Hydrological Simulation Model For A Minor Irrigation Tank

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Abstract

Minor irrigation schemes play an important role in the economy and rural livelihoods of Andhra Pradesh state. The state has 12,351 MI tanks with an individual ayacut exceeding 40 ha commanding a total ayacut of 12.5 lakh hectares. The majority of these tanks are non-system fed tanks receiving inflows entirely from rainfall. In this paper, it is attempted to study the assessment of physical benefits of one such non-system fed tank viz. Medchal MI tank located in Rangareddy district of Andhra Pradesh, India through hydrological simulation for 35 years. Strange's runoff model is used to compute inflows in to the tank. Modified penman method is used to compute crop water requirements. Such studies become necessary for the design of new MI tanks or for taking up rehabilitation of existing MI tanks for carrying out techno-economic feasibility to examine whether sufficient inflows are available from the upstream catchment areas for the prevailing spatial and temporal distribution of rainfall. The study leads to development of hydrological simulation model HSMMIT-2.1.

Keywords *- Hydrological simulation model, HSMMIT-2.1, Minor irrigation tanks, Assessment of physical benefits, Strange's runoff model, Modified penman method for computing crop water requirements.*

1. Introduction

Minor irrigation schemes have been the backbone of agriculture in Andhra Pradesh as is the case with India as a whole. The importance of these schemes in the Indian agriculture sector was highlighted by the First Irrigation Commission (1901-03) and the Royal commission of Agriculture (1928). The crucial role that minor irrigation could play in augmenting food production with in a short time was specially recognized in the "Growmore" food campaign launched in 1943.

The planning commission, since its inception, has been stressing the importance of minor irrigation schemes in increasing food production. Page 251 of first five year plan says that "they (minor irrigation schemes) provide large amount of dispersal employment. They involve smaller outlay and can be executed in a comparatively shorter period. Being spread all over the country they confer widespread benefit and it is therefore easier to mobilize public cooperation in their construction". The food grain enquiry committee (1952) also reiterated the need for paying greater attention to the MI works for the purpose of encouraging food production.

1.1 Description about Andhra Pradesh

Andhra Pradesh state ranked fourth in area and fifth in population of the country. About 75 percent of the state's population lives in rural areas and they largely depend on agriculture for their sustenance. The state has a geographical area of over 275 lakhs ha.

1.2 Agriculture Sector in Andhra Pradesh

The state cultivates a net sown area of 106.4 lakhs ha accounting for 38.6% of the total geographical area of the state. The share of agriculture sector in the gross state domestic product (GSDP) stands at 28.3%. The average annual growth rate of agriculture sector during the last five year period stands at 3.9 percent. Negative growth rate was observed in the years 1994-95 and 1997-98.

1.3 Irrigation Sector in Andhra Pradesh

Aided by 40% of net sown area under irrigation, AP has a cropping intensity of 122 percent. The net irrigated area of 44.5 lakhs ha is contributed from canals (38%) and tanks (17%); and the balance by wells, tube wells and other wells (45%). In the last three decades, net irrigated area has increased from 29.6 lakhs ha to 41.5 lakhs ha. Canal irrigated area has gone up from 13.02 lakhs ha to 15.7 lakhs ha during this period but its share in net irrigated area has come down from 45 to 38%. Tanks with a net irrigated area of 10.7 lakhs ha accounted for 36% of the net irrigated area in triennium ending 1968. But in triennium ending 1998, tanks irrigated only 7.2 lakhs ha accounting for only 17% of the net irrigated area.

"Tanks as a source of irrigation in 1960s through 1990s have therefore, depressed the overall growth in net irrigated area."

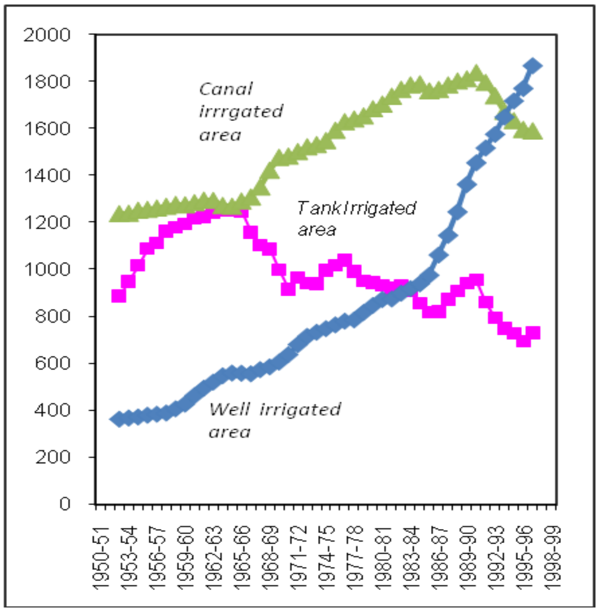

Figure 1. Declining trend in area irrigated by tanks in AP, 5-year moving average ('000 ha)

1.4 Minor Irrigation Sector in Andhra Pradesh

Minor Irrigation schemes occupy a prominent place in the history of irrigation development in the state of Andhra Pradesh. The state has 12,351 MI sources as of now commanding a total ayacut of 12.5 lakh hectares which is maintained by Irrigation department. In addition to these, there are small tanks commanding an ayacut of less than 40 ha. About 70,474 such small tanks commanding a total ayacut of over 6 lakh ha is maintained by Panchayat Raj department. During the last decade, only 9,147 MI sources out of the total of 12,351 MI sources were actually functioning in the state indicating that nearly one-fourth of the MI tanks failed to irrigate any area during this period.

1.5 Degeneration of MI Tanks

Degeneration in tank irrigation system is an established trend. This is because of deterioration in the components of these tank systems from the originally designed standards. The affected components are feeder channels, bunds, revetment of bund, sluices, shutters, irrigation canals and surplus courses. As a consequence, they have become inefficient in receiving the due share of waters from the upstream catchment areas, in holding the storage at designed levels at different stages of irrigation or in distributing the waters in the envisaged command areas. To study the performance of these tanks, it is necessary to examine whether the designed inflows are available from the upstream catchment areas for the prevailing spatial and temporal distribution of rainfall. Further it is necessary to examine even in case adequate flows are forthcoming, whether the tanks with ideal conditions of the components, will be able to alter the inflow hydrology to the desired outflow patterns.

1.6 Identification of Problem

In the above context, it is proposed to take up hydrological analysis of a typical minor irrigation tank located in a rainfed area to study its inflow hydrology and desired outflow patterns.

1.7 Problem Definition

For studying the inflow hydrology and desired outflow patterns of an MI tank, it is necessary to carryout hydrological simulation using appropriate model for runoff computation. In the present study, Strange's runoff model is identified and adopted for this purpose.

1.8 Study Area

One minor irrigation tank known as Large tank (Pedda Cheruvu in Telugu) existing in Medchal village and mandal (Latitude – 17^{o} 37' 4", Longitude – 78^{o} 29' 5") of Rangareddy district, Andhra Pradesh, India is selected as the study area. The tank is maintained by Irrigation and Command area development department of Government of Andhra Pradesh.

The village is situated at a height of 577 meters. The average rainfall is 783 mm, which increases from northwest to Southeast. The mean maximum and minimum temperature vary from 40° to 14°C The village is mainly occupied by loamy sands, sandy loams and sandy clay and are red in colour. The red soils are generally non saline, non alkaline and excessively drained. The laterite soils and black soils with a thickness ranging between 90-180 cm occur in western parts of the district.

There are no major surface water irrigation projects in the study area and farmers have been depending mostly on rainfed minor irrigation tanks or ground water resources for irrigating the crops.

1.9 Objective of the Study

The objective of the present study is to carryout hydrological simulation for the assessment of year-wise physical benefits of a typical rainfed minor irrigation tank located in Medchal village and mandal of Rangareddy district in Andhra Pradesh, India. The study ultimately leads to the development of Hydrological Simulation Model HSMMIT-2.1.

1.10 Scope and Limitations of the Study

The scope and limitations of the present study are given below.

1. To carryout hydrological simulation for the assessment of physical benefits of MI tank at Medchal for 35 years from 1963-64 to 1997-98.
2. The MI tank is assumed to be in ideal conditions.
3. Medchal raingauge station is assumed to be the only available influencing raingauge station in the catchment area.
4. 35 years monthly rainfall data recorded at Medchal raingauge station is considered as the basic input.
5. The effective catchment area is calculated by considering 100% of free catchment area and 50% of intercepted catchment area.
6. Strange's runoff model is selected for computing runoff yields.
7. The catchment area of the MI tank is found to be 100% good.
8. Two cropping seasons' kharif and rabi are considered for assessing benefits.
9. Paddy is the only identified cropping pattern in the study area.
10. Modified penman method is used to calculate the crop water requirements.
11. Appropriate agronomical inputs have been assumed.

1.11 Significance of the Study

The study assumed special significance in the context of assessing the benefits of an MI tank which will be carried out in a systematic manner. For the design of new MI tanks or for taking up rehabilitation measures for the existing MI tanks, it is necessary to study he techno-economic feasibility of the projects before making investments. For carrying out such techno-economic feasibility studies, it is necessary to examine whether sufficient inflows are available in the upstream catchment areas for the prevailing spatial and temporal distribution of rainfall. Further it becomes necessary to examine even incase adequate flows are forthcoming, whether the tanks with ideal conditions of the components will be able to alter the inflow hydrology to the desired outflow patterns.

2. Review of Literature

Hydrological simulation model may be defined as generalization of an organized methodology based on standard techniques which are repetitive and iterative in nature. A hierarchical scheme for the systematic testing of hydrological simulation models was proposed by V. Klemes [1] in the early 1986.

Shu-Li Huang and John D. Keenan [2] have developed a deterministic hydrological model by integrating the integral empirical relationships and applied it to the Brandywine basin located in south eastern Pennsylvania and northern Delaware in the year 1987.

Krishna Moan M et al. [3] were the first to devise a hydrological simulation model (HSMMIT-1) for MI tanks in the year 1999 based on 75% and 50% dependability rainfall and applied this model for assessing the simulated physical benefits of 384 MI tanks located in various districts of Andhra Pradesh.

Krishna Mohan M et al. [4] have applied this hydrological simulation model (HSMMIT-1) to assess the simulated physical benefits of 2,596 other MI tanks in Andhra Pradesh under APERP in the year 2000.

During the year 2001, the simulated physical benefits of various MI tanks proposed under APIII were assessed using this hydrological simulation model (HSMMIT-1) by Krishna Mohan M et al. [5].

Krishna Mohan M [6] has made modifications to HSMMIT-1 and developed an improved version of the hydrological simulation model HSMMIT-2 to assess the actual year wise simulated physical benefits of MI tanks rather than considering the 75% and 50% dependability rainfall and applied this model to assess the simulated physical benefits of Chittivalasa minor irrigation tank located in Bheemunipatnam mandal of Visakhapatnam district, Andhra Pradesh, India.

In the present study, it is proposed to assess the actual year wise simulated physical benefits of Medchal MI tank located in Rangareddy district of Andhra Pradesh, India using the hydrological simulation model HSMMIT-2.1.

3. Data Inputs

Data is collected on Tank Geometry, Rainfall, Pan Evaporation, Potential evapotranspiration values of the study area from various agencies. The collected data is analysed using standard techniques and the inputs for the model were prepared.

3.1 Tank Geometry

The Medchal MI tank situated in the latitude of 17^o 37' 04" and longitude of 78^o 29' 05" has the following dimensions. The tank bund is of homogeneous embankment type. The bund has a length of 1.875 km. The top width of the bund is 2.498 metres and bottom width is 33.578 metres. The capacity of the tank at FTL is 2.1859 M.cu.m. The waterspread area of the tank at FTL is 1.891 M. sq.m.

The tank geometry of Medchal MI tank is presented in the following table 1.

A part of the waterspread area of the Medchal MI tank is shown in figure 2.

Table 1: Tank Geometry of Medchal MI tank

Name of the Basin	Krishna
Sub-Basin	Musi- K10
Name of the tank	Peddacheruvu
Location: Latitude	17°-37'-4"
Longitude	78°-29'-5"
Village, Mandal and District	Medchal (v & m), Rangareddy district
Catchment area :	
Free (Sq.km.)	19.41
Intercepted (Sq.km.)	62.93
Total (Sq.km.)	82.34
Area of submergence(ha)	1.891 M.SqM
Live storage of the tank(M.cum.)	1.4573
Dead storage of the tank(M.cum)	0.7286
Gross storage of the tank (M.cum.)	2.1859
Registered ayacut (ha)	513/2.5
Irrigated ayacut (ha)	360
Gap ayacut (ha)	153
Tank bund length (mts)	62.50M.Ch.(62.5x30=1875M)
Bund top width (m)	2.498M
Bund bottom width (m)	33.578M
Slopes – water facing side	2:1
Rear side	1:1/2:1
Full Tank level (FTL)	+580.595
Maximum water level (MWL)	+581.585
Tank bund level (TBL)	+583.110
Length of surplus weir (m)	105.256M
No of sluices and their levels	3 and +576.288,+576.280 &+576.359
Tank catchment area marked on SOI toposheet (Xerox copy)	82.34Sq.Km

Figure 2. A view of waterspread area of Medchal MI tank

3.2 Catchment Area

The MI tank is identified on the SOI toposheet and the catchment area is marked with greater accuracy duly verifying the contour values along the ridges and valleys. The free as well as intercepted catchment areas were marked accordingly.

The catchment area is measured with the help of planimeter. The free catchment area of the tank is found to be 19.41 sq. km and intercepted catchment area is found to be 62.93 sq. km. The effective catchment area is worked out using the following formula.

Effective catchment area = Free catchment area + (50% * Intercepted catchment area)

The effective catchment area comes to around 50.875 sq. km.

3.3 Command Area

The Registered ayacut of the tank is 207 ha. Usual cropping pattern in the command area is Paddy in both Kharif and Rabi.

A part of the command area of the Medchal MI tank is shown below in figure 3.

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Figure 3. A view of command area of Medchal MI tank

3.4 Rainfall

The monthly rainfall data recorded at Medchal raingauge station has been collected for 35 years from 1963-64 to 1997-1998. The data is arranged in sequence from June to May as the hydrological year starts from June in the study area. Annual rainfall is computed and presented in the following tables. It is observed that the mean annual rainfall is 785.2 mm in the study area. The highest annual rainfall is recorded during 1983-84 with a magnitude of 1918.8 mm and the lowest annual rainfall is recorded during 1986-87 with a magnitude of 387.9 mm. The annual rainfall of above 1000 mm is recorded in 4 years during 1983-84 (1918.8 mm), 1981-82 (1138.5 mm), 1973-74 (1072.1 mm), 1996-97 (1049.4 mm). Below normal rainfall of less than 800 mm is recorded in 23 years during 1986-87 (387.9 mm), 1985-86 (428.6mm), 1972-73 (526.8 mm), 1979-80 (539.1 mm), 1992-93 (564.5 mm), 1965-66 (584.1 mm) etc.

Mean monthly rainfall distribution shows that the study area is receiving most of the rainfall during the 5 months south-west monsoon period starting from June to October. Maximum amount of mean monthly rainfall is observed highest in August followed by July, September, June and October. But the standard deviation is fluctuating from 130.03 in September to 52.37 in June while the coefficient of variation is fluctuating from 0.95 in October to 0.48 in June.

The 3-year moving average shows a maximum value of 1310.77 mm and a minimum value of 496.73 mm, and 5-year moving average shows a maximum value of 1098.64 mm and 649.32 mm. According to Weibull's plotting position, the 75% dependability rainfall works out to be 673.7 mm and 50% dependability rainfall works out to be 753.1 mm.

Table 2. Monthly and annual rainfall data in mm

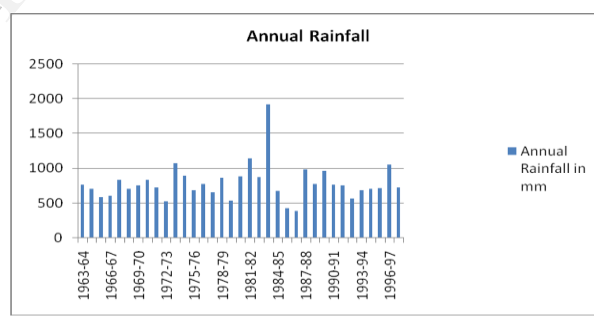
MONTHLY RAINFALL DATA FROM 1963-64 TO 1997-98

DISTRICT : Rangareddy — Raingauge Station: Medchal

Note : This rainguage Station Influences the Catchment area of the Medchal MI tank.

All units are in mm

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total Annual Rainfall
1963-64	139.2	155.8	294.5	84.9	77.5	0	0	0	9.4	0	0	0	761.3
1964-65	162.7	91.1	142.4	298	8.1	0.1	0	0	0	0	0	0	702.4
1965-66	71.5	314.7	87.6	110.3	0	0	0	0	0	0	0	0	584.1
1966-67	60.5	81.9	117.3	122.7	80.3	7.6	82.5	0	0	51.2	0	0	604
1967-68	121.2	326.6	166.4	161.1	3	0	10.2	5.1	8.9	10.2	19.3	0	832
1968-69	113.2	165.9	21.6	256.1	106.6	5.1	0	0	0	0	10.4	20.6	699.5
1969-70	109.4	106.6	116.1	203.7	67.3	76.4	0	0	0	9.2	30.4	36	755.1
1970-71	121	109.1	289.1	182.4	26.8	0	0	0	0	0	0	106.7	835.1
1971-72	155.7	36	237.5	119.9	146.6	0	1.3	0	0	0	23.4	2	722.4
1972-73	142.2	129.3	55.9	91.4	79	17.3	3.8	0	0	0	3.8	4.1	526.8
1973-74	123.5	145.9	329.7	67.4	343.8	3.8	0	0	0	0	20.4	37.6	1072.1
1974-75	91.4	50.1	202	212.6	243.1	0	0	41.2	0	27.2	0	25.9	893.5
1975-76	50.6	0	195.7	216.2	182.4	6.4	0	0	0	0	28	5.4	684.7
1976-77	134.2	243.8	252.4	123.2	0	20	0	0	0	0	0	1.5	775.1
1977-78	100.4	164.7	215.4	4	70.1	51.2	0	0	28.9	0	0	16.2	650.9
1978-79	183.4	217.0	358.1	45.2	9.7	0.0	0.0	0.0	0.0	0.0	0.0	45.0	858.4
1979-80	74.7	65.0	66.0	218.0	6.4	40.7	0.0	0.0	0.0	0.0	46.0	22.3	539.1
1980-81	217.9	130.0	258.6	188.4	0.0	8.0	3.0	5.6	0.0	70.3	0.0	5.4	887.2
1981-82	221.9	196.5	152.1	476.5	55.8	0.0	0.0	0.0	0.0	0.0	12.2	23.5	1138.5
1982-83	87.8	303.0	153.9	110.7	152.6	11.3	0.0	0.0	0.0	0.0	0.0	55.7	875
1983-84	93.6	469.1	356.4	682.7	256.5	0.0	5.0	0.0	0.0	22.5	15.0	18.0	1918.8
1984-85	70.8	170.5	212.2	100.2	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	673.7
1985-86	30.9	86.9	38.3	113.2	85.1	0.0	0.0	40.5	22.2	0.0	11.5	0.0	428.6
1986-87	75.5	68.5	147.6	19.3	8.0	0.0	0.0	0.0	0.0	16.0	35.0	18.0	387.9
1987-88	67.3	162.8	176.2	38.6	155.3	333.5	0.0	0.0	39.4	0.0	8.0	0.0	981.1
1988-89	8.6	223.7	211.0	256.8	12.0	0.0	5.0	0.0	0.0	42.2	0.0	16.0	775.3
1989-90	210.6	383.4	102.3	135.1	46.6	0.0	36.2	0.0	0.0	33.5	18.8	0.0	966.5
1990-91	82.1	117.5	204.3	117.7	190.0	39.7	0.0	0.0	0.0	0.0	5.4	9.3	766
1991-92	194.5	189.1	84.7	209.0	33.6	20.4	0.0	0.0	0.0	16.0	2.1	3.7	753.1
1992-93	129.5	81.3	212.8	43.6	6.3	73.2	0.0	0.0	0.0	0.0	9.8	8.0	564.5
1993-94	57.8	208.3	154.7	52.0	134.7	0.0	0.0	16.2	0.0	0.0	11.0	49.4	684.1
1994-95	98.7	117.8	178.7	52.0	134.7	0.0	0.0	44.4	0.0	33.0	0.0	43.1	702.4
1995-96	49.0	196.6	115.3	57.3	272.2	0.0	0.0	0.0	0.0	0.0	23.0	0.0	713.4
1996-97	64.2	87.3	411.8	92.1	62.0	48.2	0.0	71.5	59.5	94.4	9.4	49.0	1049.4
1997-98	134.0	106.2	243.4	73.9	47.6	44.4	2.4	8.0	6.0	0.0	10.0	45.0	720.9
MEAN	109.99	162.91	187.49	152.46	92.11	23.07	4.27	6.64	4.98	12.16	10.08	19.07	785.23
S.D	53.14	101.42	94.03	131.93	89.06	58.26	15.01	16.50	13.01	22.52	11.93	23.50	259.86
C.V	0.48	0.62	0.50	0.87	0.97	2.53	3.52	2.48	2.61	1.85	1.18	1.23	0.33
ANNUAL RAINFALL AT 75% EXCEEDANCE PROBABILITY LEVEL =							673.70	mm					
ANNUAL RAINFALL AT 50% EXCEEDANCE PROBABILITY LEVEL =							753.10	mm					



Figuare 4. Annual Rainfall in mm

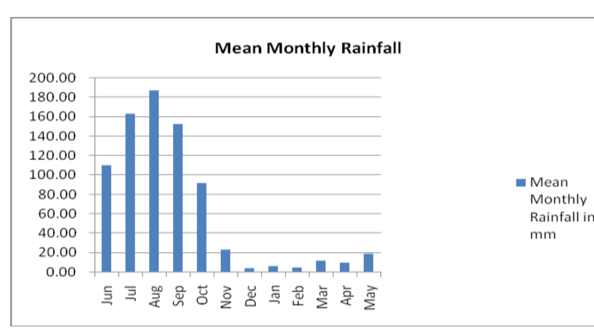


Figure 6. Mean monthly rainfall distribution

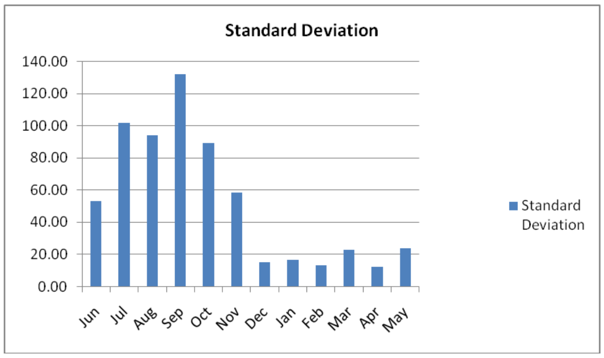


Figure 7. Standard deviation of monthly rainfall

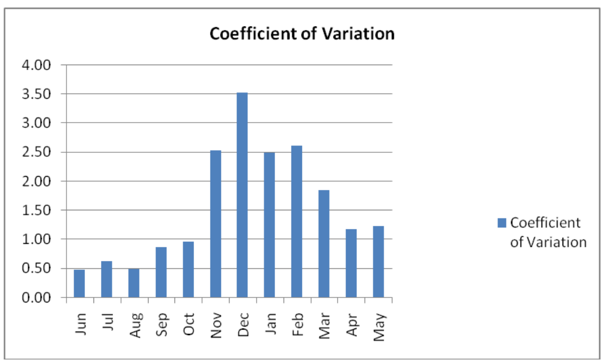


Figure 8. Coefficient of variation of monthly rainfall

Table 3. 3-year and 5-year Moving Average

Year	Annual Rainfall	3-yr MA	5-yr M.A
1963-64	761.3		
1964-65	702.4	682.60	
1965-66	584.1	630.17	696.76
1966-67	604	673.37	684.4
1967-68	832	711.83	694.94
1968-69	699.5	762.20	745.14
1969-70	755.1	763.23	768.82
1970-71	835.1	770.87	707.78
1971-72	722.4	694.77	782.3
1972-73	526.8	773.77	809.98
1973-74	1072.1	830.80	779.9
1974-75	893.5	883.43	790.44
1975-76	684.7	784.43	815.26
1976-77	775.1	703.57	772.52
1977-78	650.9	761.47	701.64
1978-79	858.4	682.80	742.14
1979-80	539.1	761.57	814.82
1980-81	887.2	854.93	859.64
1981-82	1138.5	966.90	1071.72
1982-83	875	1310.77	1098.64
1983-84	1918.8	1155.83	1006.92
1984-85	673.7	1007.03	856.8
1985-86	428.6	496.73	878.02
1986-87	387.9	599.20	649.32
1987-88	981.1	714.77	707.88
1988-89	775.3	907.63	775.36
1989-90	966.5	835.93	848.4
1990-91	766	828.53	765.08
1991-92	753.1	694.53	746.84
1992-93	564.5	667.23	694.02
1993-94	684.1	650.33	683.5
1994-95	702.4	699.97	742.76
1995-96	713.4	821.73	774.04
1996-97	1049.4	827.90	
1997-98	720.9		

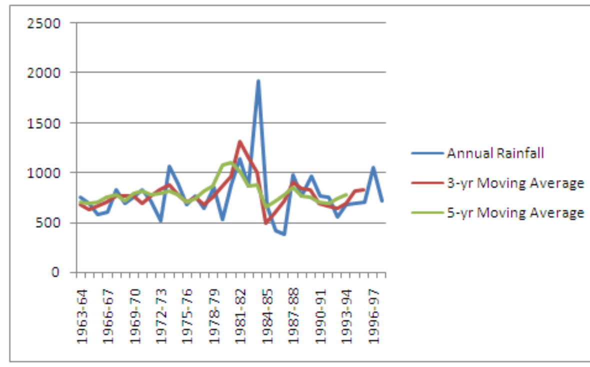


Figure 5. 3- year and 5-year moving average

Table 4. Weibull's Plotting Position

Year	Annual Rainfall	Ann RF in DO	Rank m	m/n+1
1963-64	761.3	1918.8	1	0.027778
1964-65	702.4	1138.5	2	0.055556
1965-66	584.1	1072.1	3	0.083333
1966-67	604	1049.4	4	0.111111
1967-68	832	981.1	5	0.138889
1968-69	699.5	966.5	6	0.166667
1969-70	755.1	893.5	7	0.194444
1970-71	835.1	887.2	8	0.222222
1971-72	722.4	875	9	0.25
1972-73	526.8	858.4	10	0.277778
1973-74	1072.1	835.1	11	0.305556
1974-75	893.5	832	12	0.333333
1975-76	684.7	775.3	13	0.361111
1976-77	775.1	775.1	14	0.388889
1977-78	650.9	766	15	0.416667
1978-79	858.4	761.3	16	0.444444
1979-80	539.1	755.1	17	0.472222
1980-81	887.2	753.1	18	0.5
1981-82	1138.5	722.4	19	0.527778
1982-83	875	720.9	20	0.555556
1983-84	1918.8	713.4	21	0.583333
1984-85	673.7	702.4	22	0.611111
1985-86	428.6	702.4	23	0.638889
1986-87	387.9	699.5	24	0.666667
1987-88	981.1	684.7	25	0.694444
1988-89	775.3	684.1	26	0.722222
1989-90	966.5	673.7	27	0.75
1990-91	766	650.9	28	0.777778
1991-92	753.1	604	29	0.805556
1992-93	564.5	584.1	30	0.833333
1993-94	684.1	564.5	31	0.861111
1994-95	702.4	539.1	32	0.888889
1995-96	713.4	526.8	33	0.916667
1996-97	1049.4	428.6	34	0.944444
1997-98	720.9	387.9	35	0.972222

4. Methodology and its Application

Runoff has been computed from the catchment using Strange's runoff table. Crop water requirements were calculated using Modified penman method. Evaporation losses have been appropriately assumed and the Hydrological Simulation has been carried out for 35 years.

4.1 Runoff

Mr. W. L. Strange carried out investigations on catchments in South India and worked out Runoff yields for given rainfall events according to the nature of the catchments. The catchments prone to producing higher yields were categorised as good catchments. The catchments producing low yields are categorized as bad catchments. The intermediate type of catchments were called as average catchments. The values of rainfall events and the corresponding runoff events were given in table 5. The strange's rainfall events and runoff yields were plotted for Good, Average and Bad catchments as shown in figure and an average polynomial relationship of order 2 is approximately established as given below with in the acceptable range of mean square distance. The above relationships were also established for 50% Good and 50% Average, 50% Average and 50% Bad catchments. The polynomial relationship of order 2 established between Rainfall in mm to Runoff in M.cu.m for various types of catchments are shown in figures 9 to 13.

Strange's relationship for good catchments is given by

$$y = 5E\text{-}07x^2 - 1E\text{-}04x + 0.006, \quad R^2 = 0.998$$

Strange's relationship for average catchments is given by

$$y = 3E\text{-}07x^2 - 6E\text{-}05x + 0.002, \quad R^2 = 0.999$$

Strange's relationship for bad catchments is given by

$$y = 2E\text{-}07x^2 - 4E\text{-}05x + 0.002, \quad R^2 = 0.999$$

Strange's relationship for catchments with 50% Good and 50% Average conditions is given by

$$y = 4E\text{-}07x^2 - 8E\text{-}05x + 0.004, \quad R^2 = 0.999$$

Strange's relationship for catchments with 50% Average and 50% Bad conditions is given by

$$y = 3E\text{-}07x^2 - 5E\text{-}05x + 0.002, \quad R^2 = 0.999$$

The yield rate per sq. km is estimated using the strange's method for the given nature of catchment. The yield rates multiplied by the effective catchment area will give rise to inflows during that month.

Table 5. Strange's runoff yield per sq. km of catchments which are good, average, bad etc.

STRANGE'S TABLE

Undernoted table extracted from Strange's Indian storage reservoirs is suitable for estimating runoff from rainfall in the plains of the South India

Table of total monsoon rainfall and estimated runoff and yield per square mile from cathcment

Total Rainfall in a month in mm	**Good** Yield of runoff from catchment per sq.km in M.Cum	Average Yield of runoff from catchment per sq.km in M.Cum	Bad Yield of runoff from catchment per sqkm in M.Cum	(Good+Avg)/2 Yield of runoff from catchment per sqkm in M.Cum	(Avg+Bad)/2 Yield of runoff from catchment per sqkm in M.Cum
25.4	2.21192E-05	1.10596E-05	1.10596E-05	1.65894E-05	1.10596E-05
50.8	9.95364E-05	3.31788E-05	4.42384E-05	6.63576E-05	3.87086E-05
76.2	0.000221192	0.000232252	0.000165894	0.000226722	0.000199073
101.6	0.000696755	0.000530861	0.000353907	0.000613808	0.000442384
127	0.001282913	0.000962185	0.000652516	0.001122549	0.000807351
152.4	0.002311456	0.00165894	0.001150198	0.001985198	0.001404569
177.8	0.003439535	0.002820197	0.001880132	0.003129866	0.002350165
203.2	0.005750991	0.004313243	0.002875495	0.005032117	0.003594369
228.6	0.008095626	0.006071719	0.004047813	0.007083672	0.005059766
254	0.011048538	0.008283639	0.005518739	0.009666089	0.006901189
279.4	0.014698206	0.01101536	0.007343573	0.012856783	0.009179466
304.8	0.019088866	0.014266881	0.009555493	0.016677874	0.011911187
330.2	0.024043566	0.018027145	0.012021783	0.021035355	0.015024464
355.6	0.029849855	0.022384626	0.01458761	0.026117241	0.018486118
381	0.036231243	0.027173432	0.018115621	0.031702338	0.022644527
406.4	0.043165611	0.032371443	0.021577276	0.037768527	0.026974359
431.8	0.050664018	0.037989719	0.024331116	0.044326869	0.031160417
457.2	0.059202028	0.044393226	0.031741046	0.051797627	0.038067136
482.6	0.067850633	0.050918389	0.033919787	0.059384511	0.042419088
508	0.077085398	0.057808519	0.038553758	0.067446958	0.048181139
533.4	0.086873142	0.07289381	0.043431041	0.079883476	0.058162426
558.8	0.095245258	0.073336194	0.049558058	0.084290726	0.061447126
584.2	0.108737967	0.081553475	0.054302626	0.095145721	0.067928051
609.6	0.11800591	0.090036187	0.061159577	0.104021049	0.075597882
635	0.1221422	0.099237773	0.066711495	0.110689986	0.082974634
660.4	0.145577488	0.10590671	0.073889174	0.125742099	0.089897942
685.8	0.163693109	0.119145049	0.079430033	0.141419079	0.099287541
711.2	0.172662443	0.129496833	0.086331222	0.151079638	0.107914027
736.6	0.187028861	0.139926033	0.090312677	0.163477447	0.115119355
762	0.202722431	0.152036293	0.101582407	0.177379362	0.12680935
787.4	0.218239047	0.162675626	0.10838406	0.190457336	0.135529843
812.8	0.234341821	0.186807669	0.117165381	0.210574745	0.151986525
838.2	0.244339698	0.188455549	0.125415841	0.216397624	0.156935695
863.6	0.268969422	0.201461636	0.133821135	0.235215529	0.167641386
889	0.286775375	0.211802361	0.142668814	0.249288868	0.177235587
914.4	0.298609145	0.228933678	0.148198613	0.263771411	0.188566145
939.8	0.330814694	0.243101023	0.155387351	0.286957859	0.199244187
965.2	0.343986675	0.258484924	0.172319596	0.301235799	0.21540226
990.6	0.354902499	0.273570215	0.18237277	0.314236357	0.227971493
1016	0.385073082	0.292371532	0.192669256	0.338722307	0.242520394
1041.4	0.339607075	0.304968414	0.203308589	0.322287744	0.254138502
1066.8	0.440559085	0.322055493	0.214744214	0.381307289	0.268399853
1092.2	0.446354314	0.338567472	0.22585911	0.392460893	0.282213291
1117.6	0.464868081	0.356107995	0.23739427	0.410488038	0.296751133
1143	0.476204169	0.373736994	0.249062146	0.424970581	0.31139957
1168.4	0.519933819	0.392682085	0.255155985	0.456307952	0.323919035
1193.8	0.54824639	0.403443074	0.274123195	0.475844732	0.338783135
1219.2	0.573594989	0.430107765	0.286742196	0.501851377	0.358424981
1244.6	0.598987826	0.449451002	0.298642324	0.524219414	0.374046663
1270	0.626858012	0.470187748	0.313130397	0.54852288	0.391659072
1295.4	0.65387661	0.495934492	0.326932775	0.574905551	0.411433634
1320.8	0.68139289	0.511041903	0.340690915	0.596217396	0.425866409
1346.2	0.709484269	0.532497523	0.354736605	0.620990896	0.443617064
1371.6	0.739511077	0.554528242	0.369755539	0.64701966	0.46214189
1397	0.768752654	0.576558961	0.384376327	0.672655808	0.480467644
1422.4	0.798558271	0.598910408	0.399273606	0.69873434	0.499092007
1447.8	0.828927927	0.62169318	0.414458434	0.725310554	0.518075807
1473.2	0.861354668	0.646013236	0.430671804	0.753683952	0.53834252
1498.6	0.892852403	0.669658657	0.446663983	0.78125553	0.55816132
1524	0.924969476	0.693724342	0.462479208	0.809346909	0.578101775

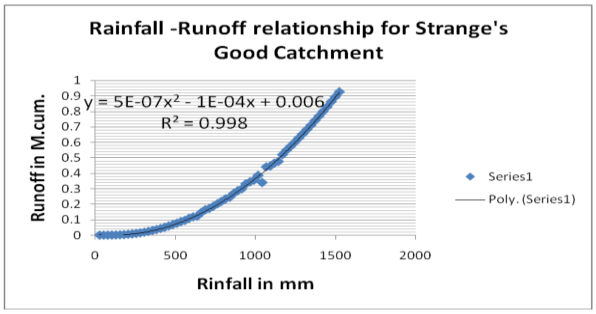


Figure 9. Rainfall – Runoff yield relationship for Strange's good catchment

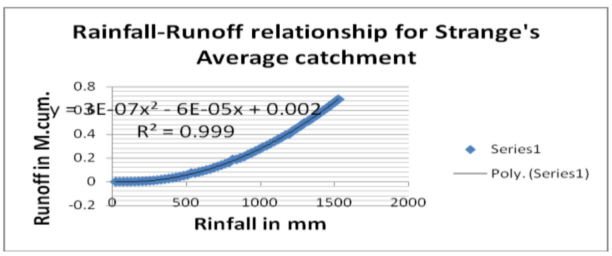


Figure 10. Rainfall – Runoff yield relationship for Strange's average catchment

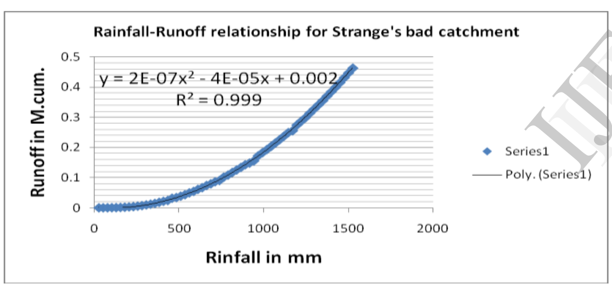


Figure 11. Rainfall – Runoff yield relationship for Strange' bad catchment

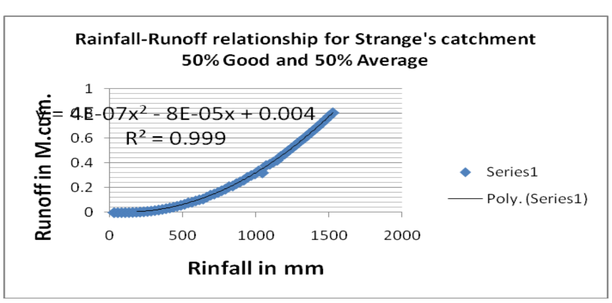


Figure 12. Rainfall – Runoff yield relationship for Strange's catchment 50% good and 50% average

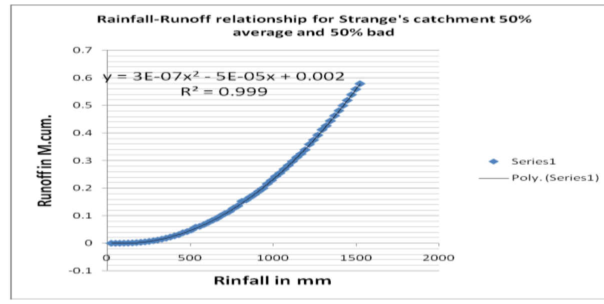


Figure 13. Rainfall – Runoff yield relationship for Strange's catchment 50% average and 50% bad

4.2 Validation of Runoff Yield Rates

Observed flows are not available for any period during the last 35 years. Hence it is attempted to validate the runoff yield rates obtained from the strange's runoff model with the inflows per sq km of a near by major irrigation project. The variation of computed and observed yield rates is found to be within ±2%.

4.3 Crop water requirements

Two crop seasons are identified in the study area viz. kharif and rabi. The identified cropping pattern in the study area is Paddy only. Modified penman method is used to compute the crop water requirements. Potential Evapotranspiration values of Ranga Reddy district are collected from the IMD through Irrigation department. The values are given in the following table 6.

Table 6. Potential Evapotranspiration values of Rangareddy district

S.No	Month	PET Values in mm
	Kharif	
1	July	140.4
2	August	135.5
3	September	119.3
4	October	123.6
	Rabi	
5	December	98.6
6	January	109.8
7	February	129.5
8	March	181.5

The modified penman method is used to compute crop water requirements. Crop coefficient for paddy is taken as 1.1 for first 3 months and 0.95 for the fourth month in both kharif and rabi. Monthly water requirement in mm is obtained by multiplying the PET value with crop coefficient. A provision of 40 mm for nursery is made during the first month in both kharif and rabi. An allowance of 90 mm for land preparation during the first month is considered in both kharif and rabi. An allowance of 90 mm for four months in both kharif and rabi is provided for deep percolation at the rate of 3 mm per day. An allowance of 50 mm for 2 months is provided for minimum depth in kharif and rabi. After making all the above allowances the gross monthly water requirement is found out in mm. Considering 50% of actual rainfall during the corresponding month as effective rainfall, it is subtracted from the gross monthly water requirement to obtain net irrigation requirement. Assuming 80% field efficiency and 80% conveyance efficiency, the total crop water requirement is found out in mm and subsequently the total requirement per ha in cu.m. is found out.

The model calculation of crop water requirements are shown in table 7 and table 8 for kharif and rabi respectively.

Table 7. Model calculation of crop water requirement for the year 1963-64, kharif

	CROP WATER REQUIREMENT 1963-64			Kharif	Paddy	
S.No.	Description of the item	July	August	Septembe	October	Total
1	E.T. Value in mm	140.4	135.5	119.3	123.6	
2	Kc (Crop coefficiant) value	1.1	1.1	1.1	0.95	
3	Monthly Water Requirement	154.44	149.05	131.23	117.42	
4	Add for Nursery	40	0	0	0	
5	Add for Land Preparation	160	0	0	0	
6	Add for deep percolation(3 mm per day)	90	90	90	90	
7	Add for minimum depth	50	0	50	0	
8	Gross total monthly requirement in mm	494.44	239.05	271.23	207.42	1212.14
9	Monthly Rainfall during the year 1963-64	155.8	294.5	84.9	77.5	
10	Effective Rainfall 50% of above	77.9	147.25	42.45	38.75	306.35
11	Net Irrigation Requirement	416.54	91.8	228.78	168.67	905.79
12	Requirement @ 80% Field efficiency	520.675	114.75	285.975	210.8375	1132.238
13	Monthly requirement @ Canal Head @ 80% conveyance efficiency	650.8438	143.4375	357.46875	263.5469	1415.297
14	Total Requirement in mm	650.8438	143.4375	357.46875	263.5469	1415.297
15	**Total Requirement per Ha in Cubic Metres**	6508.438	1434.375	3574.6875	2635.469	14152.97

Table 8. Model calculation of crop water requirement for the year 1963-64, rabi

	CROP WATER REQUIREMENT 1963-64			Rabi	Paddy	
S.No.	Description of the item	Decembe	January	Febraury	March	Total
1	E.T. Value in mm	98.6	109.8	129.5	181.5	
2	Kc (Crop coefficiant) value	1.1	1.1	1.1	0.95	
3	Monthly Water Requirement	108.46	120.78	142.45	172.425	
4	Add for Nursery	40	0	0	0	
5	Add for Land Preparation	160	0	0	0	
6	Add for deep percolation(3 mm per day)	90	90	90	90	
7	Add for minimum depth	50	0	50	0	
8	Gross total monthly requirement in mm	448.46	210.78	282.45	262.425	1204.115
9	Monthly Rainfall during the year 1963-64	0	0	9.4	0	
10	Effective Rainfall 50% of above	0	0	4.7	0	4.7
11	Net Irrigation Requirement	448.46	210.78	277.75	262.425	1199.415
12	Requirement @ 80% Field efficiency	560.575	263.475	347.1875	328.0313	1499.269
13	Monthly requirement @ Canal Head @ 80% conveyance efficiency	700.7188	329.3438	433.98438	410.0391	1874.086
14	Total Requirement in mm	700.7188	329.3438	433.98438	410.0391	1874.086
15	**Total Requirement per Ha in Cubic Metres**	7007.188	3293.438	4339.8438	4100.391	18740.86

The crop water requirement for 35 years for both kharif and rabi were computed and presented in table 9 given below.

Crop water requirement is dependant on various factors like rainfall, crop coefficient and potential evapotranspiration values. The crop water requirement will be high during first month of any season compared to other months due to additional requirement for nursery and land preparation during first month. The crop water requirements are found to be higher in Rabi compared to Kharif due to scanty rainfall during Rabi.

In kharif, the maximum value of mean monthly crop water requirement is 6453 cubic metres per hectare observed during the first month while the minimum value is 2250 cubic metres per hectare observed during the second month. The standard deviation fluctuated from 1032 during the third month to 696 during the fourth month of kharif while the coefficient of variation fluctuated from 0.12 during the first month to 0.34 during the third month.

In rabi, the maximum value of mean monthly crop water requirement is 6978 cubic metres per hectare observed during the first month while the minimum value is 3256 cubic metres per hectare observed during the second month. The standard deviation fluctuated from 210 during the fourth month to 118 during first month while the coefficient of variation fluctuated from

0.02 during the first month to 0.05 during the fourth month of Rabi.

Table 9. Computed monthly crop water requirement for 35 years from 1963-64 to 1997-98, kharif and rabi

S.No.	Year	Kharif					Rabi				
		Jul	Aug	Sep	Oct	Total	Dec	Jan	Feb	Mar	Total
1	1963-64	6508.44	1434.38	3574.69	2635.47	14152.97	7007.19	3293.44	4339.84	4100.39	18740.86
2	1964-65	7013.91	2622.66	1909.84	3177.66	14724.06	7007.19	3293.44	4413.28	4100.39	18814.30
3	1965-66	5267.03	3050.78	3376.25	3240.94	14935.00	7007.19	3293.44	4413.28	4100.39	18814.30
4	1966-67	7085.78	2818.75	3279.38	2613.59	15797.50	6362.66	3293.44	4413.28	3700.39	17769.77
5	1967-68	5174.06	2435.16	2979.38	3240.94	13829.53	6927.50	3293.44	4343.75	4020.70	18585.39
6	1968-69	6429.53	3566.41	2237.19	2408.13	14641.25	7007.19	3293.44	4413.28	4100.39	18814.30
7	1969-70	6892.81	2828.13	2646.56	2715.16	15082.66	7007.19	3293.44	4413.28	4028.52	18742.42
8	1970-71	6873.28	1476.56	2812.97	3031.56	14194.38	7007.19	3293.44	4413.28	4100.39	18814.30
9	1971-72	7444.38	1879.69	3301.25	2095.63	14720.94	7007.19	3293.44	4413.28	4100.39	18814.30
10	1972-73	6715.47	3298.44	3523.91	2623.75	16161.56	7007.19	3293.44	4413.28	4100.39	18814.30
11	1973-74	6585.78	1159.38	3711.41	555.00	12011.56	7007.19	3293.44	4413.28	4100.39	18814.30
12	1974-75	7334.22	2157.03	2577.03	1341.72	13410.00	7007.19	2971.56	4413.28	3887.89	18279.92
13	1975-76	7725.63	2206.25	2548.91	1815.94	14296.72	7007.19	3293.44	4413.28	4100.39	18814.30
14	1976-77	5820.94	1763.28	3275.47	3240.94	14100.63	7007.19	3293.44	4413.28	4100.39	18814.30
15	1977-78	6438.91	2052.34	4237.97	2693.28	15422.50	7007.19	3293.44	4187.50	4100.39	18588.52
16	1978-79	6030.31	937.50	3884.84	3165.16	14017.81	7007.19	3293.44	4413.28	4100.39	18814.30
17	1979-80	7217.81	3219.53	2534.84	3190.94	16163.13	7007.19	3293.44	4413.28	4100.39	18814.30
18	1980-81	6710.00	1714.84	2766.09	3240.94	14431.88	7007.19	3293.44	4413.28	3551.17	18265.08
19	1981-82	6190.47	2546.88	515.31	2805.00	12057.66	7007.19	3293.44	4413.28	4100.39	18814.30
20	1982-83	5358.44	2532.81	3373.13	2048.75	13313.13	7007.19	3293.44	4413.28	4100.39	18814.30
21	1983-84	4060.78	950.78	-1095.63	1237.03	5152.97	7007.19	3293.44	4413.28	3924.61	18638.52
22	1984-85	6393.59	2077.34	3455.16	2303.44	14229.53	7007.19	3293.44	4413.28	4100.39	18814.30
23	1985-86	7046.72	3435.94	3353.59	2576.09	16412.34	7007.19	3402.32	4845.54	4686.16	19941.21
24	1986-87	7190.47	2582.03	4087.19	3178.44	17038.13	7007.19	3293.44	4413.28	3975.39	18689.30
25	1987-88	6453.75	2358.59	3936.41	2027.66	14776.41	7007.19	3293.44	4105.47	4100.39	18506.48
26	1988-89	5977.97	2086.72	2231.72	3147.19	13443.59	7007.19	3293.44	4413.28	3770.70	18484.61
27	1989-90	4730.31	2935.94	3182.50	2876.88	13725.63	6724.38	3293.44	4413.28	3838.67	18269.77
28	1990-91	6807.66	2139.06	3318.44	1756.56	14021.72	7007.19	3293.44	4413.28	4100.39	18814.30
29	1991-92	6248.28	3073.44	2605.16	2978.44	14905.31	7007.19	3293.44	4413.28	3975.39	18689.30
30	1992-93	7090.47	2072.66	3897.34	3191.72	16252.19	7007.19	3293.44	4413.28	4100.39	18814.30
31	1993-94	6098.28	2526.56	3831.72	2188.59	14645.16	7007.19	3166.88	4413.28	4100.39	18687.73
32	1994-95	6805.31	2339.06	3831.72	2188.59	15164.69	7007.19	2946.56	4413.28	3842.58	18209.61
33	1995-96	6189.69	2834.38	3790.31	1114.38	13928.75	7007.19	3293.44	4413.28	4100.39	18814.30
34	1996-97	7043.59	517.96	3518.43	2756.56	13836.54	7007.18	2734.84	3948.43	3362.89	17053.34
35	1997-98	6895.93	1833.59	3660.62	2869.06	15259.20	7007.18	3230.94	4413.28	4100.39	18751.79
	Mean	6453	2270	3048	2522	14293	6978	3256	4393	4022	18650
	Std. Deviati	792	735	1032	696	1938	118	124	127	210	426
	CV	0.12	0.32	0.34	0.28	0.14	0.02	0.04	0.03	0.05	0.02

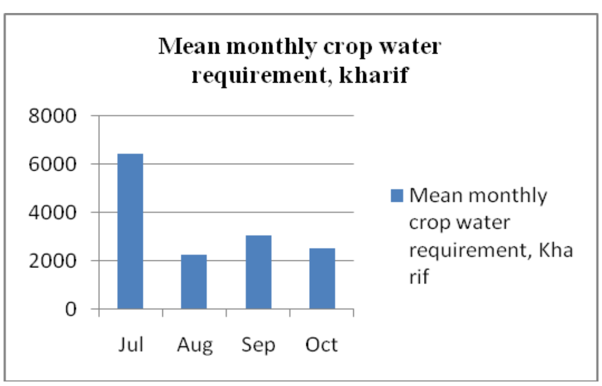


Figure 14. Mean monthly crop water requirement, kharif

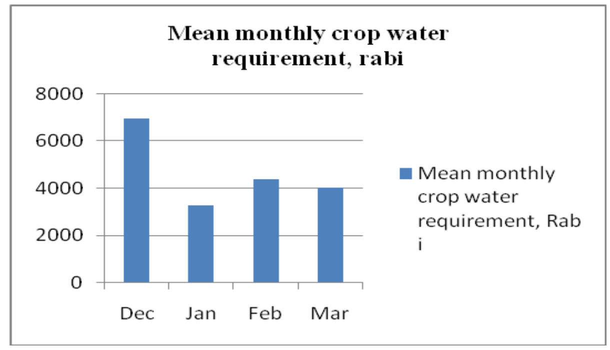


Figure 15. Mean monthly crop water requirement, rabi

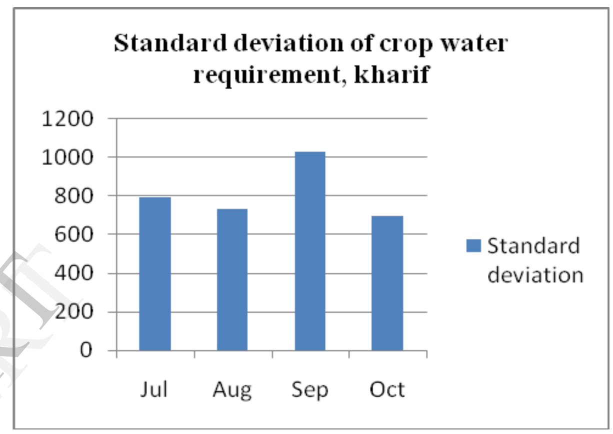


Figure 16. Standard deviation of crop water requirement, kharif

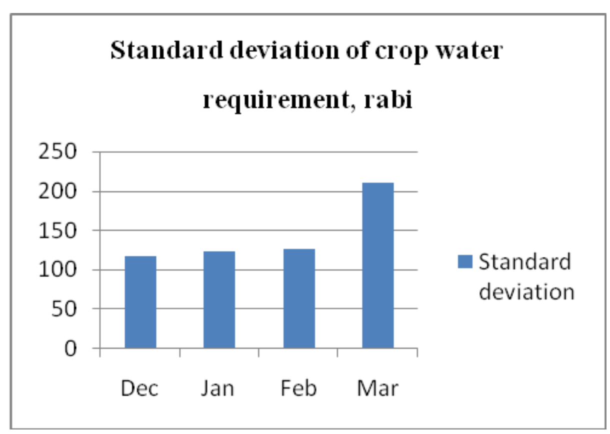


Figure 17. Standard deviation of crop water requirement, rabi

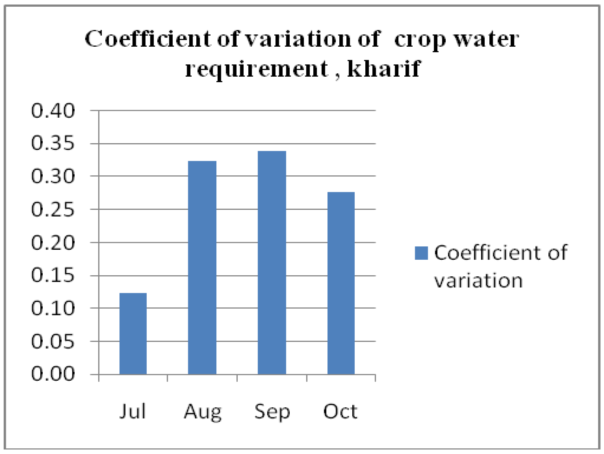


Figure 18. Coefficient of variation of crop water requirement, kharif

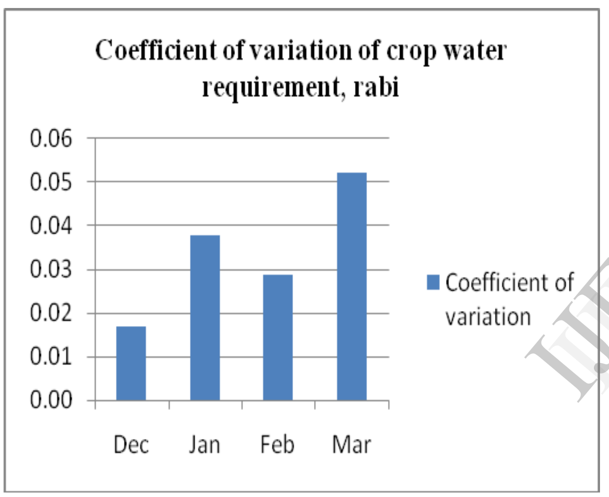


Figure 19. Coefficient of variation of crop water requirement, rabi

4.4 Evaporation losses

The monthly pan evaporation data pertaining to Rangareddy district is collected from IMD and are presented here.

The losses are calculated using the formula given below.

Average Monthly evaporation losses =

(Average Storage / Gross Storage) * Water Spread Area * Pan Evaporation.

Only 50% of the inflows of June month every year are considered as inflows for June.

Table 10. Monthly pan evaporation data of Rangareddy district

S.No	Month	Monthly Pan evaporation in m
1	June	0.187
2	July	0.156
3	August	0.136
4	September	0.129
5	October	0.143
6	November	0.126
7	December	0.127
8	January	0.149
9	February	0.169
10	March	0.246
11	April	0.238
12	May	0.239

4.5 Hydrological Simulation

After computing the month-wise inflows, crop water requirements and losses, the end storage during any month is calculated by adding the inflows to the initial storage and subtracting the crop water requirement and losses from it. If the end storage is greater than the gross capacity of the tank at FTL, then the tank will retain the water up to its gross capacity and the remaining water goes as surplus. If the sum of crop water requirements and losses during any month exceeds the sum of initial storage and inflows, then the difference of the two sums will represent deficit for that particular month.

It is with this mechanism in mind, a simulation exercise has been carried out in MS-Excel package to compute the maximum possible cropping area for each year under kharif and rabi seasons in such a way that there is no deficit and no surplus (or minimum surplus). The model run of the hydrological simulation (HSMMIT-2.1) for one year during 1963-64 is presented in table 11. It is observed from the simulation run that the tank has received inflows to irrigate 103 hectares of paddy during kharif and 0 hectares of paddy during rabi. This is termed as simulated irrigated area. The end storage of 0.0018 M.cu.m during May of hydrological year 1963-64 will be carry forwarded as initial storage for the next hydrological year starting from June 1964-65.

The simulation exercise has been continued for the subsequent 34 hydrological years in a similar fashion and in each year the simulated irrigated area is found out and tabulated in table 12 given under results.

Table 11. Model run of the hydrological simulation for the year 1963-64

Free	19.41 sqkm	Gross Capacity of the tank@	2.1859 Mcum	Waterspread area	1.891 M.Sq.m
Intercepted	62.93 sqkm				
Effective ca	50.875 sqkm				

Month	Ini Storage in Mcum	Rainfall in mm	Strange's yield rate	Inflow in Mcum	Paddy CWR/I in Cum	Paddy Area in ha	Total CWR in MCum	Mon evap in metres	Losses in MCum	End Storage in Mcum	Surplus in Mcum	Deficit in Mcum
June	0.0000	139.2	0.0018	0.0452	0	0	0	0.187	0.0037	0.0415	0.0000	0.0000
July	0.0415	155.8	0.0025	0.1253	6508	103	0.6704	0.156	0.0028	0.0000	0.0000	0.0000
August	0.0000	294.5	0.0173	0.8806	1434	103	0.1477	0.136	0.0432	0.6896	0.0000	0.0000
September	0.6896	84.9	0.0004	0.0195	3575	103	0.3682	0.129	0.0575	0.2834	0.0000	0.0000
October	0.2834	77.5	0.0002	0.0125	2635	103	0.2715	0.143	0.0190	0.0055	0.0000	0.0000
November	0.0055	0.0	0.0000	0.0000	0	0	0.0000	0.126	0.0006	0.0049	0.0000	0.0000
December	0.0049	0.0	0.0000	0.0000	7007	0	0.0000	0.127	0.0005	0.0043	0.0000	0.0000
January	0.0043	0.0	0.0000	0.0000	3293	0	0.0000	0.149	0.0006	0.0038	0.0000	0.0000
Febraury	0.0038	9.4	0.0000	0.0004	4340	0	0.0000	0.169	0.0006	0.0036	0.0000	0.0000
March	0.0036	0.0	0.0000	0.0000	4100	0	0.0000	0.246	0.0008	0.0029	0.0000	0.0000
April	0.0029	0.0	0.0000	0.0000	0	0	0	0.238	0.0006	0.0023	0.0000	0.0000
May	0.0023	0.0	0.0000	0.0000	0	0	0	0.239	0.0005	0.0018	0.0000	0.0000

5. Results

The results of the simulation are presented in table 12.

The simulated irrigated area, kharif is plotted against registered ayacut and is shown in figure 20 given below.

The simulated irrigated area, rabi is plotted against registered ayacut and is shown in figure 21 given below.

The results indicated that the tank has received sufficient inflows to irrigate the entire registered ayacut of 207 hectares during three years viz. 1973-74, 1983-84 and 1996-97.

The tank has not received sufficient inflows even to irrigate 10 ha during 4 years viz. 1972-73 (9 ha – kharif), 1985-86 (2 ha kharif and 1 ha rabi), 1986-87 (9 ha kharif and 0 ha rabi).

The surplus history of the MI tank is presented in table 13.

The surplus history of Medchal MI tank shows that the tank has surplused during two years viz. 1981-82 (September) and 1983-84 (July, August, September, October).

Table 12. Results of hydrological simulation of Medchal MI tank

Results of Hydrological Simulation of Medchal MI tank				
S.No	Year	Registered	Simulated Irrigated area	
	Year	Ayacut (ha)	Krarif (ha)	Rabi (ha)
1	1963-64	207	103	0
2	1964-65	207	36	21
3	1965-66	207	64	0
4	1966-67	207	14	1
5	1967-68	207	93	0
6	1968-69	207	16	16
7	1969-70	207	18	6
8	1970-71	207	123	0
9	1971-72	207	80	0
10	1972-73	207	9	0
11	1973-74	207	207	46
12	1974-75	207	131	11
13	1975-76	207	130	9
14	1976-77	207	74	0
15	1977-78	207	35	0
16	1978-79	207	165	0
17	1979-80	207	2	10
18	1980-81	207	94	0
19	1981-82	207	61	63
20	1982-83	207	85	0
21	1983-84	207	207	80
22	1984-85	207	49	0
23	1985-86	207	2	1
24	1986-87	207	9	0
25	1987-88	207	25	52
26	1988-89	207	114	0
27	1989-90	207	132	0
28	1990-91	207	61	4
29	1991-92	207	30	5
30	1992-93	207	32	0
31	1993-94	207	33	0
32	1994-95	207	27	1
33	1995-96	207	23	22
34	1996-97	207	207	22
35	1997-98	207	53	0

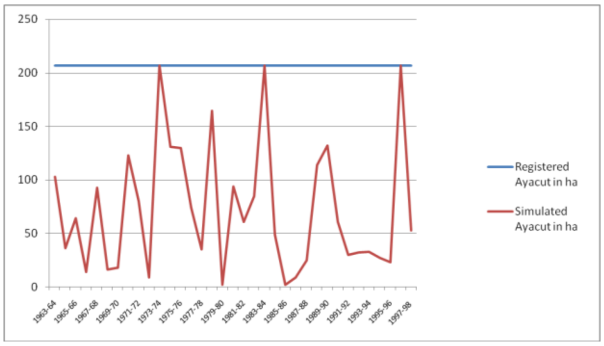


Figure 20 Registered ayacut and simulated ayacut, kharif

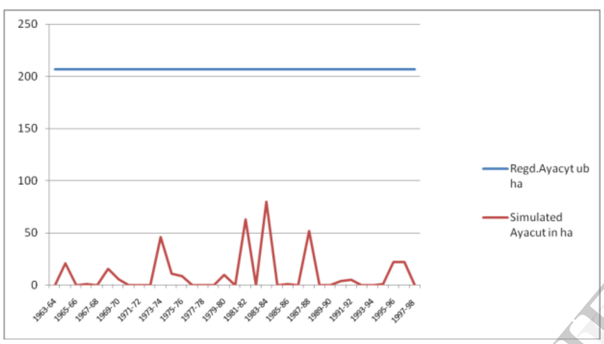


Figure 21 Registered ayacut and simulated ayacut, rabi

Table 13. Surplus history of Medchal MI Tank

S.No.	Year	Month	Surplus Quantity in M.cu.m
1	1981-82	September	1.0127
2	1983-84	July	0.0623
3	1983-84	August	1.0741
4	1983-84	September	8.1983
5	1983-84	October	0.0546

6. Conclusions

The results indicate that the tank has received sufficient inflows to irrigate the entire registered ayacut of 207 hectares during three years viz. 1973-74, 1983-84 and 1996-97.

The tank has not received sufficient inflows even to irrigate 10 ha during 4 years viz. 1972-73 (9 ha – kharif), 1985-86 (2 ha kharif and 1 ha rabi), 1986-87 (9 ha kharif and 0 ha rabi). During 1979-80, the tank has has received inflows sufficient to irrigate an ayacut of 2 ha in kharif and 10 ha in rabi.

The tank has received sufficient inflows to irrigate more than 100 hectares of paddy in kharif during 10 years out of 35 years of simulation.

The tank has not received sufficient inflows to irrigate more than 40 hectares in kharif during 15 years out of 35 years.

In rabi, the maximum simulated irrigated ayacut of 80 ha is found during 1983-84. The tank has received sufficient inflows during 4 years out of 35 years to irrigate an ayacut of more than 40 hectares. The tank has not received sufficient inflows even to irrigate more than 10 ha in rabi during 25 years out of 35 years of simulation

From the above results it is evident that there is acute shortage of water in the command area to irrigate the entire registered ayacut owing to the vagaries of monsoon. Therefore, it is advisable for the farmers to augment the short supplies using bore wells.

If the soil conditions permit, it is always advisable for the farmers to go for irrigated dry crops which consume less water rather than going for wet crops which consume more water.

Out of the 35 years from 1963-64 to 1997-98, the tank has surplused only during 2 years viz. 1981-82 and 19983-84. The tank has surplused during September month of 1981-82 and the quantity spilled over is 1.0127 M.cu.m. The tank has also surplused during 1983-84 for four months from July to October. The surplused quantities are 0.0623 M.cu.m in July, 1.0741 M.cu.m in August, 8.1983 M.cu.m in September and 0.0546 M.cu.m in October.

The surplus history of the MI tank shows that there exists scope for additional storage if de-silting operations are taken up to increase the capacity of the tank.

Since the tank has a huge capacity of 2.1859 M.cu.m which is being under utilised for most of the times, it is always advisable to link such a minor irrigation tank to a nearby major irrigation project by constructing a feeder channel to the tank.

Thus the hydrological simulation model HSMMIT-2.1 developed above for Medchal MI tank can be applied to other MI tanks for assessing the year-wise physical benefits.

7. References

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