ISSN: 2319-6505

Available Online at http://journalijcar.org

International Journal of Current Advanced Research
Vol 5, Issue 6, pp 1016-1019, June 2016

International Journal of Current Advanced Research

ISSN: 2319 - 6475

RESEARCH ARTICLE

ANALYSIS OF RAINFALL & INFLOW VALUES: CASE STUDY OF MHAISAL LIFT IRRIGATION PROJECT IN MAHARASHTRA

VidyaPurandare* Bajaj V.H

WALMI, Aurangabad
Dr. Babasaheb Ambedkar University, Aurangabad.

ARTICLE INFO

Article History:

Received 26th February, 2016
Received in revised form 17th March, 2016
Accepted 25thApril, 2016
Published online 28th May, 2016

Key words:

Water Availability, Correlation, Regression, Dependability

ABSTRACT

Water availability is the most important parameter for the success of any water Resources Project. In highly drought prone areas annual rainfall is very less & scanty, even in Kharif season crops get dried up. Employment opportunities are also very less. In such areas, many a times practically no big dams can be constructed togive irrigation facility by gravity flow. Water may have to be transported from a plentiful area to scarce area. Lift irrigation schemes are the one to give solution to provide water for drinking & irrigation. In Maharashtra, the Krishna Koyna Lift Irrigation Scheme (KKLIS) which consists of Mhaisal & Takari major Lift Irrigation projects, supply water to highly drought prone areas in Sangli, Solapur districts. The present paper discusses the water availability for Mhaisal LIS. Water is lifted from river Krishna in rainy season and from Koyna reservoir viz.Shivajisagar by releasing in river Krishna, as and when required during the other two seasons. With available rainfall & inflow data of catchment of Koyna Project, using statistical techniques, water availability for Mhaisal LIS through Shivajisagar reservoir is studied.

INTRODUCTION

The amount of rainfall received over an area or a basin is an important factor in assessing the amount of water available to meet the various demands of agriculture, industry, irrigation, hydroelectric power generation, and other human activities. The water availability is an important factor in determining the economic status of a region. In the areas where rainfall is scanty & very meager, water may have to be transported from a plentiful area to scarce area. Lift irrigation schemes are the one to give solution. By means of analysis of hydrologic data through statistical techniques one can arrive at appropriate value of water availability in the reservoir. The present paper discusses the water availability in the Koyna reservoir viz. Shivajisagar from where water is released as and when required to lift water at Mhaisal Kolhapur Type (K.T.) weir in other than rainy season to provide water for highly drought prone areas.

The Background

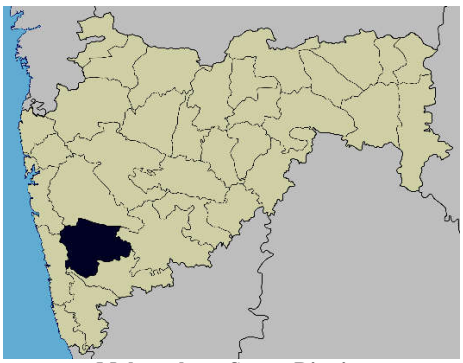
The Maharashtra State

Maharashtra is the third largest State in Union of India considering population as well as area. It is located in the north center of Peninsular India. The River Krishna which originates in sahyadri ranges flow down on eastern side. This carries plenty of water the water in basin Krishna after running 30 kms. Flows parallel to sahyadri ranges, from north to south. After crossing Karad, it flows eastward towards Sangli. Also, the waters in basins of Krishna, warna&Koyna flow parallel to sahyadri range of hills, this deprives some areas between sub basins to get water by gravity flow.

Figure 1 Krishna River course

The rainfall in Sangli & solapur is uneven, scanty and not reliable also. The talukas Jat, Sangola, Mangalaveda are at 600 to 750 feet higher elevation from Krishna River. Farming is not beneficial. This area is highly drought prone. Practically, no big dams can be constructed in these areas to give gravity flow irrigation facility. The agriculture suffers due to vagaries of monsoon to supply water for the drought prone areas, for drinking, irrigation and water use as per Krishna Water Dispute Tribunal (KWDT), the Krishna Koyna

Lift Irrigation Scheme (KKLIS) was sanctioned in the year 1984. Lift irrigation projects are the only possible solution.



Maharashtra: Satara District

Location of Koyna Dam

Figure 2

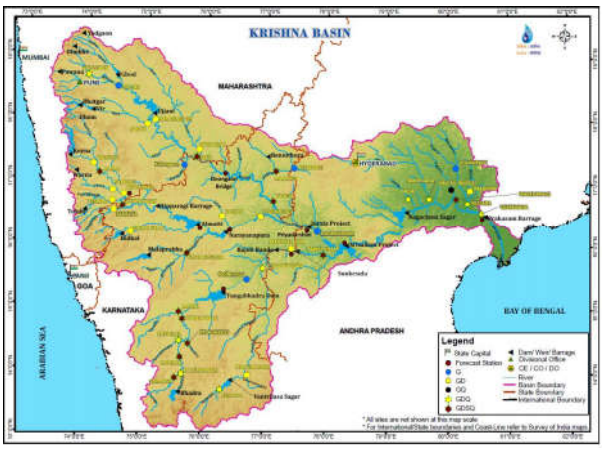


Figure 3 KRISHNA BASIN

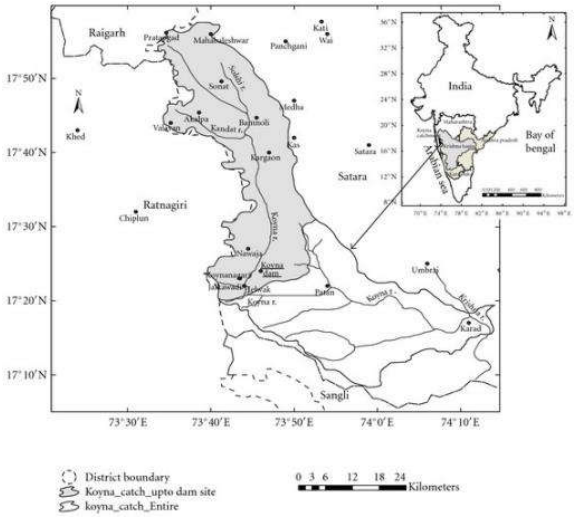


Figure 4 Koyna Catchment upto Dam site.

The Koyna Reservoir

The Koyna River rises in Mahabaleshwar (viz. Malcompeth Plateau) on the Western Ghats and is a major tributary of the Krishna River in western Maharashtra. The River is famous for the Koyna Dam which is the largest hydroelectric project in Maharashtra. The reservoir known as "Shivaji Sagar Lake" is a huge lake of 50 km in length. The dam is situated in Koyna Nagar in the Western Ghats and is built in 1963, is located in Koyna Nagar, Satara district, nestled in the Western Ghats.The catchment of the river course up till Helwak, has an average rainfall of above 5000mm. Up to Koyna Dam, the catchment area is 891.78Sq. Km. (344.32 miles).

The Krishna Koyna Lift Irrigation Scheme (KKLIS)

The original plan of KKLIS was of 82.43 Crore rupees (10 Million rupees) for the Takari LIS. To make use of all the available water, in addition to Takari LIS, another project viz. Mhaisal was also introduced. The cost increased to187.9 crores Planned water use for KKLIS is 543.961 Mm^3 (19.21 TMC) from Koyna Reservioir (Shivajisagar) and 210.675 Mm^3 (7.44 TMC) from Krishna river. So a total of 754.636 Mm^3 (26.TMC) of water use is planned. Out of 754.636 Mm^3, 263.060 Mm^3 (9.29 TMC) is the share of Takari LIS & 491.576 Mm^3 (17.36 TMC) is the share of Mhaisal LIS.

About Mhaisal Scheme

Water from Krishna River at Mhaisal KT weir, Tal.Miraj, Dist. Sangli& water from Koyna reservoir (Shivaji Sagar) is lifted to irrigate 81697 Ha. Of area in Miraj, Kavathemahakal, Jath & Tasgaontalukas of Sanglidistrict and Sangola, Magalawedha Talukas of Solapur district as 66550 Ha. Equivalent area by tank filling in Jath, Sangola, Magalawedha Talukas. In Kharif season, 5860Mcft (5.86 TMC) of water will be available from runoff of the river Krishna. Infair weather season, from Koyna Dam, 11580Mcft. (11.58 TMC) of water is lifted by releasing in river Krishna.

Water Availability

The rainfall (in Cms) & inflow (in Mm^3) relations are frequently required to estimate monthly, seasonal & annual volumes of inflow. Such estimates are needed for operational purposes or to provide a data base for evaluating reservoir storage requirements. Hence methods are devised for extrapolating or extending short term inflow records for the purpose of providing estimates of water availability for proposed reservoir. The determination of inflow under the different situations, analysis of data and correlation and regression as applied for working out long term series have more importance.

Objectives

The general objective of the study is to assess water availability for Mhaisal Lift Irrigation Scheme from Shivajisagar reservoir with 75% dependability. Also, to test whether the hypothesis of equality of means & variances, between observed & predicted values holds good.

The specific objectives are

Analyse the values of rainfall & inflow values of 5 months, June to October & overall total of 5

Months;

- For correlation between them.
- To get estimated values of inflow with the linear regression equation.
- To get estimated values of inflow with nonlinear equation viz. second degree polynomial equation.
- To compare the results of linear & non linear.
- To examine Levene's Test for Equality of Variances F viz. For observed & predicted
- To examine t-test for Equality of Means for observed & predicted
- For 75% dependable value of inflow.

Findings

Based on the data of rainfall & inflow the estimations are done using SPSS & MINITAB. Findings are given below.

Table I A) Linear Regression

Month	r = correlation coefficient	R Square	Standard Error	Linear Equation between Rainfall (X) & inflow(Y)
June	0.84	0.71	121.65	Y = -54.64 + 4.24 X
July	0.87	0.76	254.86	Y = 65.33 + 7.19 X
August	0.84	0.70	270.63	Y = 213.82 + 7.65 X
September	0.76	0.57	211.91	Y = 59.53 + 10.41 X
October	0.67	0.45	59.38	Y = 60.37 + 5.21 X
Total	0.79	0.62	617.86	Y = 144.64 + 7.44 X

- The Karl Pearson's correlation coefficient 'r' shows a strong positive correlation between Rainfall & inflow values for all the months except for Sepember & October in the catchment of Koyna reservoir.
- This indicates a good yield in the reservoir & hence water availability is assured.
- The overall correlation coefficient is 0.79
- The 75% dependable value of inflow (total) is 2484.7 Mm^3 which assures water availability for Mhaisal LIS

RESULTS

The F - Levene's Test for Equality of Variances

The null hypothesis is H0: Var (Y_{obs}) = Var (Y_{est})
Gainst H1 : Var(Y_{obs}) ≠ Var (Y_{est})

The P value is >0.05, for all the months except for October hence

That is there is no significant difference between the variances of observed & estimated values of inflow at Koyna reservoir except for October.

The t-test for equality of means

Null Hypothesis: H0: Mean (Y_{obs}) = Mean (Y_{est})
H1: Mean (Y_{obs}) ≠ Mean (Y_{est})

The P values of the inflows for all the months & total inflow of all the months together are equal to one, more than 0.05 hence, there is no significant difference between the mean of observed.

Table III Non-linear regression (The Second degree polynomial equation) results

Month	r	R Square	Standard Error	Linear Equation between Rainfall (X) & inflow(Y)
June	0.84	0.71	122.33	Y = -14.78+3.27 X+ 0.00461 X^2
July	0.89	0.79	239.24	Y= 772.33 + 0.09X+ 0.016X^2
August	0.84	0.71	267.39	Y= -119.97 + 12.63X -0.0163 X2
September	0.76	0.57	213.97	Y= 41.27 + 41.28X-0.0098 X2
October	0.69	0.48	57.91	Y= 41.59 + 8.93 X-0.103 X^2
Total	0.8	0.64	606.53	Y= 2233.64 -1.45X-0.009X^2

- The Karl Pearson's correlation coefficient 'r' shows a high degree strong positive correlation between Rainfall & inflow values for all the months except For October in the catchment of Koyna reservoir.

Table II B Levene's Test for Equality of Variances F viz. For observed & predicted & t-test for Equality of Means

Months		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
June	Equal variances assumed [EVA]	2.3	0.1	0.0	102.0	1.0	0.0	40.5	-80.2	80.2
	Equal variances not assumed [EVNA]			0.0	99.1	1.0	0.0	40.5	-80.3	80.3
July	EVA	1.1	0.3	0.0	102.0	1.0	0.0	95.0	-188.4	188.4
	EVNA			0.0	100.2	1.0	0.0	95.0	-188.4	188.4
August	EVA	1.4	0.2	0.0	102.0	1.0	0.0	88.2	-175.0	175.0
	EVNA			0.0	98.9	1.0	0.0	88.2	-175.0	175.0
Sept	EVA	1.6	0.2	0.0	102.0	1.0	0.0	56.0	-111.1	111.1
	EVNA			0.0	95.1	1.0	0.0	56.0	-111.2	111.2
October	EVA	4.5	0.0	0.0	102.0	1.0	0.0	13.3	-26.3	26.3
	EVNA			0.0	89.2	1.0	0.0	13.3	-26.3	26.3
Total	EVA	2.1	0.2	0.0	102.0	1.0	0.0	176.6	-350.2	350.2
	EVNA			0.0	96.8	1.0	0.0	176.6	-350.5	350.5

If H0 is null hypothesis & H1 is alternative hypothesis,
For P > 0.05 a c c e p t H0 Y_{obs} = observed inlfow values
For P < 0.05 a c c e p t H1 Y_{est} = estimated / predicted inflow values

- This indicates a good yield in the reservoir, & hence water availability is assured
- The overall correlation coefficient is 0.8

CONCLUSION

Based on the findings, following conclusions can be drawn:

Table IV Non Linear Regression Levene's Test for Equality of Variances F & t-test for Equality of Means

Months		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
June	Equalvariances assumed [EVA]	2.59	0.11	0.0	102	1.00	0.00	40.49	-80.31	80.31
	Equalvariances not assumed [EVNA]			0.0		1.00	0.00	40.49	-80.33	80.33
July	EVA	1.35	0.25	0.0	102	1.00	0.00	95.86	-190.13	190.14
	EVNA			0.0		1.00	0.00	95.86	-190.16	190.17
August	EVA	1.01	0.32	0.0	102	1.00	-0.01	88.54	-175.63	175.61
	EVNA			0.0		1.00	-0.01	88.54	-175.69	175.67
Sept	EVA	1.57	0.21	0.0	102	1.00	0.00	56.00	-111.07	111.07
	EVNA			0.0		1.00	0.00	56.00	-111.17	111.17
October	EVA	2.42	0.12	0.0	102	1.00	0.00	13.42	-26.63	26.63
	EVNA			0.0		1.00	0.00	13.42	-26.67	26.67
Total	EVA	2.08	0.15	0.0	102	1.00	0.00	176.58	-350.24	350.24
	EVNA			0.0		1.00	0.00	176.58	-350.47	350.47

If H0 is null hypothesis & H1 is alternative hypothesis
For P > 0.05 accept H0 Y obs = observed inlfow values For P < 0.05 accept H1 Yest = estimated / predicted inlfow values

RESULTS

The F - Levene's Test for Equality of Variances

The null hypothesis is H0: Var (Yobs) = Var (Yest)
Against H1: Var (Y obs) ≠ Var (Yest)

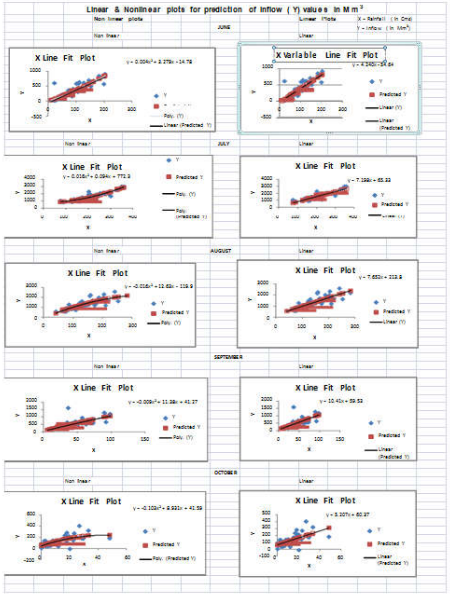
The P value is >0.05, for all the months hence there is no significant difference between the variances of observed & estimated values of inflow at Koyna reservoir except for october.

The t-test for equality of means

Null Hypothesis: H0: Mean(Y obs) = Mean (Yest)
H1: Mean(Y obs) ≠ Mean (Yest)

The P values for the inflows for all the months & total inflow of all the months are equal to one, more than 0.05. Hence, there is no significant difference between the mean of observed & estimated values of inflow at Koyna reservoir. The linear regression & non linear plots are shown in Annex-I

Linear & Nonlinear plots of rainfall X & Y inflow Annex-I



- Water availability of 491.576 Mm^3 for Mhaisal Lift Irrigation Scheme from Shivajisagar reservoir is assured with 75% dependability.
- The t-test for equality of Mean values & Levene's Test for Equality of Variances F between observed & predicted values for all the 5 months separately & for total of all 5 months together holds good both for linear & nonlinear equations.
- The correlation coefficient of 0.8 shows strong +ve correlation between rainfall & inflow
- The second degree polynomial equation fits best as compared to linear equation.

Acknowledgement

The authors are thankful to the all the concerned officers of the Krishna Koyna Lift Irrigation circle & the Koyna division, Water Resources Department, Maharashtra for providing the data required.

References

1. Ven Te Chow, Handbook of Applied Hydrology
2. Benjamin, J.R & Cornell, C.A. Probability, Statistics and Decision for Civil Engineers
3. Chube, U.C & Suarbawa, Ketut.I, Analysis of peak discharge, runoff relationship & its implications.
4. Subramanya, K Engineering Hydrology
5. Dhar, O.N. 'Estimation of Probable Maximum Precipitation for Stations in Western Ghats'
6. S.C. Gupta, Fundamentals of Statistics.
7. PWD Handbook Chapter 19, Hydrology, Govt. of Maharashtra.
8. R.S.Varshney, Engineering Hydrology.
9. Data from the offices of Water Resources Department, Maharashtra.

****