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EVOLUTION OF EXISTING CROPPING PATTERN FOR UPPER GODAVARI RIVER ON THE BASIS OF SURFACE WATER QUALITY

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ABSTRACT

Environment is relative term of the nature. God has bestowed Earth Mother Nature in various forms of resources to the universe. While going ahead towards development and production, we have forgotten that simultaneously we using our natural non-renewable sources to large extent. So we should develop considering the term "sustainable development." Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The water quality data generated by Hydrology Project, Maharashtra for 7 Water Quality sampling locations along Godavari River up to Jaikwadi Dam through various regional Water Quality Level – II, Laboratories at Nashik, Aurangabad for the period of June 2008 to May 2013 which is considered for preparation of this report. The report includes location wise classification as per criteria of CPCB, ICAR and SAR for various water uses & salinity hazards towards its use for Irrigation Purpose and for define Cropping Pattern. Location wise interpretation of water quality data as per standards specified for Water Quality assessment along with recommendations for maintaining the wholesomeness of Surface Water. On the basis of classification the suitable cropping pattern is decided towards increase in Crop Yield in the periphery of defined location.

Keywords: civilization, Cropping Pattern, Sustainable development, urbanization and industrialization.

I. INTRODUCTION

In exercise of powers conferred by sub sections (1) and (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the central government constituted an authority to be known as "Water Quality Assessment Authority". This authority is empowered to draw action plans for quality improvement in water bodies and monitor and review/assess implementation of the schemes launched or to be launched, to review the status of quality of national water resources (both surface and ground water) and identify "Hot spots" for taking necessary action for improvement in water quality, to constitute/set up state level Water Quality Review Committee (WQRC) to coordinate the work to be assigned to such committees. The Water Quality Review Committee for Maharashtra was constituted on 01/01/2003 under the chairmanship of Secretary Water

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Resources Department In order to perform aforesaid task, a uniform protocol was formulated called as **"Uniform Protocol on Water Quality Monitoring Order, 2005 vide gazette notification dated 17th June 2005".** In Maharashtra, Hydrology Project of Water Resources Department, Government of Maharashtra is monitoring 7 stations for surface water

Water: An odourless, tasteless, colourless liquid formed by a combination of hydrogen and oxygen; forms streams, lakes, and seas, and is a major constituent of all living matter.

Water bodies: The part of the earth's surface covered with water such as rivers, lakes, ponds, reservoirs and oceans etc. are described as water bodies.

Water is 'life'. It is one of the fundamental needs on the globe. Water is probably the only natural resource to touch all aspects of human civilization- from agricultural and industrial development to cultural and religious values embedded in society.

The total water amount on the earth is about 1.35 billion cubic kilometers. About 97.1 % has been locked into oceans as saltwater. Ice sheets and Glaciers have arrested 2.1 %. Only 0.2 % is the fresh water present on the earth, which can be used by human for variety of purposes. Remaining 0.6 % is in underground form. But unfortunately it has been getting polluted day by day due to different anthropogenic activities. So it is burning need, to conserve the water and prevent it from every type of pollution. There should be proper water quality investigation and management. This could be possible by continuous Water Quality Monitoring. The water quality monitoring in the area of surface water is performed in order to determine the quality of water. 26 parameters are analyzed in the laboratory and 6 parameters are tested at field level. All these tasks are recorded are utilized for preparing the Annual Report by performing some specific exercise. These data are considered in order to specify the quality of water at each location. This also helps to determine the pollution level or concentration in each source of water at each station.

River basins in India

There are thirteen major river basins in the country, which occupy 83 % of total drainage basins, contribute 85 % of total surface flow and house 80% of the country's population. They are Bramhaputra, Ganga, Indus, Godavari, Krishna, Narmada, Bhima, Cauvery, Tapi, Pennar, Mahanadi, Brahmini & Baitarni, Sabarmati and Mahi. There are also eight other basins formed by grouping together a number of medium and minor basins. All the major river basins are not perennial. Only 4 of the 13 major basin possess areas of high rainfall i.e. Brahmaputra, Ganga, Mahanadi and Brahmini having annual average discharge of a minimum of 0.47 million cubic meter per km^2 per second and they are perennial. There are a few desert rivers, which flow for some distance and are lost in the desert.

River basins in Maharashtra

Geographical area of the state is divided in five river basins viz. Godavari. Tapi, Narmada, Krishna and west flowing rivers in Konkan region**.**

Water Quality Monitoring (SW) in Hydrology Project

Hydrology project aims at establishing a Hydrological Information System (HIS) in the state and the HIS includes Water Quality Monitoring of Surface Water. The basic objectives for WQ Monitoring are:

- Monitoring for establishing baseline water quality.
- Observing trend in water quality changes.

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- Calculating of flux of water constituents of interest.
- Control and management of water pollution.

Monitoring for establishing baseline water quality

Water Quality Monitoring System (WQMS) is developed as per WQ network as below; Distribution of 7 WQ sampling locations is done amongst 2 Level-Il laboratories located at different places i.e. Nashik-25,and Aurangabad-20,.The WQ sampling frequencies considered for initially three year based on type of station classification. The Water Quality monitoring is being carried out under Hydrology project. Hydrology project (SW), Maharashtra takes care of Surface water Quality monitoring through 7 sampling locations spread over the state throughout the year. In accordance with decision taken in 1st meeting of Water Quality Review Committee of State of Maharashtra, 'The Uniform Protocol' for Water 'Monitoring finalized by the Water Quality Assessment Authority formulated by the Ministry of Water Resources is made available to H.P. SW, Maharashtra.Hydrology project, (SW), Maharashtra has gone through the recommendation given in protocol and considering needs of HP, (SW), Maharashtra some guidelines are designed and circulated to field offices. On the basis of this Protocol, it is suggested to finalize the criteria for classification of location as 'BASELINE', 'TREND',' FLUX ' etc. after collection of data. The Project Development Objective (PDO) is to extend and promote the sustained and effective use of the HIS by all potential users concerned with water resources planning and management, both public and private, thereby contributing to improved productivity and cost-effectiveness of water-related investments in the 13 states and eight Central agencies. The Ministry of Water Resources (MoWR) Govt. of India is to implement, with assistance from the World Bank, the Hydrology Phase II Project, which will be a six-year project started from 05/04/2006. The project will involve: (i) the state surface water (SW) and groundwater (GW) agencies in the nine states covered by the recently-concluded first-phase project (HP-I) - Andhra Pradesh, Chhattisgarh, Gujarat, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu; (ii) four new states — Himachal Pradesh, Goa, Pondicherry and Punjab; and Central agencies including MoWR, Central Water Commission (CWC), Central Groundwater Board (CGWB), National Institute of Hydrology (NIH), Central Water and Power Research Station (CWPRS), India Meteorological Department (IMD), Central Pollution Control Board (CPCB) and Bhakra- Beas Management Board (BBMB).

The project objective is to extend and promote the sustained and effective use of the Hydrological Information System (HIS) developed under HP I by all potential users concerned with water resources planning and management, both public and private. This will be achieved by: (a) strengthening the capacity of hydrology departments (surface ad groundwater) to develop and sustain the use of the HIS for hydrological designs and decision tools; (b) improving the capabilities of implementing agencies at state/central level in using HIS for efficient water resource planning and management to meet the country's poverty reduction objectives; (c) establishing and enhancing user-friendly, demand-responsive and easily-accessible HIS; and (d) improving access to the HIS by public agencies, civil society organizations and the private sector through supporting outreach services. The project would consist of three main components: (i) Institutional strengthening, covering all 13 states and 8 central agencies; (ii) Vertical Extension, covering the existing nine states and six central agencies; and (iii) Horizontal Expansion, covering the four new states and two new -central agencies (CPCB and BBMB).

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II. LITERATURE SURVEY

The Status Report on "Surface Water Quality Status in Maharashtra State" is prepared by S. K. Kshirsagar, Hydrology Project (SW), Nashik, Maharashtra and submitted to the Sikkim Manipal University for further needful. The same report is taken in to consideration for preparation of the "Evaluation of Existing cropping pattern for upper godavari (up to jayakwadi) on the basis of surface water quality" with respect to various uses and criteria of CPCB, ICAR for various Water Uses.This report includes water quality data generated in Maharashtra State through the Office of the Chief Engineer, Hydrology Project (SW), Nashik (Maharashtra). The data has been interpreted to know the 'Surface Water Quality Status in Maharashtra' with respect to various uses and criteria of CPCB, ICAR for various Water Uses. The report also includes location wise classification as per Wilcox Technique towards use of water for Irrigation as well Basin wise interpretation as per standards specified for water quality assessment along with recommendations for maintaining the wholesomeness of surface water.Water Quality data generated by Hydrology Project (SW), Maharashtra for 127 Water Quality Sampling locations through various regional Water Quality Level-II, Laboratories The at Nashik, Aurangabad, Nagpur, Pune and Kolhapur for the period of June 2005 to May 2010 is considered for preparation of this report. The Report includes location wise classification as per criteria of CPCB, ICAR for various Water Uses & salinity hazards towards use of water for Irrigation. Basin wise interpretation as per standards specified for water quality assessment along with recommendations for maintaining the wholesomeness of surface water.

Discussion on the Results of Previous Investigation (June 2005-May 2010)

Basin wise distribution of sampling locations Considering the said data for 127 location of the state, are well distributed in four major basins of the state to find out the basin wise trend of water quality and will be useful to find out stretch where attention is to be diverted for further monitoring or to decide action points.

In brief the basin wise locations are, Godavari – 42, Krishna – 33, Tapi – 18 & Konkan – 34 & Total of the state are 127 Locations

First criteria considered is on the basis of CPCB criteria with respect to designated best use and quality class : As per CPCB Classification of Water as Class A, B, C, D, & E, the Suitability in State shows that Class A- 6 Stations, Class B- 44 Stations, Class C-72 Stations, Class D- 121 Stations & Class E- 125 Stations out of 127 Stations which indicate that for Irrigation Purpose there is no any problem but for other uses care should be taken into considerations.As per Quality Class and their significance Class A & C are for Drinking purposes and result show that only 6 locations out of 127 are fit in Class A and 72 locations out of 127 having quality of water that may use for drinking purpose with conventional treatment as per Class C.

On the Class B indicates for the use of Out Door Bathing where only 44 locations out of 127 water is suitable for Organized Outdoor bathing. In the case of Class D which is useful for Propagation of wild life and fisheries, the results shows that nearly 121 location out of 127 are having capability of fisheries during flow period as the results are during flow period.

Second criteria is classification of sampling location on the basis of ICAR standards for irrigation water on the basis of average values for the period of June 2005 to May 2010 : Classification of Sampling Location on the basis of ICAR Standards for Irrigation water on the basis of Average values for the period of June 2005 to May 2010 with respect to Irrigation water use.Out of 127 Water Quality Sampling locations in the state 67 locations are found OK for Irrigation as per ICAR Standard, for other locations need detailed monitoring and

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nearly 30 % location need to be observe frequently to find out point and non-point sources as these locations are marginally crossing the limits.

Third criteria is on the basis of station classification with respect to EC & SAR on the basis of Wilcox technique & average values for the period of June 2005 to May 2010 : For the interpretation on the basis of EC & SAR water is Classified as A, B & C where A- Water Is Good For Irrigation Purpose, B- Water Is Suitable For Irrigation Purpose .C- Water Is Suitable For Salt Tolerant Crop & ND- No Data**.**As per ICAR guideline only 67 locations having water Good for Irrigation, 31 Locations having high % Sodium that indicates that water at these locations may be useful for Salt tolerance crop and 28 locations are having inadequate data causes difficulty in interpretation.

Gains of This Study

In order to prevent water pollution and for conservation of water and create mass awareness in general public regarding surface and ground water quality aspects, recommendation /remedial measures are described as below.

Qualitative/Technical

1) Domestic effluents may be treated and disinfected before discharging.

2) Effluents from the non-point sources may be identified. These are required to be collected and treated.

3) Tree plantation may be done on banks of rivers to minimize soil erosion and to improve the area aesthetically.

4) The artificial recharge of ground water through integrated watershed management programme and rainwater harvesting will help to improve the ground water quality in the area where the problem exists.

III. DATA COLLECTION AND ANALYSIS

Data Collection

Water Quality data for the period of June 2008 to May 2013 is received in the form of SWDES (Surface Water Data Entry System) a computerized Software dedicated to Water Quality data Entry and validation in Hydrology Project and having facility of data interpretation.The said data is interpreted by using this SWDES Software which outcome various reports and graphical interpretation.

Analysis of Data

The water quality monitoring in the area of surface water is performed in order to determine the quality of water. 26 parameters are analyzed in the laboratory and 6 parameters are tested at field level. All these tasks are recorded are utilized for preparing the Annual Report by performing some specific exercise. These data are considered in order to specify the quality of water at each location. This also helps to determine the pollution level or concentration in each source of water at each station.

In order to study water quality status, 7 locations covered during the reported period. Yearly averages of all related parameters are calculated for study of water quality trend in the lieu of following various criteria led down by CPCB, ICAR SAR and various water uses.

Inferences made during analysis

Classification of sampling location on the basis of CPCB Criteria with respect to average values for the period of June 2008 to May 2013 .Classification of water

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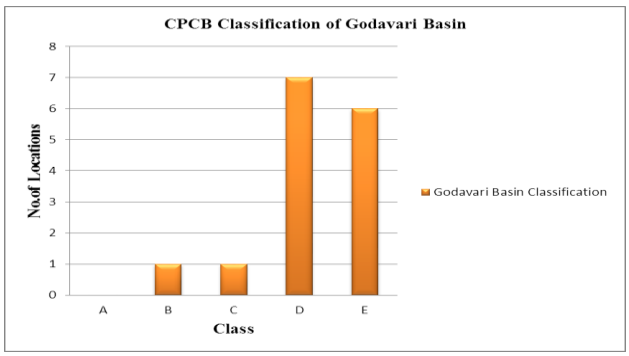
Class A - Drinking Water Source without conventional treatment but after disinfections.

Class B - Outdoor bathing (Organized).

Class C – Drinking water source after conventional treatment and disinfections.

Class D - Propagation of Wild life and Fisheries.

Class E - Irrigation, Industrial cooling, Controlled waste disposal.



STUDY OF WATER QUALITY STATUS AS PER SALINITY HAZARDS

Classifications as per salinity hazard

Remark

A – Good for irrigation.

B – Suitable for irrigation.

C – Suitable for salt tolerance crop.

GODAVARI BASIN					
Sr.No.	Station Name	EC_GEN	SAR	Classificatio	Remarks
1	Kushawarta	300	0.6	C2 & S1	B
2	Gangapur Dam	240	0.4	C1&S1	A
3	Takli	605	0.9	C2&S1	B
4	Kopargaon	610	1.2	C2 & S1	B
5	Nandur-madhyameshwar weir	352	0.7	C2 & S1	B
6	Toka	658	1.4	C2&S1	B
7	Jayakwadi dam	414	1.4	C2 & S1	B

Station Classification on the basis of EC & SAR with respect to

Wilcox technique & average values for the period of June 2008 to May 2013

Findings on the basis of above criteria (Salinity Hazards) Godavari basin.

Sr.No.	Status	Godavari Basin
1	A:Good For Irrigation	1
2	B:Suitable For Irrigation	6
3	C:Suitable For Salt Tolerance Crop	0
4	No Data	0

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GODAVARI BASIN										
Sr.No.	Location	pH_ GEN	EC_ GEN	TDS	Cl	SO4	B	Na%	SAR	Remark
	Tolerance Limit	*6.5-8.5*	*2250 mg/L*	*2100 mg/L*	*600 mg/L*	*1000 mg/L*	*2 mg/L*	*60%*	*26*	
1	Kushawarta	7.2	300	174	22.7	-	0.1	23	0.6	Inadequate
2	Gangapur Dam	7.9	240	139	11.4	86.2	0.07	15	0.4	OK
3	Takli	7.4	605	351	44.3	271	0.16	22	0.9	OK
4	Kopargaon	8.4	610	354	49.4	247	-	29	1.2	Inadequate
5	Nandur-madhyameshwar weir	7.9	352	204	29.4	-	0.09	21	0.7	Inadequate
6	Toka	8	658	455	76.2	-	0.25	35	1.4	Inadequate
7	Jayakwadi dam	8.2	414	292	52.6	30.9	0.11	36	1.4	OK

Classification of sampling location on the basis of ICAR standards

For irrigation water with respect to average values for the period of June 2008 to May 2013

GODAVARI BASIN										
Sr.No.	Location	pH_ GEN	EC_ GEN	TDS	Cl	SO4	B	Na%	SAR	Remark
	Tolerance Limit	*6.5-8.5*	*2250 mg/L*	*2100 mg/L*	*600 mg/L*	*1000 mg/L*	*2 mg/L*	*60%*	*26*	
1	Kushawarta	8	340	163	29.4	15.1	0.11	53.9	2.51	Inadequate
2	Gangapur Dam	7.2	280	120	17.2	7	0.08	38.7	1.3	OK
3	Takli	7.9	530	295	47.6	34.05	0.13	58.8	3.18	OK
4	Kopargaon	8.3	660	260	48.6	32.6	0.21	59.7	3.3	Inadequate
5	Nandur-madhyameshwar weir	8.2	410	198	24.8	12.8	0.1	48.2	1.94	Inadequate
6	Toka	7.6	620	365	47.1	32.2	0.25	59.6	3.28	Inadequate
7	Jayakwadi dam	8	560	352	48.6	34.4	0.21	59.6	3.28	OK

Water sample Analysis by us at Water quality Laboratory Level-2,Nashik.

1. Conductivity	It is a rapid measure of the total dissolved solids. It is an important parameter for determining suitability of water & wastewater for irrigation.
2. PH	pH of water gets drastically changed due to disposal of waste, exposure to air, biological activity & temperature changes. A lower value below 4 produces sour taste & higher value above 8.5 an alkaline taste. Extreme pH can result in rapid fish kills & alteration in flora and fauna.
3. Dissolved Oxygen	It is the most important parameter in water quality assessment. It is essential to maintain presence of higher forms of biological life in the water. Low oxygen in water can kill fish. Fish require oxygen concentration of 2 to 5 mg/L depending on species. In waters heavily contaminated with organic matter, dissolved oxygen disappears. Oxygen saturated waters have a pleasant taste.
4. B.O.D.	It is the measure of biodegradable organic matter. If BOD is high, there is depletion of DO.
5. Sodium	It occurs naturally. Industrial & Domestic Waste contributes to it. High concentration can be related to cardiovascular diseases. High concentration affects soil permeability & texture.
6.Biological Parameters	In water receiving sewage, pathogenic organisms may be present. The bacteria causing cholera, typhoid & dysentery may be present in sewage polluted water. Polluted water also contains several pathogenic viruses like that of jaundice & poliomyelitis. Ingesting polluting water causes protozoan diseases like amoebic dysentery. Besides pathogens, unwanted biological growth of algae & fungi are of importance. They lead to eutrophication & hence hinder recreation & spoil aesthetic value.

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IV. DISCUSSION AND RESULT

The Water Quality data generated by Hydrology Project for 7 Water Quality Sampling Locations spread over the state for godavari basins is used to find out water use for various uses as a need of human being with various steps as described in Chapter VII with the help of SWDES Software being used in Hydrology Project.

Distribution of sampling stations: Considering the said data for 7 stations of the state, are well distributed in Godavari basins of the state to find out the basin wise trend of water quality and will be useful to find out stretch where attention is to be diverted for further monitoring or to decide action points.

First Criteria considered is on the basis of CPCB Criteria with respect to average values for the period of June 2008 to May 2013 : As per CPCB Classification of Water as Class A, B, C, D, and E the suitability in state shows that Class A- 0 stations, Class B- 1 station, Class C- 1 station, Class D- 7 stations and Class E - 6 stations out of 7 stations which indicate that for Irrigation Purpose there is no problem but for other uses care should be taken into considerations. As per Quality Class and their significance.

Class A- indicates for drinking purposes without conventional treatment, where sample of no station is suitable out of 7 stations for drinking purpose.

Class B- indicates for the use of Outdoor bathing, where sample of only 1 station out of 7 stations is suitable for outdoor bathing.

Class C- indicates for Drinking water source after conventional treatment, where sample of only 1 station out of 7 stations is suitable for drinking purpose.

Class D- Indicates for Propagation of wild life and fisheries, the results shows that all 7 out of 7 stations are having capability of fisheries during flow period as the results are during flow period.

Third criteria is classification on the basis of EC & SAR with respect to Wilcox technique and average values for the period of June 2008 to May 2013

For the interpretation on the basis of EC & SAR water is Classified as A, B & C where,

Water Is Good For Irrigation Purpose.

Water Is Suitable For Irrigation Purpose.

Water Is Suitable For Salt Tolerant Crop and

ND- No Data

As per EC and SAR guideline only 1 station has water Good for Irrigation, 6 stations have water suitable for irrigation.

Second criteria is classification of sampling location on the basis of ICAR Standards for irrigation water with respect to average values for the period of June 2008 to May 2013

Out of 7 Water Quality Sampling stations in the state 3 stations are found OK for Irrigation as per ICAR Standard, for other stations need detailed monitoring and nearly 30 % stations need to be observe frequently to find out point and non-point sources as these stations are marginally crossing the limits.

Expected Benefits

Above discussion clearly indicates following benefits after studying the results of Water Quality Monitoring.

Direct Benefit: Data generated primarily shows the indications of pollution level of each station, which is primarily useful for station classification and management of monitoring programme.

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Indirect Benefit: As per detailed discussion and data interpretation it shows the water quality status of each station independently which is useful to find out point source or non-point source of pollution which gives the future benefit in terms of Irrigation development as well as to overcome the various water uses of human being.

Monitoring Benefit- As a part of Water Quality Monitoring programme at National level and as per Uniform Protocol for Water Quality Monitoring order 2005 the mandates can be reviewed on the basis of data generated and analysed for long term, which gives the directives toward analysis of certain parameters in certain river stretches can be decided and further base full and long term beneficial Water Quality Monitoring programme can be organized.

Expected Time, Cost and Efforts

As any monitoring is interdisciplinary activity, hence the data generated by one organization may access to others to interrelate and for finding further monitoring needs.

Under National Hydrology Project Inter State as well as Interdisciplinary approach is considered and is now on process and in coming time there will be the day when one can access the data at his home itself through websites. Whereas this interdisciplinary process may take some time for activation. As Water Quality Assessment Authority at National Level is working for the same and in coming future we will get the results.

In Hydrology Project, Hydrological Data User Group is formed State level (HDUG) and the said generated data by Hydrology Project is disseminated to the honorable member with nominal cost.

Efforts are being taken to get the data to an individual's various agencies are involved in this activity. Various Government as well as Non-Government Organizations are participating in such awareness activities.

Precautions

The data generated by various organizations is valuable and costly, hence need to be taken that the said data can only be used for proper purposes and by the user who needs so that the data can be utilized properly for work of national pride and benefits.

V. CONCLUSION

- As per CPCB Classification of Water as Class A, B, C, D, & E, the Suitability in State shows that Class A- 0 Stations, Class B- 1 Stations, Class C-1 Stations, Class D- 7 Stations & Class E- 6 Stations out of 7 Stations which indicate that for Irrigation Purpose there is no any problem but for other uses care should be taken into considerations.
- Water flowing in Godavari basin is having comparatively good water quality for Irrigation purpose according to the EC and SAR parameters, as water at 6 stations out of 7 is suitable for Irrigation purpose.
- No stations is fulfilling the Drinking water Criteria (Class A) as per CPCB guideline in whole state, which indicates that the water at all stations needs a proper treatment before use.

  As per ICAR guideline only 3 locations having water Good for Irrigation.

5.1 Findings, Observation and Recommendation

An evaluation of existing cropping pattern of Jayakwadi dam is done for the locations in upper godavari region namely 1) Kushawarta 2) Gangapur Dam 3) Takli 4) Kopargaon 5) Nandur - madhyameshwar weir 6) Toka 7) Jayakwadi dam. Existing cropping pattern along at Jayakwadi location is mentioned in the annexure [2]. During

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analysis of data for 7 location those are classified on the basis of EC and SAR these location are classified as per salinity hazards to identify the location sensitivity towards the desire crop. These locations are also classified as per CPCB and ICAR criteria from which water passing from each location is evaluated towards the suitability for irrigation purpose. To evaluate the location for suitability of irrigation purpose it is observed that all 7 location value of EC is less than 1500 micromhos/cm. On the basis of EC and SAR with respect to location are classified as C1, S1 and C2, S1 as the value of EC for all these location lies between 240to658 which is less than 1500umhos/cm. The water passing through these locations is broadly suitable for irrigation at an around the area of these location. As per objective of these project report and with respect to cropping pattern of jayakwadi it shows that as per water quality rating in India crops to be grown around these area are semi tolerant type crop. Example of semi tolerant crops are Sweet potato, Oat, Maize, Wheat, Barley, Jawar, Peas, Tomato, Cotton, Potato, Sunflower. Hence the semi tolerant crops are recommended as per surface water quality data analysis. This analysis shows it is not mean that cropping pattern of jayakwadi is not suitable but it is evaluated on the basis of tolerance of the water passing through these location. Crop shown in above paragraph as semi tolerant crop which gives more potential, yield in this area with respect to other crop. Hence it is recommended that as per existing water quality passing through these location is mostly suitable for irrigation purpose and it also recommended that on the basis of EC and SAR criteria semi tolerant crop will give maximum potential with respect to other crop. Finally it is evaluated that upper portion of jayakwadi dam along godavari river classified as semi tolerant area which is broadly suitable for semi tolerant crop.

SENSATIVE	SEMI-TOLERANT	TOLERANT
Citrus,Fig,	Sweet potato,	Carrot,
Grape,Apple	oat,Maize,Wheat,	Cabbage,
	Barley, jawar,Peas,	Onion,Beans, Lucerne,Palm
	Tomato, Cotton,Potato, Sunflower	

Administrative

1. Non-industrial activities such as Effluent Treatment Plants, Composting, Vermiculture, Animal stalls, Cattle and Goat pens, Animal husbandry, Fish farming, Dumping of ash, Solid waste may not be allowed in 'No Development Zone' (3 km on either side of river) of A-I stretch of river. (Source to first dam).

2. No industries may be allowed in 'No Development Zone'. Industries are to be set up at distances specified by Pollution Control Board. River policy criteria (MPCB) may to be fulfilled.

3. Classification, zoning of land for designated uses such as agriculture, forestry, green areas, industrial activities, watersheds and human settlements based on assessment of environmental considerations is necessary.

4. Countrywide campaign to minimize soil and runoff losses by carrying out extensive works like contour trenching, contour bunding, terracing and watersheds needs strengthening.

5. Measures for water conservation, recycling and optimal conjunctive use of surface and ground water for specific uses are necessary.

6. Classification, zoning and regulations for monitoring the quality of the water bodies to protect and enhance their capabilities to support the various designated uses may be implemented.

7. Measures for sustainable use of water resources are necessary.

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8. Farmers may be encouraged to use advanced irrigation system like drip irrigation in order to conserve water and prevent erosion of the topsoil.

9. Farmers in the catchment area should be educated against use of extensive amount of pesticides and chemical fertilizers. They should be encouraged to use organic manures.

10. To create Environmental consciousness through education and mass awareness programme may be planned.

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