Name of scheme: "Development of Performance Evaluation system for Multipurpose Water Resources Project"

Name of Pricipal Investigator: Dr. Geeta S. Joshi

Name of Co- Investigator: Dr. Gaurang L Joshi

Completion Report

1.	**Title of the scheme**	Research scheme on "Development of Performance Evaluation system for Multipurpose Water Resources Project"
2.	**Name and addresses of the PI and other Investigators**	**Principal Investigaor** Dr.Geeta S. Joshi Associate Professor, Civil Engineering Department, Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Vadodara-390001 Gujarat **Co-Investigator** Dr.Gaurang I. Joshi Assistant Professor, Civil Engineering Department, Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Vadodara-390001 Gujarat
3.	**Name and address of the Institute**	Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Vadodara-390001 Gujarat
4.	**Financial details (Sanctioned cost; amount released; expenditure; unspent balance (if any) and return of unspent balance)**	Sanctioned cost : Rs.9,46,680/- Amount released:Rs.3,20,000/- Expenditure: Rs.98,418/- Unspent balance: Rs. 2,21,582/- Return of unspent balance Rs. 2,21,582/-
5	**Utilisation certificate**	Utilisation certificate for the year 2012-13,2013-14, 2014-15,2015-16, 2016-17 are attached herewith as per the standard format.
6	**Statement of equipment**	Not applicable as no equipment purchase

	purchased under the scheme	
7	**Original objectives and methodology as in the sanctioned proposal:** ❖ To devise a new innovative computational procedure and to evaluate the technical performance of the existing Water Resources Projects. ❖ To evolve the procedure for rapid appraisal, rapid evaluation of the policy and to identify the causes of poor performance of the Water Resources projects. ❖ To help the government/ project authorities in their efforts to build, strengthen, and fully institutionalize the monitoring and evaluation system of performance of the existing Water Resources Projects. ❖ To help the government to provide higher standard of services with reliability with feasibility, to review the program and policy decisions, to improve future maintenance and operation of the Water Resources projects, and for prevailing safety standards.	
8	**Any changes in the objectives during the operation of the scheme**	No change has made in the objectives.
9	**All data collected and used in the analysis with sources of data** All data have been collected from Karjan,Kadana and Sukhi dam authorities shown respectively as under.The data of Sukhi dam is collected from department of Irrigation Project Division No.2, Bodeli and Vadodara Irrigation circle, Vadodara. **Data collection of Sukhi dam** The data collection for performance evaluation of Sukhi dam is mainly divided into two parts • Performance evaluation of Sukhi Irrigation System • Performance evaluation of Sukhi Dam Parameters under these types of data are shown below in table no. 1.	

Table No.1 Sources of Data of Sukhi Dam

Type of Data	Sources	Detail of Data
Data for Performance Evaluation of Irrigation System	Irrigation Project Division No.2, Bodeli Vadodara Irrigation circle	1. Reservoir Capacity 2. Head work 3. Conveyance system 4. Operation & Maintenance 5. Agricultural practices
Data for Performance Evaluation of Dam	Irrigation Project Division No.2, Bodeli	Performa for periodical Inspection of Dam

Data Collection for Karjan Dam

The data for Karjan dam is collected from department of Irrigation Project Division No.29, Rajpipla, Medium Irrigation Project Division No.1 & 15, Ankleshwar and Irrigation Project Division No.27, Rajpipla and types of data i.e. Data for Performance Evaluation of Irrigation System and Data for Performance Evaluation of Dam respectively are shown below in Table no.2.

Table No.2 Sources of Data of Karjan Dam

TYPE OF DATA	SOURCES	DETAIL OF DATA
Data for Performance Evaluation of Irrigation System	Irrigation Project Division No.29 ,Rajpipla Medium Irrigation Project Division No.1 & 15, Ankleshwar	1. Reservoir Capacity 2. Head work 3. Conveyance system 4. Operation & Maintenance 5. Agricultural practices
Data for Performance Evaluation of Dam	Irrigation Project Division No.27, Rajpipla	Performa for periodical Inspection of Dam

Data collection for Kadana dam

The data of Kadana dam is collected from department of Kadana Division No. 1 Diwada Colony, Diwada& K.L.B.C Sub. Division Lunawada and Masonry Division No. 1, Diwada Colony, Diwada. There are mainly two types of data i.e. Data for Performance Evaluation of Irrigation System and Data for Performance Evaluation of Dam. Parameters comes under these types of data are shown below in table no. 3.

Table No.3 Sources of Data of Kadana Dam

TYPE OF DATA	SOURCES	DETAIL OF DATA
Data for Performance Evaluation of Irrigation System	Kadana Division No. 1 Diwada Colony K.L.B.C Sub. Division Lunawada	1. Reservoir Capacity 2. Head work 3. Conveyance system 4. Operation & Maintenance 5. Agricultural practices
Data for Performance Evaluation of Dam	Masonry Division No. 1 Diwada Colony	Performa for periodical Inspection of Dam

10 **Methodologyactually followed(observation, analysis,results and inferences)**

For development of performance evaluation system for water resource project the following steps is follow.

STEP 1: First is followed as per data collection as shown above.

STEP 2: After collected the information next step is to identify the performance evaluation parameters with respectto operation, maintenance and safety criteria of the Water Resources Projects.

- **Operation** – In this, Parameters for flood control, reliability and timely services towards fulfilling the objectives of the projects,

- **Maintenance** –In this, Parameters for reduced capacity, i.e. sedimentation, and routine and preventive maintenance schedule are taken into consideration.
- **Safety** – In this, parameters for indicating the safety of the structure based on the instrumentations records are considered.

The performance indicators or parameters used in this study are discussed below.

a) **Reliability Index**: It is defined as the ratio of the total water release to the total demand targeted.
b) **Sedimentation Rate**: It is considered as the process of deposition of silt on the upstream side of dam.
c) **Non-Spillover Efficiency:** It is defined as the efficiency of operation for release of water on the D/S side as per there schedule when there is sufficient inflow is available. It is calculated as no. of years of non-spilling to the total no. of years of data.
d) **Conveyance Efficiency:** It is defined as the difference in the water released through the canal for irrigation to the water available on the field for irrigation.
e) **Water Quality:** In this parameter the quality of water sample of dam is checked and whether they are in limit or not as per Indian standards (drinking purpose) is checked.
f) **Expenditure towards Operation & Maintenance of Dam:** It is defined as the total expenditure accrued on the repairing and replacement of the different components of dam.
g) **Irrigation Intensity:** It is defined as the ratio of total Culturable Command Area provided for irrigation to the total command area on which actual irrigation is done.

STEP 3: After identifying the performance evaluation parameters the next step isfor evolving the data base input for monitoring the performance of

1) Policy decisions,

2) Inflows, weather details (change in the flood pattern), technical D details of the project, d/s channel capacity, details of the reservoir Capacity and if there any change.

STEP 4: After evolving the data base input next step is to evolve the

	procedure for computing the overall performance of the project. **STEP 5:** The final step is for evolving the system for interpreting the overall performance and the reasons for poor performance. **STEP 6:**Developing the software for performance evaluation system **STEP 7:** Application of software.
11	**Conclusions/Recommendations:** **CONCLUSION** ➢ The performance evaluation system has been evolved to evaluate the performance of the water resource of the project considering the performance measures such as Reliability index, Reservoir sedimentation rate, Non-spilling efficiency, Conveyance efficiency, Water quality (drinking purpose), Expenditure towards operation and maintenance and Irrigation intensity and for monitoring database towards performance evaluation. ➢ It is found that Sukhi reservoir is performing well with respect to Reliability index, Rate of reservoir sedimentation, Conveyance efficiency and Expenditure towards operation and maintenance. ➢ It is found that Karjan reservoir is performing well with respect to Reliability index, Conveyance efficiency, Water quality (drinking purpose) and Expenditure towards operation and maintenance. ➢ It is found that Kadana reservoir is performing well with respect to Reliability index, Conveyance efficiency, Expenditure towards operation and maintenance and Irrigation intensity. ➢ On an average the Sukhi reservoir performance have been 70.23 % while Karjan reservoir performance is 52.24 % and Kadana reservoir performance is 58 %. ➢ The main reason of low performance of Karjan and Kadana reservoir is found thatSedimentation at higher rate than the allowable and Spilling over the reservoir frequently. ➢ The performance of Karjan reservoir can be improved by lowering the sedimentation rate, improving non-spilling efficiency and irrigation intensity. ➢ The performance of Kadana reservoir can be improved by

	irrigation intensity. ➢ The performance of Kadana reservoir can be improved by lowering the sedimentation rate, improving non-spilling efficiency and water quality. ➢ The software evolved under this project "PESMP" have been found yielding the reliable results. **RECOMMENDATIONS:** Similar performance evaluation system can be adopted by the government department so as review the operation policyto under the changing environmental conditions.	
12	**How do the conclusions/recommendations compare with current thinking**	They found to be justified with the current situations.
13	**Field tests conducted**	Field test for water quality assessment have been conducted.
14	**Software generated, if any**	Yes. The software "PESMP" for "Performance Evaluation system for Multipurpose Water Resources Project " have been developed.
15	**Possibilities of any patents/copyrights. If so, then action taken in this regard**	No
16	**Suggestions for further work**	No

18.7.2017

Signature
(Head of the Department)
Name (Prof. H. M. Patel)

HEAD,
CIVIL ENGINEERING DEPT.
FACULTY OF TECH. AND ENGG

Co-Investigator
(Dr Gaurang I Joshi)

Signature
(Principal Investigator)
Name (Dr.Geeta S. Joshi)

Principal Investigator,

17 **Research Papers**

Detail of published research papers as shown in below.

Sr. No.	Title of the Research Paper	Name of Seminar	Place	Duration	National / International Level
1.	Development of performance evaluation for sukhi dam-case study		e-ISSN:2393-9877,p-ISSN: 2394-2444 Volume 3,Issue 3, March-2016 Impact factor (SJIF):3.632	3 , March-2016	International Journal of Advance research in engineering ,science & technology
2.	Development of Performance evaluation for Multipurpose water resources project- a case study (Karjan Dam)	**Presented and Published** 1st International seminar of ISTE Gujarat section on "Multidisciplinary research approach for the accomplishment of academic excellence in higher & technical education through Industrial practices."	Bangkok(Thailand) ISBN: 978-93-5258-821-3	10 and 11th June 2016	Proceedings of "1st International seminar of ISTE Gujarat section"

INTRODUCTION

Different countries or regions, at different stages of development, have developed and will continue to pursue their own policies to face their challenges and fulfil their needs. In India, the Water Resources projects are governed by the Government bodies. The Performance of the Water Resources Projects is being evaluated on the basis of the benefits cost ratio at the planning stage.

Performance Evaluation is a stock taking exercise to assess the achievements of Water resources project. Through regular evaluation the project authorities come to know where they stand, whether the project is performing as per design considerations and the extent to which the envisaged objectives have been achieved. The degree to which dams could provide services against planned varies substantially from one to the next. This justifies the need for the regular monitoring and evaluations of the performance of the Water Resources projects.

One of the examples of the failure of the dam in Gujarat, India i.e. Machhu II dam, which was failed causing the loss of life of thousands of people due to unsatisfactory operation and maintenance activities.

Large dams are designed to deliver irrigation services have typically fallen short of physical targets, did not recover their costs and have been less profitable in economic terms than expected

Due to several competing demands, the irrigation systems are sometimes partly diverted to domestic, industrial, recreational and pisiculture purposes. Without the Project, these benefits would not have accrued and separate investment was necessary to create such facilities. The project performance studies will identify all and discuss the qualitative changes resulting on account of the project.

Before deciding the strategy and measures for further improving the efficiency through modification of the system, it is necessary that diagnostic analysis through Performance evaluation of the project is carried out and only the identified items not Functioning at desired level are proposed for preservation of modernisation. This will provide better justification for modernisation by quantification of benefits. As the Causes for deficiency would differ from project to project, the measures for improving the water use efficiency would also be different.

LITERUTURE REVIEW

The dams are national property constructed for the development of the national economy and in which large investments and other resources have been deployed. For the development of performance evaluations of dam Monitoring and Evaluation system have to be properly planned. The safety of the dams and allied structures is an important aspect to be examined for ensuring public confidence in the continued accrual of benefits from the national investment made and to protect the downstream area from any potential hazard.

DAM SAFETY IN INDIA

The safety of dams in our country is the principal concern of the State agencies that are involved in the various aspects of their Investigation, planning, design, construction, operation and Maintenance.

. The practices of dam safety-operation-maintenance and surveillance, etc., being adopted by the various agencies differ from State to State and also from agency to agency within the State. The broad objective is to provide a comprehensive review and to recommend means of assuring the effectiveness of existing State agencies, their practices and procedures affecting various aspects of dam safety.

The ultimate objective of this review would be to assure that the dam safety is given proper consideration by the State agencies in the discharge of their responsibilities, providing the greatest possible dam safety consistent with the current state of knowledge available.

IRRIGATION SYSTEM IN INDIA

Water is precious element without which no life can be sustained on earth.The country has made substantial progress in development of water resources through 201 major, 839 medium and numerous minor irrigation schemes taken up till 1994-95. The total potential created is of the Order of 87 million hectares (mha) and utilisation is about 78 mha. The potential contributed through major & medium projects is 32 mha. There are 53 major and 189 medium irrigation projects which have a utilisation lag of more than 10%.

Performance evaluation is a useful tool to find viable and economical solutions for problems related to design, construction, management, operation & maintenance of irrigation projects. The efficiency of different components of an irrigation system can be determined after critical review of their intended functions.

MONITORING AND EVALUATION

A growing number of governments are working to improve their performance by creating systems to measure and help them understand their performance. These systems for monitoring and evaluation (M&E) are used to measure the quantity, quality, and targeting of the goods and services—the outputs—that the state provides and to measure the outcomes and impacts resulting from these outputs. These systems are also a vehicle to facilitate understanding of the causes of good and poor performance.

Performance indicators are measures of inputs, activities, outputs, outcomes, and impacts of government activities. Indicators can be very high level, in terms of measuring the government's performance relative to the MDGs or the national development plan, or in terms of ministry and agency activities and outputs.

Rapid appraisal methods are quick, low-cost ways to gather the views and feedback of beneficiaries and other stakeholders. These views provide rapid information for management decision making, especially at the activity or program level. Methods include interviews, focus group discussions, direct observation, and mini-surveys. It can be difficult to generalize the findings from these qualitative methods. They are also less valid, reliable, and credible than formal surveys.

Rapid evaluation involves a formal review of a government activity or program The main strengths of rapid evaluations are their speed and relatively low cost. Their main disadvantages— compared with more rigorous approaches— are their weaker empirical evidence and much weaker data-analysis techniques.

Impact evaluation focuses on the outcomes and impacts of government activities. Rapid evaluation methods can be used to estimate impact, but more sophisticated methods of impact evaluation can provide much more reliable and persuasive findings.

Comprehensive spending reviews are a type of policy evaluation. Chile's finance ministry uses these to review all programs within a particular functional area, such as schools. These entail desk reviews of issues of inefficiency and program duplication.

The successful institutionalization of M&E involves the creation of a sustainable, well-functioning M&E system within a government, where good quality M&E information is used intensively

Three dimensions of success are stressed here:

1. **Utilization of M&E information:** That is, to support government policy making, including performance budgeting or national planning;

2. **Good quality M&E information**. There are standards against whichM&E can be compared to determine if it represents good quality or not.

3. **Sustainability**. This relates to the likelihood that the M&E system will survive a change in administration or in government ministers or top officials. Where the utilization of M&E information is firmly embedded—that is, mainstreamed—in core government processes such as the budget cycle, it can be said to be institutionalized and thus is likely to be sustained over time.

STUDY AREA

For the development of performance evaluation system of water resources project we consider the case study of three dams i.e. **Sukhi, Karjan and Kadana dam**. The general descriptions of all three dam are given below.

1. Sukhi Reservoir Project

Sukhi reservoir project, one of the major water reservoir projects is envisaged, constructed and developed by the Govt. of Gujarat at the confluence of Sukhi and Bharaj River near village Sagadhara and Khos in Pavijetpur and Chhota-udepur Taluka respectively of Vadodara district.

The project comprises of composite masonry with spillway as well as Main Earthen Dam and saddle dam No.2 and No.3 on Left and Right flank respectively. Masonry dam having ogee shaped spillway with 10 Nos. of radial gates of size 12.50 m X 8.233 m for disposal of surplus floods in the river.

2. KARJAN REESERVOIR PROJECT

Karjan dam is the first masonry-cum-concrete dam in Gujarat where pre cooled concrete technology is adopted. At present this is the first highest (100m) gravity dam in Gujarat State. It is located 10 km away from Rajpipla in Narmada District across river Karjan, a tributary of river Narmada, in Gujarat State.

3. KADANA RESERVOIR PROJECT

Kadanareservoir project is constructed at Kadana village of Taluka Kadana of Panchmahal district comprise of water spread area of 16600 Hectares with direct canal on left bank giving command area of 11059 Ha. Of Kadana & Lunawada Taluka, Further it also covers the 212194 Ha. C.C.A. of Kheda & Anand Districts through mahi Right Bank Canal from Wanakbori Weir.

PROBLEM DEFINATION.

The Objectives of This Study

1. To devise a new innovative computational procedure to evaluate the technical performance of the existing Water Resources Projects.
2. To evolve the procedure for rapid appraisal, rapid evaluation of the policy and to identify the causes of poor performance of the Water Resources projects.
3. To help the government/ project authorities in their efforts to build, strengthen, and fully institutionalize the monitoring and evaluation system of performance of the existing Water Resources Projects.
4. To help the government to provide higher standard of services with reliability with feasibility, to review the program and policy decisions, to improve future maintenance and operation of the Water Resources projects, and for prevailing safety standards.

METHODOLOGY

For development of performance evaluation system for water resource project the following steps is follow.

STEP 1: First of all collected the information on the present system of monitoring the performance.

STEP 2: After collected the information next step is to identify the performance evaluation parameters (discussion with project authorities is proposed) - parameters with respect to operation, maintenance and safety criteria of the Water Resources Projects.

- **Operation** – In this, Parameters for flood control, reliability and timely services towards fulfilling the objectives of the projects, services provided against services planned and their magnitude of importance are come.

- **Maintenance** –In this, Parameters for reduced capacity, sedimentation, routine and preventive maintenance are taken into consideration.
- **Safety** – In this, parameters for indicating the safety of the structure based on the instrumentations records are seen.

The performance indicators or parameters used in this study are discussed below.

a) **Reliability Index**: It is defined as the ratio of the total water release to the total demand required.
b) **Sedimentation Rate**: It is defined as the process of deposition of silt on the upstream side of dam.
c) **Non-Spillover Efficiency:**It is defined as the efficiency of operation for release of water on the D/S side as per there schedule when there is sufficient inflow is available which is fixed by dam authority. It is calculated by dividing the no. of years of non-spilling to the total no. of year.
d) **Conveyance Efficiency:** It is defined as the difference in the water release through the canal for irrigation to the water reached in the field for irrigation.
e) **Water Quality:** In this parameter the quality of water sample of dam is check and whether they are in limit or not as per Indian standards (drinking purpose) is check.
f) **Expenditure towards Operation & Maintenance of Dam:** It is defined as the total expenditure accrued on the repairing and replacement of the different components of dam.
g) **Irrigation Intensity:** It is defined as the ratio of total Culturable Command Area provided for irrigation to the total Area on which actual irrigation is done.

STEP 3: After identify the performance evaluation parameters the next step is to evolving the data base input for monitoring the performance of

1) Policy decisions,

2) Inflows, weather details (change in the flood pattern), technical Details of the project, d/s channel capacity, details of the reservoir Capacity and if there any change.

STEP 4: After evolving the data base inputnext step is to evolve the procedure for computing the overall performance of the project.

STEP 5: The final step is to evolving the system for interpreting the overall performance and the reasons for poor performance.

CHAPTER 6

DATA COLLECTION AND RESULT ANALYSIS

6.1 ANALYSIS OF PERFORMANCE EVALUATION FOR SUKHI DAM

(A) Reliability Index (R.I)

The reliability index for 8 years is shown in the below table 6.1.

Table No. 6.1 Reliability index of Sukhi Dam

Years	Inflow (Mm^3)	Spillage (Mm^3)	Release (Mm^3)	Release/ Demand= (Mm^3) %
2005-2006	125.17	0	90	76.31
2006-2007	**400.096**	**223.91**	**116.09**	**97.65**
2007-2008	326.036	160.75	87.87	73.91
2008-2009	111.325	4.3091	43.6	36.67
2009-2010	57.05	0	50.94	42.85
2010-2011	116.95	0	89.32	75.12
2011-2012	183.357	4.86	93.78	78.88

Demand =118 Mm^3 (Constant)

Reliability Index = (76.31+97.65+73.91+36.67+42.85+75.12+78.88) / 7

= 68.77 %

The result shows that the release of water is done properly and as required in demand for irrigation.

(B) Reservoir Sedimentation Rate

a) Designed Area-Capacity : Area -26.95 Km^2Capacity-178.47Mm^3

b) Actual Area – capacity : Area -26.95 Km^2Capacity-177.006(Mm^3)

c) Loss in capacity &likely effects : LOSS in capacity- 1.464 Mm^3

d) Years of sedimentation study : 2005

From the sedimentation survey report of 2005, the annual % loss in the Gross Storage Capacity is 0.05 % and hence the reservoir is classified as "*Insignificant Category*" as per IS 12182-19.

(C) Non-Spilling Efficiency

It is calculated by dividing the no. of years of non-spilling to the total no. of year. Operation of gates is working properly when the rue level is maintained. In the below table 6.2 years in which spill is done is shown from the year 2005-06 to 2011-12.

Table No. 6.2 Non-Spilling Efficiency of Sukhi Dam

Years	Inflow(Mm^3)	Spillage(Mm^3)	Rule Level on 15th Oct.(147.82 m)
2005-2006	125.17	N	145.52
2006-2007	**400.096**	**Y**	**147.82**
2007-2008	**326.036**	**Y**	**147.82**
2008-2009	111.325	Y	145.95
2009-2010	57.05	N	142.65
2010-2011	116.95	N	147.1
2011-2012	183.357	Y	147.32

Operating Efficiency = No. of years of non-spillover / Total No. of years

= 3 /7 = **42.86 %**

Here, No. of years having spillover= 3 Total no of years count = 7

(D) Conveyance Efficiency

In the table 6.3 conveyance losses is shown from year 2002-03.

Table No. 6.3 Conveyance Efficiency of Sukhi Dam

Sr. No.	Year	Canal Releases (Mcft)	Releases at Field(Mcft)	Conveyance Losses(Mcft)	% Losses=Col.5/Col.3
Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
1	2002-03	1545.81	1468.84	76.97	4.97
2	2003-04	3967.99	3774.71	193.28	4.87

3	2004-05	4143.65	4071.92	71.73	1.73
4	2005-06	3445.54	3204.36	241.18	6.99
5	2006-07	4556.03	4100.43	455.6	9.99
6	2007-08	3567.13	3103.4	463.73	13
7	2008-09	1974.07	1539.78	434.29	21.99
8	2009-10	581.06	1743,20	581.06	24.99
9	2010-11	4031.66	3154.33	877.33	21.76
10	2011-12	4139.98	3311.99	827.99	19.99

From the above analysis we can see that in the initial years i.e. 2002-03 to 2006-07 the conveyance losses are within **10 %** but in later years i.e. 2007-08 to 2011-12 there is sudden increase in conveyance losses which goes more than **20 %**.

Conveyance losses = (4.97+4.87+1.73+6.99+9.99+13+21.99+24.99+21.76+19.99) / 10

= 13.02 %Conveyance Efficiency = **86.08 %**

From this analysis we conclude that Conveyance Efficiency of canal is good and this is a result of proper maintenance of Canal network.

(E)Water Quality Analysis of Sukhi Dam (Drinking purpose)

Table No. 6.4Water Quality Analysis of Sukhi Dam

Parameters	BIS Limit		Sample no.1 (Upstream)	Within limit	Sample no.2 (Downstream)	Within limit	Sample no.3 (Gallery)	Within limit
	Permissible	Excessive						
pH	6.5-8.5	9.2	8.3	Y	9.13	N	10.3	N
TDS (mg/lit)	500	1000	152	Y	134	Y	112	Y
Total Alkalinity (mg/lit)	200	600	124	Y	104	Y	124	Y
D.O. (mg/lit)	5.0-6.0	>6	6.4	N	6.5	N	---	---
M.P.N. index for E. Coli count / 100 ml	500	1600	>1600/ 100ml	N	>1600/ 100ml	N	---	---
Total Bacterial count /100ml	10000	15000	3.5×10^4	N	3.68×10^4	N	---	---

Sample no. 1 upstream = out of 6 parameter only 3 parameter are within limit. = 3/6 = **50 %**

Sample no. 2 Downstream = out of 6 parameter only 2 parameter are within limit.= 2/6= **33 %**

Sample no. 3 Gallery = out of 3 parameter only 2 parameter are within limit. = 2/3 = **66 %**

Average of 3 Samples = (50 + 33 +66)/3 = **49.66 %**

From the above result it is conclude that the water quality of Sukhi dam either of upstream or downstream is not suitable for drinking purpose.

(F) EXPENDITURE TOWARDS OPERATION& MAINTENANCE

Table No. 6.5Expenditure on Operation & Maintenance of Sukhi Dam

Sr. No	Name of Division	Expenditure of Mandalies from Amount refunded	PIM restoration Works	Expenditure in Other Type of Works	Expenditure in Modernisation Works	Total Expenditures
1	2	3	4	5	6	7
1	2007-08	0.67	0.67	-	-	0.67
2	2008-09	1.36	5.56	363.32	-	1.36
3	2009-10	10.55	10.39	10.16	-	10.55
4	2010-11	2.28	19.73	43.8	0	63.53
5	2011-12	3.43	0	2.79	0	6.22

The normal Operation and Maintenance cost in rupees / Ha has been obtained as 428 rupees/Ha for the state of Gujarat (Source: Planning Commission Report 2002-2007)

Operation and Maintenance cost / Ha = Average Operation and Maintenance cost (rupees) /Total C.C.A. (Ha)

= 1646600/21209 **= 77.6 rupees / Ha which is < 428 rupees / Ha**

Hence it's in the limit and efficiency is 100 %

(G) Irrigation Intensity

The irrigation intensity of Sukhi dam for last 10 years is shown in the below table 6.6

Table No. 6.6 Irrigation Intensity of Sukhi Dam

Year	C.C.AHa.	KharifHa.	RabiHa.	HotHa.	TotalHa.	Irrigation Intensity %
2002-03	21209	650	3963.83	0	4613.83	21.75
2003-04	21209	0	5108.99	4250.5	9359.53	44.12
2004-05	*21209*	*568*	*6555.3*	*4122.9*	*22492.6*	*106.05*
2005-06	21209	0	4540.46	3264.8	15610.6	73.6
2006-07	21209	0	4475.03	2491.3	13932.8	65.69
2007-08	21209	0	3151	2486.8	11275.7	53.16
2008-09	21209	0	2998.24	1502	9000.48	42.43
2009-10	21209	63.06	3725.35	68	3586.48	16.91
2010-11	20922	583	4670	3916	9169	43.82
2011-12	*20922*	*174*	*5071*	*2362*	*7607*	*36.35*

The Irrigation intensity which is 106 % in year 2004-05 is decreasing at very fast rate and in year 2011-12 is comes to only 36.35 %.

IrrigationIntensity =

$$\frac{(21.75+44.12+106.05+73.60+65.69+53.16+42.43+16.91+43.82+36.35)}{10} = \mathbf{50.30\ \%}$$

The low irrigation intensity can be justified by the poor performance of canal operation or maintenance.

6.2ANALYSIS OFPERFORMANCE EVALUATIONFORKARJAN DAM

(A) Reliability Index:

The reliability index for 10 years is shown in the below table 6.1.

Table No. 6.7 Reliability Index of Karjan Dam

YEARS	Inflow (Mm^3)	Spillage (Mm^3)	Release(Mm^3)	Release/ Demand (Mm3)%
2003-04	1176.64	871.73	201.39	78.05
2004-05	1437.97	1024.87	236.41	91.63
2005-06	924.22	590.11	262.04	101.56
2006-07	1972.49	1738.17	74.83	29
2007-08	1323.96	1033.63	223.5	86.62
2008-09	1054.44	631.23	262.75	101.84
2009-10	727.71	303.85	304.93	118.18
2010-11	531.837	126.15	258.81	100.31
2011-12	835.039	385.08	350.06	135.68

Demand= 258 Mm^3 (Constant)

Reliability Index= (78.05+91.63+101.56+29.00+86.62+101.84+118.18+100.31+135.68)/ 10

= **84. 2 %**

The result shows that the release of water is done properly and as required in demand for irrigation.

(B) Reservoir Sedimentation

a) Designed Area-Capacity : Area - 31.730 Km^2, Capacity- 630.000 Mm^3

b) Actual Area – capacity : Area - 31.260 Km^2, Capacity- 545.394Mm^3

c) Loss in capacity &likely effects : LOSS in capacity- 84.606 Mm^3

d) Years of sedimentation study :2005

From the sedimentation survey report of 2005, the annual % loss in the Gross Storage Capacity is *0.63 %* and hence the reservoir is classified as *"Significant Category"* as per IS 12182-1987.

(C) Non-Spilling Efficiency

It is calculated by dividing the no. of years of non-spilling to the total no. of year. Operation of gates is working properly when the rue level is maintained. In the below table 6.8 the rule level on 15th October is shown from the year 2003-04 to 2011-12.

Table No. 6.8 Non-Spilling Efficiency of Karjan Dam

YEARS	INFLOW (Mm3)	SPILLAGE (Mm3)	Rule levelon15th OCT.(m)
2003-04	1176.64	Y	115.04
2004-05	1437.97	Y	112.29
2005-06	924.22	Y	115.14
2006-07	1972.49	Y	113.9
2007-08	1323.96	Y	115.26
2008-09	1054.44	Y	115.25
2009-10	727.71	Y	115.05
2010-11	531.837	Y	115.44
2011-12	835.0388	Y	114.9

Non-SpillingEfficiency = No. of years having non-spill/ Total No. of years= 0/7 = 0 %

Here, No. of years having spillover= 0 Total no of years count = 7

(D) Conveyance Efficiency

Table No. 6.9 Conveyance Efficiency of Karjan Dam

Sr. No.	Year	Canal Releases (Mcft)	Releases at Field (Mcft)	Conveyance Losses (Mcft)	% Losses= Col.5/Col.3
Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
1	2009-10	4071.6	2443	1628.6	39.99
2	2010-11	7516.44	4730.8	2785.54	37.05
3	2011-12	7225.5	4890.7	2335.78	32.32

From the above analysis we can see that the conveyance losses are not within **20 %.**

Conveyance losses = (39.99+37.05+32.32) / 3 = **36.45 %**

Conveyance Efficiency = 100 – 36.45 = **63.54 %**

From this analysis we conclude that maintenance of Canal network is not maintained as a result Conveyance Efficiency is low.

(E)Water Quality Analysis of Karjan Dam (Drinking purpose)

Table No. 6.10 Water Quality Analysis of Karjan Dam

Parameters	BIS		Sample no.1 (Upstream)	Within limit	Sample no.2 (Downstream)	Within limit	Sample no.3 (GALLERY)	Within limit
	Permissible	Excessive						
pH	6.5-8.5	9.2	8.46	Y	8.2	Y	8.03	Y
TDS (mg/lit)	500	1000	168	Y	172	Y	226	Y
Total Alkalinity (mg/lit)	200	600	160	Y	140	Y	152	Y
D.O. (mg/lit)	5.0-6.0	>6	5.9	Y	5.8	Y	5.3	Y
M.P.N. index for E. Coli count per 100 ml	500	1600	>1600/100ml	N	>1600/100ml	N	>1600/100ml	N
Total Bacterial count /100ml	10000	15000	3.5×10^4	N	2.85×10^4	N	3.1×10^4	N
Turbidity NTU	10	25	5.2	Y	3	Y	1.4	Y

Sample no. 1 upstream= out of 7 parameter only 5 parameter are within limit. = 5/7 = 71.42 %

Sample no. 2 Downstream= out of 7 parameter only 5 parameter are within limit. = 5/7 = 71.42 %

Sample no. 3 Gallery= out of 7 parameter only 5 parameter are within limit. = 5/7 = 71.42 %

Average of 3 samples = **71.42 %**

From the above result it is conclude that the water quality of Karjan dam either of upstream or downstream is fairly suitable for drinking purpose.

(F) EXPENDITURE TOWARDS OPERATION& MAINTENANCE OF KARJAN DAM

Table No. 6.11 Expenditure for O & M of Karjan Dam

Sr. No	Year	Total No of structures	No. of structures required repairing	No. of Structure repaired	Expenditure of repairing in lacs	Requirement of other types of works in lacs	Amount spent for other types of works Rs. In lacs	Amount spent on modernization works in lacs	Total Expenditure on works in lacs
1	2009-10	7983	309	29	6.00	402.60	37.60	0.00	43.60
2	2010-11	7821	98	49	45.29	238.38	80.45	0.00	125.74
3	2011-12	5435	84	31	8.23	238.05	57.23	335	65.46

The normal Operation and Maintenance cost in rupees / Ha has been obtained as 428 rupees/Ha for the state of Gujarat (Source: Planning Commission Report 2002-2007)

Operation and Maintenance cost / Ha = Average Operation and Maintenance cost (Rupees) /Total C.C.A. (Ha)

= 7826660 / 26268 **= 297.9 rupees / Ha which is <428 rupees / Ha**

Hence it's in the limit and efficiency is 100 %

(C) RRIGATION INTENSITY

The irrigation intensity of Karjan dam for last 7 years is shown in the below table 6.12

Table No. 6.12 Irrigation intensity of Karjan Dam

Year	C. C. A. Ha.	Kharif Ha.	Rabi Ha.	HotHa.	Total Ha.	Irrigation Intensity %
2005-06	26268	0	8464.84	4990.02	13454.9	51.22
2006-07	26268	0	1655.99	2804.47	4460.46	16.98
2007-08	26268	0	5510.01	6094.98	11605	44.17
2008-09	26268	0	6337.05	6401.3	12738.4	48.49
2009-10	26268	2355.5	7269.69	6331.12	15956.3	60.74
2010-11	26268	0	7117.74	6601.7	13719.4	52.22
2011-12	26268	1283.62	6713.33	5708.44	13705.4	52.17

$$\text{IrrigationIntensity} = \frac{(51.22+16.98+44.17+48.49+60.74+52.22+52.17)}{7}$$

$$= \mathbf{46.57\ \%}$$

The low irrigation intensity can be justified by the poor performance of canal operation or maintenance.

6.3 ANALYSIS OFPERFORMANCE EVALUATIONFOR KADANA DAM

(A) **Reliability Index**

Table No. 6.13 Reliability Index of Kadana Dam

Year	Inflow (Mm3)	Spillage (Mm3)	Releases (Mm3)	In power house (Mm3)	Total Demand (Mm3)	Total release (Mm3)	Release / Demand %
2002-03	674.44	0	472.57	182.77	562.77	472.57	83.9721
2003-04	2786.36	1009.59	2272.85	1821.15	2201.15	1263.26	57.3909
2004-05	6646.6	4450.51	8307.9	2884.88	3264.88	3857.39	118.148
2005-06	2371.31	780.89	2632.92	1956.38	2336.38	1852.03	79.2692
2006-07	20371.1	18678.4	19934.6	3173.31	3553.31	1256.2	35.353

2007-08	7500.17	5632.32	7661.55	3015.97	3395.97	2029.23	59.7541
2008-09	998.55	0	865.06	486.87	866.87	865.06	99.7912
2009-10	1432.66	0	1406.42	1082.43	1462.43	1406.42	96.1701
2010-11	1242.03	0	1411.29	1186.04	1566.04	1411.29	90.1184
2011-12	6899.59	4161.98	5662.05	2685.83	3065.83	1500.07	48.9287

Reliability Index= (83.97+57.39+118.14+79.26+35.35+59.75+99.79+96.17+90.11+48.92)/10

= **76.88 %**

The result shows that the release of water is done properly and as required in demand for irrigation.

(B) Reservoir Sedimentation

	Dead Storage (Mm^3)	Live Storage (Mm^3)	Gross Storage (Mm^3)
As per project	340	1203	1543
In year 2000	294.58	954.68	1249.26
% loss in capacity	**13.36%**	**20.64%**	**19.04%**
Annual % loss		0.83%	

The silt index of 5.011 ham/100Km^2 /year worked out as per sedimentation survey against designed silt index of 1.30 ham/100Km^2 /year indicates high siltation. The *annual % loss is 0.83 %* which is above 0.5 % and hence the reservoir is classified as *"SERIOUS CATEGORY"* as per IS 12182-1987.

(G) RRIGATION INTENSITY

The irrigation intensity of Karjan dam for last 7 years is shown in the below table 6.12

Table No. 6.12 Irrigation intensity of Karjan Dam

Year	C. C. A. Ha.	Kharif Ha.	Rabi Ha.	HotHa.	Total Ha.	Irrigation Intensity %
2005-06	26268	0	8464.84	4990.02	13454.9	51.22
2006-07	26268	0	1655.99	2804.47	4460.46	16.98
2007-08	26268	0	5510.01	6094.98	11605	44.17
2008-09	26268	0	6337.05	6401.3	12738.4	48.49
2009-10	26268	2355.5	7269.69	6331.12	15956.3	60.74
2010-11	26268	0	7117.74	6601.7	13719.4	52.22
2011-12	26268	1283.62	6713.33	5708.44	13705.4	52.17

$$\text{IrrigationIntensity} = \frac{(51.22+16.98+44.17+48.49+60.74+52.22+52.17)}{7}$$

$$= \mathbf{46.57\ \%}$$

The low irrigation intensity can be justified by the poor performance of canal operation or maintenance.

6.3 ANALYSIS OFPERFORMANCE EVALUATIONFOR KADANA DAM

(A) Reliability Index

Table No. 6.13 Reliability Index of Kadana Dam

Year	Inflow (Mm3)	Spillage (Mm3)	Releases (Mm3)	In power house (Mm3)	Total Demand (Mm3)	Total release (Mm3)	Release / Demand %
2002-03	674.44	0	472.57	182.77	562.77	472.57	83.9721
2003-04	2786.36	1009.59	2272.85	1821.15	2201.15	1263.26	57.3909
2004-05	6646.6	4450.51	8307.9	2884.88	3264.88	3857.39	118.148
2005-06	2371.31	780.89	2632.92	1956.38	2336.38	1852.03	79.2692
2006-07	20371.1	18678.4	19934.6	3173.31	3553.31	1256.2	35.353

2007-08	7500.17	5632.32	7661.55	3015.97	3395.97	2029.23	59.7541
2008-09	998.55	0	865.06	486.87	866.87	865.06	99.7912
2009-10	1432.66	0	1406.42	1082.43	1462.43	1406.42	96.1701
2010-11	1242.03	0	1411.29	1186.04	1566.04	1411.29	90.1184
2011-12	6899.59	4161.98	5662.05	2685.83	3065.83	1500.07	48.9287

Reliability Index= (83.97+57.39+118.14+79.26+35.35+59.75+99.79+96.17+90.11+48.92)/10

= 76.88 %

The result shows that the release of water is done properly and as required in demand for irrigation.

(B) Reservoir Sedimentation

	Dead Storage (Mm^3)	Live Storage (Mm^3)	Gross Storage (Mm^3)
As per project	340	1203	1543
In year 2000	294.58	954.68	1249.26
% loss in capacity	**13.36%**	**20.64%**	**19.04%**
Annual % loss		0.83%	

The silt index of 5.011 ham/100Km^2 /year worked out as per sedimentation survey against designed silt index of 1.30 ham/100Km^2 /year indicates high siltation. The *annual % loss is 0.83 %* which is above 0.5 % and hence the reservoir is classified as *"SERIOUS CATEGORY"* as per IS 12182-1987.

(C)Non-Spilling Efficiency

It is calculated by dividing the no. of years of non-spilling to the total no. of year. Operation of gates is working properly when the rue level is maintained. In the below table 6.14 the rule level on 15th October is shown from the year 2002-03 to 2011-12.

Table No. 6.14 Non-Spilling Efficiencyof Kadana Dam

YEARS	INFLOW (Mm3)	SPILLAGE (Mm3)	Rule levelon 15th OCT.(m)
2002-03	674.44	N	120.7
2003-04	2786.36	Y	127.7
2004-05	6646.6	Y	127.2
2005-06	2371.31	Y	127.7
2006-07	20371.1	Y	127.7
2007-08	7500.17	Y	127.7
2008-09	998.55	N	125.3
2009-10	1432.66	N	128.8
2010-11	1242.03	N	126
2011-12	6899.59	Y	127.71

Operating Efficiency = No. of years having non-spillover / Total No. of years

= 4 /10 = **40 %**

Here, No. of years having non-spillover= 4 Total no of years count = 10

(D)Conveyance Efficiency

Table No. 6.15 Conveyance Efficiency of Kadana Dam

Sr.No.	Year	Canal Releases (Mcft)	Releases at Field (Mcft)	Conveyance Losses (Mcft)	% Losses= Col.5/Col.3
Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
1	2009-10	6241.5	5193.2	1048.3	16.79
2	2011-12	4366.23	3492.98	873.25	20

From the above analysis we can see that the conveyance losses are within **20 %**. From this analysis we conclude that maintenance of Canal network is fairly maintained.

From the above analysis we can see that the conveyance losses are not within **20 %**.

Conveyance losses = (16.79+20) / 2 = **18.39 %**

Conveyance Efficiency = 100 – 18.39= **81.60 %**

From this analysis we conclude that maintenance of Canal network is properly maintained as a result Conveyance Efficiency is high.

(E)Water Quality Analysis of Kadana Dam (Drinking purpose)

Table No. 6.16 Water Quality Analysis of Kadana Dam

Parameters	BIS		Sample no.1 (Upstream)	Within limit	Sample no.2 (Downstream)	Within limit
	Permissible	Excessive				
pH	6.5-8.5	9.2	8.53	N	8.2	Y
TDS (mg/lit)	500	1000	296	Y	334	Y
Total Alkalinity (mg/lit)	200	600	168	Y	206	N
D.O. (mg/lit)	5.0-6.0	> 6	7.2	N	7.8	N
M.P.N. index for E. Coli count per 100 ml	500	1600	>1600/100ml	N	>1600/100ml	N
Total Bacterial count /100ml	10000	15000	3.42×10^4	N	4.08×10^4	N
Turbidity NTU	10	25	1.2	Y	1.5	Y

Sample no. 1 upstream= out of 7 parameter only 3 parameter are within limit. = 3/7 =42.85 %

Sample no. 2 Downstream= out of 7 parameter only 3 parameter are within limit. = 3/7 = 42.85 %

Average of 2 samples = **42.85 %**

From the above result it is conclude that the water quality of Kadana dam either of upstream or downstream is not suitable for drinking purpose.

(A) EXPENDITURE TOWARDS OPERATION & MAINTENANCE OF KADANA DAM

Table No. 6.17 Expenditure for O & M of Kadana Dam

Sr. No	Year	Total No of structures	No. of structures required repairing	No. of Structure repaired	Expenditure of repairing in lacs	Requirement of other types of works in lacs	Amount spent for other types of works Rs. In lacs	Amount spent on modernization works in lacs	Total Expenditure on works in lacs
1	2009-10	649	357	19	30	0	0	130	160
2	2011-12	649	357	30	41	1512	0	138	179

The normal Operation and Maintenance cost in rupees / Ha has been obtained as 428 rupees/Ha for the state of Gujarat (Source: Planning Commission Report 2002-2007)

Operation and Maintenance cost / Ha = Average Operation and Maintenance cost (Rupees) /Total C.C.A. (Ha)

= 1695000 / 10500 **= 161.42 rupees / Ha which is < 428 rupees / Ha**

Hence it's in the limit and efficiency is 100 %.

(G) Irrigation Intensity

The irrigation intensity of Kadana dam for last 10 years is shown in the below table 6.17

Table No. 6.18 Irrigation intensity of Kadana Dam

Year	C.C.A. Ha.	Kharif Ha.	Rabi Ha.	Hot Ha.	Total Ha.	Irrigation Intensity %
2002-03	10500	0	5939	623	6562	62.49
2003-04	10500	1200	4896	3398	9494	90.41
2004-05	10500	2492	3600	0	6092	58.01
2005-06	10500	2886	0	0	2886	27.48
2006-07	10500	1950	450	3618	6018	57.31
2007-08	10500	2256	1128	3800	7184	68.41
2008-09	10500	3078	2744	1711	7533	71.74
2009-10	10500	3070	3445	1700	8215	78.23
2010-11	10500	2915	2772	2088	7775	74.04
2011-12	10500	2111	2238	1938	6287	59.87

IrrigationIntensity =

$$\frac{(62.49+90.41+58.01+27.48+57.31+68.41+71.74+78.23+74.04+59.87)}{10} = \mathbf{64.7\ \%}$$

The irrigation intensity of Kadana dam is good and it can be justified by the proper performance of canal operation or maintenance.

6.4 COMPARISON OF RESULTS OF DAMS

Sr. No.	Parameters	Sukhi Dam	Karjan Dam	Kadana Dam
1	Reliability index	68.77 %	84.2 %	76.88 %
2	Performance parameter for sedimentation rate	100 % (Insignificant category)	0 % (Significant category)	0 % (Significant category)
3	Performance parameter for Non-spilling efficiency	42.86 %	0	40 %
4	Conveyance efficiency	80 %	63.54 %	81.60 %
5	Water quality	Not suitable for drinking purpose (49.66 %)	Not suitable for drinking purpose (71.42 %)	Not suitable for drinking purpose (42.85 %)
6	Expenditure towards Operation& Maintenance	100 % 77.6 rupees/Ha.	100 % 297.9 rupees/Ha.	100 % 161.42 rupees/Ha.
7	Irrigation intensity	50.35 %	46.57 %	64.7
AVERAGE		**70.23 %**	**52.24 %**	**58 %**

6.5 CONCLUSION

1. The performance evaluation system has been evolved to evaluate the performance of the water resource of the project considering the performance measures such as Reliability index, Reservoir sedimentation rate, Non-spilling efficiency, Conveyance efficiency, Water quality (drinking purpose), Expenditure towards operation and maintenance and Irrigation intensity.

2. It is found that Sukhi reservoir is performing well with respect to Reliability index, Rate of reservoir sedimentation, Conveyance efficiency and Expenditure towards operation and maintenance.

3. It is found that Karjan reservoir is performing well with respect to Reliability index, Conveyance efficiency, Water quality (drinking purpose) and Expenditure towards operation and maintenance.

4. It is found that Kadana reservoir is performing well with respect to Reliability index, Conveyance efficiency, Expenditure towards operation and maintenance and Irrigation intensity.

5. On an average the Sukhi reservoir performance have been 70.23 % while Karjan reservoir performance is 52.24 % and Kadana reservoir performance is 58 %.

6. The main reason of low performance of Karjan and Kadana reservoir is found Sedimentation at higher rate than the allowable and Spilling over the reservoir frequently.

7. The performance of Karjan reservoir can be improved by lowering the sedimentation rate, improving non-spilling efficiency and irrigation intensity.

8. The performance of Kadana reservoir can be improved by lowering the sedimentation rate, improving non-spilling efficiency and water quality.

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"PESMP"

Software coding

```
PublicClassDAM_Form
PrivateSub Form1_Load(sender AsObject, e AsEventArgs) HandlesMyBase.Load
Try
'Using MyConnaction As New SqlConnection("Data Source=******* \SQLEXPRESS;Initial
Catalog=test;Persist Security Info=True;User ID=**;Password=******")
'    MyConnaction.Open()
'    Using MyCommand As New SqlCommand("", MyConnaction)
'        MyCommand.CommandText = "insert into Table_2 Values('" & lable4.Text & "','" &
lable5.Text & "','" & lable6.Text & "')"
'        MyCommand.ExecuteNonQuery()
'    End Using
'End Using
'MsgBox("insert Sucessfully..", MsgBoxStyle.OkOnly)
Catch ex AsException
MsgBox(ex, MsgBoxStyle.Critical)
EndTry
EndSub
PrivateSub Button1_Click(sender AsObject, e AsEventArgs) Handles Button1.Click
        TextBox1.Text = (ComboBox6.SelectedItem - ComboBox8.SelectedItem)
        TextBox2.Text = (ComboBox24.SelectedItem - ComboBox25.SelectedItem)
EndSub

PrivateSub Button2_Click(sender AsObject, e AsEventArgs) Handles Button2.Click
        TextBox3.Text = (ComboBox59.SelectedItem - ComboBox58.SelectedItem)
EndSub

PrivateSub Button3_Click(sender AsObject, e AsEventArgs) Handles Button3.Click
        TextBox5.Text = (ComboBox96.SelectedItem + ComboBox97.SelectedItem +
ComboBox96.SelectedItem + ComboBox97.SelectedItem)
EndSub
PrivateSub Button7_Click_1(sender AsObject, e AsEventArgs) Handles Button7.Click
        TextBox59.Text = ((ComboBox523.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox60.Text = ((ComboBox518.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox61.Text = ((ComboBox513.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox62.Text = ((ComboBox516.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox63.Text = ((ComboBox512.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox64.Text = ((ComboBox509.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox65.Text = ((ComboBox505.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox66.Text = ((ComboBox501.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox67.Text = ((ComboBox497.SelectedItem / ComboBox489.SelectedItem) * 100)
        TextBox68.Text = ((ComboBox493.SelectedItem / ComboBox489.SelectedItem) * 100)
Dim A, B, C, D, Q, F, G, H, I, J AsDouble
        A = TextBox59.Text
        B = TextBox60.Text
        C = TextBox61.Text
        D = TextBox62.Text
        Q = TextBox63.Text
        F = TextBox64.Text
        G = TextBox65.Text
        H = TextBox66.Text
        I = TextBox67.Text
        J = TextBox68.Text
```

```
        TextBox53.Text = ((A + B + C + D + Q + F + G + H + I + J) / 10)
If TextBox53.Text > 50 Then
            Label228.Text = ("The result shows that the release of water is done properly
and as required in demand for irrigation")
Else
            Label228.Text = ("The result shows that the release of water is not done
properly")
EndIf
EndSub

PrivateSub Button6_Click(sender AsObject, e AsEventArgs) Handles Button6.Click
        TextBox144.Text = (ComboBox452.SelectedItem - ComboBox449.SelectedItem)
        TextBox152.Text = ((TextBox144.Text / ComboBox452.SelectedItem) * 100)

Dim AAA AsDouble
        AAA = TextBox152.Text
        TextBox153.Text = ((AAA * 0.05) / 0.82)
If TextBox153.Text > 0.5 Then
            Label251.Text = ("SERIOUS CATEGORY")
ElseIf 0.1 < TextBox153.Text Then
            Label251.Text = ("SIGNIFICANT CATEGORY")
ElseIf TextBox153.Text < 0.1 Then
            Label251.Text = ("INSIGNIFICANT CATEGORY")
EndIf
EndSub

PrivateSub Button4_Click(sender AsObject, e AsEventArgs) Handles Button4.Click
        TextBox145.Text = ((ComboBox402.SelectedItem / ComboBox403.SelectedItem) * 100)
If TextBox145.Text > 50 Then
            Label271.Text = ("The result shows that the gates are opened as per schedule
or properly.")
Else
            Label271.Text = ("The result shows that the gates are not opened as per
schedule or improperly.")
EndIf
EndSub

PrivateSub Button5_Click(sender AsObject, e AsEventArgs) Handles Button5.Click
        TextBox15.Text = ((ComboBox438.SelectedItem / ComboBox436.SelectedItem) * 100)
        TextBox16.Text = ((ComboBox433.SelectedItem / ComboBox439.SelectedItem) * 100)
        TextBox17.Text = ((ComboBox428.SelectedItem / ComboBox434.SelectedItem) * 100)
        TextBox18.Text = ((ComboBox431.SelectedItem / ComboBox429.SelectedItem) * 100)
        TextBox19.Text = ((ComboBox427.SelectedItem / ComboBox425.SelectedItem) * 100)
        TextBox20.Text = ((ComboBox424.SelectedItem / ComboBox422.SelectedItem) * 100)
        TextBox21.Text = ((ComboBox420.SelectedItem / ComboBox418.SelectedItem) * 100)
        TextBox22.Text = ((ComboBox416.SelectedItem / ComboBox414.SelectedItem) * 100)
        TextBox23.Text = ((ComboBox412.SelectedItem / ComboBox410.SelectedItem) * 100)
        TextBox24.Text = ((ComboBox408.SelectedItem / ComboBox406.SelectedItem) * 100)
Dim AB, BC, CD, DE, PQ, EF, FG, GH, HI, IJ, XY AsDouble
        AB = TextBox15.Text
        BC = TextBox16.Text
        CD = TextBox17.Text
        DE = TextBox18.Text
        PQ = TextBox19.Text
        EF = TextBox20.Text
        FG = TextBox21.Text
        GH = TextBox22.Text
        HI = TextBox23.Text
```

```
        IJ = TextBox24.Text

        TextBox146.Text = ((AB + BC + CD + DE + PQ + EF + FG + GH + HI + IJ) / 10)
        XY = TextBox146.Text
        TextBox147.Text = (100 - XY)
If TextBox147.Text > 50 Then
            Label249.Text = ("From this analysis we conclude that Conveyance Efficiency
of canal is good and this is a result of proper maintenance of Canal network")
Else
            Label249.Text = ("From this analysis we conclude that Conveyance Efficiency
of canal is not good")
EndIf
EndSub

PrivateSub Button8_Click(sender AsObject, e AsEventArgs) Handles Button8.Click
        TextBox86.Text = ((ComboBox445.SelectedItem / 6) * 100)
        TextBox88.Text = ((ComboBox446.SelectedItem / 6) * 100)
        TextBox87.Text = ((ComboBox448.SelectedItem / 6) * 100)
Dim ABC, BCD, CDE AsDouble
        ABC = TextBox86.Text
        BCD = TextBox88.Text
        CDE = TextBox87.Text

        TextBox89.Text = ((ABC + BCD + CDE) / 3)
If ABC > 50 Then
            Label263.Text = ("From the above result it is conclude that the water quality
of dam of upstream is suitable for drinking purpose")
Else
            Label263.Text = ("From the above result it is conclude that the water quality
of dam of upstream is Not suitable for drinking purpose")
EndIf
If BCD > 50 Then
            Label276.Text = ("From the above result it is conclude that the water quality
of dam of downstream is suitable for drinking purpose")
Else
            Label276.Text = ("From the above result it is conclude that the water quality
of dam of downstream is Not suitable for drinking purpose")
EndIf
EndSub

PrivateSub Button9_Click(sender AsObject, e AsEventArgs) Handles Button9.Click
        TextBox106.Text = (ComboBox466.SelectedItem + ComboBox467.SelectedItem)
        TextBox107.Text = (ComboBox470.SelectedItem + ComboBox472.SelectedItem)
        TextBox108.Text = (ComboBox477.SelectedItem + ComboBox479.SelectedItem)
        TextBox109.Text = (ComboBox483.SelectedItem + ComboBox484.SelectedItem)
        TextBox110.Text = (ComboBox488.SelectedItem + ComboBox530.SelectedItem)
        TextBox111.Text = (ComboBox532.SelectedItem + ComboBox533.SelectedItem)
        TextBox112.Text = (ComboBox536.SelectedItem + ComboBox534.SelectedItem)
        TextBox113.Text = (ComboBox538.SelectedItem + ComboBox537.SelectedItem)
        TextBox114.Text = (ComboBox541.SelectedItem + ComboBox539.SelectedItem)
        TextBox115.Text = (ComboBox543.SelectedItem + ComboBox544.SelectedItem)

Dim ABA, BCA, CDA, DEA, PQA, EFA, FGA, GHA, HIA, IJA, XYA AsDouble
        ABA = TextBox106.Text
        BCA = TextBox107.Text
        CDA = TextBox108.Text
        DEA = TextBox109.Text
        PQA = TextBox110.Text
```

```
        EFA = TextBox111.Text
        FGA = TextBox112.Text
        GHA = TextBox113.Text
        HIA = TextBox114.Text
        IJA = TextBox115.Text

        TextBox148.Text = ((ABA + BCA + CDA + DEA + PQA + EFA + FGA + GHA + HIA + IJA) /
10)
        XYA = TextBox148.Text
        TextBox95.Text = ((XYA / ComboBox630.SelectedItem) * 100000)

EndSub

PrivateSub Button10_Click(sender AsObject, e AsEventArgs) Handles Button10.Click
        TextBox124.Text = (ComboBox593.SelectedItem + ComboBox564.SelectedItem +
ComboBox568.SelectedItem)
        TextBox125.Text = (ComboBox588.SelectedItem + ComboBox572.SelectedItem +
ComboBox576.SelectedItem)
        TextBox126.Text = (ComboBox591.SelectedItem + ComboBox580.SelectedItem +
ComboBox583.SelectedItem)
        TextBox127.Text = (ComboBox586.SelectedItem + ComboBox584.SelectedItem +
ComboBox587.SelectedItem)
        TextBox128.Text = (ComboBox582.SelectedItem + ComboBox589.SelectedItem +
ComboBox594.SelectedItem)
        TextBox129.Text = (ComboBox579.SelectedItem + ComboBox601.SelectedItem +
ComboBox602.SelectedItem)
        TextBox130.Text = (ComboBox575.SelectedItem + ComboBox603.SelectedItem +
ComboBox604.SelectedItem)
        TextBox131.Text = (ComboBox571.SelectedItem + ComboBox605.SelectedItem +
ComboBox606.SelectedItem)
        TextBox132.Text = (ComboBox567.SelectedItem + ComboBox607.SelectedItem +
ComboBox608.SelectedItem)
        TextBox133.Text = (ComboBox563.SelectedItem + ComboBox609.SelectedItem +
ComboBox610.SelectedItem)

Dim ABAA, BCAA, CDAA, DEAA, PQAA, EFAA, FGAA, GHAA, HIAA, IJAA, XYAA, ABAAA, BCAAA,
CDAAA, DEAAA, PQAAA, EFAAA, FGAAA, GHAAA, HIAAA, IJAAA AsDouble
        ABAA = TextBox124.Text
        BCAA = TextBox125.Text
        CDAA = TextBox126.Text
        DEAA = TextBox127.Text
        PQAA = TextBox128.Text
        EFAA = TextBox129.Text
        FGAA = TextBox130.Text
        GHAA = TextBox131.Text
        HIAA = TextBox132.Text
        IJAA = TextBox133.Text

        TextBox134.Text = ((ABAA / ComboBox592.SelectedItem) * 100)
        TextBox135.Text = ((BCAA / ComboBox595.SelectedItem) * 100)
        TextBox136.Text = ((CDAA / ComboBox590.SelectedItem) * 100)
        TextBox137.Text = ((DEAA / ComboBox585.SelectedItem) * 100)
        TextBox138.Text = ((PQAA / ComboBox581.SelectedItem) * 100)
        TextBox139.Text = ((EFAA / ComboBox578.SelectedItem) * 100)
        TextBox140.Text = ((FGAA / ComboBox574.SelectedItem) * 100)
        TextBox141.Text = ((GHAA / ComboBox570.SelectedItem) * 100)
        TextBox142.Text = ((HIAA / ComboBox566.SelectedItem) * 100)
        TextBox143.Text = ((IJAA / ComboBox562.SelectedItem) * 100)
```

```
        ABAAA = TextBox134.Text
        BCAAA = TextBox135.Text
        CDAAA = TextBox136.Text
        DEAAA = TextBox137.Text
        PQAAA = TextBox138.Text
        EFAAA = TextBox139.Text
        FGAAA = TextBox140.Text
        GHAAA = TextBox141.Text
        HIAAA = TextBox142.Text
        IJAAA = TextBox143.Text
        TextBox101.Text = ((ABAAA + BCAAA + CDAAA + DEAAA + PQAAA + EFAAA + FGAAA + GHAAA
+ HIAAA + IJAAA) / 10)
        XYAA = TextBox101.Text
If XYAA > 60 Then
            Label269.Text = ("The high irrigation intensity can be justified by the good
performance of canal operation or maintenance")
Else
            Label269.Text = ("The low irrigation intensity can be justified by the poor
performance of canal operation or maintenance")
EndIf
EndSub

PrivateSub Button11_Click(sender AsObject, e AsEventArgs) Handles Button11.Click
Dim AAAA, BBBB, CCCC, DDDD, EEEE, FFFF, GGGG, HHHH, IIII, JJJJ, KKKK, LLLL, MMMM, NNNN,
OOOO, PPPP, QQQQ, RRRR, SSSS, TTTT, UUUU AsDouble
        AAAA = ComboBox642.SelectedItem
        BBBB = ComboBox645.SelectedItem
        CCCC = ComboBox640.SelectedItem
        DDDD = ComboBox635.SelectedItem
        EEEE = ComboBox631.SelectedItem
        FFFF = ComboBox628.SelectedItem
        GGGG = ComboBox624.SelectedItem
        HHHH = ComboBox611.SelectedItem
        IIII = ComboBox612.SelectedItem
        JJJJ = ComboBox613.SelectedItem
        KKKK = ComboBox614.SelectedItem
        LLLL = ComboBox615.SelectedItem
        MMMM = ComboBox616.SelectedItem
        NNNN = ComboBox617.SelectedItem
        OOOO = ComboBox619.SelectedItem
        PPPP = ComboBox621.SelectedItem
        QQQQ = ComboBox622.SelectedItem
        RRRR = ComboBox623.SelectedItem
        SSSS = ComboBox625.SelectedItem
        TTTT = ComboBox626.SelectedItem
        UUUU = ComboBox627.SelectedItem
        TextBox149.Text = ((AAAA + BBBB + CCCC + DDDD + EEEE + FFFF + GGGG) / 7)
        TextBox150.Text = ((HHHH + IIII + JJJJ + KKKK + LLLL + MMMM + NNNN) / 7)
        TextBox151.Text = ((OOOO + PPPP + QQQQ + RRRR + SSSS + TTTT + UUUU) / 7)

EndSub

PrivateSub Button12_Click(sender AsObject, e AsEventArgs) Handles Button12.Click
If ComboBox485.SelectedItem > 9.2 Then
            TextBox32.Text = ("Yes")
Else
            TextBox32.Text = ("No")
```

```
EndIf
If ComboBox480.SelectedItem > 1000 Then
            TextBox33.Text = ("Yes")
Else
            TextBox33.Text = ("No")
EndIf
If ComboBox475.SelectedItem > 600 Then
            TextBox37.Text = ("Yes")
Else
            TextBox37.Text = ("No")
EndIf
If ComboBox478.SelectedItem > 6 Then
            TextBox34.Text = ("Yes")
Else
            TextBox34.Text = ("No")
EndIf
If ComboBox474.SelectedItem > 15 Then
            TextBox35.Text = ("Yes")
Else
            TextBox35.Text = ("No")
EndIf
If ComboBox471.SelectedItem > 15000 Then
            TextBox36.Text = ("Yes")
Else
          TextBox36.Text = ("No")
EndIf

If ComboBox447.SelectedItem > 9.2 Then
            TextBox38.Text = ("Yes")
Else
            TextBox38.Text = ("No")
EndIf
If ComboBox451.SelectedItem > 1000 Then
            TextBox39.Text = ("Yes")
Else
            TextBox39.Text = ("No")
EndIf
If ComboBox454.SelectedItem > 600 Then
            TextBox40.Text = ("Yes")
Else
            TextBox40.Text = ("No")
EndIf
If ComboBox455.SelectedItem > 6 Then
            TextBox41.Text = ("Yes")
Else
            TextBox41.Text = ("No")
EndIf
If ComboBox456.SelectedItem > 15 Then
            TextBox50.Text = ("Yes")
Else
            TextBox50.Text = ("No")
EndIf
If ComboBox457.SelectedItem > 15000 Then
            TextBox51.Text = ("Yes")
Else
            TextBox51.Text = ("No")
EndIf
```

```
If ComboBox458.SelectedItem > 9.2 Then
            TextBox52.Text = ("Yes")
Else
            TextBox52.Text = ("No")
EndIf
If ComboBox459.SelectedItem > 1000 Then
            TextBox69.Text = ("Yes")
Else
            TextBox69.Text = ("No")
EndIf
If ComboBox460.SelectedItem > 600 Then
            TextBox82.Text = ("Yes")
Else
            TextBox82.Text = ("No")
EndIf
If ComboBox461.SelectedItem > 6 Then
            TextBox83.Text = ("Yes")
Else
            TextBox83.Text = ("No")
EndIf
If ComboBox463.SelectedItem > 15 Then
            TextBox84.Text = ("Yes")
Else
            TextBox84.Text = ("No")
EndIf
If ComboBox465.SelectedItem > 15000 Then
            TextBox85.Text = ("Yes")
Else
            TextBox85.Text = ("No")
EndIf
EndSub
EndClass
```

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Reservoir Capacity | Performance Evaluation of Head works | Performance Evaluation of Conveyance System | Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATI

Levels (m) | Capacity at Design Stage (Mm^3) | Capacity in Year | is

Capacity decrease by

Rules curve for filling and depletion of reservoir:

13 February , 2017 | Standard Reservoir Level(m) | Actual Reservoir Level(m) | Reservoir Capacities

Annual Inflows:

Year | Inflow (Mm^3) | Spillage (Mm^3)

RELEASE (Mm^3) | Evaporation loss (Mm^3)

Monthly Inflows:

Month | Years | Inflow

Releases for Irrigation with Actual Demand:

Demand for | Releases for

Reservoir Sedimentation

Designed Area-Capacity | Actual Area – capacity | Loss in capacity

SUBMIT

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

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Head works location:

State | District | Taluka | Latitude | Longitude

Type of Head works with structural details:

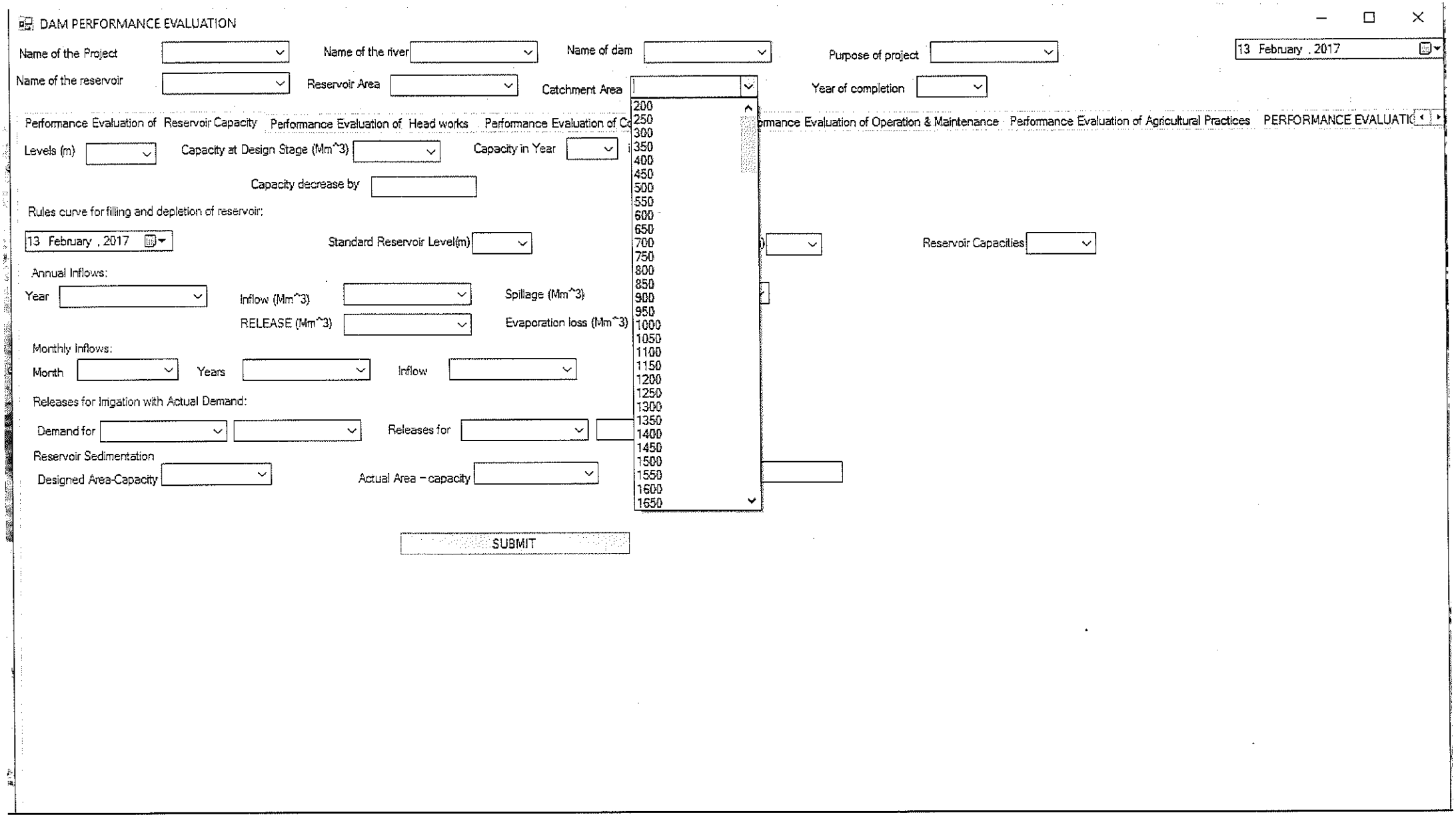
Type | Gates type | No. of gates

Operation system for water releases:

Sequence of gate operation:

For Opening of gates

For closing of gates


DAM PERFORMANCE EVALUATION
Name of the Project
Name of the river
Name of dam
Purpose of project
13 February , 2017
Name of the reservoir
Reservoir Area
Catchment Area
Year of completion
Performance Evaluation of Reservoir Capacity
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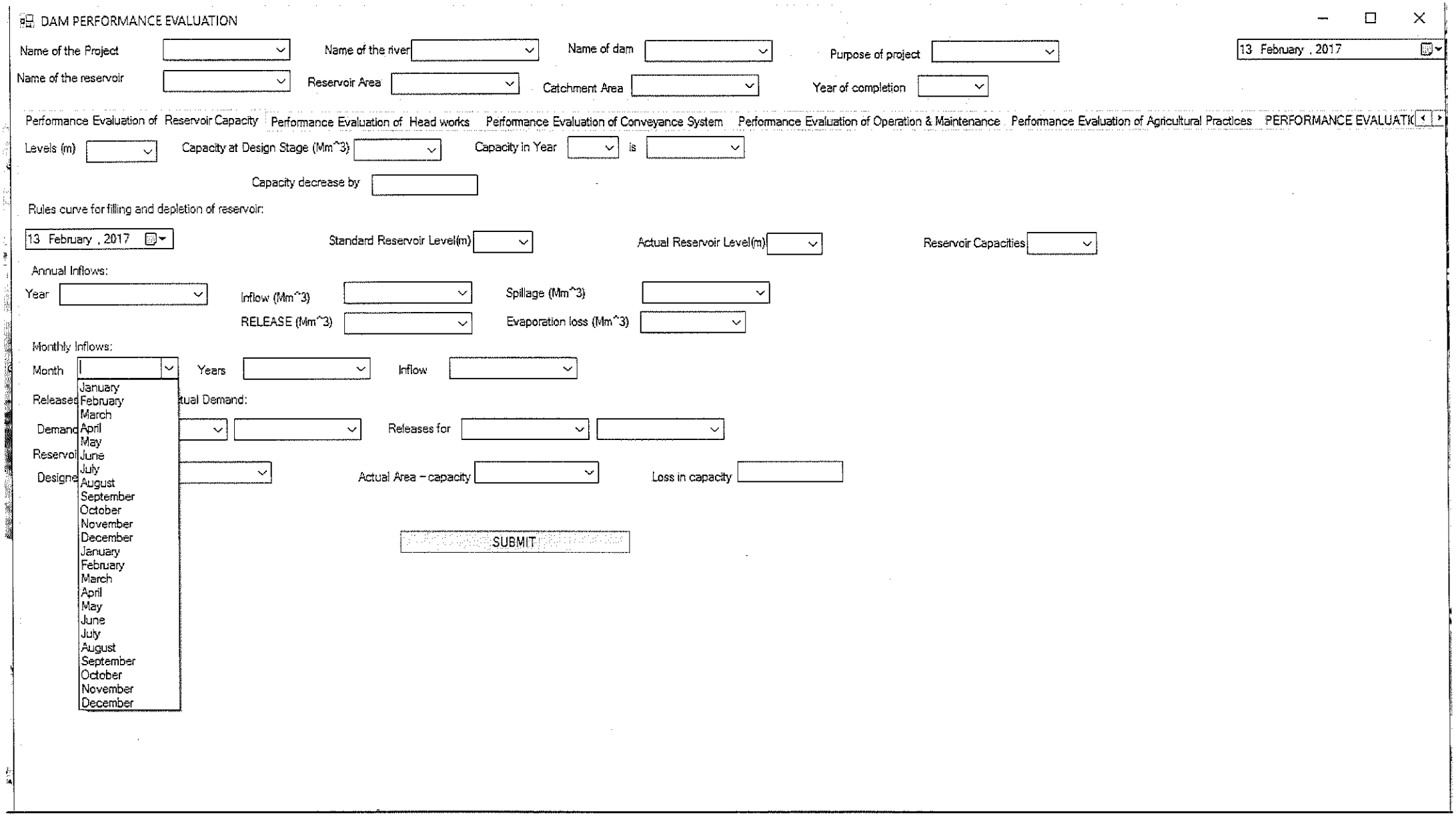
Performance Evaluation of Co
ormance Evaluation of Operation & Maintenance
Performance Evaluation of Agricultural Practices
PERFORMANCE EVALUATIC
Levels (m)
Capacity at Design Stage (Mm^3)
Capacity in Year
Capacity decrease by
Rules curve for filling and depletion of reservoir:
13 February , 2017
Standard Reservoir Level(m)
Reservoir Capacities
Annual Inflows:
Year
Inflow (Mm^3)
Spillage (Mm^3)
RELEASE (Mm^3)
Evaporation loss (Mm^3)
Monthly Inflows:
Month
Years
Inflow
Releases for Irrigation with Actual Demand:
Demand for
Releases for
Reservoir Sedimentation
Designed Area-Capacity
Actual Area – capacity
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
SUBMIT


DAM PERFORMANCE EVALUATION
Name of the Project
Name of the river
Name of dam
Purpose of project
13 February , 2017
Name of the reservoir
Reservoir Area
Catchment Area
Year of completion
Performance Evaluation of Reservoir Capacity
Performance Evaluation of Head works
Performance Evaluation of Conveyance System
Performance Evaluation of Operation & Maintenance
Performance Evaluation of Agricultural Practices
PERFORMANCE EVALUATI
Levels (m)
Capacity at Design Stage (Mm^3)
Capacity in Year
is
Capacity decrease by
Rules curve for filling and depletion of reservoir:
13 February , 2017
Standard Reservoir Level(m)
Actual Reservoir Level(m)
Reservoir Capacities
Annual Inflows:
Year
Inflow (Mm^3)
Spillage (Mm^3)
RELEASE (Mm^3)
Evaporation loss (Mm^3)
Monthly Inflows:
Month
Years
Inflow
January
February
March
April
May
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
Releases for
Actual Area – capacity
Loss in capacity
SUBMIT

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Reservoir Capacity | Performance Evaluation of Head works | Performance Evaluation of Conveyance System | Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATI

Name of Main Canal / distributary / minor

Year of construction | Cost of construction in crores

Canal Operation at the release structure is

Total length of canal / distributary / minor (km):

Main canal | Minor | Canal cross-section throughout the length is

Designed canal dimensions at each uniform cross-section:

Cross-sectional dimensions | Wetted Perimeter | Designed full supply level (FSL)

Free board | Length of Uniform section | Canal gradient in each irrigation section

Designed discharge at FSL: | Maximum attained discharge

Whether the canal is lined or unlined | Type of lining

Conveyance losses:

Year | Releases at Field (Mcft) | Conveyance Losses (Mcft) | Canal Releases (Mcft)

Number of canal outlets for irrigation distribution / supply | Location of outlet | Type of outlet

Capacity of each outlet in cusec | Frequency of release through each outlet | Duration of release

Arrangements for measuring / metering the flow | Area for Irrigation by each Outlet (as per design) | Area actually irrigated

General condition of the canal / distributaries / minor and other structures:

Breaches or cracks-Specify length affected | Siltation - specify length affected | Excessive vegetation causing flow obstruction

Bathing / washing points | Animal crossing | Deterioration of canal shape

Water Quality:

Effluent discharge, if any with location | Source of effluent | Water quality monitoring Arrangements

Water Quality Test:

Sample no. | pH | TDS (mg/lit) | Total Alkalinity (mg/lit) | D.O. (mg/lit)

M.P.N. index for E. Coli count per 100 ml | Total Bacterial count /100ml

Submit

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

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Performance Evaluation of Reservoir Capacity | Performance Evaluation of Head works | Performance Evaluation of Conveyance System | Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATI

Maintenance norms

Maintenance schedule of Dam and Reservoir for Daily:

water surface Elevation | reservoir inflow | Spillway discharge | Canal releases | Toe and gallery drain flows | Security and safety device

weather gauges and record data | Required changes in Gates and valves | pertinent information in Operating Log

- [ ] Check in with DEE's office
- [ ] Check log or safety boom
- [ ] Check spillway apron for Debris
- [ ] Check instrumentation Schedule

Maintenance schedule of Dam and Reservoir for Monthly:

Check condition of:

- [ ] Top of dam
- [ ] Upstream and D/s. faces
- [ ] Visible portions of foundation
- [ ] Abutment contacts
- [ ] Galleries
- [ ] Spillway stilling basin
- [ ] Outlet works stilling basin
- [ ] Critical landslide areas, if any
- [ ] Reservoir area
- [ ] Measuring devices
- [ ] Drainage systems, toe drains, gallery drains, etc.
- [ ] Rodent problems
- [ ] Security and Safety devices
- [ ] Inspect and repair animal burrows, eliminate animals
- [ ] Inspect, remove and repair encroachments

Electrical System:

Standby diesel engine driven generator:

- [ ] Run for minimum of 1 hour
- [ ] Keep battery charged
- [ ] Check diesel supply
- [ ] Replace light bulbs

Outlet Works:

- [ ] Grease all moving parts

Check signs that warn public of hazards:

- [ ] Near inspection steps
- [ ] D/s headwall steps
- [ ] At gate room
- [ ] Check for debris in approach channel

Spillway:

- [ ] Check operation of gates
- [ ] Check railing condition and caution signs

Maintenance schedule of Dam and Reservoir for Quarterly:

Outlet Works:

- [ ] Operating instructions up to date and legible
- [ ] Check gate air vents on downstream face

Embankment dams:

- [ ] Inspect and repair settlement, sloughs, slumps, bulges, cracks and depression

Spillway:

- [ ] Check and clear bridge drains
- [ ] Clean inside of motor control cabinet

Maintenance schedule of Dam and Reservoir for Semi Annually:

Outlet Works:

- [ ] Lubricate gate rollers
- [ ] Check rubber seals and seal clamp bar
- [ ] Check hoist cables-lubricate

Embankment dam:

- [ ] Inspect embankment for trees, vegetation, shrubs, bush growth and remove deep rooted vegetation and shrubs
- [ ] Inspect embankment for erosion
- [ ] Inspect and record quality and clarity of seepage and corresponding water level in the reservoir

Spillway:

- [ ] Check paint on gates
- [ ] Check hoist cables-lubricate
- [ ] Check mechanical hoist bearings flexible coupling bearings

Check gear case:

- [ ] Hoist gear case, replace grease
- [ ] Spur gear units and gear motors

Maintenance schedule of Dam and Reservoir for Annually:

Outlet Works: Paint:

- [ ] Metal works
- [ ] Colour-coded valves
- [ ] Woodwork and trim
- [ ] Exercise gates and valves
- [ ] Check condition of interior and exterior of outlet conduit

Dam and Reservoir:

- [ ] Review the SOP
- [ ] Inspect ends of drainage pipes at or near upstream toe of embankment and clean out debris / material that might choke that drain

Spillway:

- [ ] Check and repaint metal work on spillway bridge and railing
- [ ] Operate and exercise gates
- [ ] Examine stilling basin and downstream channel

Electrical:

- [ ] Check electrical conduits, pull-boxes, and switches
- [ ] Gate hoists
- [ ] Spillway
- [ ] Galleries

Maintenance schedule of Dam and Reservoir at 3 Year Period:

- [ ] Examine intake structure and stilling basin which normally are under water

Operation and maintenance tasks which are performed after heavy rains:

- [ ] Inspect and repair the embankment

Expenditure on Operation and Maintenance: Year | Name of Division

Expenditure of Mandalies from Amount refunded | PIM restoration Works | Expenditure in Other Type of Works | Expenditure in Modernisation Works | Total Expenditures

Submit

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Reservoir Capacity | Performance Evaluation of Head works | Performance Evaluation of Conveyance System | Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATI

Culturable Command Area: Already developed | Yet to be developed

Designed irrigation potential | Gross Irrigated Area | Net Irrigated Area | Potential utilized | Irrigation intensity | Method of irrigation

Designed Cropping pattern:

Season	Percentage%	Area (Ha)
Kharif		
Rabi		
Hot		
Total		

Present cropping pattern:

Season	Percentage%	Area (Ha)
Kharif		
Rabi		
Hot		
Total		

Cropping intensity

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Head works | Performance Evaluation of Conveyance System | Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embank

First filling (years / levels) | Benefits accrued in crores

Important controlling levels (in meters):

Top of dam | Maximum water level | Full reservoir level | Sill level of irrigation sluices | Spillway crest level | Minimum drawdown level | Deepest foundation level

Important salient features:

Dead storage capacity | Design flood adopted: | relevant magnitude | Design spillway discharge capacity and type of spillway

Type, number and size of spillway gates

Height of the dam in meter (Above deepest foundation) | Gross storage capacity in million cubic meters at FRL | Length of the dam (at crest) in meters

Date of inspection and the corresponding reservoir water level | 13 February | Maximum and minimum water levels reached during the last season with dates: Maximum | 13 February , 2017 | Minimum | 13 February , 2017

Maximum overflow during preceding monsoon with dates | 13 February , 2017 | History of past distress, if any, and brief details of remedial measures carried out

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

Checklist for Inspection of Embankment Dam:

Upstream face:
- Slope protection
- Erosion
- Vegetative growth
- Settlement
- Debris
- Burrows or burrowing animals
- Unusual conditions

Downstream face:
- Slope protection
- Signs of movement
- Seepage or wet areas
- Vegetative growth
- Drainage
- Unusual conditions

Abutments:
- Seepage
- Cracks, joints and bedding planes
- Drainage
- Slides
- Vegetation
- Signs of movement

Drainage:
- General
- Longitudinal drains

Seepage and drainage:
- Locations (s)
- Estimated flow (s)
- Color (staining)
- Erosion of outfall
- Toe drain and relief walls

Measurement:
- Method
- Amount
- Change in flow
- Clearness of flow
- Color
- Fines
- Condition of measurement devices
- Records

Spillway:
- Approach channel
- Vegetation (trees, etc.)
- Debris
- Slides above channel
- Channel slide slope stability
- Log boom
- Slope protection
- Control structure (observed operation)

Apron:
- Surface condition
- General condition of concrete
- Movement
- Settlement
- Joints
- Cracks

Crest:
- Surface condition
- General condition of concrete
- Cracks or areas of distress
- Signs of movement

Gates:
- Condition
- Hoist equipment
- Leakage
- Lighting
- Exercising frequency

Walls:
- Surface condition
- General condition of concrete
- Movement (offsets)
- Cracks or areas of distress
- Settlement
- Joints

- Drains
- Backfill

Bridge:
- Condition of piers
- Surface of roadway slab
- Structural condition of slab beams Bridge bearings
- Overall condition

CHUTE:
- Debris

Walls:
- Surface condition
- General condition of concrete
- Movement (offsets)
- Cracks or areas of distress
- Settlement
- Joints
- Condition of backfill

Floor:
- Surface condition
- General condition of concrete
- Baffle blocks / energy dissipators
- Movement
- Settlement
- Joints

- Drains
- Cracks

Stilling basin:
- Debris in basin

Walls:
- Surface condition
- General condition of concrete
- Movement (offsets)
- Cracks or areas of distress
- Settlement
- Joints
- Condition of backfill

Floor (if visible):
- Surface condition
- Condition of concrete
- Movement (offsets)
- Cracks or areas of distress
- Joints
- Erosion

Access Road:
- Condition
- Ditches

Bridge:
- General condition
- Vegetation at abutments piers

- Bridge supports
- Foundations
- Substructures - piers
- Bridge bearings
- Moving parts
- Accumulation of birds' nests, etc
- Visual inspection of scour protection
- Protective coatings

Main supporting members:
- Deteriorated and/or damaged
- Protective coatings

Bridge deck:
- General condition
- Drainage
- Expansion joints
- Guard rails
- Sign boards
- Live load capacity

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

Checklist for Inspection of Masonry Dam:

DAM:

- Upstream face:
- Downstream face:
- General condition
- Seepage on downstream face
- Measurement of seepage

Crest:

- Offsets
- Roadway
- Walls
- Parapet wall
- Lighting, etc

Galleries:

- Concrete
- Metalwork
- Electrical
- Ventilation
- Seepage

Drainage gallery:

- General condition
- Ventilation
- Cleanliness
- Lighting
- Movement (alignment)
- Cracks
- Drains drainage

- Location of seepages
- Measurement of seepages
- Amount of flow
- Uplift pressures
- Probing of foundation and formed drains
- Chemical analysis of water
- Amount of leaching
- Drainage pump
- Pumping arrangements
- Alternative source of power

Spillway:

- Crest
- Sluices

Gates:

- Type of gate
- General condition
- Protective coatings
- Leakage (closed)
- Operation of gates at the time of examination
- Mechanical Hoists
- Wire ropes
- Protective coatings for wire

Stop logs:

- General condition
- Protective coating
- Seals

Electrical:

- Power supply
- Standby power
- Operation instructions

Stilling basin:

- Walls
- Floor

Outlet Works:

- Intake
- Trash rack
- Concrete

Outlet conduit:

- Metal work
- Cavitations
- Control facilities
- Gatehouse
- Crane

Gate and controls

- General conditions
- Protective coatings
- Cavitation

- Exercising frequency
- Operation at the time of examination

Control system:

- Electrical
- Auxiliary power
- Mechanical
- Operating instructions

Power Features:

- Intake structure
- Trash rack
- General condition
- Cleaning arrangemen
- Intake gate(s)
- Intake gate hoist
- Gantry crane
- Mechanical
- Electrical
- Paint
- Operating instructions
- Operation during examination
- Storage area

Tail race:

- Draft tube closure structure

- Draft tube gates
- Gantry crane (hoists)
- Standby power unit
- Condition
- Exercising frequency
- Automatic features
- Operation during examination

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM;

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(A) Reliability Index (R.I):

Years	Inflow (Mm3)	Spillage (Mm3)	Release (Mm3)	Release/ Demand= (Mm3) %

Constant Demand

Reliability Index =

Submit

Result

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(B) Reservoir Sedimentation:

Years of sedimentation study

Designed Area

Designed Capacity

Actual Area

Actual capacity

Loss in capacity

Loss in capacity in %

Annual % loss in the Gross Storage Capacity

Submit

Result

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(D) Conveyance Efficiency:

Years	Canal Releases (Mcft)	Releases at Field (Mcft)	Conveyance Losses (Mcft)	% Losses

Conveyance losses =

Conveyance Efficiency =

Submit

Result

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(C) Operating Efficiency:

Years	Inflow (Mm3)	Spillage (Mm3)	Rule Level

No. of years having spillover=

Total no of years count =

Operating Efficiency =

Submit

Result

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(E) Water Quality Analysis of Sukhi Dam (Drinking purpose):

Parameters	BIS Limit-Permissible	Excessive	Sample no.1 (Upstream)	Within limit	Sample no.2 (Downstream)	Within limit	Sample no.3(Gallery)	Within limit
pH	6.5-8.5	9.2						
TDS (mg/lit)	500	1000						
Total Alkalinity (mg/lit)	200	600						
D.O. (mg/lit)	5.0-6.0	>6						
M.P.N. index /100ml	0	>15						
Bacterial count/100ml	10000	15000						

Submit

Total parameter=

Parameter within limit for sample no.1 upstream = | Parameter within limit for sample no.2 downstream = | Parameter within limit for sample no.3 gallery =

Sample no. 1 upstream =

Sample no. 2 Downstream =

Sample no. 3 Gallery =

Average of 3 Samples =

Submit

Result

Result

DAM PERFORMANCE EVALUATION

Name of the Project: DHAROI RESERVO | Name of the river: SABARMATI | Name of dam: DHAROI DAM | Purpose of project: Irrigation & Flood con | 13 February , 2017

Name of the reservoir: DHAROI | Reservoir Area: 3000 | Catchment Area: 5350 | Year of completion: 1993

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(E) Water Quality Analysis of Sukhi Dam (Drinking purpose):

Parameters	BIS Limit-Permissible	Excessive	Sample no.1 (Upstream)	Within limit	Sample no.2 (Downstream)	Within limit	Sample no.3(Gallery)	Within limit
pH	6.5-8.5	9.2	9	No	26	Yes	21	Yes
TDS (mg/lit)	500	1000	17	No	27	No	28	No
Total Alkalinity (mg/lit)	200	600	27	No	27	No	27	No
D.O. (mg/lit)	5.0-6.0	>6	25	Yes	24	Yes	27	Yes
M.P.N. index /100ml	0	>15	10	No	26	Yes	29	Yes
Bacterial count/100ml	10000	15000	16000	Yes	7000	No	21000	Yes

Submit

Total parameter= 6

Parameter within limit for sample no.1 upstream = 1 | Parameter within limit for sample no.2 downstream = 4 | Parameter within limit for sample no.3 gallery = 6

Sample no. 1 upstream = 16.6666666666667

Sample no. 2 Downstream = 66.6666666666667

Sample no. 3 Gallery = 100

Average of 3 Samples = 61.1111111111111

Submit

From the above result it is conclude that the water quality of dam of upstream is Not suitable for drinking purpose

From the above result it is conclude that the water quality of dam of downstream is suitable for drinking purpose

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

(F) EXPENDITURE ON OPERATION MAINTENANCE:

Years	Expenditure of Mandalies from Amount refunded	PIM restoration Works	Expenditure in Other Type of Works	Expenditure in Modernisation Works	Total Expenditures

Average Operation and Maintenance cost (Rs) | Total C.C.A. (Ha)

Operation and Maintenance cost / Ha =

Submit

Result

DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

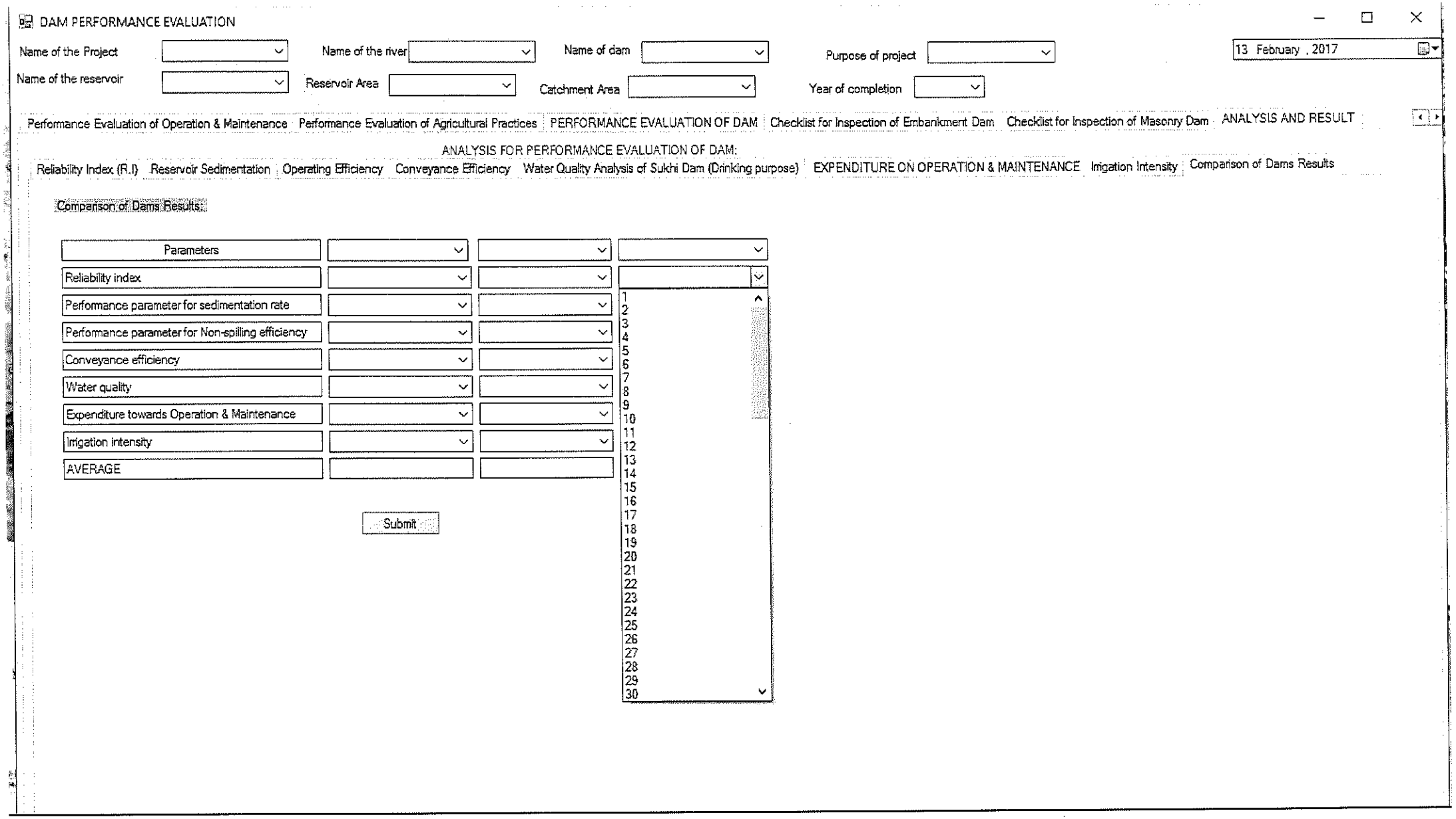
(G) Irrigation Intensity

Years	C.C.A Ha.	Kharif Ha.	Rabi Ha.	Hot Ha.	Total Ha.	Irrigation Intensity %

Irrigation Intensity =

Submit

Results


DAM PERFORMANCE EVALUATION
Name of the Project
Name of the river
Name of dam
Purpose of project
13 February , 2017
Name of the reservoir
Reservoir Area
Catchment Area
Year of completion
Performance Evaluation of Operation & Maintenance
Performance Evaluation of Agricultural Practices
PERFORMANCE EVALUATION OF DAM
Checklist for Inspection of Embankment Dam
Checklist for Inspection of Masonry Dam
ANALYSIS AND RESULT
ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:
Reliability Index (R.I)
Reservoir Sedimentation
Operating Efficiency
Conveyance Efficiency
Water Quality Analysis of Sukhi Dam (Drinking purpose)
EXPENDITURE ON OPERATION & MAINTENANCE
Irrigation Intensity
Comparison of Dams Results
Comparison of Dams Results:
Parameters
Reliability index
Performance parameter for sedimentation rate
Performance parameter for Non-spilling efficiency
Conveyance efficiency
Water quality
Expenditure towards Operation & Maintenance
Irrigation intensity
AVERAGE
Submit
1
2
3
4
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11
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14
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DAM PERFORMANCE EVALUATION

Name of the Project | Name of the river | Name of dam | Purpose of project | 13 February , 2017

Name of the reservoir | Reservoir Area | Catchment Area | Year of completion

Performance Evaluation of Operation & Maintenance | Performance Evaluation of Agricultural Practices | PERFORMANCE EVALUATION OF DAM | Checklist for Inspection of Embankment Dam | Checklist for Inspection of Masonry Dam | ANALYSIS AND RESULT

ANALYSIS FOR PERFORMANCE EVALUATION OF DAM:

Reliability Index (R.I) | Reservoir Sedimentation | Operating Efficiency | Conveyance Efficiency | Water Quality Analysis of Sukhi Dam (Drinking purpose) | EXPENDITURE ON OPERATION & MAINTENANCE | Irrigation Intensity | Comparison of Dams Results

Comparison of Dams Results:

Parameters			
Reliability index			
Performance parameter for sedimentation rate			
Performance parameter for Non-spilling efficiency			
Conveyance efficiency			
Water quality			
Expenditure towards Operation & Maintenance			
Irrigation intensity			
AVERAGE			

Submit