preparedness, crisis management response, and medium and long-term drought mitigation measures with greater application of state-of-the-art technology and scientific tools. Several Central government schemes/Programmes have evolved to address the need for medium and long-term drought mitigation requirements. Notable among them are the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Integrated Watershed Management Programme (IWMP), subsuming erstwhile Drought Prone Area Programme (DPAP)), National Rural Drinking Water Programme (NRDWP), Swarna-Jayanthi Grameen Swarozgar Yojana (SGSY), Rashtriya Krishi Vikas Yojana (RKVY), Fodder & Feed Development Scheme, etc. Besides, various area development programmes by State Governments either through their resources or with the Government of India's support like the Backward Region Grant Fund (BRGF), and Rural Infrastructure Development Fund (RIDF) are contributing significantly to enhancing drought resilience. Central and State Governments

continue to consider further possibilities of reorienting/synergizing regular development programs for achieving a robust drought-resilient regime.

Key Aspects of these Programmes

- **Water conservation:** Promoting efficient irrigation practices, rainwater harvesting, and groundwater recharge through various schemes.
- **Livelihood support:** Providing employment opportunities through rural development programs like MGNREGA, especially during drought periods.
- **Crop diversification:** Encouraging the cultivation of drought-resistant crops suitable for rainfed areas.
- **Early warning systems:** Establishing monitoring mechanisms to detect drought conditions early and initiate preventive measures.
- **Community participation:** Engaging local communities in planning and implementing drought mitigation strategies.

10.2 Approaches for drought mitigation measures (A few suggestions are mentioned below)

10.2.1 Water harvesting and conservation

Water harvesting from external catchments involves diverting runoff water from an area that is not cropped to the area where crops are grown. Water is stored in a simple reservoir structure and can be applied to the crops when it is needed. The flow of water from the reservoir into the cropped area can be controlled using tied bunds that can be built up or dismantled as required.

Water harvesting techniques gather water from an area termed the 'catchment area' and channel it to the cropping area or wherever it is required. Conservation techniques conserve water within the biomass and the soil by reducing run-off and keeping the water where it falls as much as possible.

Water harvesting and conservation are vital in drought management, ensuring sustainable water availability. Techniques like rainwater harvesting, construction of check dams, and use of retention ponds capture and store rainwater. Practices such as soil moisture retention, efficient irrigation (e.g., drip systems), and recharging groundwater enhance water conservation, supporting communities during droughts. Water harvesting and conservation are practices that help manage water resources. The details are as follows:

Water Harvesting

- Involves collecting rainwater from a catchment area and storing it for later use
- Can be done in many ways, such as using a water butt, rooftop harvesting, or surface runoff harvesting
- Helps recharge groundwater levels and reduce reliance on municipal water supply
- Can be used for drinking, gardening, washing, and irrigation

Water Conservation

- Involves using water efficiently to reduce unnecessary water usage
- Includes policies, strategies, and activities to manage fresh water as a sustainable resource
- Helps protect the water environment and meet current and future human demand
- Conserving water within the biomass and the soil by reducing run-off

The benefits of water harvesting and conservation include preserving water for future needs, contributing to sustainable living, being cost-effective, minimizing the impact of droughts, and helping to meet current and future human demand.

10.2.2 Artificial recharge of groundwater

The basic purpose of artificial recharge of groundwater is to restore supplies from aquifers depleted due to excessive groundwater development. The sub-surface reservoirs are very attractive and technically feasible alternatives for storing surplus monsoon runoff. One of the key advantages of artificial groundwater recharge is its ability to store excess surface water during periods of abundance for later use during times of scarcity.

Artificial groundwater recharge is a key drought management strategy that replenishes depleted aquifers. Methods include constructing recharge wells, percolation ponds, and check dams to enhance water infiltration. Treated wastewater and excess rainwater are directed to recharge zones, increasing groundwater storage, ensuring water availability, and improving drought resilience for agriculture and communities.

Community RWH systems collect runoff through watershed management methods. Structures generally used to recharge groundwater are recharge shafts (vertical and lateral shafts with bore wells), spreading techniques (check dams, nala bunds, percolation tanks, ponds, ditches, and furrows), and injection wells.

10..2.3 Contour Bunding

Contour bunding is an effective drought management practice that prevents soil erosion and enhances water retention. It involves constructing embankments along the natural contours of sloped land, reducing runoff and promoting water infiltration. This technique improves soil moisture, supports vegetation growth, and increases agricultural productivity in drought-prone areas, ensuring long-term sustainability. Contour bunding is a soil conservation technique that involves building low walls across a slope to create terraces. It's a sustainable way to manage land on hillsides, slopes, and marginal lands. Contour bunding is used to

- **Retain water**: Contour bunds create small dams that increase soil moisture
- **Increase crop production**: Contour bunding is used to promote water retention and prevent erosion
- **Prevent erosion**: By dividing the slope into a series of smaller slopes, contour bunds reduce the volume of runoff water

10.2.4 Contour Trenching

Contour trenching is a drought management technique that involves digging trenches along natural land contours to capture and store rainwater. This reduces surface runoff, enhances soil moisture, and replenishes groundwater. The retained water supports vegetation growth, prevents soil erosion, and helps restore degraded lands, improving resilience in drought-prone areas. Contour trenching is a soil and water conservation technique that involves digging trenches along a hillside. The trenches are dug perpendicular to the slope of the land and follow a contour line. Contour trenching is a soil and water conservation technique that involves digging trenches along a hillside. The trenches are dug perpendicular to the slope of the land and follow a contour line. The main purpose is to use it for:

- **Water conservation:** Contour trenches help control flooding and keep soil moisture intact.
- **Soil conservation:** Contour trenches help prevent soil erosion.
- **Agricultural production:** Contour trenches help increase agricultural production by providing a water reserve for crops during the growing season.

10.2.5 Contour Cultivation

Contour cultivation involves ploughing and planting crops along the natural contours of sloped land to conserve water and soil in drought management. This method reduces water runoff, increases infiltration, and minimizes soil erosion. Retaining moisture in the soil, it enhances crop growth and resilience in drought-prone regions.

Contour cultivation, also known as contour farming, is a farming technique that involves working the land along the natural slope of the land. It's a conservation practice that helps reduce soil erosion.

Benefits

- Reduces soil erosion
- Reduces sediment and runoff
- Improves water quality
- Increases crop yields
- Minimizes fertilizer loss
- Reduces wear on equipment

10.2.6 Bench Terracing

Bench terracing is a drought management technique that transforms steep slopes into step-like flat areas to reduce water runoff and soil erosion. These terraces retain rainwater, enhance infiltration, and improve soil fertility. By creating arable land on slopes, bench terracing supports sustainable agriculture and boosts resilience in drought-prone regions.

Bench terraces are a series of level or virtually level strips running across the slope at vertical intervals, supported by steep banks or risers. Bench terraces can be constructed from the bottom of the slope to the top of the mountain (bottom-up), or it can be the other way around, from the top of the slope to the bottom of the mountain (top-down). While the farmer approach is more common, the expert chose the bottom-up approach.

10.2.7 Graded Bunding

Graded bunding is a drought management practice involving the construction of earthen bunds along graded contours to control water runoff and prevent soil erosion. These bunds allow excess water to flow gently, enhancing groundwater recharge and soil moisture retention. Graded bunding supports sustainable agriculture and improves resilience in drought-prone areas.

Graded bunding is a technique that involves constructing dams or mounds to manage excess water runoff and prevent flooding. It's used in low-lying areas or flat terrain. The uses are:

- Graded bunds are built with a slight incline to help control water flow and reduce soil erosion.
- They are often larger and higher than contour bunds.
- The bunds are laid out with a longitudinal slope gradient that leads to an outlet.
- The gradient can be uniform or variable.
- Uniformly graded bunds are suitable for areas with shorter bunds and low runoff.

10.2.8 Gully Plugging

Gully plugging is a drought management technique that involves blocking eroded gullies with materials like stones, earth, or concrete to prevent further erosion and water loss. This helps retain rainwater, promotes soil stability, and encourages vegetation growth. It improves water conservation, supports agriculture, and enhances drought resilience in affected areas. Gully plugging is a technique that uses small dams to prevent gullies from deepening. These dams are also known as check dams. The uses are:

- **Slows water flow**: Check dams reduce the speed of water flow, which reduces erosion and prevents gullies from forming during floods.
- **Deposits eroded materials**: Check dams promote the deposition of eroded materials, which stabilizes gullies.
- **Collects water**: Check dams that can collect water during heavy rainfall events.
- **Recharges groundwater**: Check dams can help recharge shallow wells.

10.2.9 Check dams/Nalla bunding constructions

Check dams and nalla bunding are key drought management strategies that involve constructing small barriers across streams or watercourses to capture and store rainwater. These structures help recharge groundwater, control surface runoff, and prevent soil erosion. By improving water availability, they support agriculture and enhance community resilience during droughts.

A "check dam" or "nala bund" is a small dam built across a stream or gully to slow down water flow, reduce erosion, and promote groundwater recharge by retaining water on the land; essentially, it's a small embankment constructed across a natural drainage channel to trap sediment and increase water infiltration into the soil, often used in series along a slope to maximize its impact.

Benefits of Check Dams/Nala Bunds

- **Reduced soil erosion:** By slowing down water flow, check dams trap sediment and prevent soil from being washed away.
- **Groundwater recharge:** The retained water percolates into the soil, replenishing groundwater levels.
- **Improved agricultural productivity:** By enhancing soil moisture, check dams can support better crop yields.
- **Flood mitigation:** By slowing down water flow, check dams can help reduce flood peaks.

10.2.10 Gabion Structure

Gabion structures are wire mesh containers filled with rocks, used in drought management to control erosion and manage water flow. Placed in riverbeds or along slopes, they stabilize soil, reduce water runoff, and promote water infiltration. Gabions help conserve water, prevent land degradation, and improve agricultural resilience in drought-prone areas.

A gabion structure is a flexible, permeable wall made of rectangular baskets filled with rocks, concrete, or sand. Gabions are used in civil engineering applications such as retaining walls, flood protection, and erosion control.

Uses of Gabion Structures

- **Retaining walls**: Gabions are used to retain soil in highways, bridges, canal linings, and buildings
- **Flood protection**: Gabions are used to control erosion and scouring in rivers and streams
- **Military**: Gabions are used to protect gun emplacements, forward operating bases, and sleeping quarters
- **Landscape art**: Gabions can be used as landscape art elements

10.2.11 Farm Ponds

Farm ponds are small, dug-out water storage systems that capture and store rainwater for agricultural use during dry periods. In drought management, they provide a reliable water source for irrigation, livestock, and domestic needs. Farm ponds enhance water conservation, improve crop yields, and help sustain farming communities during droughts. A farm pond is a dug-out basin that stores water for irrigation, livestock, and other farm needs. They are a vital part of India's agriculture and water resource management.

Benefits

- **Water harvesting:** Farm ponds capture rainwater, especially during the monsoon, which can be used for irrigation during dry periods.
- **Wildlife habitat:** Farm ponds provide food, cover, and nesting habitats for many species, including fish, birds, reptiles, amphibians, and mammals.

- **Environmental benefits:** Farm ponds can reduce erosion and sedimentation, increase watershed health, and conserve wildlife habitats.
- **Property values:** Farm ponds can increase the aesthetic quality of a landscape, which can increase property values.

10.2.12 Percolation Tanks

Percolation tanks are artificial water storage structures designed to capture rainwater and facilitate groundwater recharge. In drought management, they help retain water, promote soil moisture, and recharge aquifers. These tanks reduce surface runoff, prevent soil erosion, and enhance water availability, supporting agriculture and improving community resilience during droughts. A percolation tank is a man-made reservoir that stores rainwater and allows it to seep into the ground. This method is used to recharge groundwater tables.

Benefits

- Percolation tanks are an effective way to restore groundwater levels
- They can be built using existing village tanks that have been designed and modified

10.2.13 Injection Wells

Injection wells are used in drought management to directly recharge groundwater by injecting surface water or treated wastewater into aquifers. This method helps replenish depleted water sources, improving water availability for agricultural and drinking purposes. Injection wells support sustainable water management and enhance drought resilience by restoring underground water levels.

An injection well is a pipe that injects fluids underground into porous rock formations or soil. Injection wells are used in many industries and applications, including environmental reclamation, water management, and oil and gas production. Mainly, injection wells are used for:

- **Water management:** Injection wells can recharge aquifers, reduce saltwater intrusion, and mitigate land subsidence.
- **Waste disposal:** Injection wells can dispose of treated or untreated liquid waste into geologic formations.
- **Oil and gas production:** Injection wells can enhance pressure within a formation and sweep for remaining petroleum.

10.2.14 Rainwater Harvesting

Rainwater harvesting in drought management involves collecting and storing rainwater from roofs, surfaces, or catchment areas for future use. This practice reduces reliance on traditional water sources, conserves water, and ensures a steady supply during dry periods. It supports agriculture and drinking water needs and enhances community resilience in drought-prone regions.

Rainwater harvesting (RWH) is the practice of collecting and storing rainwater instead of letting it run off. It can be done by redirecting rainwater from roofs to tanks, cisterns, or wells.

Benefits of RWH

- **Water conservation**: RWH reduces the need for imported water and helps to conserve water.
- **Groundwater replenishment**: RWH can replenish groundwater supplies and prevent seawater intrusion.
- **Cost-effectiveness**: RWH is a cost-effective alternative to other water recycling methods.
- **Environmental benefits**: RWH can reduce soil erosion, flooding, and surface water pollution.

10.2.15 Water Saving Technologies

Water-saving technologies in drought management include efficient irrigation systems like drip and sprinkler irrigation, soil moisture sensors, and rainwater harvesting. These technologies reduce water wastage, optimize water usage for crops, and enhance groundwater recharge. By promoting conservation, they ensure sustainable water availability and improve agricultural resilience in drought-prone areas.

Water-saving technologies include devices, systems, and management tools that reduce water waste and improve water efficiency.

- **Smart irrigation systems**: Use sensors, controllers, and software to adjust water delivery based on soil moisture, weather, and plant needs
- **Drip irrigation systems**: Deliver water directly to plant roots, reducing water loss from evaporation and runoff
- **Greywater recycling systems**: Recycle water from sinks and showers for other uses
- **Rainwater harvesting systems**: Collect rainwater for use in gardening and washing

10.2.16 Improved Water-Saving Farm Practices

Improved water-saving farm practices in drought management include techniques like mulching, crop rotation, conservation tillage, and the use of drought-resistant crops. These methods reduce water evaporation, enhance soil moisture retention, and optimize water use, ensuring more efficient irrigation. They help maintain agricultural productivity while conserving water during droughts.

Improved water-saving farm practices include: drip irrigation to deliver water directly to plant roots, rainwater harvesting to capture and store precipitation for irrigation, choosing drought-tolerant crops suited to the local climate, cover cropping to improve soil structure and water retention, conservation tillage to minimize soil disturbance and evaporation, and using soil moisture sensors to monitor soil moisture levels and optimize irrigation timing. The water-saving practices are as follows:

- **Drip irrigation:** Considered one of the most efficient methods, as it minimizes water loss through evaporation and runoff by delivering water directly to the plant roots via a network of tubes with small emitters.

- **Rainwater harvesting:** Collecting rainwater from rooftops or land surfaces and storing it in tanks or ponds to supplement irrigation needs.
- **Drought-tolerant crops:** Selecting crop varieties naturally adapted to drier conditions, requiring less water to thrive.
- **Cover crops:** Planting cover crops during fallow periods to protect the soil from erosion, improve water infiltration, and enhance soil organic matter.
- **Conservation tillage:** Minimizing soil disturbance by leaving crop residue on the surface, which helps retain moisture and reduce erosion.
- **Soil moisture sensors:** Technology to monitor soil moisture levels, allowing farmers to irrigate only when necessary.
- **Crop rotation:** Rotating different crops to optimize water usage and manage nutrient needs
- **Mulching:** Adding organic material like mulch to the soil surface to reduce evaporation
- **Efficient irrigation scheduling:** Adjusting irrigation timings based on weather conditions and crop needs
- **Water-efficient sprinkler systems:** Using sprinkler systems designed to minimize water waste
- **Improved water conveyance systems:** Maintaining irrigation canals and ditches to reduce water losses during transport

10.2.17 Afforestation

Afforestation in drought management involves planting trees to restore vegetation and improve water retention in the soil. Trees reduce soil erosion, enhance groundwater recharge, and mitigate climate extremes. By increasing biodiversity and stabilizing ecosystems, afforestation helps protect water resources, improve agricultural productivity, and build long-term resilience to droughts.

Afforestation, the process of planting trees in previously barren areas, plays a crucial role in drought management by enhancing a region's water retention capacity through increased soil infiltration, groundwater recharge, and reduced surface runoff, essentially acting like a natural sponge to absorb and store rainwater, making it available during dry periods; this is especially beneficial in arid and semi-arid regions prone to drought. Key mechanisms of how afforestation combats drought:

- **Improved soil structure:** Tree roots bind soil particles together, creating better soil structure and increasing its water-holding capacity, allowing more water to be absorbed and retained during rainfall.
- **Increased infiltration:** Dense tree canopies and leaf litter slow down rainwater runoff, allowing more time for water to infiltrate the soil and replenish groundwater.
- **Reduced evaporation:** Tree canopies provide shade, which helps to reduce water evaporation from the soil surface.

- **Microclimate regulation:** Forests create a cooler and more humid microclimate, which can positively impact vegetation growth and water availability.
- **Species selection:** Choosing native tree species adapted to the local climate and soil conditions is crucial for successful establishment and drought resistance.
- **Agroforestry practices:** Integrating trees into agricultural systems (agroforestry) can provide multiple benefits like shade for crops, windbreaks, and improved soil fertility while mitigating drought impacts.
- **Watershed management:** Afforestation is most effective when implemented within a watershed management plan to maximize the benefits of water conservation and distribution.

10.2.18 Identification and integration of drought mitigation measures into development plans and projects

Identifying and integrating drought mitigation measures into development plans involves incorporating strategies like water conservation, drought-resistant agriculture, and infrastructure for water storage into policy and project design. By prioritizing these measures, development plans ensure long-term resilience, sustainable resource use, and reduced vulnerability to future droughts, enhancing community and environmental sustainability.

Integration of drought mitigation measures into development plans and projects" means actively incorporating strategies to combat drought, like water harvesting, efficient irrigation techniques, and diversified crop selection, into the design and implementation of any new development project, ensuring that potential drought impacts are minimized while promoting long-term sustainability across sectors like agriculture, infrastructure, and land use planning. The key aspects of integrating drought mitigation measures:

- **Early assessment and monitoring:** Regularly monitoring weather patterns and water availability to identify potential drought risks early on.
- **Water conservation practices:** Implementing efficient irrigation systems, rainwater harvesting techniques, and measures to reduce water losses in urban areas.
- **Sustainable land management:** Promoting practices like agroforestry, contour farming, and soil conservation to improve water infiltration and retention.
- **Diversification of crops:** Encouraging the cultivation of drought-resistant crops suitable to the local climate.
- **Community engagement:** Involving local communities in planning and implementing drought mitigation strategies to ensure ownership and participation.

10.2.19 Development of Innovative Drought Mitigation Measures

The development of innovative drought mitigation measures involves creating new technologies and strategies to conserve water and enhance resilience. This includes smart irrigation systems, drought-resistant crop varieties, climate forecasting tools, and water-efficient farming techniques. Innovation fosters sustainable agricultural practices, improves water management, and reduces vulnerability to future droughts.

Innovative drought mitigation measures include advanced drought monitoring systems, smart irrigation technologies, crop diversification, groundwater recharge techniques, watershed management practices, climate-resilient crop breeding, and data analytics to predict drought events, all aimed at optimizing water usage and building resilience in drought-prone regions. The key aspects of innovative drought mitigation:

- **Improved drought monitoring:**
  - Utilizing satellite imagery and advanced data analysis to monitor soil moisture levels and drought severity in real time.
  - Developing drought indices that incorporate multiple parameters like precipitation, temperature, and vegetation condition.
- **Smart irrigation systems:**
  - Sensor-based irrigation systems that adjust water application based on soil moisture levels and plant needs.
  - Precision agriculture techniques like drip irrigation to minimize water waste.
- **Crop diversification:**
  - Planting a mix of drought-tolerant and high-yielding crops to spread risk and ensure consistent yields during dry periods.
  - Utilizing intercropping practices to optimize water usage and protect soil.
- **Groundwater recharge:**
  - Constructing artificial recharge structures like infiltration ponds and trenches to replenish groundwater during rainy seasons.
  - Implementing rainwater harvesting systems to capture and store rainwater for later use.
- **Watershed management:**
  - Revegetation of degraded watersheds to increase water infiltration and reduce runoff.
  - Implementing soil conservation practices like contour farming and terracing
- **Climate-resilient crop breeding:**
  - Developing new crop varieties with enhanced drought tolerance traits through genetic modification.
- **Data analytics and prediction models:**
  - Utilizing advanced data analysis to forecast potential drought events and develop proactive mitigation strategies.

10.2.20 Credit linkage and insurance facilities

Credit linkage and insurance facilities in drought management provide financial support to farmers and communities affected by drought. Access to affordable loans enables them to invest in resilient farming practices, while drought insurance protects against crop failures.

These financial tools help stabilize incomes, reduce risks, and enhance recovery during droughts. The Central Government implements Centrally Sponsored Schemes (CSS) / Central Sector (CS) Schemes such as Pradhan Mantri Krishi Sinchai Yojana (PMKSY), the Rainfed Area Development Programme (RAD), National Rural Drinking Water Programme (NRDWP), etc., which contribute towards drought proofing.

10.2.21 Community participation in drought mitigation (e.g., community-led water management)

Community participation in drought mitigation: Engaging local communities in water management and conservation efforts to build resilience against drought. Community participation in drought mitigation" refers to the active involvement of local people in planning, implementing, and monitoring strategies to reduce the impacts of drought in their area, including activities like water conservation practices, rainwater harvesting, improved land management, and early warning system development, contributing significantly to a more resilient community in dry periods. The key aspects of community participation in drought mitigation:

- **Awareness raising:** Educating community members about the causes and impacts of drought, promoting understanding of water conservation methods, and encouraging responsible water use.
- **Data collection and monitoring:** Involving local people in gathering information on rainfall patterns, water levels, and crop conditions to support early warning systems and informed decision-making.
- **Participatory planning:** Facilitating community discussions to identify local vulnerabilities, prioritize mitigation strategies, and develop action plans tailored to their specific needs.
- **Implementation of water conservation practices:** Engaging communities in adopting techniques like rainwater harvesting, efficient irrigation systems, and improved land management practices to maximize water use.
- **Community-based infrastructure development:** Supporting the construction and maintenance of small-scale water storage facilities, rainwater harvesting tanks, and water distribution systems.
- **Livelihood diversification:** Encouraging communities to explore alternative income sources that are less reliant on water-intensive agriculture, promoting sustainable livelihoods.

10.3 Mitigation Measures

Mitigation Measure	Sub-Thematic Area of DRR	Responsibility-District	Department/Agency	Remarks
1. Structural Measures	Water supply	SE, RWSS	Dept. Of Rural water supply and sanitation division	Long Term

2. Structural Measures	Ensure the health system.	Chief District Medical Officer	Dept. Of Health & Family welfare	Medium -term
2. Non-Structural Measures	1. Supply of drought-resistant varieties of crops 2. Stocking of seeds and seedlings ahead of time to mitigate seedling death in nurseries due to drought. 3. Encouraging more no. of drip and sprinklers in farmer's fields. 4. More water harvesting structures to be built under PMKSY	1. Chief District Agriculture Officer 2. Chief District Agriculture Officer 3. Deputy Director Horticulture 4. P.D., watershed	1. Agriculture & Farmers Empowerment 2. Agriculture & Farmers Empowerment 3. Agriculture & Farmers Empowerment 4. Agriculture & Farmers Empowerment	Short term

10.4 Summary of Mitigation Measures

Task	Activity	Authority for implementation	Starting date	Date of completion	Cost	Funding sources
Water Supply	Ensure water supply to drought area	SE, RWSS & SE, IRRIGATION	Before drought	Within a week		Department of Water Resources
Health	Ensure all first aid kits are ready, and ambulance and ORS powder will be ready in drought place.	CDMO	Before drought	Within a week		Dept. of Health & Family welfare
Agricultural Crop, Soil conservation,	1. Supply of drought-resistant	CDAO, DDH, PD	Before drought	Within a week		Agriculture & Farmers Empowerment

Horticultural crop, Livestock, Fishery	varieties of crops 2. Stocking of seeds and seedlings ahead of time to mitigate seedling death in nurseries due to drought. 3. Encouraging more no of drip and sprinklers in farmer's fields. More no. Of water harvesting structure to be built under PMKSY	WATERSHED, CDVO, DFO				& Dept. Of Animal husbandry.

10.5 Financing Options for Prevention and Mitigation

i. **State Budget/Plan funds**
Odisha's government allocates specific budgetary provisions for disaster management, including drought. The funds are directed towards creating sustainable water resources, improving irrigation systems, and implementing drought-resistant agricultural practices. The state also focuses on enhancing the capacity of local communities to cope with drought conditions through training and support programs.

ii. **Mitigation Fund.**
A dedicated mitigation fund can be established to specifically address the prevention and reduction of drought impacts. This fund would support activities such as rainwater harvesting, afforestation, soil conservation, and the development of drought-resistant crop varieties. It could also finance early warning systems and community awareness programs.

iii. **District Planning Fund.**
Each district in Odisha can have a planning fund to address local needs and priorities related to drought management. This fund would enable district authorities to implement tailored drought management strategies, such as constructing check dams, desilting existing water

bodies, and promoting efficient water use practices among farmers. Community participation in planning and decision-making would ensure that the interventions are effective and sustainable.

iv. Disaster Risk Insurance

To protect farmers and vulnerable communities from the financial impact of droughts, disaster risk insurance schemes can be promoted. The state government, in collaboration with insurance companies, can offer affordable and comprehensive insurance products that cover crop losses, livestock mortality, and other drought-related damages. Awareness campaigns and capacity-building programs can help increase the uptake of these insurance schemes.

v. Other financial options

Public-Private Partnerships (PPPs):

1. Collaborating with private enterprises to fund and implement drought mitigation projects.
2. International Aid and Grants: Leveraging funds from international organizations and donor agencies for drought management initiatives.
3. Microfinance and Self-Help Groups (SHGs): Encouraging microfinance institutions and SHGs to provide small loans to farmers and communities for drought-resilient practices.
4. Corporate Social Responsibility (CSR): Engaging corporations in funding and supporting community-based drought management projects as part of their CSR activities. These strategies, when implemented effectively, can significantly enhance Nabarangpur's resilience to drought and ensure the sustainable management of water resources.

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CHAPTER 11

PROCEDURE, METHODOLOGY FOR PREPARATION, MONITORING, EVALUATION AND UPDATING THE PLAN

11.1 Methodology for Preparation of Drought Plan

The preparation of the Drought Management Plan (DMP) for Nabarangpur District will follow a systematic approach that incorporates participatory methodologies to ensure comprehensive stakeholder engagement and effective planning. The process will include:

1. **Literature Review**: Analyzing existing guidelines and frameworks for drought management to inform the local context.
2. **Data Collection**: Gathering historical data on drought occurrences, impacts, and responses in the district.
3. **Stakeholder Engagement**: Involving local communities, government bodies, NGOs, and experts throughout the planning process.

11.1.1 Formation of the Stakeholders Committee for the Preparation of the Plan

A multi-disciplinary Stakeholders Committee will be established to oversee the DMP's development. This committee will include representatives from:

- All members of the District Drought Management Committee
- Local government ULBs/ Blocks/ Tahasils
- Agricultural departments
- Environmental agencies
- KVK Representatives
- Community organizations
- Academic institutions

This committee will ensure that diverse perspectives are considered in the planning process.

11.1.2 Assigning Roles and Responsibilities for Preparation of the Plan Policy Development:

Each member of the Stakeholders Committee will be assigned specific roles based on their expertise. Responsibilities may include:

- **Data Analysis**: Collecting and analyzing drought-related data.
- **Community Outreach**: Engaging with local populations to gather input and disseminate information.
- **Policy Development**: Drafting policy recommendations based on stakeholder feedback.

11.1.3 Orientation of the Stakeholders on Preparation of the Plan

Orientation sessions will be conducted to familiarize stakeholders with the objectives, methodologies, and expected outcomes of the DMP. These sessions will cover:

- The importance of drought management.
- The roles of different stakeholders.
- The overall structure and timeline of the planning process.

11.1.4 Formulation of Vision Statement

A collaborative vision statement will be developed during initial meetings with stakeholders. This statement will encapsulate the collective goals for drought management in Cuttack District, focusing on resilience, sustainability, and community involvement.

11.1.5 Major Tasks and Steps to be Taken in the Formulation of the Plan

Key tasks in formulating the DMP will include:

- Assessment of Vulnerabilities: Identifying areas most at risk from drought.
- Development of Mitigation Strategies: Creating strategies to reduce vulnerabilities.
- Establishing Monitoring Indicators: Defining indicators for assessing drought conditions.

11.1.6 Fixing Timelines for Collection, Compilation, and Review of the Draft Plan

A timeline will be established to ensure the timely completion of each phase of the DMP development. Key milestones may include:

- Data collection completion by Month 3.
- Draft plan compilation by Month 6.
- Stakeholder review by Month 7.

11.1.7 Consultation Procedure at Various Levels

Consultation will occur at multiple levels:

- Community Level: Workshops and focus groups to gather local input.
- Block / Tahasil Level to collect data from the field and monitor the situation.
- District Level: Regular meetings with government officials and stakeholders to discuss progress.
- State Level: Coordination with state authorities for alignment with broader policies.

11.1.8 Approval of the Plan at the District-Level Committee

Once finalized, the draft DMP will be submitted to the District Level Committee for approval. This committee will review the plan's alignment with local needs and policies before granting formal approval.

11.1.9 Submission of the District Plan to the State

Following district approval, the finalized DMP will be submitted to state authorities for consideration within state-level drought management frameworks.

11.1.10 Flow Chart of the Approach

A flow chart illustrating this approach may include stages such as:

1. Formation of Stakeholders Committee
2. Data Collection and Analysis
3. Drafting Vision Statement
4. Development of DMP Components
5. Stakeholder Review and Feedback 6. Approval Process

11.2 Monitoring the Implementation of the Plan

Monitoring the implementation of a drought plan involves actively tracking key indicators and metrics to assess how well the plan's strategies are being carried out, identifying potential issues, and making necessary adjustments to ensure effective drought mitigation and response actions are taken across different sectors like agriculture, water supply, and environment. Implementation monitoring will involve the following key aspects of the drought plan implementation:

➔ **Data Collection:**

- **Meteorological data:** Regularly monitoring precipitation levels, temperature trends, and evapotranspiration using weather stations.
- **Hydrological data:** Tracking River flows, reservoir levels, groundwater levels, and soil moisture content.
- **Agricultural data:** Monitoring crop conditions, irrigation practices, and yield projections.
- **Social and economic data:** Assessing impacts on water access, livelihoods, and potential conflicts related to water scarcity.

➔ **Drought Indices Calculation:**

- **Standardized Precipitation Index (SPI):** Analyses precipitation deviations from historical norms over different time scales.
- **Palmer Drought Severity Index (PDSI):** Considers precipitation and temperature to assess drought severity.
- **Standardized Precipitation Evapotranspiration Index (SPEI):** Incorporates both precipitation and potential evapotranspiration.

➔ **Trigger Points and Action Levels:**

- Defining specific thresholds for drought indices that trigger different response actions, such as initiating water conservation measures, implementing water rationing, or activating emergency response plans.

➔ **Monitoring Key Activities:**

- **Water conservation efforts:** Tracking water usage patterns in households, industries, and agriculture to assess the effectiveness of conservation measures.

- **Water allocation management:** Monitoring water distribution across different sectors and ensuring adherence to allocation plans.
- **Emergency response actions:** Evaluating the effectiveness of emergency water supplies, water trucking, and livestock management strategies.

➔ **Stakeholder Engagement:**

- Regular communication with affected communities, water management authorities, agricultural stakeholders, and local government officials to gather feedback and ensure a coordinated response.

➔ **Evaluation and Reporting:**

- Periodic reviews of drought plan implementation, analyzing the effectiveness of strategies, identifying gaps, and recommending adjustments to improve future responses.
- **Regular Reporting**: Stakeholders will provide periodic updates on progress.
- **Performance Indicators**: Assessing effectiveness through defined indicators related to drought preparedness and response.

➔ **Tools and Technologies for Monitoring:**

- **Remote Sensing:** Satellite imagery to monitor vegetation health, soil moisture, and land cover changes.
- **Geographic Information Systems (GIS):** Spatial analysis to visualize drought conditions and identify vulnerable areas.
- **Early Warning Systems:** Utilizing data analysis and modelling to predict potential drought events and trigger timely response actions.

11.2.1 Dissemination of the Plan

The DMP will be widely disseminated through various channels, such as community meetings, online platforms, and local media, to ensure public awareness and involvement.

11.3 Reviewing and Coordination Mechanism for Revision of the Plan on Need Basis

The following mechanisms will be established:

- **Planning Teams**: Designated teams responsible for ongoing review processes.
- **Recurring Reviews**: Scheduled evaluations every year or after significant drought events.

Mandatory Review Triggers

The plan should undergo mandatory reviews after:

1. A significant drought or drought-like event occurs.
2. New climate change data becomes available.
3. Changes in operational resources (e.g., new policies or personnel).
4. Shifts in demographics or hazard profiles within Cuttack District.

5. Enactment of new laws or regulations affecting water management.

Updating the Plan (Periodicity)

The DMP should be updated periodically based on findings from monitoring activities and stakeholder feedback to remain relevant and effective. The Chief District Agriculture Office Cuttack will coordinate with all line departments and update the Plan annually in February and March.

Monitoring and Gap Evaluation in the Plan

Ongoing evaluations should focus on identifying gaps in implementation or areas needing improvement, ensuring that lessons learned from past experiences are integrated into future updates of the DMP. This structured approach ensures that Cuttack District's Drought Management Plan is comprehensive, adaptive, and responsive to both current needs and future challenges related to drought management.

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CHAPTER 12

STANDARD OPERATING PROCEDURE FOR DROUGHT MANAGEMENT

The Standard Operating Procedure (SOP) for Drought Management in Nabarangpur District outlines a systematic approach to effectively respond to drought conditions. This chapter details the processes, roles, and strategies necessary for timely and coordinated drought response by various stakeholders. Standard Operating Procedure (SOP) for a drought management plan typically includes three key stages: monitoring and early warning, risk and impact assessment, and mitigation/preparedness and response; each stage involves specific steps like data collection, vulnerability analysis, implementing water conservation practices, and triggering emergency response mechanisms depending on drought severity levels.

1. Monitoring and Early Warning:

- **Establish a monitoring network:** Set up a network of weather stations, rain gauges, soil moisture sensors, and water level monitoring points across the affected area.
- **Data collection and analysis:** Regularly collect data on rainfall patterns, streamflow, reservoir levels, groundwater levels, and vegetation health.
- **Develop an early warning system:** Utilize data analysis tools to identify drought trends and issue timely alerts based on pre-defined drought severity thresholds.
- **Community engagement:** Train local communities on drought monitoring practices and encourage reporting of local observations.

2. Risk and Impact Assessment:

- **Vulnerability mapping:** Identify areas most vulnerable to drought based on factors like population density, socioeconomic conditions, water availability, and land use patterns.
- **Impact analysis:** Assess the potential impacts of drought on agriculture, water supply, livelihoods, health, and ecosystems.
- **Stakeholder engagement:** Consult with local communities, government agencies, and relevant experts to understand diverse perspectives and needs.

3. Mitigation, Preparedness, and Response:

- **Water conservation practices:** Promote water-efficient irrigation techniques, rainwater harvesting, and greywater reuse.
- **Crop diversification:** Encourage the cultivation of drought-tolerant crop varieties and rotation systems.

- **Infrastructure development:** Improve water storage capacity through building and maintaining dams, tanks, and groundwater recharge structures.

(i) Action on Receipt of Warning and Warning Dissemination

Upon receiving a drought warning, the following actions will be taken:

- **Immediate Notification:** The DMC will immediately disseminate the warning to all stakeholders, including local government bodies, agricultural departments, and community leaders.
- **Public Awareness Campaigns:** Utilize local media and community meetings to inform residents about the warning and recommended actions.
- **Activation of Response Protocols:** Initiate pre-defined response protocols to mobilize resources and personnel.

(ii) Process of Accessing Financial and Technical Resources for Drought Response

Accessing financial and technical resources involves:

- **Identifying Funding Sources:** The DMC will identify potential funding sources, such as state disaster relief funds, national grants, and international aid.
- **Proposal Submission:** Prepare and submit proposals for financial assistance to relevant authorities.
- **Collaboration with NGOs:** Partner with non-governmental organizations that specialize in drought response to leverage additional resources and expertise.

(iii) Roles and Responsibilities of Stakeholders at Various Stages of Drought Management

Clearly defined roles for stakeholders include:

- **Drought Management Committee:** Oversee the entire drought response process, coordinate between agencies, and ensure compliance with SOPs.
- **Local Government Bodies:** Implement local response strategies, facilitate community engagement, and manage resource allocation.
- **Agricultural Departments:** Provide technical support to farmers, disseminate information on drought-resistant crops, and monitor agricultural impacts.

(iv) Information Management and Dissemination Strategy

An effective information management strategy will include:

- **Data Collection:** Regularly collect data on weather patterns, soil moisture levels, and crop conditions.
- **Information Sharing Platforms:** Establish platforms for sharing information among stakeholders, including online dashboards and community bulletin boards.
- **Feedback Mechanism:** Create channels for community feedback on drought impacts to inform ongoing management strategies.

(v) Drought Reporting and Drought Assessment

Drought reporting will involve:

- **Regular Assessment Reports:** Prepare periodic reports assessing the severity of drought conditions based on established indicators.
- **Impact Analysis:** Conduct assessments to evaluate the socio-economic impacts of drought on communities.
- **Documentation of Response Actions:** Maintain records of actions taken during drought events for future reference and learning.

(vi) Request for State Government Assistance

The process for requesting state assistance includes:

- **Formal Request Submission:** The DMC will draft a formal request outlining the situation's severity and the required assistance.
- **Documentation of Needs:** Include data supporting the request, such as affected population numbers, economic losses, and resource needs.
- **Follow-up Communication:** Establish communication with state officials to track the progress of the request.

(vii) Visit of Teams from Central or State Level

When teams from central or state levels visit:

- **Preparation of Itinerary:** Coordinate with visiting teams to prepare an itinerary that includes key sites affected by drought.
- **Stakeholder Meetings:** Organize meetings with local stakeholders to discuss challenges faced during the drought.
- **Feedback Collection:** Gather insights from visiting teams to enhance future drought management strategies.

Conclusion

Drought, directly or indirectly, affects the health and well-being of people in both areas at risk of drought and areas directly impacted by drought, particularly in groups with a higher vulnerability to the negative health impacts, including persons living off the land or in remote rural areas, communities with lower incomes, historically and/or systematically marginalized populations, Indigenous Peoples and local communities, older adults, women, including those who are pregnant and lactating, children and youth.

The SOP outlined in this chapter provides a clear framework for effective drought management in Nabarangpur district. By establishing well-defined processes, roles, and communication strategies, stakeholders can enhance their preparedness and responsiveness to drought conditions. This proactive approach is essential for minimizing the socio-economic impacts of drought on the community.

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CHAPTER 13

CHECKLISTS

Drought Monitoring & Management Checklist for District-Level Officers

1. Pre-Drought Preparedness

- Establish a District Drought Monitoring Cell with relevant stakeholders
- Ensure weather forecasting infrastructure is in place
- Maintain updated rainfall data records and analyze trends
- Identify drought-prone areas using GIS and IT tools
- Stockpile emergency water supply for drinking and irrigation
- Develop a district-level drought contingency plan for all line departments

2. Early Warning & Monitoring

- Conduct regular soil moisture and crop health assessments
- Monitor reservoir, groundwater, and river levels
- Disseminate early warnings to farmers & stakeholders
- Track livestock health & fodder availability
- Ensure the functioning of rainwater harvesting & irrigation systems

3. Response Measures

- Implement emergency water supply schemes
- Promote drought-resistant crops & alternative livelihoods
- Activate relief distribution (food, fodder, and water)
- Enforce water conservation measures
- Coordinate with NGOs and agencies for support & assistance

4. Post-Drought Recovery

- Assess drought impact on agriculture, water, and economy
- Provide financial & technical assistance to affected farmers
- Improve drought resilience infrastructure
- Document and analyze lessons learned for future preparedness

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CHAPTER 14

FORMATS AND ANNEXURES

(i) Forms as provided in the Manual for Drought Management, 2020, may be included here. e.g., Form1, Form 2A, Form3, Form4, Form5, Form6, Form7, Form11, etc.

(ii) List of emergency supplies with contact details of emergency suppliers.

(iii) Contact details of Nodal officers of different departments, agencies, leading NGOs, suppliers and other related stakeholders. *To be updated frequently. The data may also be uploaded in the ODRN portal.

Success Stories of Drought Mitigation Measures

Success Story -1, "Fodder Cultivation"

Name of the Farmer: Mr. IRFAN KHAN,
S/o: Khalil Khan, At Taragaon,
Block: Nabarangpur, District: Nabarangpur
Scheme: Fodder Cultivation (State Plan)

Irfan Khan is a dairy farmer residing at Taragaon of the Nabarangpur block. He has 40 Milch cows with a production of 250 litres per day. Previously, he was managing the cows on concentrate feeds with a little fodder. The production cost of the milk was a little higher, with less profit. When he came to know the fodder cultivation scheme of the Government and applied for fodder cultivation at Taragaon. Now, he has cultivated 4 acres of perennial fodder and 3 acres of seasonal fodder by utilising the fodder seeds from the ARD Dept. free of cost. Now, he is managing the cows with sufficient fodder. Hence, he has utilised less concentrated feed and is getting 400 litres of milk. The cost of production is less compared to his previous one. Now he is getting more profit.

He was very grateful to the Officials of the ARD sector of Nabarangpur for their guidance and for making my business a profitable one, which will inspire other farmers to adopt fodder cultivation for better milk production and better livestock health.

Contingent strategies for Livestock & Poultry (ARD SECTOR)			
Livestock	Suggested contingency measures		
	Before the events	During the event	After the event
Drought			
Shortage of feed ingredients			
Drinking water			
Health and disease management			
Feed and fodder availability	1. Cultivation of fodder tree. 2. Storage of Improved Quality Fodder 3. Conservation & Storage of feed & fodder	1. Feeding of complete feed block 2. Feeding of urea-molasses-mineral-block & fodder 3. Feeding of stored Hay/Silage/ Improved Quality Fodder 4. Feeding of Tree leaves	1. Production of forage crops 2. Balanced feeding of Animals supported with a little higher concentrate mixture
	Hay & Silage: Preserve the fodder in the form of hay from Berseem & other grasses as well as silage from (a) Maize-harvesting at well-developed cob. (b) Jowar - at flowering stage. (c) Oat (d) Hybrid Napier – 40-45 days old. (e) Water hyacinth mixed with Paddy straw in a ratio of 4:1 with 70 kg molasses /ton of clean water hyacinth. (f) Potato leaves mixed with wheat straw in a ratio of 7:1 and should be supplemented with 3% molasses. Hay: Berseem/ Lucerne and	some of which are as follows: 1. Bamboo leaves 2. Neem 3. Bargad 4. Peepal 5. Seesam 6. Subabul Use of unconventional feed stuff: (i) Aquatic Plants – water hycianth (i) Lotus (ii) Aquatic weeds	1.Cultivation of fodder Rabi maize if water stagnated up to Nov/ December 2. Jowar/Cowpea 3. Maize in September

	other grasses. Bales of hay and other dry fodder should be stored in dry places at the height of the last flood level and covered with asbestos sheet or polythene sheet. 4. Development & storage of: – (a) Complete Feed Block (CFB) (b)Urea-Molasses-Mineral-Block (U.M.M.B)		
	5. Capacity building of farmers: trainings are organized to create awareness for fodder cultivation to minimize the cost of production and better livestock health. 60 farmers of Nabarangpur, Umerkote & Nandahandi were trained in fodder cultivation.	Farmers will use unconventional feed & fodder stuff.	Farmers will cultivate the fodder & feed ingredients to minimize the feed cost and cost of production
	6. Development of Fodder Bank	Fodders will be used at the time of need.	Surplus feed & fodder will be stored for future use in the lean period.
Drinking water	Construction of water vats at the available water resources in the district with the help of BDOs/ NGOs	The water vats will be used as per the need.	The water vats will be repaired if damaged by the help of district administration NGOs
Health and disease management	Veterinary Preparedness with Medicines, Vaccines and provision for mobile ambulatory van. · Vaccination During the flood, stress becomes an incriminating factor for the precipitation of diseases in livestock and poultry. So, necessary vaccination of livestock and poultry should be done against economically important contagious disease. This will be helpful not only to check epidemic in animals, but also to reduce the probability of	Animal safety, Health camp and Treatment The people should be made conscious through announcement with the help of mikes or other means of communicatio n, Health care will be provide through Mobile Veterinary units as and when required..	Treatment of sick animals: The Disposal of Carcass: the disposal of dead animals and birds are to be done by Animal Husbandry Department. Accordingly, Sanitation, deworming, treatment, health camps Culling of Sick animals and disposal of carcass Maintenance of Sanitation: Adequate attention is to be paid to disinfect the premises of temporary sheds with the help of bleaching powder, phenol, carbolic acid etc. In no case the carcass/ cadaver should come in contact with healthy animals

	zoonoses in human beings. Care should be taken for mass vaccination of livestock and poultry with a view to covering 80% of livestock population in order to achieve herd immunity. Mass vaccination should be conducted by a team of Department staff with proper maintenance of detailed Inoculation Register. Pro-active steps should be taken to receive and stock the required doses of vaccines against different diseases for their use at the time of need.	When releasing. Report the location, identification and disposition of livestock and poultry to authorities handling the disaster. Health camp and treatment Stress related diseases outbreaks can Report the location, identification and disposition of livestock and poultry to authorities handling the disaster.	rehabilitated in sheds. Arrangements should be made accordingly. De-worming after the flood: Immediately after flood, the animals like cattle, buffalo. Sheep, goat, pig, dog and poultry need to be de-wormed with suitable broad spectrum an the lmentics. This will enable the animals to regain proper health. In water logged area, sucks can be introduced as biological control measures against snails to protect livestock from parasitic disease.

Poultry

	Suggested contingency measures		Conver gene/linkage s with ongoing programs, if any
	Before the event	During the event	After the event
Drought			
Shortage of feed ingredients			
Drinking water			
Health and disease manageme nt			
Shortage of feed ingredients	Storage of feed ingredients will be done to facilitate the poultry farmers at the time of need. The local vendors will be instructed to store the poultry feed ingredients. Awareness should be created to aware the farmers aware of the locally available feeds for use at time of need.	Poultry feed will be made available to the farmers	Production of Poultry feed ingredients like Maize, oats, groundnuts and storage facility will be made for surplus outputs for future use

Health and disease management	Vaccines to be used for PoultryPoultry Mareks disease vaccine RDV (F1 & R2B),FPV, IBRV, & IBDV· Medicines All Districts should be earmarked for droughtAn inventory of required medicines to treat the affected birds in case of eventualities will be made.The Govt should take steps to procure a sufficient quantity of essential life-saving medicines.· **Mobile Veterinary Clinics** Mobile Veterinary Clinics should be kept ready at each block HQ to treat the birds.	Poultry safety, Health camp and Treatment. The people should be made conscious through announcements with the help of mikes or other means of communication, Health care will be provided through Mobile Veterinary units as and when required. When releasing. Report the location, identification and disposition of livestock and poultry to authorities handling the disaster.Health camp and treatmentStress-related disease	Treatment of sick animals: The Disposal of Carcass: the disposal of dead animals and birds is to be done by the Animal Husbandry Department. Accordingly, Sanitation, deworming, treatment, health camps Culling of Sick animals and disposal of carcassMaintenance of Sanitation:Adequate attention is to be paid to disinfecting the premises of temporary sheds with the help of bleaching powder, phenol, carbolic acid etc. In no case, the carcass/ cadaver should come in contact with healthy animals rehabilitated in sheds.

	Veterinary hospitals or Veterinary Camps so that immediate treatment of injured and affected animals may be done. For this, MVC must have adequate drugs and emergency health care facilities, along with trained personnel. A good no. of mobile clinic teams should be planned to consist of dedicated and experienced technical workers with allotment of area of operation. The teams should be kept in readiness, having the required stock of medicines and equipment to work in any adverse situation. A telephone directory should be maintained at the District level by collecting the telephone nos. of Vets, Para-Vets, NGOs / youth clubs/societies, volunteers etc. to collect feedback and plan the activities during the emergency. An emergency kit for poultry should be made ready well in advance. The Poultry kit should have a Cage, mask, mash, pellet feed trough, waterers, detergents, poultry vaccines, Veterinary drugs, workers' protection uniform	outbreaks can report the location, identification and disposition of livestock and poultry to authorities handling the disaster.	

Story-2

Ridge-to-Valley Approach Micro Watershed of Kosagumuda Block in Nabarangpur District

To conserve every drop of water starting at the ridge and reduce the surface run-off, while planning NRM works ridge-to-valley approach has been adopted in all the MWSs under WD-PMKSY 2.0 of Nabarangpur District.

1. **Drainage Line Treatment:**

a. Treatment of upper Drainage Line-

To check soil erosion in the channel bed and control the velocity of runoff water, 10 nos. of Loose Boulder Structures (LBS) with an E.C. of Rs. 25,000/- each have been constructed in series across the drainage line. The LBSs have been so designed that the crest elevation of the LBS at Down Stream is the same as the base elevation of the adjacent LBS at Up Stream. Each LBS divides the overall catchment of the drainage line into small sections.

b. Treatment Of Middle and Lower Drainage Line-

For successfully retaining water, checking soil erosion and transforming the channel gradient from a steep slope to a succession of flat steps with low drops, 3 Nos. of Masonry Checks with an estimated cost of Rs. 3.93 Lakh each have been constructed in the middle and lower end of the drainage line.

2. Treatment of Upper Reach:

To stop the further advancement of Gully heads and to improve moisture regime in the command areas, 20 Masonry Gully Control Structures of different spans have been constructed in the upper reaches.

Similar site-specific works with ridge-to-valley approaches have been taken up in other MWSs of Kosagumuda Block, Nabarangpur Dist., under WD-PMKSY 2.0. Some of the representative photographs are given below.

1. 20 Nos. of Gully Control Structures in upper reaches of Balenga MWS, Kosagumuda Block

2. Loose Boulder Structure of size 15 ft span and 4 ft HW height in upper reach of Balenga MWS, Kosagumuda Block.

Check Dam with shutter system across the drainage line at Balenga MWS of Kosagumuda Block.

3. Farm Pond with provision of water inlet & outlet system, Balenga MWS, Kosagumuda Block.

4. Assistance to SHGs under PSME,

Asonga MWS, Kosagumuda Block.

5. Assistance to Farmers under Production System, Balenga MWS, Kosagumuda Block

Success story of Cashew plantation of PD, Watersheds, Nabarangpur District

Nabarangpur District lies under the Eastern Ghats highland and Western Ghats undulating-type agro-ecological zone. The average annual rainfall varies from 1030.21 mm to 1569.50 mm. Even after receiving so much rainfall, the farmer could not produce their crop as per desired yield. So, the farmers often leave their land fallow, given the cost-benefit ratio of cultivation.

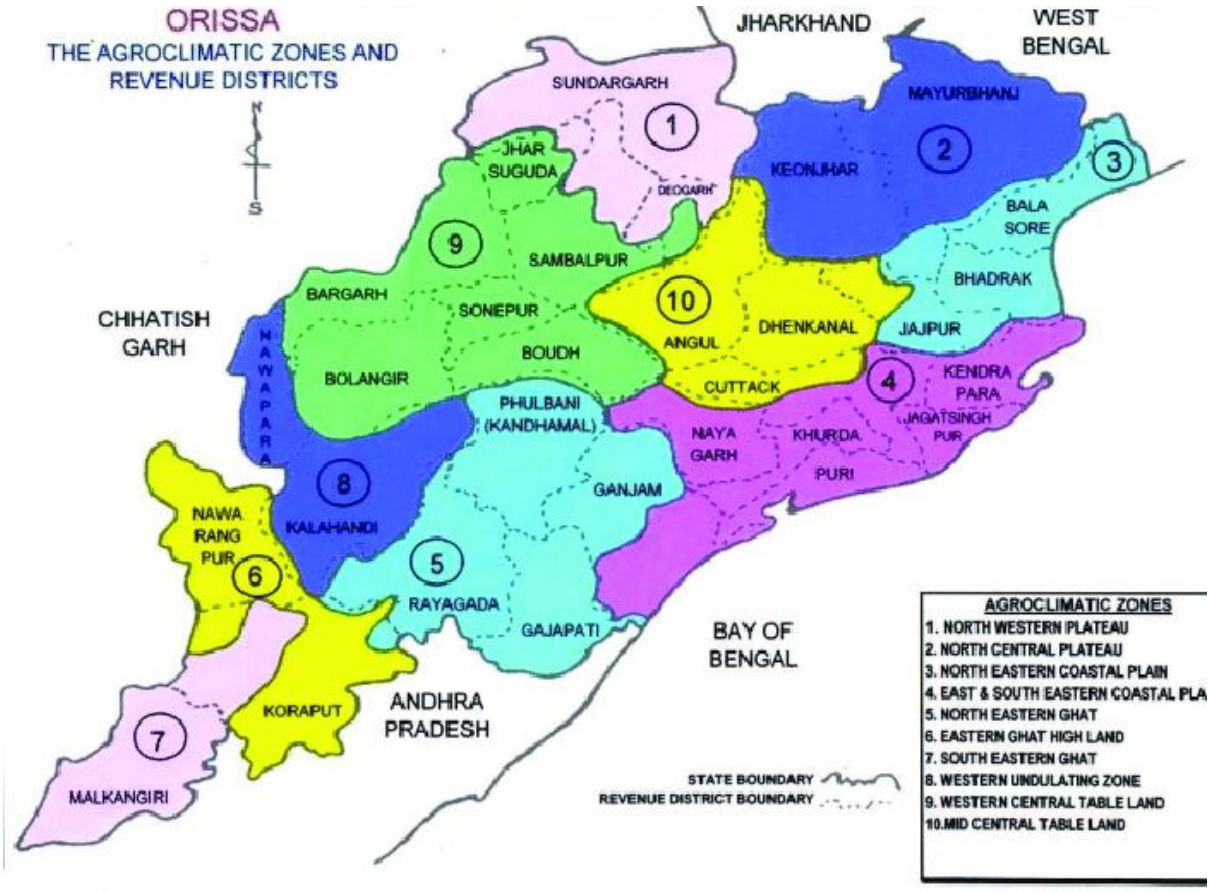
Farming is a gamble in the rainfed areas, especially for the small and marginal farmers who suffer the most due to their small landholdings. Failure of monsoon crop challenges the livelihood of farmer. To provide a sustainable livelihood to the farmers, Cashew plantation was started by the Department since 1978-79, cashew plantation has been covered over an area of 43772.40 Ha. till 2020-21 in the district. Earlier local cashew plantations were prevalent till 2017-18, having an average yield of 5 to 7 Kg per plant with a plantation density of 175 nos. of plants per hectare. During 2018-19, grafted cashew plantation was introduced in the district, having a potential yield of 10 to 15 Kg per plant with a plant population of 200 nos. plant per hectare. These cashew plantation programmes were taken up under the scheme MGNREGS, which not only provides wage employment to the farmers during the kharif season but also sustains livelihood during the lean period.

After the introduction of grafted cashew plantations, this has been taken up in 8 blocks of the district covering 2260 number Household comprises of ST-1599 Nos., SC-383 Nos.& OC-278 Nos. over 1800 Ha. during the year 2019- 20 to 2020-21. Each beneficiary is provided with 2.0 acres of grafted cashew plants that accommodate 160 Nos. plants, and from the 5th year onward till the 30th year, the farmer gets an income over Rs.2,40,000/- per annum from cashew nuts. Each plant will yield 10 kg to 15 Kg per plant, and each beneficiary has 160 nos. of plants over 2.00 acres of land, i.e, 160 nos. × 10 kg = Kg=1600 Kg and the Cashew nut per Kg selling price is Rs.150/- then total selling price of Cashew nut is Rs.2,40,000/-. Apart from cashew nut, the farmers get additional income from intercrop during the Kharif season. Marketing of cashew nut is at the doorstep of the farmers in the district. Furthermore, more than 20 Private cashew processing industries have been established, which is employing the labourers in the district. Therefore, Grafted Cashew Plantation is the most promising and remunerative crop for the farmers, providing a door-step market and lucrative income annually.

03. DEPARTMENT OF HORTICULTURE, NABARANGPUR

1. District crop contingency plan

Odisha has been divided into 10 Agro-Climatic Zones (ACZ) based on soil structure, humidity, elevation, topography, vegetation, rainfall and other agro-climatic factors and indicated below.



Among the 10 agroclimatic zones of Odisha, Nawarangpur comes under the Eastern Ghat Highlands zone. So, it comes under drought-prone areas. Out of 10 Blocks of Nabarangpur District, mainly Jharigaon , Chandahandi & Raighar Block have the most chances of drought occurrence.

Schemes with Climate Resilient Practices

Sl No.	Name of the Scheme	Blocks covered	Total area coverage (In ha)
1	OIIPCRA	Raighar, Chandahandi	34 ha
2	CDP-MLIP	Umerkote , Nandahandi, Nabarangpur	670 ha
3	Hyb veg (NHM)	All 10 Blocks	200 ha
4	HYb Veg (State plan)	All 10 Blocks	700 ha
5	Mushroom Cultivation	All 10 Blocks	Mushroom production unit – 27 Nos

			& Area expansion -260 Nos
6	Nutrition at Doorstep	All 10 Blocks	13376 Nos

Micro-irrigation: Micro-irrigation such as drip, micro-sprinkler and subsurface drip was found advantageous in increasing water productivity considerably. The drip irrigation system has proved to be a great success in terms of water saving up to 70-80%.

According to the annual action plan of PMKSY(PDMC) - 2024 -25, it has been planned to cover 7200 Ha under micro-irrigation (1200 Ha of Drip irrigation + 6000 Ha of Sprinkler irrigation) in Nabarangpur district.

Crop and cropping system management: -

Horticulture Crop management patterns for Nabarangpur district to mitigate drought are: -

Rainfed

- Vegetables (Cowpea, Okra, Brinjal, Tomato, Bean, Cucumber, Pumpkin, Turmeric, Ginger) -black gram/toria
- Turmeric/ginger
- Fruit crops (Apple ber, Date palm, Pomegranate, Dragon fruit, Pineapple, Tamarind)

Irrigated

- Rice-sweet corn/pulses-vegetables
- Rice-potato-vegetables
- Rice-onion/coriander
- Maize/millets-vegetables-pulses
- Turmeric/ginger-green gram/black gram
- Sweet potato- green gram/black gram

Major key points: -

- Select efficient crops and cropping systems matching the length of the growing season. Some of the promising non-rice crops for rainfed uplands are cowpea, pumpkin, sweet potato, elephant foot yam, yam, tapioca, yambean, arrowroot, colocassia. Among kharif crops, Crop diversification with low-duty non-paddy crops like cowpea, pumpkin, sweet potato, elephant foot yam, yam, tapioca, yam bean, arrowroot, colocassia may be taken.
- Vegetables come up well in drought/low rainfall years. Utilize the ponds, reservoirs and water bodies for growing tomato, cauliflower, radish, brinjal, and runner beans in the inland hilly districts.
- Adopt intercropping/mixed cropping system in recurrent drought-prone areas:

Sl No.	Intercropping	Row Ratio	Row distance of intercrop (cm)
1	Arhar+ Radish	2:2	30
2	Arhar + Okra	2:2	30
3	Maize+ Cowpea	2:2	30

4	Maize+ Runner Bean	2:2	40
5	Okra+ Rice	2:4	15
6	Radish + Rice	2:4	15
7	Maize + Yam	Two rows of maize grown at a 30 cm distance on both sides of the yam were planted in mounds 90 cm x 90 cm to act as live stakes.	

VEGETABLE CROP MANAGEMENT UNDER CLIMATE STRESS CONDITIONS

Vegetable crops can adjust to short-term water stress by maintaining higher water potential, increased root-shoot ratio, lowered transpiration rate, etc., under mild drought conditions. Measures to alleviate water stress

» It is recommended to use short-duration varieties.

Brinjal : - Utkal Anushree, Ukeshari, U.Tarini, UMadhuri
Hybrid: JK-8035, Rakshita, Songro-132, VNR
Tomato : - summer-KaligaTomato101, Mhyco, Sakhyam, VL642 (Seminis)
Chilli : - Utkal Abha, Ragini, EW-Daya, VNR-305
Cowpea : - KashiKanchan, Utkal Manik
Dolichus : - Local, BDB-2, Yam-Odisha elite, Hatikhojia
Sweet potato : - Gauri, Dhenkanal local
Drumstick : - PKM2, Bhagya, Rohit 2
Bottle gourd : - Utkal Shobha
Pointed gourd : - Swarnaaloukik, Swarnarekha

Provision for short-span production of quality seedling Contour cultivation, contour strip cropping, mixed Cropping, tillage, Vertical mulching, and zero tillage are some of the agronomical measures for in-situ soil moisture conservation.

For drip irrigation, generally, in-line drip laterals having emitting points spaced at 30cm distance and emitting at the rate of 2LPH are selected for vegetable crops. In crops like chilli, Brinjal, Cauliflower and okra, paired row planting is practiced and one drip lateral is used for two crop rows. In summer, the sprinkling of water with a micro sprinkler helps reduce the microclimate temperature and increases the humidity, thereby improving the growth and yield of the crop. The water saved is to the tune of 20 to 30 per cent. In capsicum, tomato, okra and cauliflower, it was indicated that adopting alternate-furrow irrigation and widely-spaced furrow irrigation saved 35 to 40 per cent of irrigation water without adversely affecting yield.

- Enhancing soil organic matter content.
- Apply foliar nutrition.
- Mulching Practices in Vegetable Production.
- Windbreaks, hedges and intercropping.
- Use of protected cultivation of vegetables.

- Special care to control leaf miners, thrips and mites during high-temperature stress.
- Chemicals for mitigating Water Stress.
- Foliar spray of 2%c DAP + 1% KCl (MOP) during critical stages of flowering and grain formation.
- 3% Kaoline spray at critical stages of moisture stress.
- Foliar spray of 500 ppm Cycocel (1 ml of commercial product per litre of water).
- Use of biofertilizers viz., Azotobactor, Azospirillum and phosphobacteria @ 10 packets (500g) / ha along with 25 kg of soil or FYM.
- Seed hardening with 1% KH2 PO4 and other salts for 6 – 8 hours (depending upon the nature of the seed coat) soaked in an equal volume of water.
- Spray of 40 ppm NAA to check flower and fruit drops (4 ml of PlanoỊ x in 4.5 litres of water) .
- Amino acid-based hormones like Tata amino (tatarallis), phantac plus help in fruit setting and flower initiation.
- To avoid flower and fruit drop spray planofix (1ml/4.5 lit), brassinoloid based horrmone.
- Alcohol-based hormone (tricontanol) ,miraculan -1ml/lit increased photosynthetic rate.
- Anti-transparent like kaolinite dust 5gm/lit may be spread to check transpiration loss.
- Spray micronutrient, particularly Ca, Boron viz. cal-bor (multiplex) 2gm/lit.
- Application of apsa-80 (amway) 2ml/lit applied on soil surface.
- Grafted brinjal, tomato, chilli (rootstock S.turvum, S.microcarpum,S. Sisimbrifolium) help for absorbing water below 32-45 cm subsurface soil.
- Foliar spray of 100 ppm salicylic acid for increasing stem reserve utilization under high moisture stress.
- Foliar spray of 0.3 % Boric acid + 0.5 % ZnSO4 + 0.5 % FeSO4 + 1.0 % urea during critical stages of the stress.

2.22(b) Infrastructure Availability

Input dealer points of the Horticulture Department at different Blocks: -

Sl No.	Name of Block	Name of Farm/ Nursery	Input material (Grafts) available	Total Graft available
1	Nabarangpur	T.N.Nuaguda	Mango Graft - 10000	**15000**
			K.Lime - 5000	
2	Nandahandi	BLN, Daibhatta	Mango Graft - 50000	**130000**
			K.Lime - 25000	
			Jackfruit -10000	
			Hyb Papaya - 45000	
3	Papadahandi	Semla Farm	Mango Graft - 50000	**65000**
			K.Lime - 5000	
			Jackfruit -10000	
		BLN, Papadahandi	Mango Graft - 15000	**22500**
			Guava Goote-2500	
			K.Lime - 5000	
4	Tentulikhunti	Nil	Nil	

5	Dabugaon	T.N.Dabughaon	Mango Graft - 10000	**12500**
			Guava Goote-2500	
6	Kosagumuda			
7	Umerkote	HDPO,Umerkote	Mango Graft - 10000	**22000**
			Litchi -2000	
			K.Lime - 10000	
		Cashew Nursery,Umerkote	Cashew Graft -50000	**50000**
8	Raighar	BLN, Raighar	Mango Graft - 5000	**5000**
9	Jharigaon	BLN, Jharigaon	Mango Graft - 10000	**13000**
			Litchi Gootee -3000	
10	Chandahandi	Nil	Nil	
			Total	**335000**

Capacity building training and awareness programme

As per the scheme under state plan 2024-25, Thirty Capacity building training programme for farmers is allocated for Nabarangpur district regarding awareness about various schemes of the Government and drought preparedness plan and flood control situations.

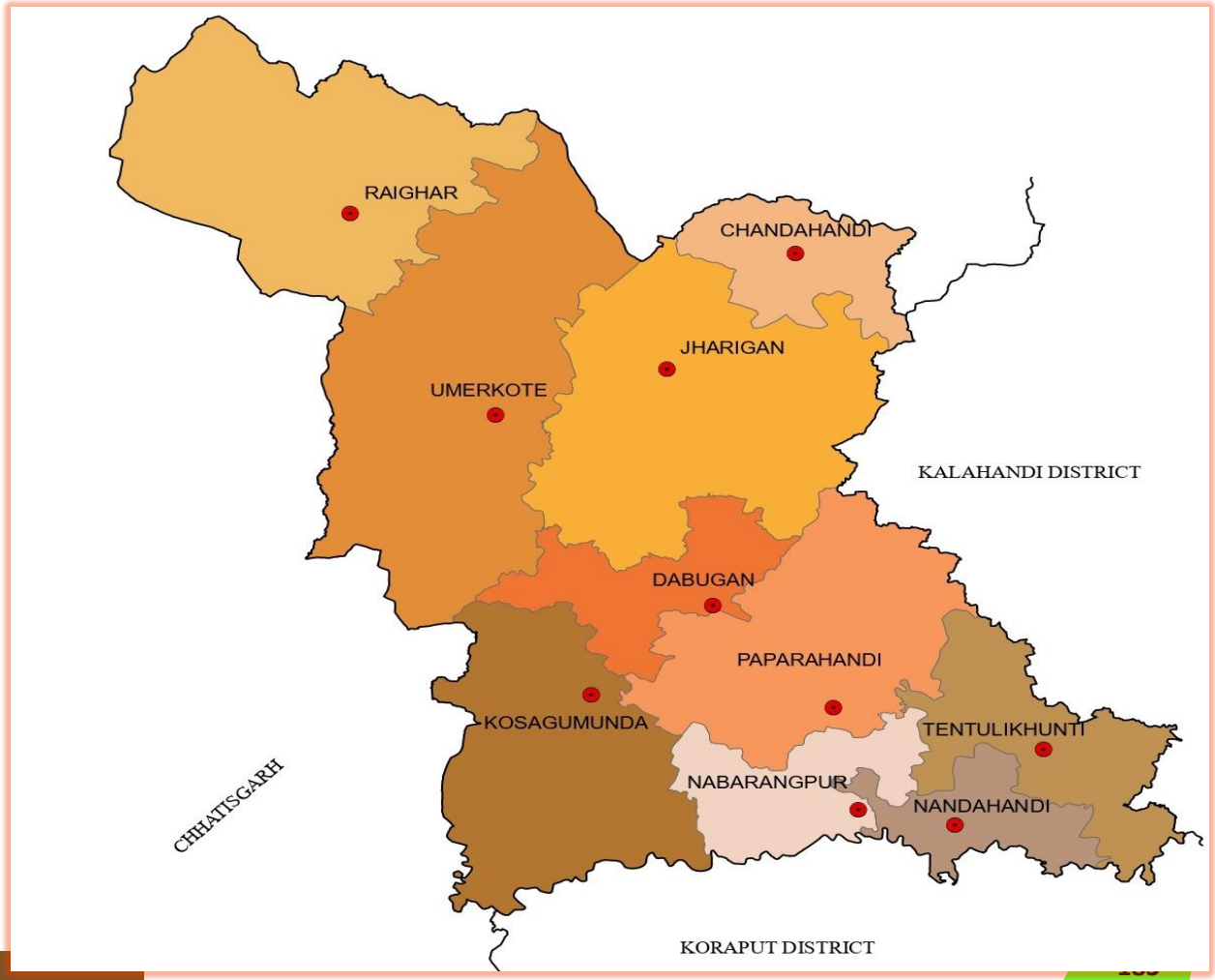
Success Story of Millet Growers of Alguni Village

Three decades ago, the farmers of Alguni were cultivating different varieties of millet like little millet, foxtail millet, sorghum and finger millet. After the boom of maize crops in the area as a cash crop, these farmers replaced traditional millet cultivation with hybrid maize. After several years of maize farming, the productivity of their land was reduced during high chemical usage. Due to an increase in the price of fertilizer, pesticide and daily wages, the cost of maize cultivation became higher. Odisha Millets Mission has supported farmers like Salata Santa, Buchi Santa Radha Santa and others to revive millets on their farms and plates.

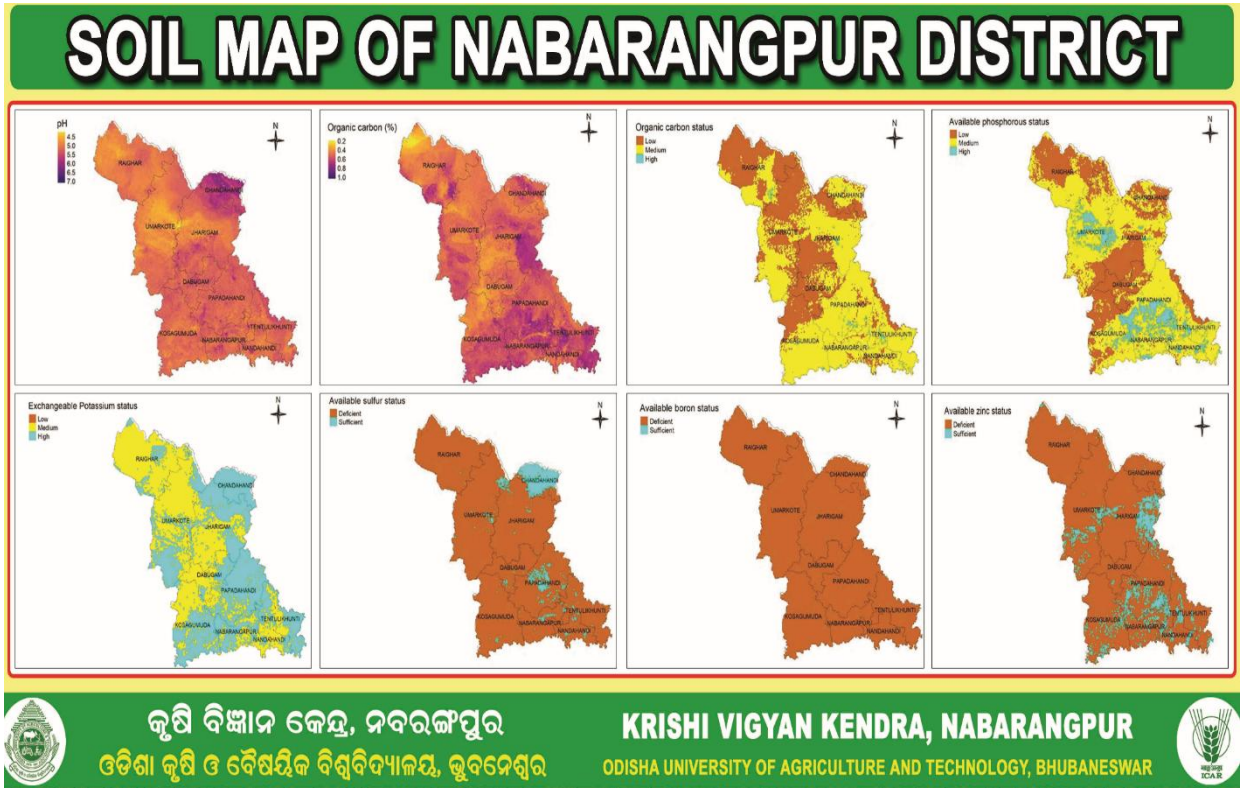
Agragamee has promoted millet cultivation under the System of Millet Intensification (SMI) and Line Transplanting (LT) under Shree Anna Abhiyan Project Nabrangpur, supported by Dept. of Agriculture and Farmers Empowerment, Govt. of Odisha. “We have been switching from hybrid maize to little millet and foxtail millet in upland,” said Salata Santa (34 yrs.), a millet grower from Alguni village at Manchagan G.P. in Nabarangpur district of Odisha. Farmers like Salata are beginning to see the merits of millet. It is not only “climate resistant” – a huge plus in drought-prone Odisha – but its prodigious productivity brings more yields. The small-seeded grass species of millet is a cereal grown around the world in semi-arid and tropical regions, requiring minimal input. It is used both as human food and fodder, she added. Following her efforts, many farmers in the village now dedicate part of their holding to growing millet. She possesses native types of foxtail millet, little millet and sorghum millet, which are presently in short supply. "I have conducted trials on my one acre of land and demonstrated how, on average, little millet and foxtail millet can offer yields as high as 4.5 quintals per acre. The majority of farming now uses organic inputs, which lowers production costs, she claimed. “We grew maize on 1 acre of land and spent 28,500 rupees to get 3.5 quintals of maize eventually. In comparison, we have

been getting 4.5 quintals of little and foxtail millet from 1 acre of land after spending only 2500 rupees," she said. A total 25 farmers of Alguni village have cultivated millet like Finger millet, Little Millet, Foxtail Millet and Sorgum on 37 acres during Khrif 2024-2025 while 25 farmers of Alguni village cultivated millets on 30 acres in Kharif 2023-2024 and in the year 2022-23, 12 farmers have cultivated Little Millet and Foxtail Millet in 14 acres and harvested 58 Qntls of Little Millet and 42 Foxtail Millet. Most of the farmers now accept it as a major value crop. The usage of Jeevamruta and Handikhata has enhanced production. It is further boosted by the application of methods like System of Millets Intensification (SMI), Line Transplantation (LT), and Line Sowing (LS). Seeing the scope of growth of crops using a set of practices and returns on the same, many farmers have taken up millet cultivation during the last few years and this number is steadily increasing. With the initiation of the Shree Anna Abhiyan Project and the provision of incentives, farm machinery for drudgery reduction, equipment for processing, and storage of grain and marketing support through procurement, farmers of Tagapali village have realized the importance of millet as an aspirational crop that can ensure livelihood as well as nutritional security.

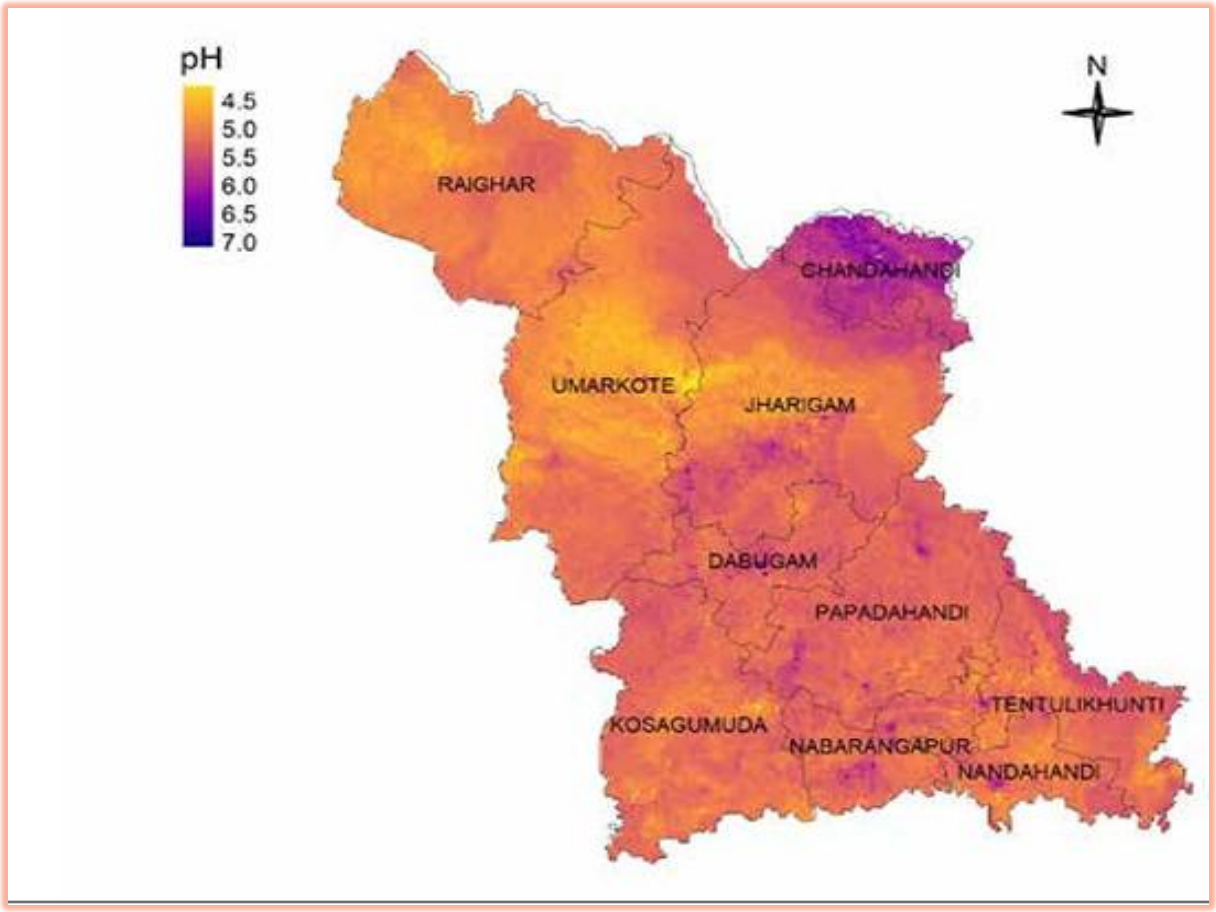
Annexure –I, DIGITAL MAP OF THE DISTRICT NABARANGPUR INSIDE THE STATE ODISHA

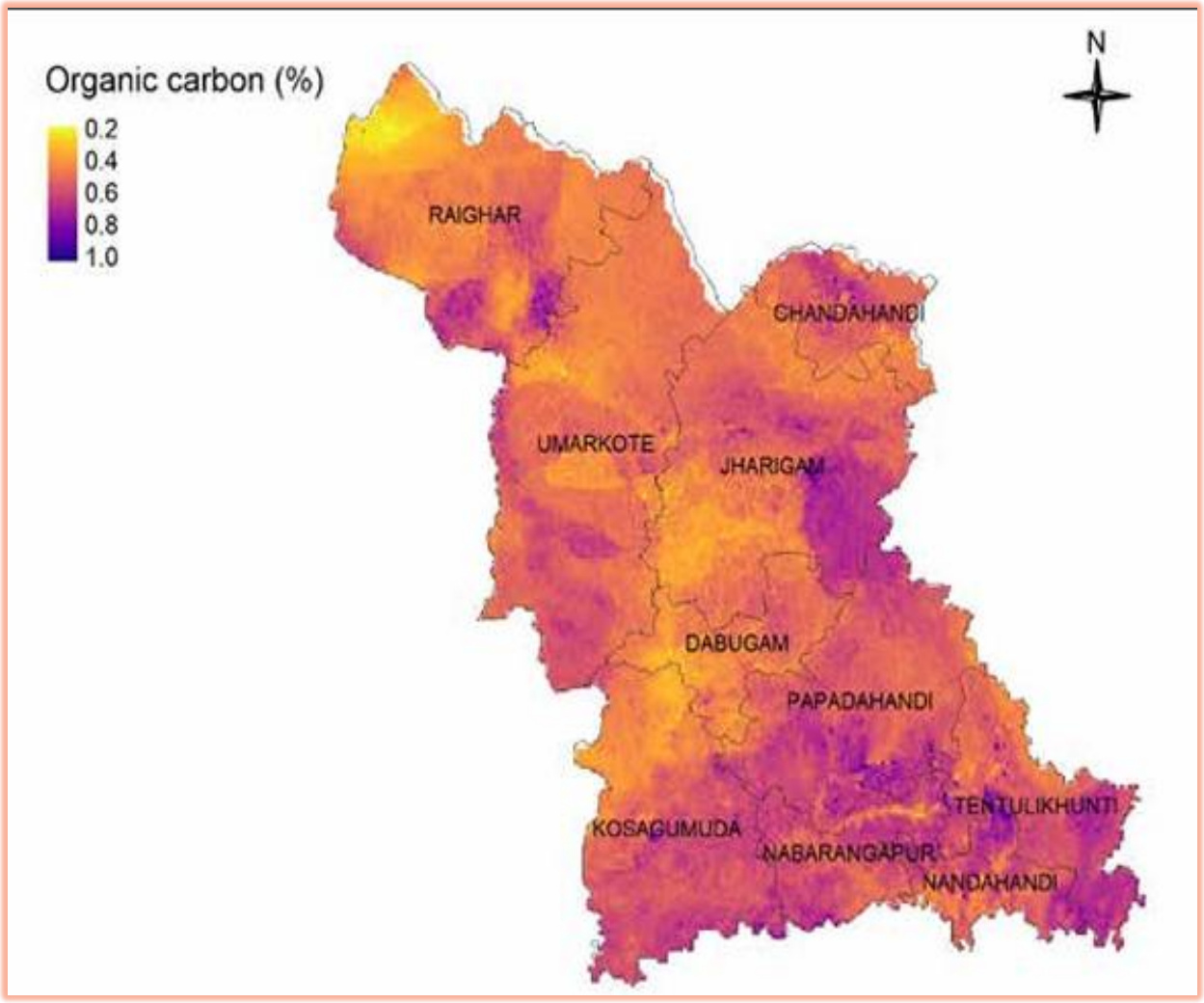


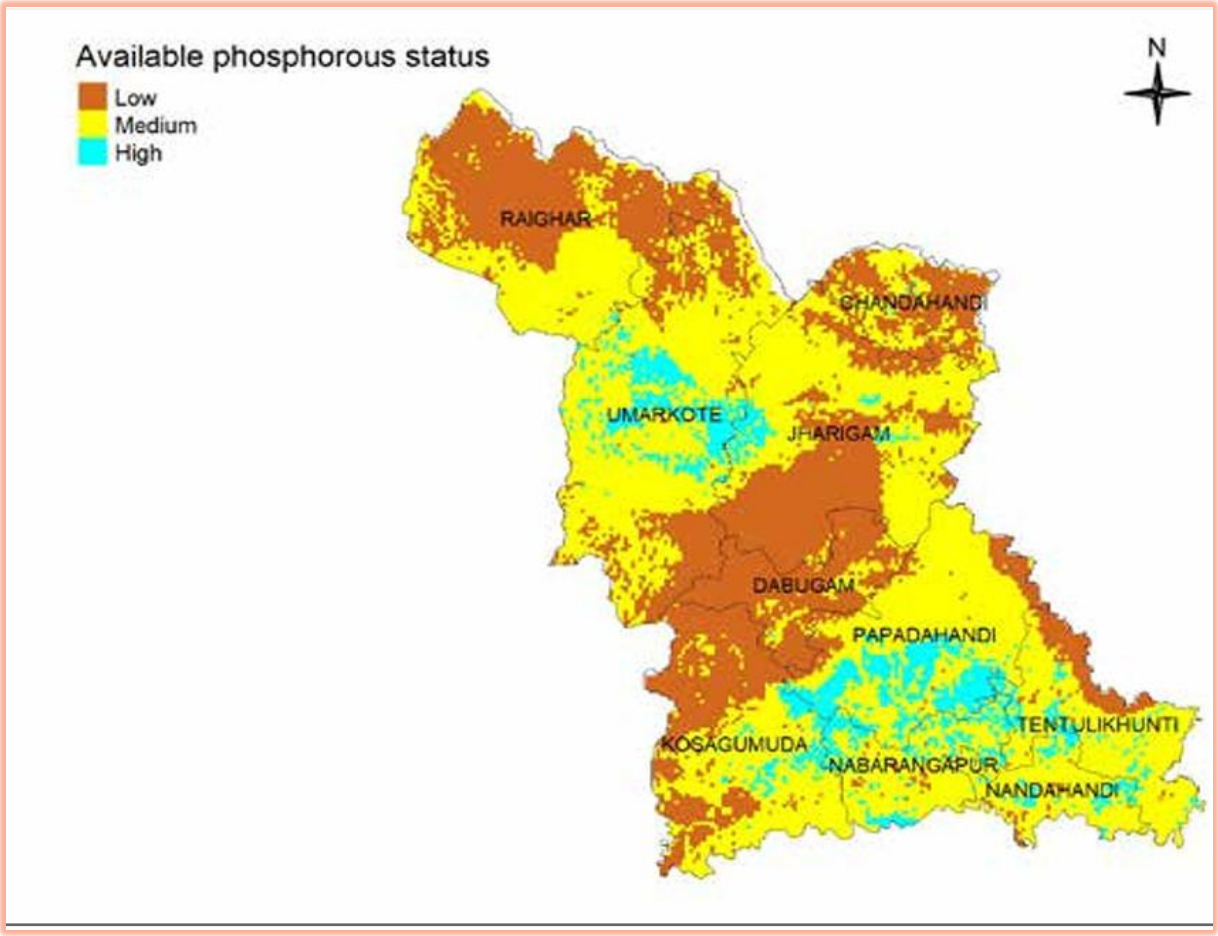
ANNEXURE – II – SOIL MAP OF NABARANGPUR DISTRICT

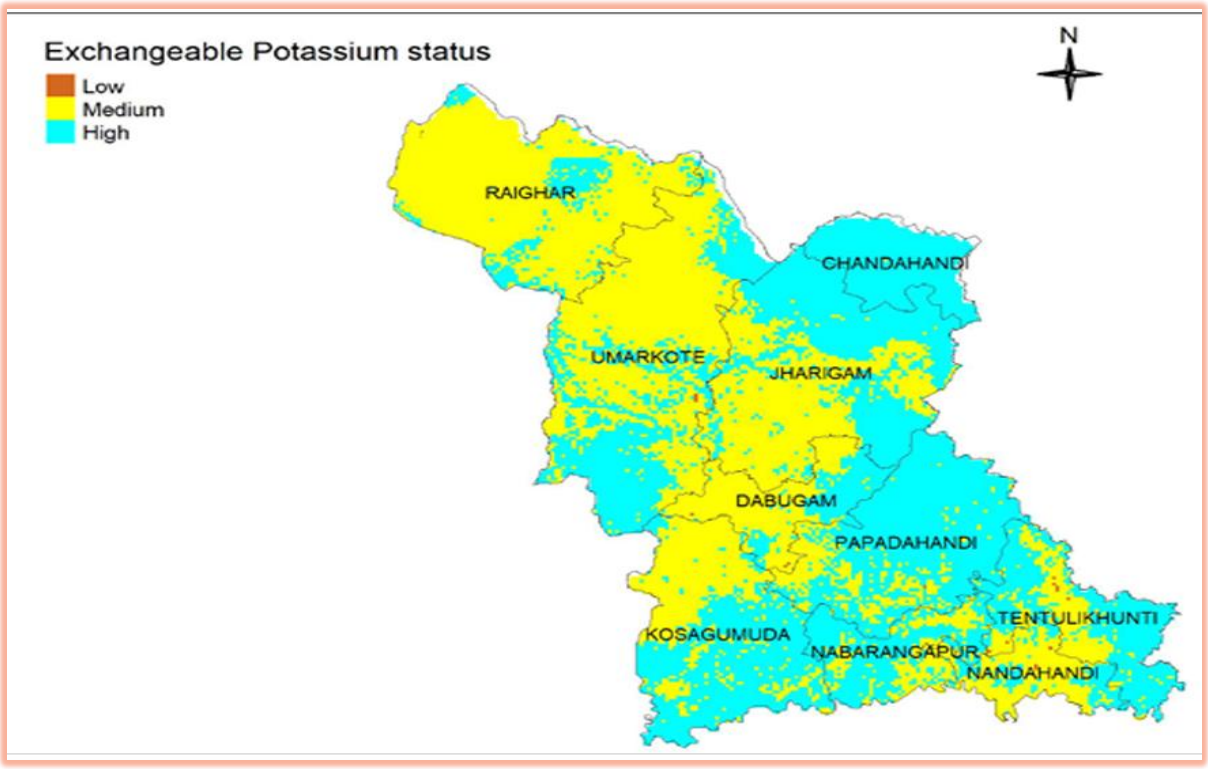


ANNEXURE – III – BLOCLWISE NITROGEN OF NABARANGPUR DISTRICT




Organic carbon (%)
0.2
0.4
0.6
0.8
1.0
N
RAIGHAR
CHANDAHANDI
UMARKOTE
JHARIGAM
DABUGAM
PAPADAHANDI
TENTULIKHUNTI
KOSAGUMUDA
NABARANGAPUR
NANDAHANDI


Available phosphorous status
Low
Medium
High
N
RAIGHAR
CHANDAHANDI
UMARKOTE
JHARIGAM
DABUGAM
PAPADAHANDI
TENTULIKHUNTI
KOSAGUMUDA
NABARANGAPUR
NANDAHANDI


Exchangeable Potassium status
Low
Medium
High
N
RAIGHAR
CHANDAHANDI
UMARKOTE
JHARIGAM
DABUGAM
PAPADAHANDI
TENTULIKHUNTI
KOSAGUMUDA
NABARANGAPUR
NANDAHANDI